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AMERICAN NATIONAL STANDARD

ANSI C12.20-1998

AMERICAN NATIONAL STANDARD

FOR

ELECTRICITY METERS

0.2 AND 0.5

ACCURACY CLASSES

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
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ANSI C12.20-1998

AMERICAN NATIONAL STANDARD

FOR ELECTRICITY METERS 0.2 AND 0.5 ACCURACY CLASSES

Accredited Standard Committee on Electricity Metering, C12

Accredited by

American National Standards Institute

Approved March 19, 1998

American National Standards Institute, Inc.

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Foreword (This foreword is not part of ANSI C12.20-1997.)

This American National Standard establishes acceptable performance criteria for electricity meters. Accuracy class designations, current class designations, voltage and frequency ratings, test current values, service connection arrangements, pertinent dimensions, form designations, and environmental tests are covered.

Suggestions for improvement to this standard are welcome. They should be sent to:

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This standard was processed and approved for submittal to ANSI by Accredited Standards Committee for Electricity Metering, C12. At the time the committee approved this standard, the C12 Committee had the following members:

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American National Standard for Electricity Meters 0.2 and 0.5 Accuracy Classes

1 Scope

This standard establishes the physical aspects and acceptable performance criteria for 0.2 and 0.5 accuracy class electricity meters meeting Blondel's Theorem. This standard does not apply to meters manufactured before the date of publication of this document.

2 Definitions

See clause 2 of ANSI C12.1-1995.

3 References

1 ANSI C12.10-1997, *American National Standard for Watthour Meters.*
2 ANSI C12.1-1995, *American National Standard for Electric Meters, Code for Electricity Metering.*
3 IEC 801-4-1988, *Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 4.*

4 Requirements

4.1 Mounting

Mounting arrangements may include detachable socket, type "S," bottom-connected, type "A," or any other arrangement agreed upon between the manufacturer and user.

4.2 Voltage and frequency

Typical voltage and frequency ratings are 120, 240, 277, and 480 volts with a frequency rating of 60 Hz.

4.3 Current classes and test amperes

The current classes and test amperes shall be as listed in Table 1.

Table 1 – Current classes and test amperes

Current Class	Test Amperes
10	2.5 A
20	2.5 A
100	15 A
200	30 A
320	50 A

NOTE—Other values of test amperes may be used as recommended by the manufacturer.

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4.4 Form designations

The form designations for 0.2 and 0.5 accuracy class, electricity meters are listed in Table 2. For internal wiring diagram, refer to [1], ANSI C12.10.

Table 2 – Typical form designations

Form Designation	Elements	Current Circuits	External Circuit Wires	See Figure
1S	One	One	Two	10
3S	One	One	Two	10
5S	Two	Two	Three	11
9S	Three	Three	Four	11
10S	Three	Three	Four	11
12S	Two	Two	Three	12
13S	Two	Two	Three	12
16S	Three	Three	Four	12
17S	Three	Three	Four Delta	12
25S	Two	Two	Three	12
26S	Two	Two	Three	11
35S	Two	Two	Three	11
45S	Two	Two	Three	11
56S	Two	Two	Three	11
3A	One	One	Two	16
5A	Two	Two	Three	17
9A	Three	Three	Four	17
10A	Three	Three	Four	17
13A	Two	Two	Three	18
16A	Three	Three	Four	18
35A	Two	Two	Three	17
45A	Two	Two	Three	17
48A	Three	Three	Four	17

4.5 Displays

4.5.1 Viewing requirements

All displayed elements, with the cover in place, must be able to be read under the following conditions:

1. Vertical viewing angle: ±15° from the center of the display
2. Horizontal viewing angle: ±10° from the center of the display
3. Viewing conditions: up to 3 feet from the face of the meter
4. Viewing conditions: outdoor and daylight

4.5.2 Size of digits

The numeric digits for visual reading of billing quantities, excluding identification codes, shall be no less than 0.300 inches high.

4.5.3 Direction of energy flow

A means to indicate direction of energy flow shall be provided.

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4.6 Provisions of testing energy

Meters shall provide a test output that is proportional to energy.

4.7 Nameplate

The nameplate shall have the information specified in ANSI C12.10 [1], along with the following item and permissible observation.

CA = Accuracy Class

5 Acceptable performance

5.1 General

See subclauses 4.1.2 through 4.6.2 of ANSI C12.1 [2].

5.1.1 Acceptable meters

To be deemed acceptable, meters shall conform to the requirements specified in subclause 5.4. Such requirements are intended to determine meter reliability, safety, and accuracy, insofar as these qualities can be demonstrated by laboratory tests.

5.2 Meter type

Meters are considered to be of the same type if produced by the same manufacturer, have similar measurement techniques, and same uniform construction of parts determining these measuring techniques.

5.3 Tests to be applied

The tests noted in subclause 5.4 are to be conducted on the number of meters specified in subclause 4.4.2 of ANSI C12.1 [2]. It is not required to conduct all tests on each individual meter. Meters for special services, or meters that have been modified as a result of these tests, may be exempt from non-applicable tests. Replacement meters can be used for those meters that have failed some tests, that are defective, or that have been damaged during the tests.

5.4 Performance requirements

5.4.1 Test conditions

The meter shall be mounted on a support that is free of vibration. All alternating-current tests shall be conducted on a circuit supplied by a sine-wave source, with a distortion factor no greater than 3%. If the meter has more than one voltage and current circuit, it shall be tested with the voltage circuits effectively in parallel and with the appropriate current circuit(s) energized effectively in series, unless otherwise specified.

All tests, unless otherwise indicated in specific tests, shall be made at 23°C ±3°C; rated voltage ±3%; rated frequency ±1 Hz; test amperes ±3%; and unity power factor ±2°. The meter shall be stabilized at ambient temperature before performance tests are made.

5.4.2 Accuracy tests

5.4.2.1 Test no. 1: No load

See subclause 4.7.2.1 of ANSI C12.1 [2].

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5.4.2.2 Test no. 2: Starting load

The meter shall operate continuously with a load current specified in Table 3 using the lowest rated voltage.

Table 3 – Starting load test

Current Class	Current in Amperes	
	0.5 Accuracy Class	0.2 Accuracy Class
10	0.01	0.01
20	0.01	0.01
100	0.05	0.05
200	0.10	0.10
320	0.16	0.16

5.4.2.3 Test no. 3: Load performance

The performance of the meter shall not deviate from the reference registration by an amount exceeding that specified in Table 4.

5.4.2.4 Test no. 4: Effect of variation of power factor

Each element of a multi-element meter shall be tested as a single-element meter, but all voltage circuits shall be in parallel.

5.4.2.4.1 Single-element meters

The effect of variation of power factor upon performance of the meter shall not exceed that specified in Table 5.

Table 4 – Load performance test

Condition	Current in Amperes					Maximum Deviation in Percent from Reference Performance	
	Current Class					Accuracy Class	
	10	20	100	200	320	0.5	0.2
(1)	0.15	0.15	1	2	3	±1.0	±0.4
(2)	0.25	0.25	1.5	3	5	±0.5	±0.2
(3)	0.50	0.5	3	6	10	±0.5	±0.2
(4)	1.5	1.5	10	20	30	±0.5	±0.2
(5)	2.5	2.5	15	30	50	Reference	Reference
(6)	--	5	30	60	75	±0.5	±0.2
(7)	5	10	50	100	100	±0.5	±0.2
(8)	7.5	15	75	150	150	±0.5	±0.2
(9)	--	18	90	180	250	±0.5	±0.2
(10)	10	--	100	200	300	±0.5	±0.2
(11)	--	20	--	--	320	±0.5	±0.2

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Table 5 – Effect of variation of power factor for single-element meters

Condition	Current in Amperes – Current Class 10	20	100	200	320	Power Factor	Maximum Deviation in Percent from Reference Performance – Accuracy Class 0.5	0.2
Reference performance for condition (1)	0.25	0.5	1.5	3	5	1.0	Reference	Reference
Condition (1)	0.5	1	3	6	10	0.5 lag	± 1.0	± 0.5
Reference Performance for Condition (2)	5	10	50	100	150	1.0	Reference	Reference
Condition (2)	5	10	50	100	150	0.5 lag	± 0.6	± 0.3
Reference Performance for condition (3)	10	20	100	200	320	1.0	Reference	Reference
Condition (3)	10	20	100	200	320	0.5 lag	± 0.6	± 0.3

5.4.2.4.2 Two-element meters

The effect of variation of power factor upon the performance of the meter shall not exceed that specified in Table 6.

5.4.2.4.3 Three-element meters

The effect of variation of power factor upon the performance of the meter shall not exceed that specified in Table 7.

5.4.2.5 Test no 5: Effect of variation of voltage

The effect of variation of voltage upon the performance of the meter shall not exceed that specified in Table 8.

Table 6 – Effect of variation of power factor for two-element meters

Condition	Current in Amperes – Current Class 10	20	100	200	320	Power Factor	Maximum Deviation in Percent from Reference Performance – Accuracy Class 0.5	0.2
Reference performance for conditions (1) and (2)	0.5	0.5	3	6	10	1.0	Reference	Reference
Condition (1)	0.5	0.5	3	6	10	0.866 lead	± 1.0	± 0.5
Condition (2)	1.0	1.0	6	12	20	0.5 lag	± 1.0	± 0.5
Reference performance for condition (3)	2.5	2.5	15	30	50	1.0	Reference	Reference
Condition (3)	2.5	2.5	15	30	50	0.866 lead	± 0.6	± 0.3
Reference performance for conditions (4) and (5)	5	10	50	100	150	1.0	Reference	Reference
Condition (4)	5	10	50	100	150	0.866 lead	± 0.6	± 0.3
Condition (5)	5	10	50	100	150	0.5 lag	± 0.6	± 0.3
Reference performance for conditions (6) and (7)	10	20	100	200	320	1.0	Reference	Reference
Condition (6)	10	20	100	200	320	0.866 lead	± 0.6	± 0.3
Condition (7)	10	20	100	200	320	0.5 lag	± 0.6	± 0.3

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Table 7 – Effect of variation of power factor for three-element meters

Condition	Current in Amperes – Current Class 10	20	100	200	320	Power Factor	Maximum Deviation in Percent from Reference Performance – Accuracy Class 0.5	0.2
Reference performance for condition (1)	0.5	0.5	3	6	10	1.0	Reference	Reference
Condition (1)	1	1	6	12	20	0.5 lag	± 1.0	± 0.5
Reference performance for condition (2)	5	10	50	100	150	1.0	Reference	Reference
Condition (2)	5	10	50	100	150	0.5 lag	± 0.6	± 0.3
Reference performance for condition (3)	10	20	100	200	320	1.0	Reference	Reference
Condition (3)	10	20	100	200	320	0.5 lag	± 0.6	± 0.3

Table 8 – Effect of variation of voltage

Condition	Current in Amperes – Current Class 10	20	100	200	320	Maximum Deviation in Percent from Reference Performance – Accuracy Class 0.5	0.2
Reference performance 100% of calibration voltage for condition (1) and (2)	0.2	0.25	1.5	3	5	Reference	Reference
Condition (1) 90% of calibration voltage	0.25	0.25	1.5	3	5	±0.2	±0.1
Condition (2) 110% of calibration voltage	0.25	0.25	1.5	3	5	± 0.2	± 0.1
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	±0.2	±0.1
Condition (4) 110% of calibration voltage	2.5	2.5	15	30	50	±0.2	±0.1

5.4.2.6 Test no. 6: Effect of variation of frequency

The effect of variation of frequency upon the registration of a meter carrying constant load shall not exceed that specified in Table 9.

5.4.2.7 Test no. 7: Equality of current circuits

5.4.2.7.1 Multi-element meters

The change in the performance of a multi-element meter when using only one current circuit, compared with the change when using all current circuits, shall not exceed that specified in Table 10.

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Table 9 – Effects of variation of frequency

Condition	Current in Amperes					Percent Rated Frequency	Max. Deviation in % from Reference Performance	
	Current Class						Accuracy Class	
	10	20	100	200	320		0.5	0.2
Reference performance for conditions (1) & (2)	0.25	0.25	1.5	3	5	100	Reference	Reference
Condition (1)	0.25	0.25	1.5	3	5	98	± 0.2	± 0.1
Condition (2)	0.25	0.25	1.5	3	5	102	± 0.2	± 0.1
Reference performance for conditions (3) & (4)	2.5	2.5	15	30	50	100	Reference	Reference
Condition (3)	2.5	2.5	15	30	50	98	± 0.2	± 0.1
Condition (4)	2.5	2.5	15	30	50	102	± 0.2	± 0.1

Table 10 – Equality of current circuits for multi-element meters

Condition	Connections of Current Circuits	Current in Amperes					Max. Deviation in % from Reference Performance	
		Current Class					Accuracy Class	
		10	20	100	200	320	0.5	0.2
Reference performance for conditions (5), (6), (7), (8), etc.	All Circuits	0.25	0.25	1.5	3	5	Reference	Reference
Condition (5)	Circuit A only	0.25N*	0.25N*	1.5N*	3N*	5N*	±0.7	±0.3
Condition (6)	Circuit B only	0.25N*	0.25N*	1.5N*	3N*	5N*	±0.7	±0.3
Condition (7), (8), etc.	Circuits C, D, etc.	0.25N*	0.25N*	1.5N*	3N*	5N*	±0.7	±0.3
Reference performance for conditions (9), (10), (11), (12), etc.	All Circuits	2.5	2.5	15	30	50	Reference	Reference
Condition (9)	Circuit A only	2.5	2.5	15	30	50	±0.7	±0.3
Condition (10)	Circuit B only	2.5	2.5	15	30	50	±0.7	±0.3
Condition (11), (12), etc.	Circuits C, D, etc.	2.5	2.5	15	30	50	±0.7	±0.3

*N represents the number of elements in the meter

5.4.2.8 Test no. 8: Internal meter losses

Refer to subclause 4.7.2.8 of ANSI C12.1 [2].

5.4.2.9 Test no. 9: Temperature rise

Refer to subclause 4.7.2.9 of ANSI C12.1 [2].

5.4.2.10 Test no. 10: Effect of internal heating

The test shall be conducted with the meter conventionally mounted on a suitably rated meter mounting. Such meter shall be wired with conductor no less than 4 feet (8 foot jumper between terminals), sized adequately for the load range of the meter. Openings around the conductor, and any other openings, shall be closed with suitable material to prevent drafts.

The effect of internal heating upon the performance of a meter shall not exceed that specified in Table 11a and Table 11b.

The reference test is to be made immediately upon energizing the meter.

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Table 11a – Effect of internal heating

Condition	Current in Amperes		Maximum Deviation in Percent from Reference Performance	
	Current Class		Accuracy Class	
	10	20	0.5	0.2
Reference performance for conditions (1), (2), and (7)	10	20	Reference	Reference
Reference performance for conditions (3) and (5)	0.25	0.25	Reference	Reference
Reference performance for conditions (4) and (6)	2.5	2.5	Reference	Reference
Condition (1) One-half hour after application of load	10	20	±0.2	±0.2
Condition (2) One hour after application of load	10	20	±0.3	±0.2
Condition (3) Immediately following test for condition (2)	0.25	0.25	±0.3	±0.2
Condition (4) Immediately following test for condition (2)	2.5	2.5	±0.3	±0.2
Condition (5) Two hours after test for condition (4) with meter at no load current during the two-hour interval	0.25	0.25	±0.3	±0.2
Condition (6) Immediately following test for condition (5)	2.5	2.5	±0.2	±0.2
Condition (7) Immediately following test for condition (6)	10	20	±0.2	±0.2

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Table 11b – Effect of internal heating for current classes 100, 200, and 300

Condition	Current in Amperes			Maximum Deviation in Percent from Reference Performance	
	Current Class			Accuracy Class	
	100	200	300	0.5	0.2
Reference performance for conditions (1), (2), and (7)	100	200	320	Reference	Reference
Reference performance for conditions (3) and (5)	1.5	3	5	Reference	Reference
Reference performance for conditions (4) and (6)	15	30	50	Reference	Reference
Condition (1) One-half hour after application of load	100	200	320	±0.4	±0.4
Condition (2) One hour after application of load	100	200	320	±0.5	±0.4
Condition (3) Immediately following test for condition (2)	1.5	3	5	±0.5	±0.4
Condition (4) Immediately following test for condition (2)	15	30	50	±0.5	±0.4
Condition (5) Two hours after test for condition (4) with meter at no load current during the two-hour interval	1.5	3	5	±0.5	±0.4
Condition (6) Immediately following test for condition (5)	15	30	50	±0.4	±0.4
Condition (7) Immediately following test for condition (6)	100	200	320	±0.4	±0.4

5.4.2.11 Test no. 11: Effect of polyphase loading

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 0.5 accuracy class and 0.3% for 0.2 accuracy class.

5.4.3 External influences

5.4.3.1 Performance verification

Time, program, and register readings shall be stored in the meter and/or register to be used as a reference for tests 5.4.3.2 through 5.4.3.19. After each test, proper operation of the meter and/or register shall be verified by checking time, program, and register reading; the meter shall show no damage and shall operate correctly in accordance with the requirement of the standard. Any change in energy and power quantities shall be limited to ± 1 least significant digit displayed.

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5.4.3.2 Test no. 12: Insulation

Refer to subclause 4.7.3.1 of ANSI C12.1 [2].

5.4.3.3 Test no. 13: Voltage interruptions test

Refer to subclause 4.7.3.2 of ANSI C12.1 [2].

5.4.3.4 Test no. 14: Effect of high voltage line surges

Refer to subclause 4.7.3.3 of ANSI C12.1 [2].

5.4.3.5 Test no. 15: Effect of external magnetic field

Refer to subclause 4.7.3.4 of ANSI C12.1 [2].

5.4.3.6 Test no. 16: Effect of variation of ambient temperature

The test shall be applied to three meters. The meters shall be placed in a space with a temperature of 23°C ± 5°C and allowed to stand for no less than 2 hours with the voltage circuits of the meters energized. Reference performance at each of the loads specified in Table 12 shall be obtained after operating the meters for 1 hour at the specified load. The meters shall then be operated and tested at each of the following conditions:

1. Conditions (1) through (6): These tests shall be conducted by placing the meter in a space with a temperature of 50°C ± 5°C. After energizing the voltage circuits of the meters for no less than 2 hours, the appropriate test currents at the power factors listed for conditions (1) through (6) of Table 12 shall be sequentially applied to the meters. Each condition shall be maintained for a period of at least 1 hour before performing tests to determine the deviation from reference performance.
2. Conditions (7) through (12): Repeat conditions (1) through (6), respectively, but place meters in a space with a temperature of -20°C ± 5°C.

The effect of variation of temperature upon the performance of the meters shall not exceed that specified in Table 12.

Nominally available voltage and current can be used for the duration of this test when the metering device is not undergoing the specified accuracy test.

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Table 12 – Effect of variation of ambient temperature

Condition	Current in Amperes, Current Class 10	20	100	200	320	Power Factor	Ambient Temperature	Max. Deviation in % from Reference Performance at Nominal Temp. Difference*, Accuracy Class 0.5	0.2
Reference performance for conditions (1) and (7)	0.25	0.25	1.5	3	5	1.0	23°C±5°C	Reference	Reference
Reference performance for conditions (2) and (8)	2.5	2.5	15	30	50	1.0	23°C±5°C	Reference	Reference
Reference performance for conditions (3) and (9)	5	10	50	100	150	1.0	23°C±5°C	Reference	Reference
Reference performance for conditions (4) and (10)	0.5	0.5	3	6	10	0.5 lag	23°C±5°C	Reference	Reference
Reference performance for conditions (5) and (11)	2.5	2.5	15	30	50	0.5 lag	23°C±5°C	Reference	Reference
Reference performance for conditions (6) and (12)	5	10	50	100	150	0.5 lag	23°C±5°C	Reference	Reference
Condition (1)	0.25	0.25	1.5	3	5	1.0	50°C±5°C	±0.8	±0.3
Condition (2)	2.5	2.5	15	30	50	1.0	50°C±5°C	±0.8	±0.3
Condition (3)	5	10	50	100	150	1.0	50°C±5°C	±0.8	±0.3
Condition (4)	0.5	0.5	3	6	10	0.5 lag	50°C±5°C	±1.4	±0.5
Condition (5)	2.5	2.5	15	30	50	0.5 lag	50°C±5°C	±1.4	±0.5
Condition (6)	5	10	50	100	150	0.5 lag	50°C±5°C	±1.4	±0.5
Condition (7)	0.25	0.25	1.5	3	5	1.0	-20°C±5°C	±1.3	±0.5
Condition (8)	2.5	2.5	15	30	50	1.0	-20°C±5°C	±1.3	±0.5
Condition (9)	5	10	50	100	150	1.0	-20°C±5°C	±1.3	±0.5
Condition (10)	0.5	0.5	3	6	10	0.5 lag	-20°C±5°C	±2.1	±0.9
Condition (11)	2.5	2.5	15	30	50	0.5 lag	-20°C±5°C	±2.1	±0.9
Condition (12)	5	10	50	100	150	0.5 lag	-20°C±5°C	±2.1	±0.9

*When the actual temperature difference between two tests differs from the nominal temperature difference specified for the two tests, the deviation shall be adjusted proportionally.

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Table 13 – Effect of temporary overloads on accuracy

Condition	Current in Amperes			Maximum Deviation in Percent from Reference Performance	
	Current Class			Accuracy Class	
	100	200	320	0.5	0.2
Reference performance for condition (1)	15	30	50	Reference	Reference
Reference performance for condition (2)	1.5	3	5	Reference	Reference
Condition (1)	15	30	50	±0.1	±0.1
Condition (2)	1.5	3	5	±0.1	±0.1

Table 14 – Effect of current surge in ground conductor

Condition	Current in Amperes			Maximum Deviation in Percent from Reference Performance	
	Current Class			Accuracy Class	
	100	200	320	0.5	0.2
Reference performance	15	30	50	Reference	Reference
Condition (1)	15	30	50	±0.1	±0.1

5.4.3.7 Test no. 17: Effect of temporary overloads

5.4.3.7.1 Effect on accuracy

Self-contained meters shall be subjected to a short-circuit current of 7000 A peak, 60 Hz, for no more than 6 cycles (0.1 second). For this test, current circuits of the meter shall be connected series adding.

The effect of a short-circuit current on the performance of a meter should not exceed that specified in Table 13.

In order to eliminate residual effect, it is essential that tests of condition (1) be conducted before tests of condition (2).

5.4.3.7.2 Effect on mechanical structure and insulation

The meter shall withstand, for a duration of 4 cycles (0.07 seconds), a 60 Hz symmetrical fault current without damage to the mechanical structure or reduction in the insulation level as follows:

Current Class 100: 10 000 A rms
Current Class 200: 12 000 A rms
Current Class 320: 12 000 A rms

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5.4.3.8 Test no. 18: Effect of current surge in ground conductor

Three meters shall be subjected to one transient surge of 20 000 A (20/50 microsecond wave), of either polarity, through a conductor placed vertically 1.5 inches behind the flat portion of the base of the meter, with a socket in place. This test shall not apply to meters with terminal compartments (Type A), or for Class 10 or Class 20 meters. The effect of current surge upon the performance of a meter shall not exceed that specified in Table 14.

5.4.3.9 Test no. 19: Effect of superimposed signals

Refer to subclause 4.7.3.8 of ANSI C12.1 [2].

5.4.3.10 Test no. 20: Effect of voltage variation-secondary time base

Refer to subclause 4.7.3.9 of ANSI C12.1 [2].

5.4.3.11 Test no. 21: Effect of variation of ambient temperature-secondary time base

Refer to subclause 4.7.3.10 of ANSI C12.1 [2].

5.4.3.12 Test no. 22: Electrical fast transient/burst test

Refer to subclause 4.7.3.11 of ANSI C12.1 [2]. The meter shall meet the Fast Transient Surge Test requirements of IEC 801-4 [3] for electrical fast transient/burst. See Figures 1 and 2.

This test subjects the power inputs and I/O circuits of the meter to repetitive bursts of 5 nanosecond rise time in 50 nanosecond duration.

The test shall be carried out according to IEC 801-4, under the following conditions:

1. Test severity level: 4
2. Test voltage on the voltage and current circuit: 4kV
3. Test voltage on I/O signal, data, and control lines: 2kV
4. Duration of the test: minimum of 60 seconds
5. Voltage and auxiliary circuits energized with reference voltage
6. No current in the current circuits and open circuit current terminals

This test shall be conducted on all metering devices containing solid state components, excluding voltage indicators.

5.4.3.13 Test no. 23: Effect of radio frequency interference

This test shall be conducted with all cables connected and all options and accessories specified, in a configuration closely resembling typical field in-service connections. See Figures 3, 4, and 5 for screen room testing, and Figure 6 for GTEM™ testing. This test shall be conducted on all metering devices containing solid-state components, excluding voltage indicators. For approval testing, the manufacturer need only use one test procedure, screen room, or GTEM. Utility verification should use the same procedure as the manufacturer.

5.4.3.13.1 Basic radiation susceptibility test

The test sample shall be subjected to both vertical and horizontal polarized continuous wave signals over a frequency range of 200 kHz-1000 MHz with a field strength of 15 +/-5 V/m. The test shall be performed with the antenna facing the most sensitive side of the meter. The field may be generated by 1) a linearly polarized antenna positioned vertically and again with the antenna positioned horizontally; 2) a circularly polarized antenna may be used to simultaneously provide both vertical and horizontal susceptibility testing over those frequency ranges where circular polarized antennas are available; or 3) a uniform field generator. The test procedures shall be conducted with samples configured so that disturbances can be

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readily noted. Optional (add-on) functions and circuitry shall be installed when this represents a normal configuration for the test sample. Special internal wiring or wire routing of the test sample are prohibited.

The test fixture shall be composed of a minimum amount of metal (or other EMI reflecting or absorbing material) capable of shielding or otherwise distorting the field in the vicinity of the test sample. If a uniform field strength is not available, the fixture must allow the test sample to be oriented in each of 10 orientations to allow both horizontal and vertical irradiation of the front, left side, right side, top, and bottom of the test sample.

Below 50 MHz, the signal must be 90% amplitude modulated with a 1.0 kHz sine wave. A continuous wave signal is used above 50 MHz. Beginning at 200 kHz, the scan rate will double the frequency no faster than every 200 seconds (.005 octaves/second) through 1000 MHz.

One test sample is used to determine the orientation which provides the greatest sensitivity.

With a field strength set to 15 +/- 5 V/m, test the test samples over a frequency range in the most sensitive orientation.

In each orientation above, the fixture must place the test sample in a test volume in which the field strength remains within acceptable test limits.

Use Figures 3 through 5 for typical shielded room testing and Figure 6 for GTEM testing.

When using GTEM testing, power and I/O leads should be only as long as needed to make connection from the GTEM shielded I/O connectors to the test sample. Leads shall not exceed 5 meters in length. Excess leads shall be coiled in a 0.4 meter diameter coil and supported 0.02 to 0.1 meter off the floor and other metal surfaces of the GTEM.

5.4.3.14 Test no. 24: Radio frequency conducted and radiated emission test

Refer to subclause 4.7.3.13 of ANSI C12.1 [2].

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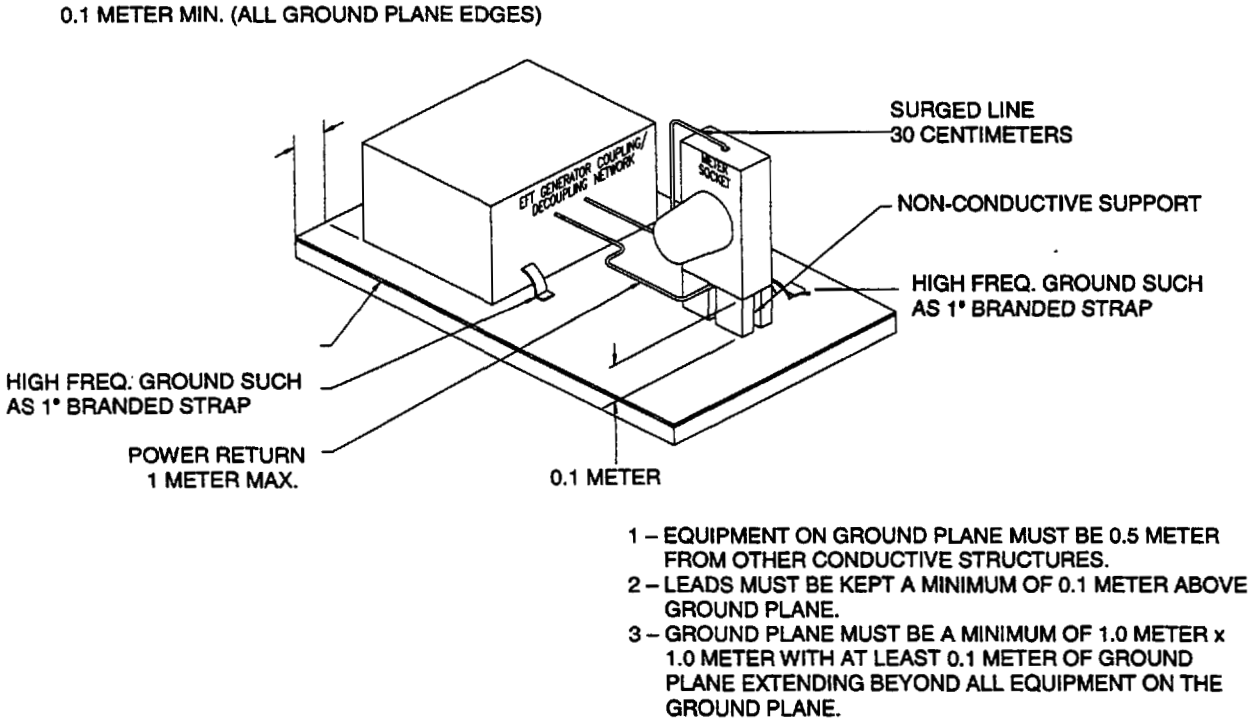


Figure 1 – Electrical fast transient/burst test #22

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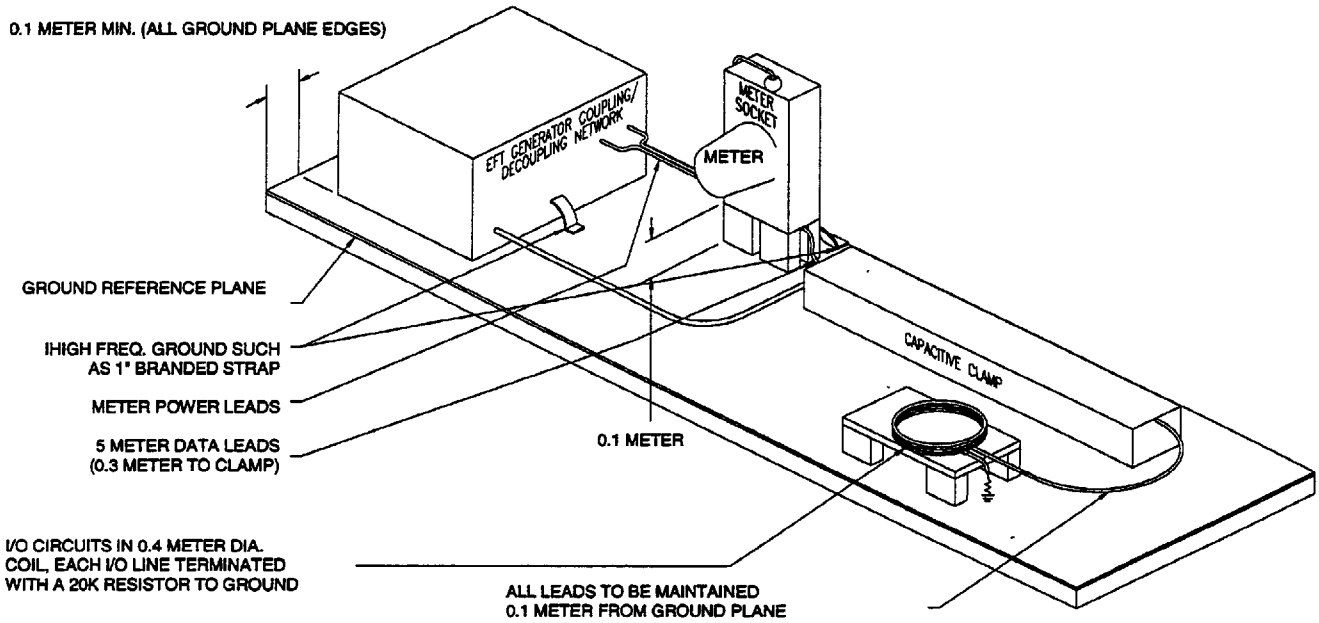


Figure 2 – Electrical fast transient/burst test #22: Use of capacitive clamp to test data and I/O lines

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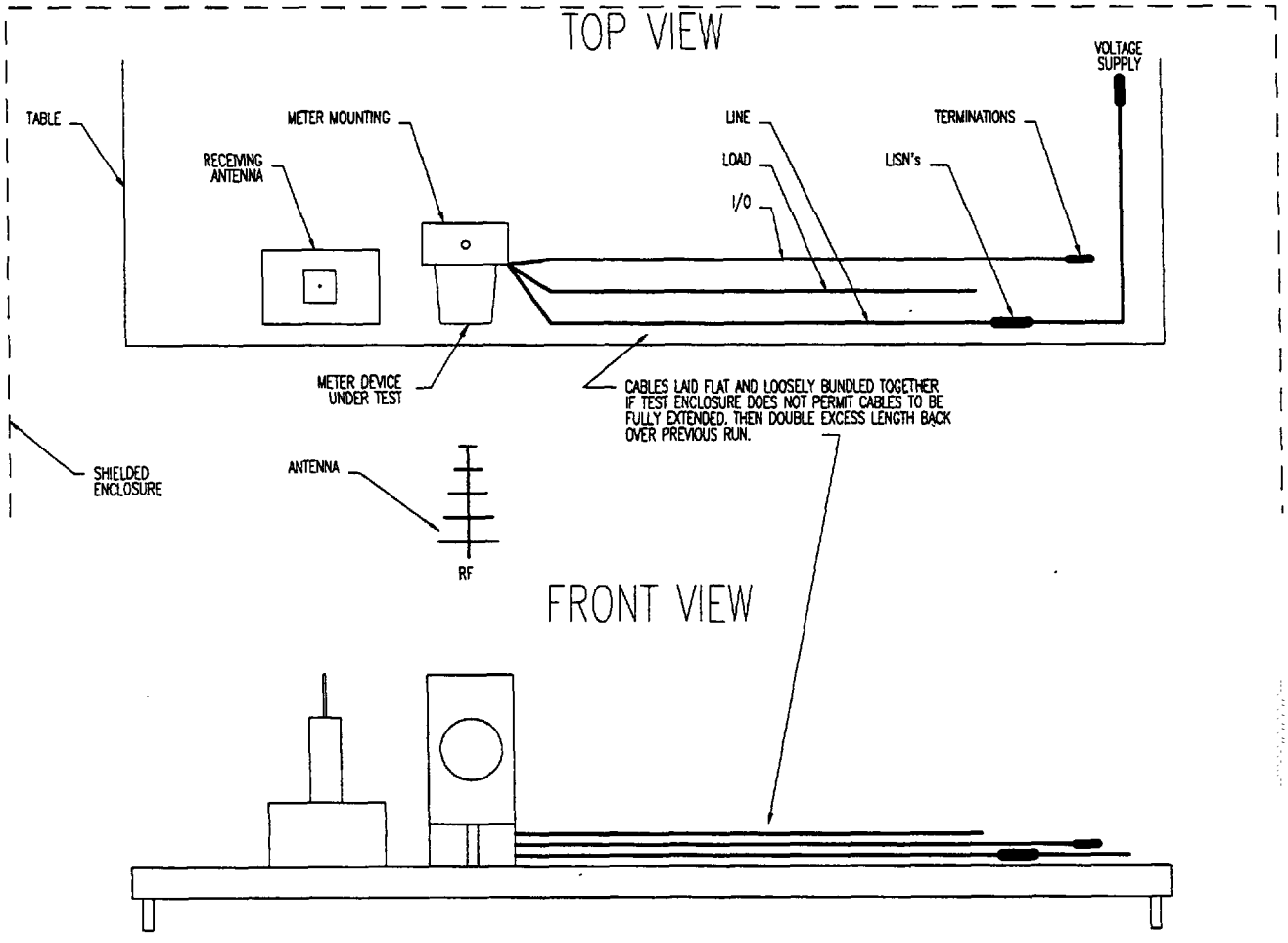


Figure 3 – Typical test layout for radiated susceptibility, radiated emissions, and conducted emissions

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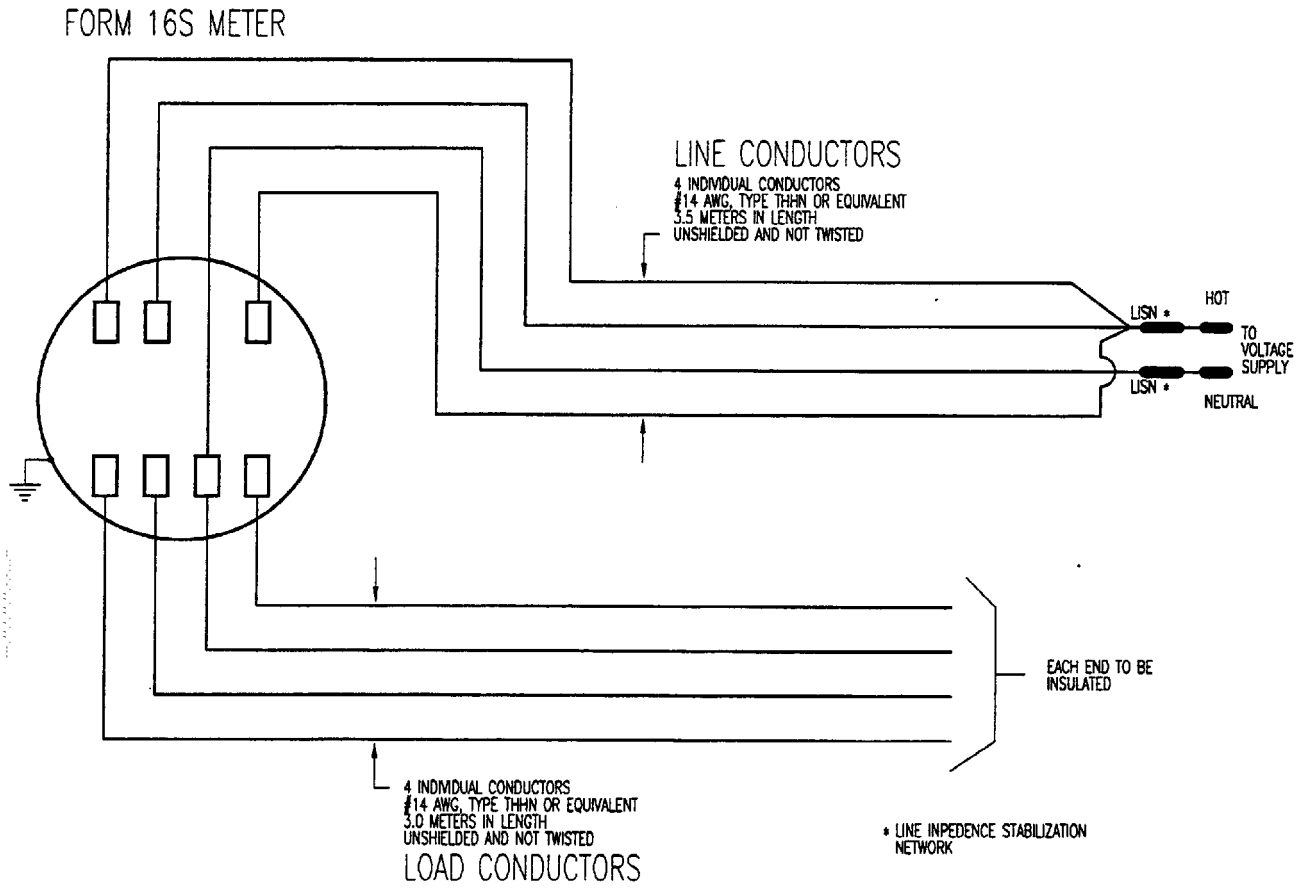


Figure 4 – Typical wiring detail for self contained meters for radiated susceptibility, radiated emissions, and conducted emissions

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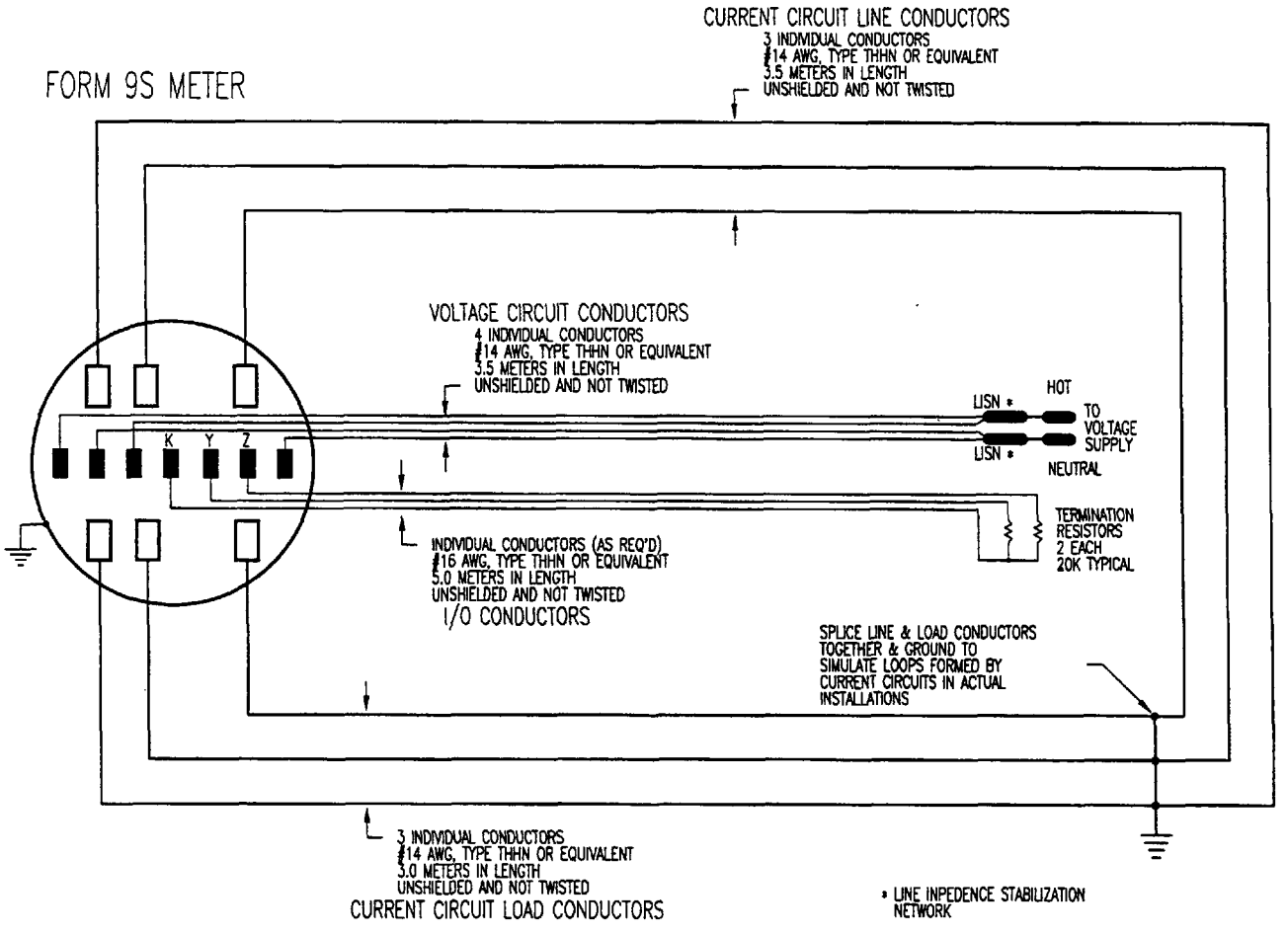
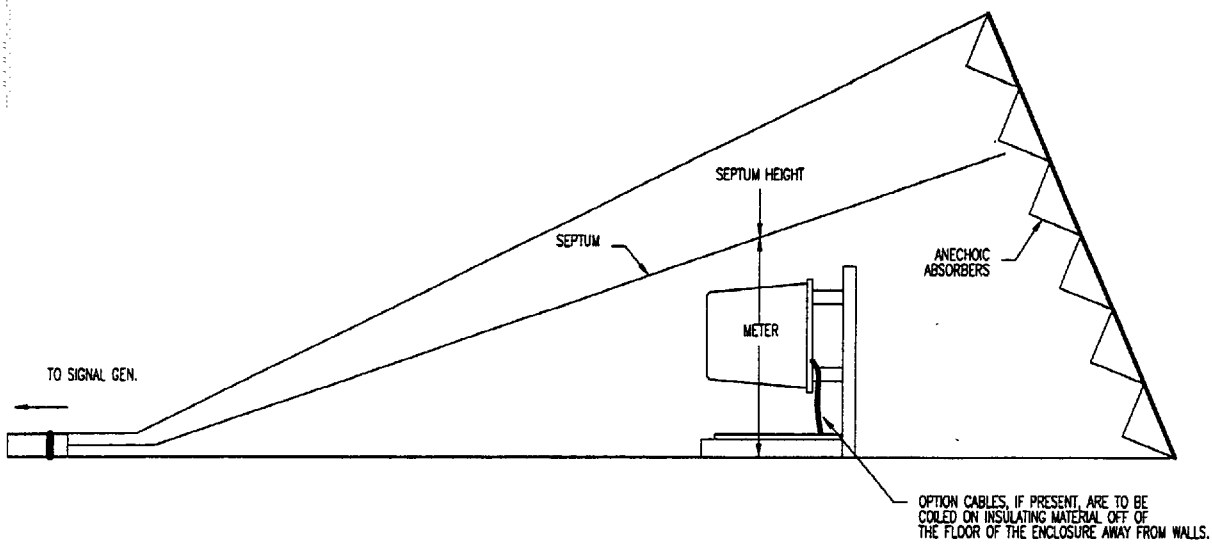


Figure 5 – Typical wiring detail for transformer rated meters for radiated susceptibility, radiated emissions, and conducted emissions

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NOTES —

1 Uniformity of the test field must be demonstrated to ensure field does not fall below minimum field requirements.
2 All power and cabling exiting the enclosure must be suitably filtered to prevent RF leakage.
3 Orientation of the test meter is shown for front, horizontal polarization.
4 Field intensity is controlled by septum voltage (direct measurement), or by field probes located in the cell.
5 Field strength should be determined from the central axis of the meter : voltage on septum divided by septum height equals field strength.

Figure 6 – GTEM test

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5.4.3.15 Test no. 25: Effect of electrostatic discharge (ESD)

Refer to subclause 4.7.3.14 of ANSI C12.1 [2].

5.4.3.16 Test no. 26: Effect of storage temperature

Refer to subclause 4.7.3.15 of ANSI C12.1 [2].

5.4.3.17 Test no. 27: Effect of operating temperature

Refer to subclause 4.7.3.16 of ANSI C12.1 [2].

5.4.3.18 Test no. 28: Effect of relative humidity

Refer to subclause 4.7.3.17 of ANSI C12.1 [2].

5.4.3.19 Test no. 29: Mechanical shock

Refer to subclause 4.7.3.18 of ANSI C12.1 [2].

5.4.3.20 Test no. 30: Transportation drop

Refer to subclause 4.7.3.19 of ANSI C12.1 [2].

5.4.3.21 Test no. 31: Vibration

Refer to subclause 4.7.3.20 of ANSI C12.1 [2].

5.4.3.22 Test no. 32: Transportation vibration

Refer to subclause 4.7.3.21 of ANSI C12.1 [2].

5.4.3.23 Test no. 33: Weather simulation test

Refer to subclause 4.7.3.22 of ANSI C12.1 [2].

5.4.3.24 Test no. 34: Salt-spray test

Refer to subclause 4.7.3.23 of ANSI C12.1 [2].

5.4.3.25 Test no. 35: Raintightness

Refer to subclause 4.7.3.24 of ANSI C12.1 [2].

6 Requirements applicable to detachable electricity meters

For construction requirements, refer to ANSI C12.10 [1], clause 4.

7 Requirements applicable to bottom-connected electricity meters

For construction requirements, refer to ANSI C12.10 [1], clause 5.

8 Procedure for assigning form designations

Refer to clause 7 of ANSI C12.10 [1].

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