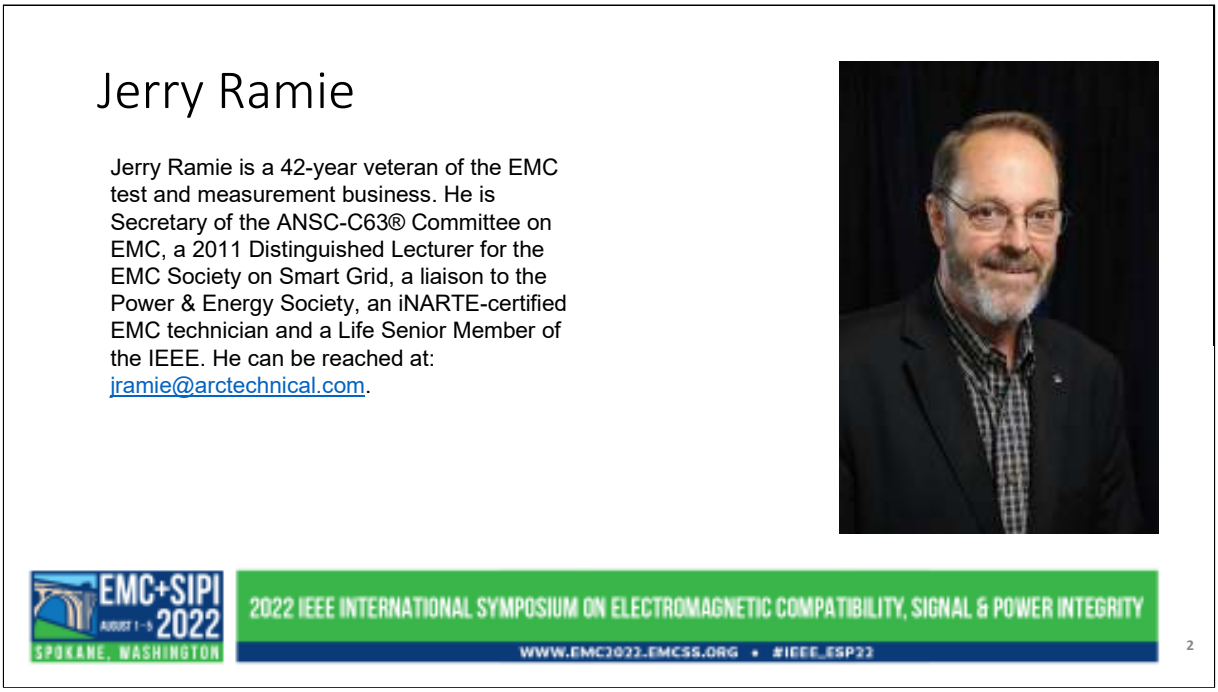
Testing Requirements for Devices with Communications Functions used with Electric Power Apparatus

By

Jerry Ramie, ARC Technical Resources



Session ID#

Biography:

Jerry Ramie is a 42-year veteran of the EMC test and measurement business. He is Secretary of the ANSC-C63® Committee on EMC, a 2011 Distinguished Lecturer for the EMC Society on Smart Grid, our liaison to the Power & Energy Society, an iNARTE-certified EMC technician and a Life Senior Member of the IEEE. He can be reached at: jramie@arctechnical.com.

I have been in the EMC test equipment business for many years. Since 2001, I have added writing, consulting and EMC Standards work on the immunity testing of electric utility equipment.

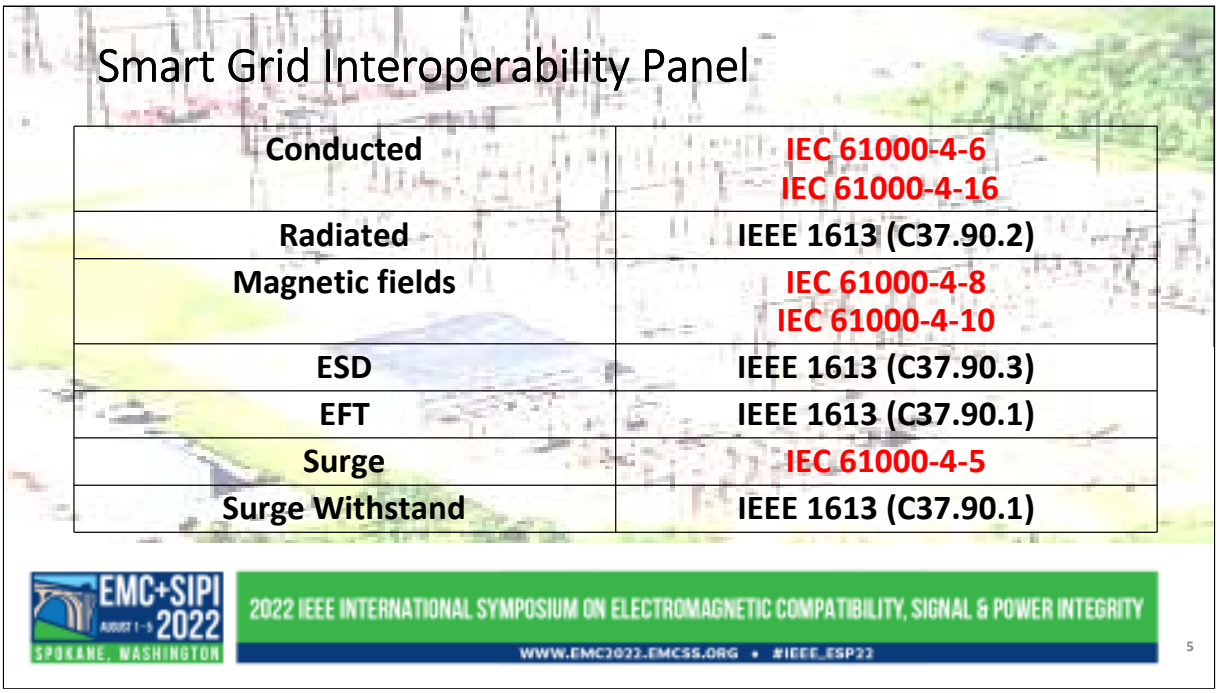
Smart Grid Interoperability Panel

The **NIST-SGIP** formed the EMII Working Group in September of 2010 to address equipment immunity testing and installed reliability. Eight months were allocated to develop recommendations for the governing board. Twenty-one months later the White Paper was posted.

https://www.nist.gov/sites/default/files/documents/smartgrid/EMII_WG_EMC_White_Paper_SGIP_2012_005.pdf

Smart Grid Interoperability Panel

The EMII Working Group report was completed by November, 2012. **IEC 61850-3** (2002) was the Best Practice guide used for determining which EMC immunity tests to recommend for addition to IEEE – 1613. In addition, these two Standards are already widely used in Industry. (as shown in their advertising)

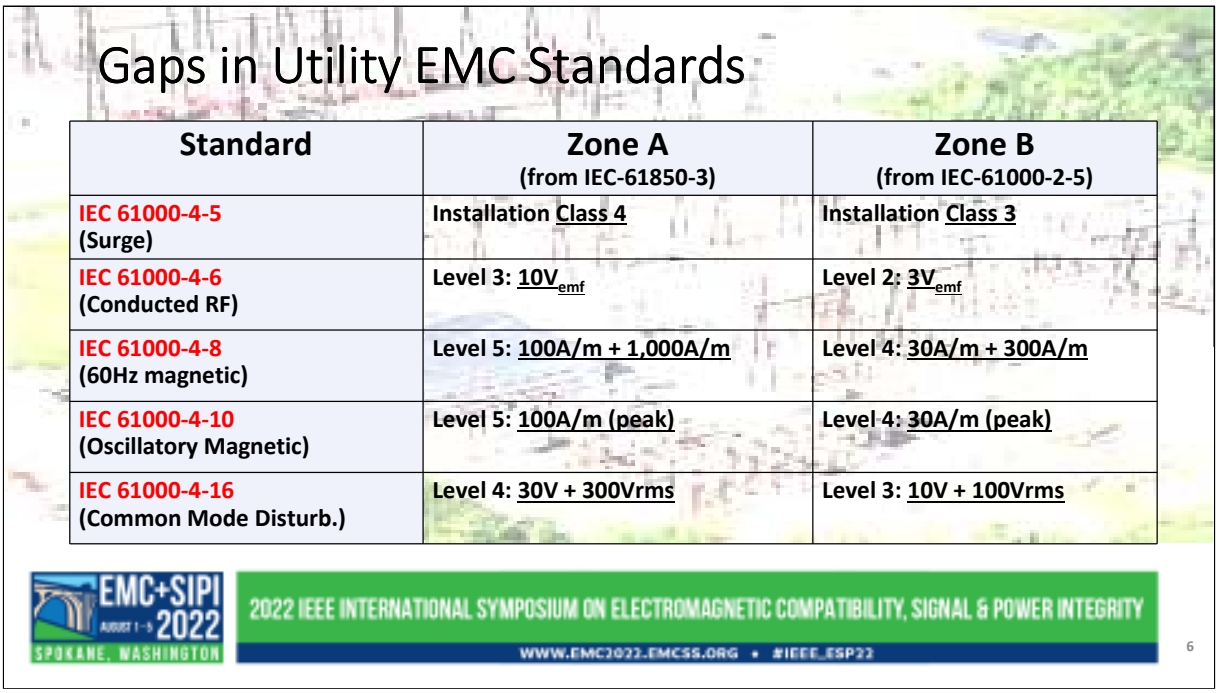


IEC 61850-3 (2002) required these immunity tests shown on the right: If the test was addressed in IEEE-1613:2009, it was not considered a "gap" by the NIST-SGIP.

- IEC 61000-4-6 (Conducted RF Immunity)
- IEC 61000-4-3 Radiated RF Fields (covered by C37.90.2)
- IEC 61000-4-8 (Power-frequency magnetic fields)
- IEC 61000-4-10 (Damped Oscillatory Magnetic Fields)
- IEC 61000-4-2 (ESD) (covered by C37.90.3)
- IEC 61000-4-16 (Conducted Common-Mode Disturbances)
- IEC 61000-4-4 Electrical Fast Transient (covered by C37.90.1)
- IEC 61000-4-5 (Surge)
- IEC 61000-4-12 Ring & Damped Oscillatory Waves (covered by C37.90.1)

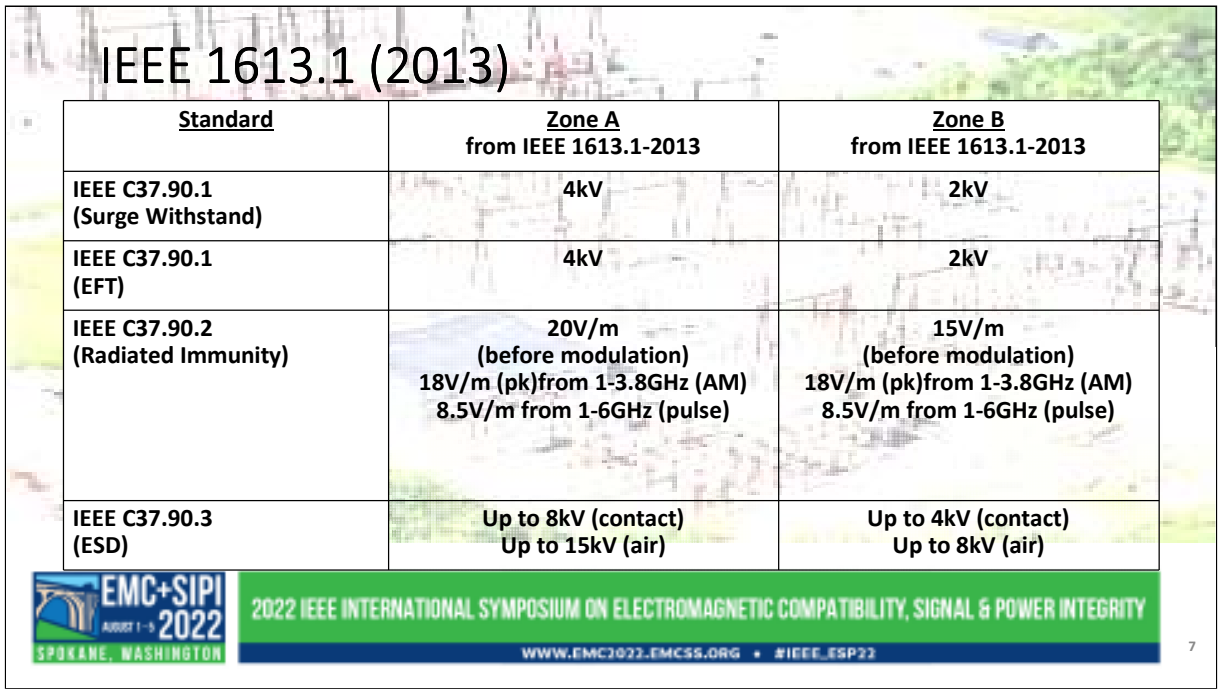
The five "gaps" found when comparing this European list to tests covered in the US under the IEEE-C37.90.x series are shown in red in this table. They can be found on pg.60 of the White Paper:

https://www.nist.gov/sites/default/files/documents/smartgrid/EMII_WG_EMC_White_Paper_SGIP_2012_005.pdf



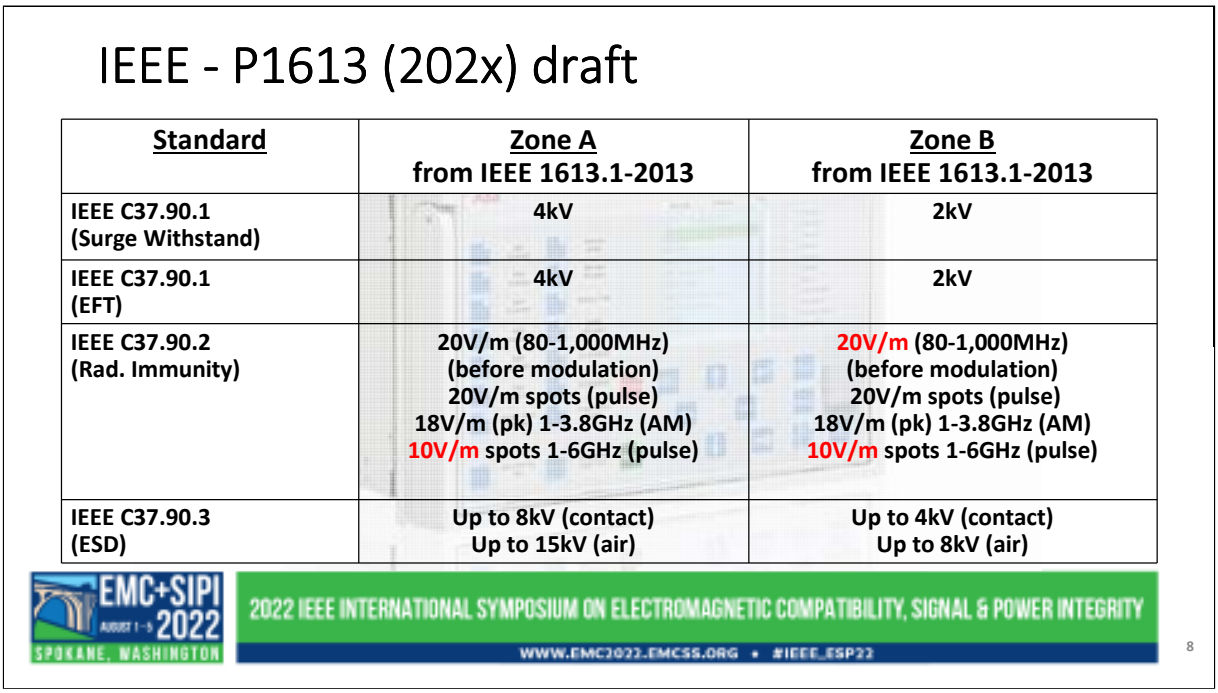
Gaps in Utility EMC Standards

These five “gap” immunity tests were addressed in IEEE -1613.1:2013. IEC-61850-3 (2002) invoked the test levels for substation products that were called out for products used in **Zone A** (inside the substation boundary) as shown in the middle column. **Zone B** was defined as outside the substation boundary in the distribution network and required a lower test level in each case.



IEEE 1613.1 (2013)

These tests, originally taken from IEEE-1613(2009), were modified slightly in the extension called IEEE-1613.1 (2013). Two zones were added, both inside and outside the substation boundary. The Radiated RF Immunity field strength was enhanced with additional microwave frequencies and modulation schemes. ESD testing was also mandated in Zone B, for equipment out in the Distribution network.



IEEE P1613 (202x) draft

Work began on a new IEEE-P1613(202x) in 2016 in the Power & Energy Society with myself as liaison to the EMC Society as the Co-Vice Chair. Three sponsoring Committees within the Power & Energy Society sponsored the work to expand the scope of the 1613 “pair” of Standards to cover all devices with communication functions. It sould replace both IEEE-1613:2009 and IEEE-1613.1:2013. It covered devices with communication functions, as most devices have.

These Radiated RF Immunity tests, taken from IEEE 1613.1 (2013), had the test levels increased slightly, both inside (Zone A) and outside the substation boundary (Zone B), as shown in **red**.

As before, ESD testing was also mandated in both zones.

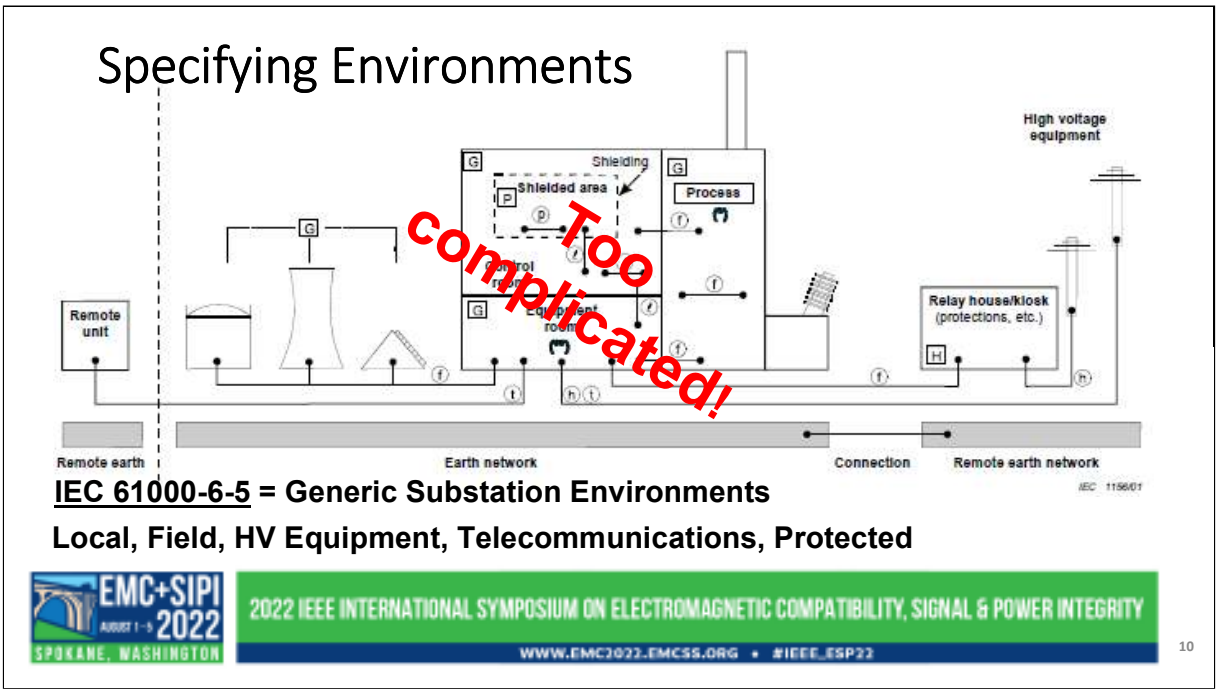
The draft p1613 was met with wide-spread disdain by the Power Systems Relaying Committee.

IEEE P1613 (201x) draft

In the EMC Society, our Standards call out various **Environments**. (heavy industrial, light industrial, commercial, consumer)
In the Power & Energy Society, EMC Standards are organized by **Function**. (protective, communications, switchgear, transformers, generation equipment)

The same or similar electronic controllers next to one another in a substation may be governed by different EMC Standards, although other functional committees tend to use the Protective Relaying Standards (C37.90.x) for their immunity testing requirements. They may invoke their own Acceptance Criteria based on their particular function. They all seem to want the same test levels for any environment their functional equipment is installed in.

At meetings in 2018, there was severe push-back against the idea of using two zones, inside and outside substations, with different test levels. The consensus was to test the functions accessible through a communications port. The older IEEE-1613 (2009) covered Communications Networking Equipment, so the scope was expanded to devices with communications functions.



Specifying Environments

IEC 61000-6-5 Generic Substation Environments
Five environments, Local, Field, HV Equipment, Telecommunications, Protected
Too complicated!

Specifying Environments

Too complicated!

IEEE 1613.1 (2013) = Two Environments

Inside substation boundary, Outside substation boundary

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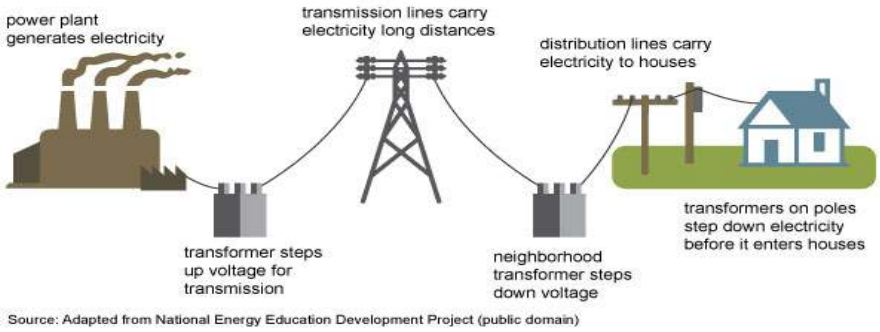
Specifying Environments

IEEE - 1613.1 (2013) – Communications Networking Equipment
Two environments, inside and outside the substation boundary

Too complicated!

Specifying Environments



Source: Adapted from National Energy Education Development Project (public domain)

IEEE P1613 (202x) = One Environment (based on function)

Any device with a communications port (most devices)

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Specifying Environments

IEEE - P1613 (201x) – Devices with Communications Functions

Any device with a communications port (including an antenna) used anywhere in Transmission or Distribution. **One environment = everywhere**. Most devices will have communications functionality, so this allowed P1613 to contain all the tests that were not in the existing family of C37.90.x immunity Standards.

Immunity Tests in IEEE-1613 + 1613.1

Test	IEEE Standards 1613:2009 + 1613.1:2013 *Differentiated by location (substations / distribution)*
Electrostatic Discharge	C37.90.3
Radiated RF (radio frequency)	C37.90.2
Fast Transients / Bursts	C37.90.1
Surge (e.g. indirect lightning)	IEC 61000-4-5
Conducted RF Immunity	IEC 61000-4-6
Power Frequency Magnetic Field	IEC 61000-4-8
Damped Oscillatory Magnetic Field	IEC 61000-4-10
Oscillatory Surge Withstand Capability	C37.90.1
Mains Voltage Common Mode	IEC 61000-4-16
Ripple on DC supplies	C37.90

Existing immunity tests from the IEEE-1613 and 1613.1 pair of Standards

The C37.90 series were called out in the previous IEEE-1613-2009. The five IEC tests in **red** were “gaps” that were added in the IEEE-1613.1 extension in 2013.

This IEEE Standard closed the gaps between IEC-61850-3-2002, which was in the NIST Catalog of Standards, and IEEE-1613-2009, thus enabling the harmonization of EMC immunity testing requirements throughout much of the world and promoting better quality, more immune substation communications networking products. It also addressed the immunity testing of distribution communications networking equipment.

Additional Tests in IEC-61850-3: 2013

Test	New tests in IEEE-P1613 (201x) *Taken from IEC-61850-3:2013 (substations) and IEC 61000-2-5:2017 (distribution)*
ESD	Already covered before as C37.90.3
AC Voltage Dips/Interruptions	IEC 61000-4-11
DC Voltage Dips/Interruptions	IEC 61000-4-29
Damped Oscillatory Waves	IEC 61000-4-18 is partly covered by C37.90.1 (GIS & HEMP are not addressed)

The test levels for all environments were taken from IEC 61850-3(2013) (substations) and the C37.90.x series for all environments (no zones)

The C37.90.x series of Standards are due for updates and discussion

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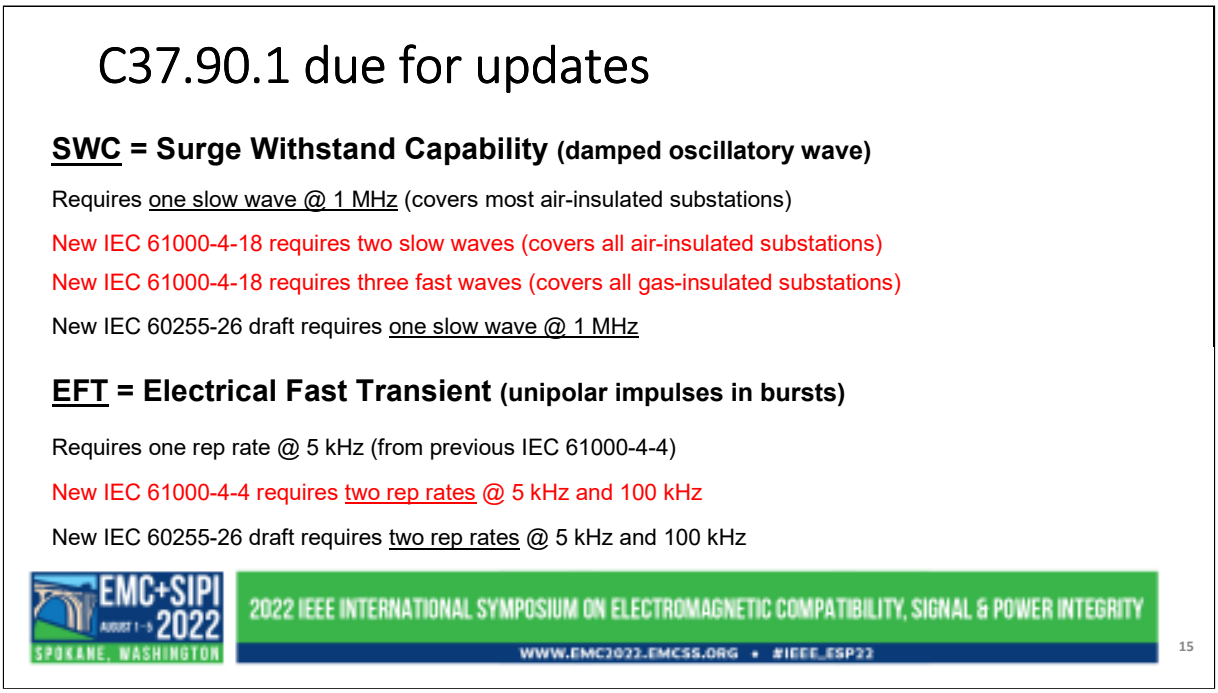
Additional Tests derived from IEC – 61850-3 - 2013

In order to avoid opening any new testing "gaps" in the IEEE-P1613(201x) document when compared to the newer IEC-61850-3(2013), three new immunity type tests (in red) were added.

- ESD (Already covered before as C37.90.3)
- Ripple on DC supplies (Already covered as C37.90 @ 5%)
- AC Voltage Dips/Interruptions **IEC 61000-4-11**
- DC Voltage Dips/Interruptions **IEC 61000-4-29**
- Damped Oscillatory Waves **IEC 61000-4-18** is partly covered by C37.90.1 (GIS and HEMP are not addressed)

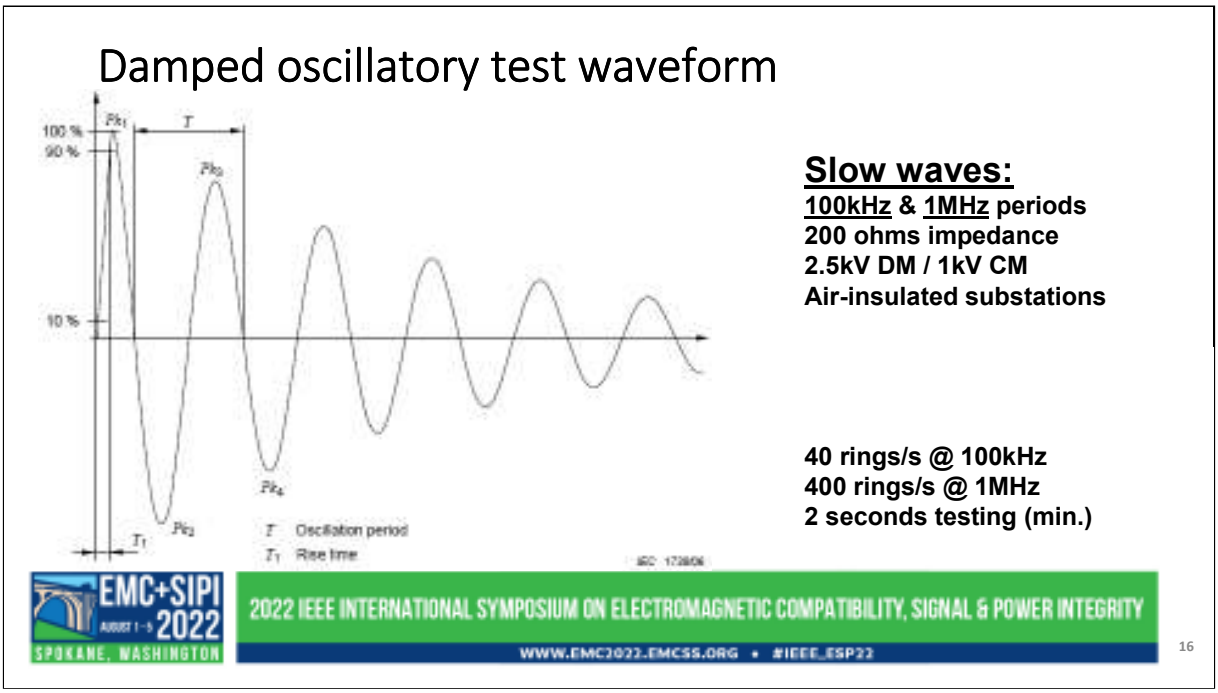
Test levels in substations and distribution are the same now. (No zones)
The C37,90.x series of Standards are undergoing updates.



The IEEE C37.90.x series of Standards were due for revisions

C37.90.1 covered Surge Withstand Capability (SWC) with a single damped oscillatory wave at 1 MHz. This covered most air-insulated substations. The new IEC 61000-4-18 (called out in IEC 61850-3 (2013)) required two slow waves (for all air-insulated substations) and three fast waves (for all gas-insulated substations)
However, the product Standard for protective relays, IEC 60255-26, only requires one slow wave @ 1 MHz.

C37.90.1 also contains unrelated requirements for Electrical Fast Transient (EFT) testing with a single 5 kHz repetition rate. The newer version of IEC 61000-4-4 requires two rep rates, 5 & 100 kHz. It noted that the higher rate was more realistic. The new draft of IEC 60255-26 also requires both rep rates.



IEC 61000-4-18 (2010)
Damped oscillatory test waveform

6.1.1 Slow damped oscillatory waves

Slow damped oscillatory waves are specified for air-insulated substation environments. Two oscillation frequencies are specified, 100 kHz and 1 MHz, corresponding to larger and smaller air-insulated substation layouts. The impedance is the same as the IEEE document at 200 ohms. The test voltage is 2.5kV (CM) and 1kV (DM) for air-insulated substations. The newest draft IEC 60255-26 for protective relays only calls out the 1MHz wave.

The repetition rates are lower than the IEEE document requires at 40 rings/second for 100 kHz and within the specified range of 400 rings/second for the 1 MHz waveform. (C37.90.1 currently calls for rep rates of 360 – 600 rings/second) The test duration of 2 seconds (minimum) is the same in both documents.

Summary of Recommendations

Oscillatory SWC

Consider using the SWC rep. rates as defined in IEC 61000-4-18.

(40 and 400 rings/sec rather than 6-10 rings/period = 360-600 rings/sec)

Don't call out the repetition rate as "bursts per period" but rather as "rings per second"

Electrical Fast Transient (EFT)

Minimize IEC diagrams and cite the IEC 61000-4-4 Standard as Normative.

Keep differential coupling on DC lines above 48VDC as in IEEE – 1613 (2009) and continue to show the balun diagram in Annex D.

Implement both repetition rates (5 kHz & 100 kHz) as per IEC 61000-4-4

IEEE – pC37.90.1 (201X)
Summary of Recommendations

Oscillatory SWC

Consider using the SWC repetition rates in IEC 61000-4-18. (40 and 400 rings/sec rather than 6-10 rings/period = 360-600 rings/sec) This will ensure that all SWC generators that meet the current IEC 61000-4-18 Standard will also work for this Standard.

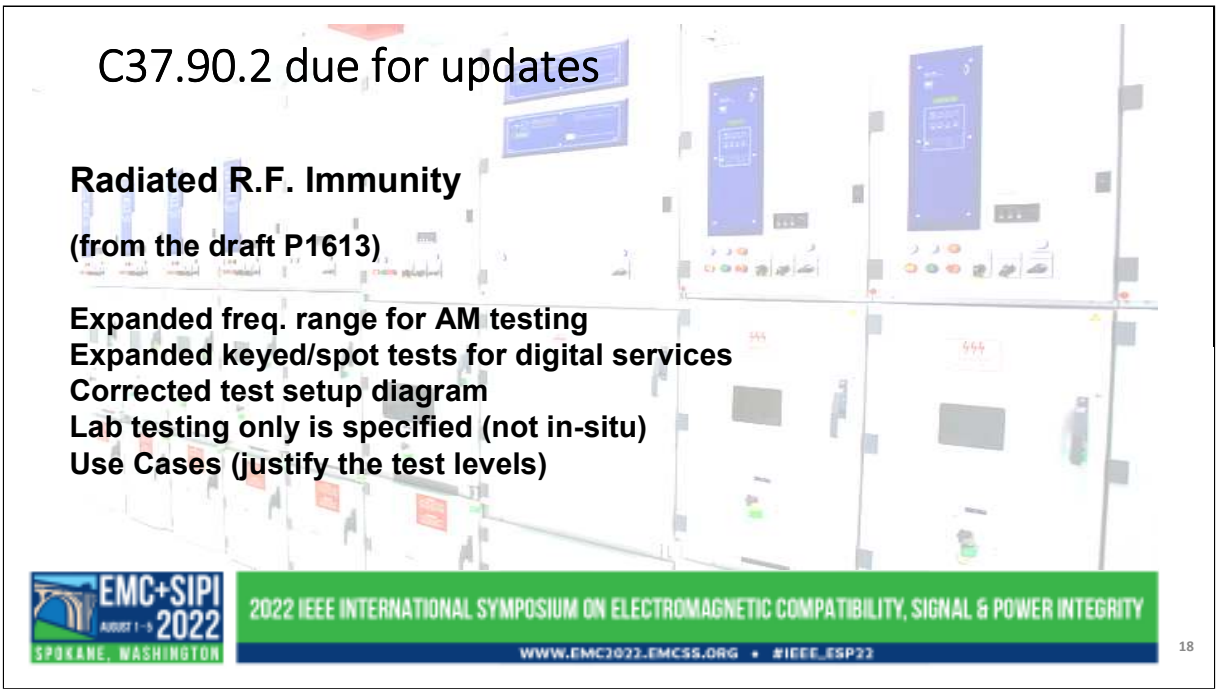
Don't call out the repetition rate as "bursts per period" but rather as "rings per second" for consistency and to avoid confusion with EFT (burst) testing.

EFT

Minimize IEC diagrams and cite the IEC 61000-4-4 Standard as Normative for waveforms, impedances, test generator and capacitive clamp calibrations, etc.

Keep the differential coupling on DC power lines above 48VDC as in IEEE – 1613 (2009) and continue to show the balun diagram in Annex D. (as most generators still require this balun externally)

Implement both repetition rates (burst frequencies) of 5 kHz & 100 kHz as verified into both impedances (50 & 1,000 ohms) per IEC 61000-4-4 & IEC 60255-26



C37.90.2 due for updates

The changes proposed:

Expanded frequency range for AM testing (using previous test level)
Expanded keying / spot frequency tests for digital services (pulse)
Corrected test setup diagram (now from IEC 61000-4-3)
Clarification that this Std. specifies laboratory testing only (not in-situ) This addresses an ambiguity.
Use Cases (justify the test levels)

Expanded range for AM tests

Frequency range	Field Strengths (CW and *Modulated*)
80-1,000 MHz	20V/m from 80-1,000MHz (before modulation) 1% steps or swept (*35V/m* peak w/ AM)
1.0 - 3.8 GHz	10V/m from 1-3.8GHz (before modulation) 1% steps or swept (*18V/m* peak w/ AM)

Table 1 – Test severity levels

Expanded range for AM tests

"Over the frequency range of 80 to 1,000 MHz: The rms (CW) field strength prior to modulation shall be 20 V/m. The waveform shall be amplitude modulated with a 1 kHz sine wave. Modulation shall be equal to 80%, with the resulting peak field strength not being less than 35 V/m. The modulated carrier test frequency shall be swept or stepped through the range of 80 MHz to 1,000 MHz."

"Over the frequency range of 1.0 to 3.8 GHz: The rms (CW) field strength prior to modulation shall be 10 V/m. The waveform shall be amplitude modulated with a 1 kHz sine wave. Modulation shall be equal to 80%, with the resulting peak field strength not being less than 18 V/m. The modulated carrier test frequency shall be swept or stepped through the range of 1.0 GHz to 3.8 GHz."

"If frequency steps are used, the test signal may be turned off between steps to produce the keying simulation. The on and off periods should not be less than 0.5 s. This may be done during the frequency step test to eliminate the need for a separate keying test."

Keyed/spot tests 80 – 1,000 MHz

Test	Frequency MHz	Tolerance	Field Strength (before mod.)	Modulation	Duty Cycle	Field Strength (peak)	Rep. rate (Hz)
1	80	± 0.5%	20V/m	80% AM	100%	35V/m	–
2	160	± 0.5%	20V/m	80% AM	100%	35V/m	–
3	380	± 0.5%	20V/m	80% AM	100%	35V/m	–
4	450	± 0.5%	20V/m	80% AM	100%	35V/m	–
5	900	± 0.5%	20V/m	80% AM	100%	35V/m	–
6	866	± 1 MHz	20V/m	Pulse	50%	20V/m	100 ± 1%
7	885	± 1 MHz	20V/m	Pulse	50%	20V/m	50 ± 1%
8	901	± 1 MHz	20V/m	Pulse	50%	20V/m	217 ± 1%

Table 2 – Spot frequencies (80 to 1,000 MHz)

Expanded keying/spot tests from 80 – 1,000 MHz

"During each spot frequency test, the input energizing quantities shall be adjusted to cause the EUT to change from the normal energized state to the operate state, and held until the EUT operates correctly. The input energizing quantities shall then be re-adjusted to cause the EUT to return to its normal reset condition."

cordless telephone, second generation (CT-2), 866MHz

North American digital cellular (NADC), 885MHz

global system for mobile communications (GSM) 901MHz

Keyed/spot tests 1 – 6 GHz

Test	Frequency MHz	Tolerance	Field Strength (before mod.)	Modulation	Duty Cycle	Field Strength (peak)	Rep. rate (Hz)
9	1850	± 0.5%	10V/m	80% AM	100%	18V/m	–
10	2150	± 0.5%	10V/m	80% AM	100%	18V/m	–
11	1600	± 1 MHz	10V/m	Pulse	50%	10V/m	217± 1%
12	1740	± 1 MHz	10V/m	Pulse	50%	10V/m	217± 1%
13	1920	± 1 MHz	10V/m	Pulse	50%	10V/m	100± 1%
14	1900	± 1 MHz	10V/m	Pulse	50%	10V/m	200± 1%
15	1910	± 1 MHz	10V/m	Pulse	50%	10V/m	1,000± 1%
16	1950	± 1 MHz	10V/m	Pulse	50%	10V/m	1,000± 1%
17	2310	± 1 MHz	10V/m	Pulse	50%	10V/m	1,000± 1%
18	2352	± 1 MHz	10V/m	Pulse	50%	10V/m	1,000± 1%
19	2450	± 1 MHz	10V/m	Pulse	50%	10V/m	1,000± 1%
20	3550	± 1 MHz	10V/m	Pulse	50%	10V/m	217± 1%
21	5800	± 1 MHz	10V/m	Pulse	50%	10V/m	1,000± 1%

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Expanded keying/spot tests from 1 – 6 GHz

The Spot Frequency tests were expanded as specified in IEC 60255-22-3:2008[D2], IEC 61000-4-3:2010 [D4], IEC 60255-26:2013 [D3] and IEC 61000-2-5:2017 [D8].

mobile satellite service (MSS), 1.6GHz

digital cellular system (DCS) 1800, 1.74GHz

digital enhanced cordless telecommunications (DECT), 1.92GHz

personal handy phone system (PHS), 1.90GHz

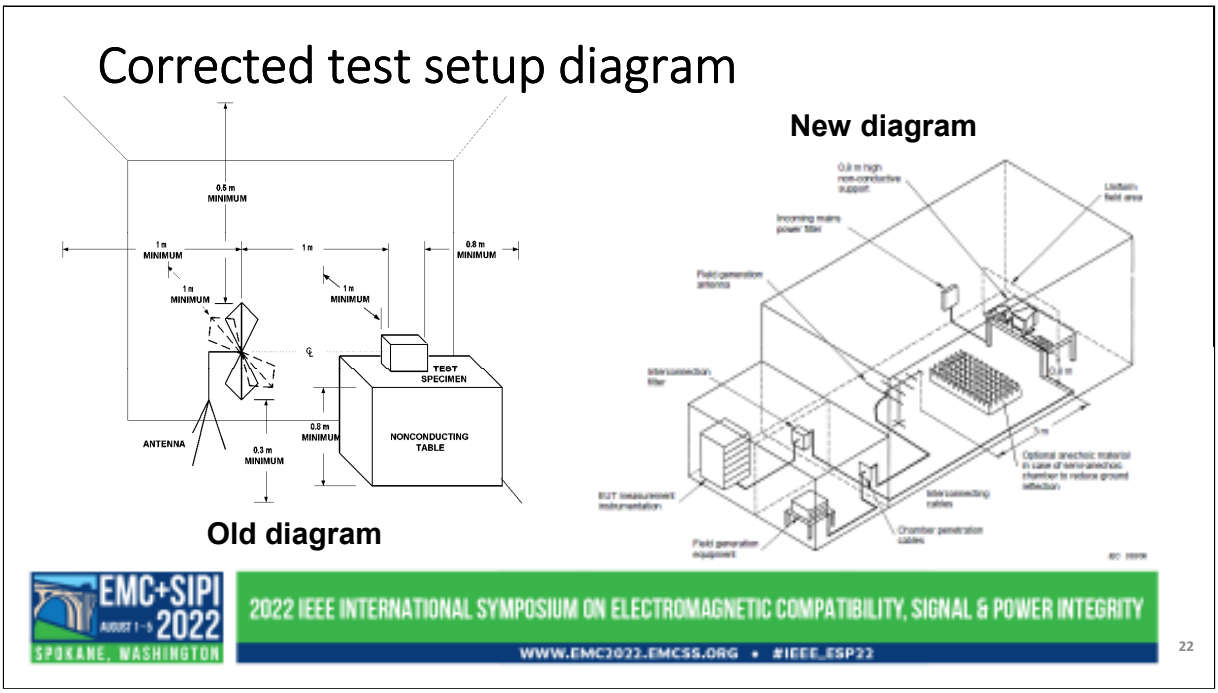
international mobile telephone (IMT)-2000 time domain division (TDD), 1.91GHz

IMT-2000 frequency division duplex (FDD), 1.95GHz

wireless communication service (WCS), 2.31GHz
wireless communication service (WCS), 2.352GHz
wireless LAN, 2.45GHz

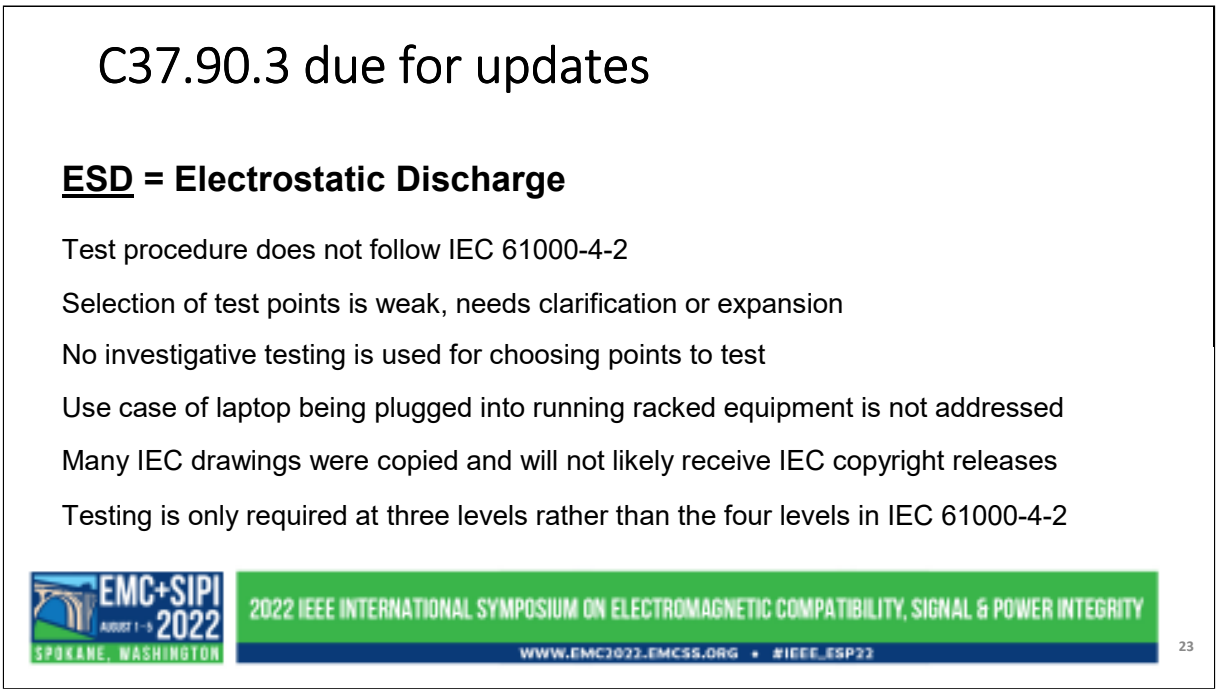
worldwide interoperability for microwave access (WiMAX) 3.55GHz

digital enhanced cordless telecommunications at 6GHz (DECT-6.0) 5.8GHz



Corrected test setup diagram

The old diagram on the left showed an un-lined shielded room being used for radiated RF immunity testing, while the old document called out field uniformity and frequency ranges associated with IEC 61000-4-3. The correct figure from the IEC was inserted, as shown on the right.



C37.90.3 is due for updates
Electrostatic Discharge

Test procedure does not follow IEC 61000-4-2

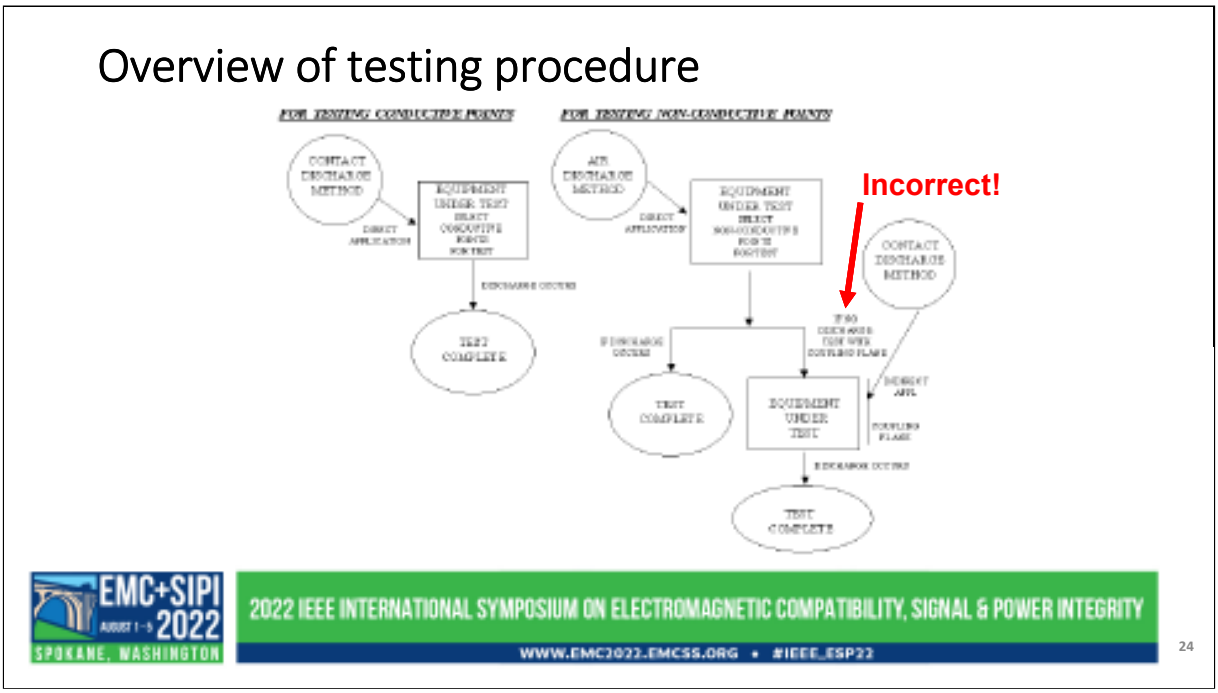
Selection of test points is weak, needs clarification or expansion

No investigative testing is used for choosing points to test

Use case of laptop being plugged into running racked equipment is not addressed

Many IEC drawings were copied and will not likely receive IEC copyright releases

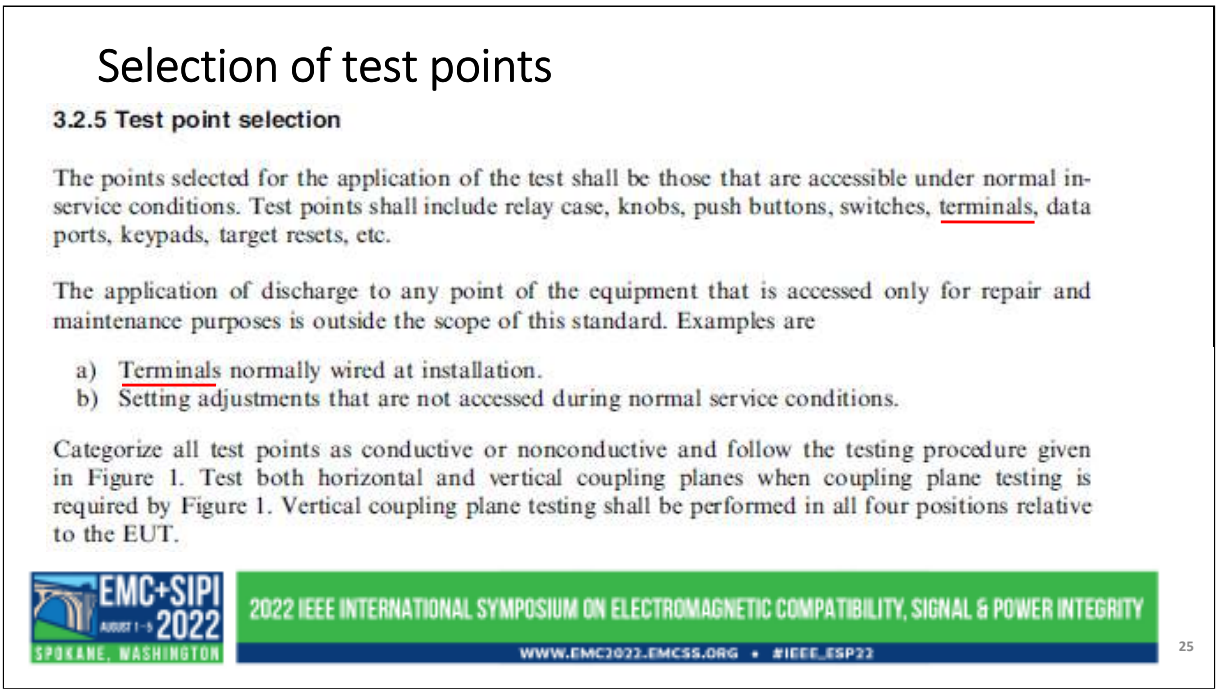
Testing is only required at three levels rather than the four levels in IEC 61000-4-2



IEEE C37.90.3 (2016)
Overview of testing procedure

This flow-chart diagram for testing does not follow IEC 61000-4-2. For air discharge, the operator is required to decide if a discharge has occurred or not. This is incorrect and allows subjective decisions during the testing to eliminate coupling methods that are required. The basic ESD Standard, IEC 61000-4-2, requires all three methods of testing.

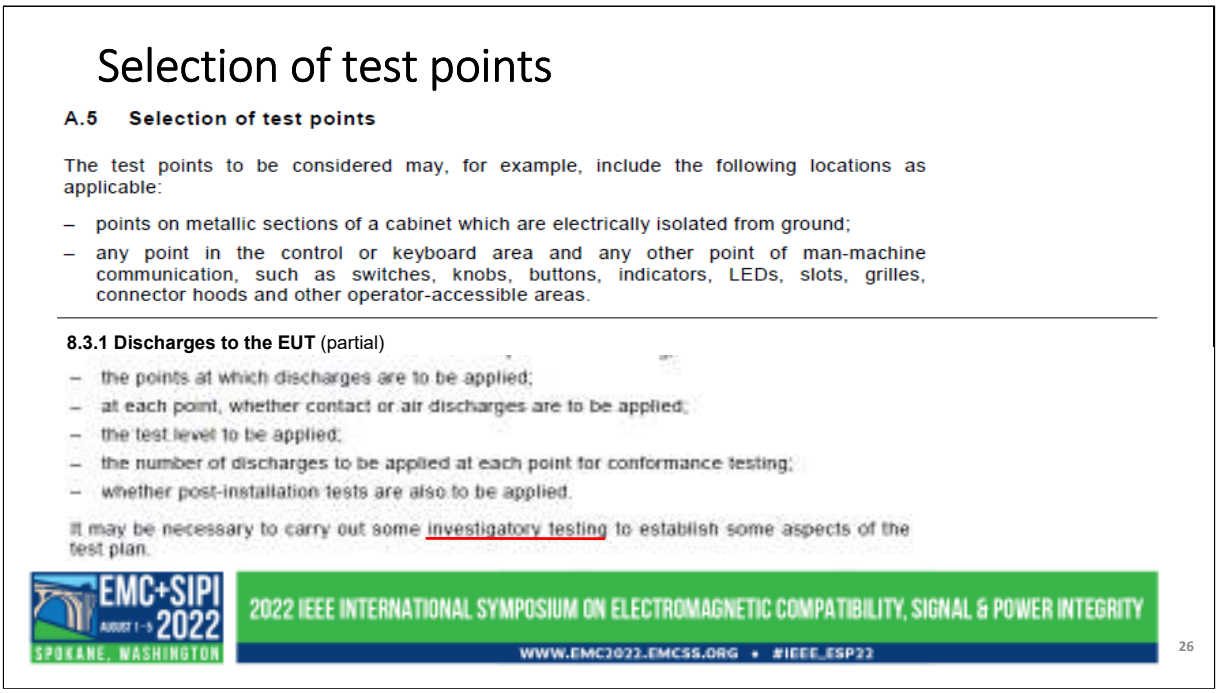
Recommendations:
Delete the figure as it introduces an if/then statement that is not in the basic Standard for ESD, IEC 61000-4-2. Call for “investigatory testing” to IEEE – C63.16. Insert clear instructions for three types of testing:
1) Air discharge to insulated areas of EUT
2) Contact discharge to conductive areas of EUT
3) Contact discharge to vertical and horizontal coupling planes.



IEEE-C37.90.3 (2001) Guidance
Selection of test points

3.2.5 Test point selection

This section is very weak. It requires testing on terminals in the first paragraph, then forbids testing on terminals in the second paragraph. It requires that test points be selected and gives a suggested list of them without further guidance on what criteria or method to use in their selection.

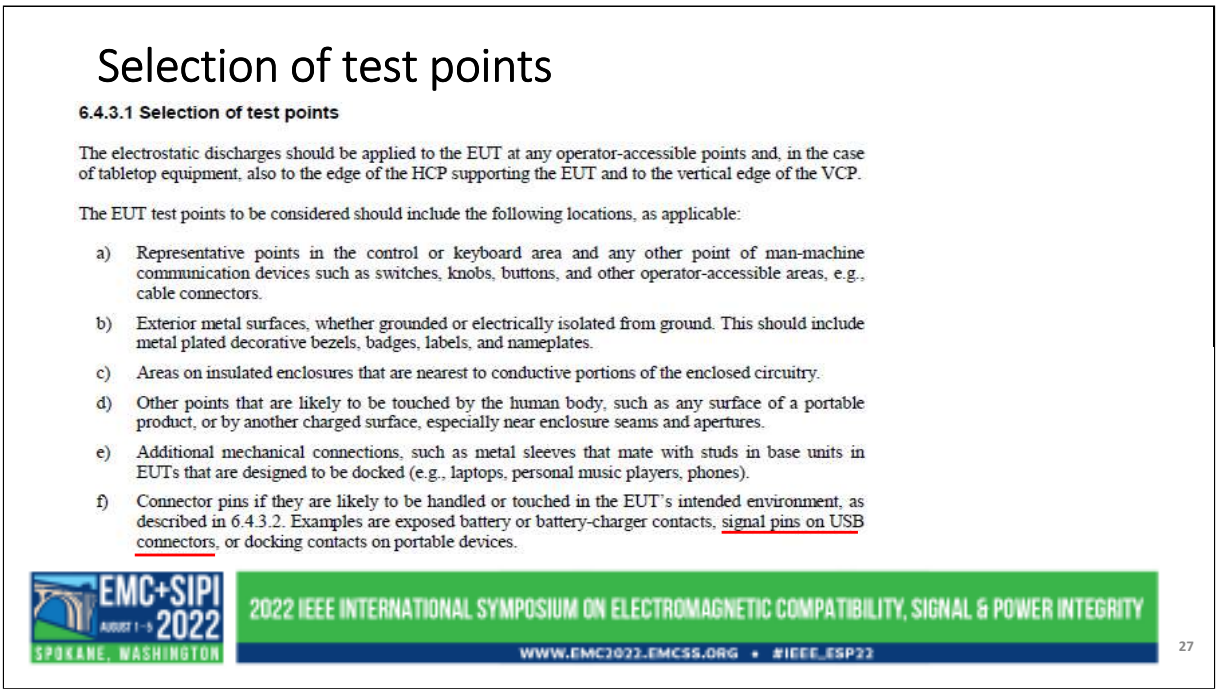


IEC-61000-4-2 (2008) Guidance
Selection of test points

A.5 Selection of test points

This section is even weaker. It requires that un-grounded sections of the cabinet be tested in the first paragraph but doesn't specify which method to use. What about the typical condition when a metallic case is grounded? Does that mean there is no test? Contact mode only to the case? It only requires that test points be "considered" and gives a suggested list of them without criteria for judging if they are to be included in that list.

8.3.1 Discharges to the EUT (partial list)
Additional guidance is in section 8.3.1 instructing the operator to carry out "***investigatory testing***" to establish a test plan, including "*the points at which discharges are to be applied*." There is no guidance on how to carry out the suggested "***investigatory testing***." however.

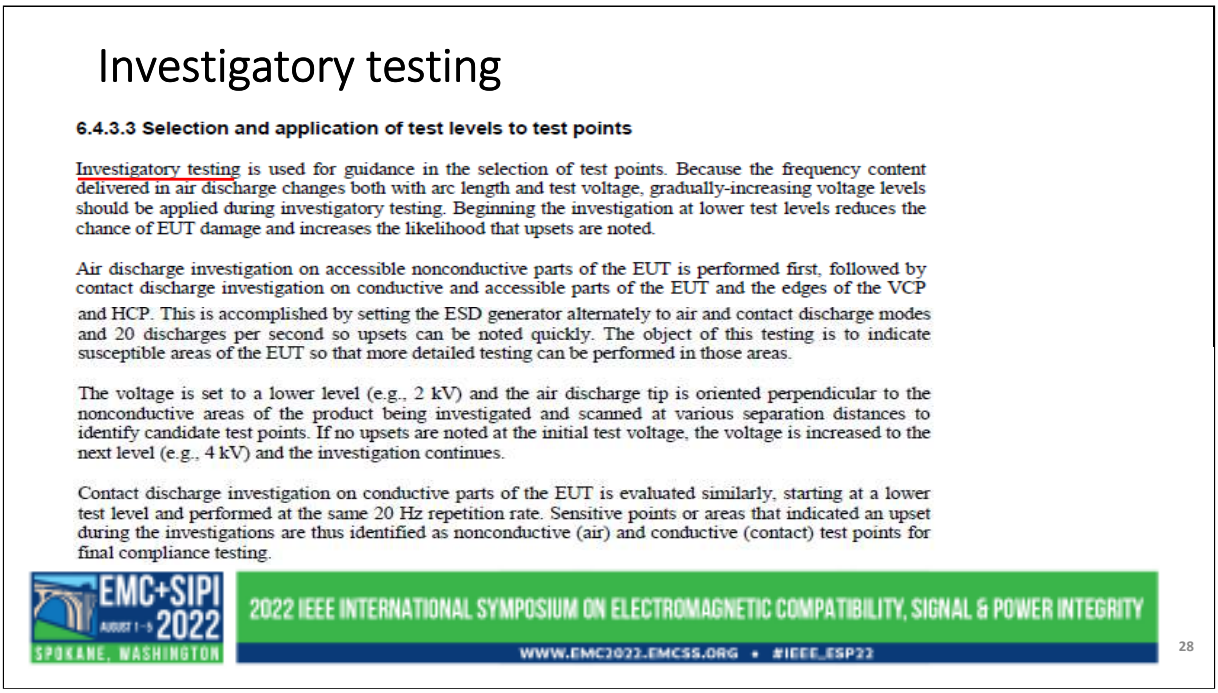


IEEE-C63.16 (2016) Guidance
Selection of test points

6.4.3.1 Selection of test points

This guidance is much more complete. Also, Sections **6.4.3.2, 6.4.3.3, 6.4.3.4 and 6.4.3.5** all offer more guidance on the selection of test points.

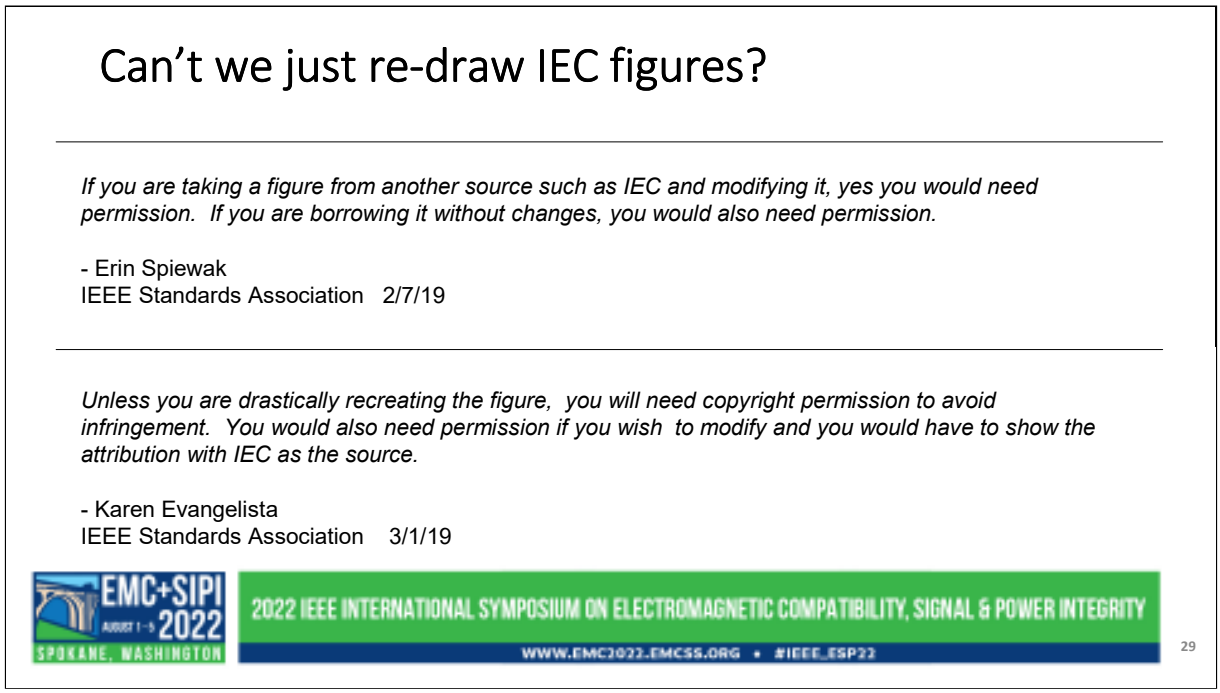
Notice that the signal pins on front-panel USB connectors should be tested. This is a special Use Case for protective relay controllers that are typically programmed by a battery-powered laptop on a rolling cart connecting to a running controller in a rack. A separate Annex is suggested for this Use Case.



IEEE-C63.16 (2016) Guidance
Investigatory testing

6.4.3.3 Selection and application of test levels to test points
This provides guidance on how to run investigatory testing. Also, Sections **6.4.3.2 Accessible parts**, **6.4.3.4 Identification of test points** and **6.4.3.5 Additional considerations** all offer more guidance on investigatory testing to determine the list of test points. This material is new and available nowhere else. The US Technical Advisory Group has submitted this text for consideration in the next version of IEC 61000-4-2.

Recommendation:
Base the selection of test points on the guidance in these five sections of IEEE-C63.16 (2016) covering the selection of points by investigatory testing in accordance with all of Section 6.4.3 (Test Points).



Use of figures
Can't we just re-draw IEC figures?

If you are taking a figure from another source such as IEC and modifying it, yes you would need permission. If you are borrowing it without changes, you would also need permission.
- Erin Spiewak
IEEE Standards Association 2/7/19

Unless you are drastically recreating the figure, you will need copyright permission to avoid infringement. You would also need permission if you wish to modify and you would have to show the attribution with IEC as the source.
- Karen Evangelista
IEEE Standards Association 3/1/19

IEEE-C37.90.3 vs. IEC 61000-4-2

Contact discharge waveform

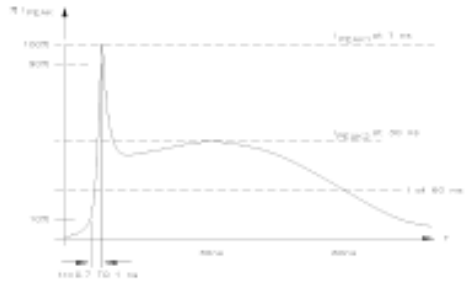


Figure 2—Typical waveform of the contact discharge current of the ESD generator

Contact discharge waveform

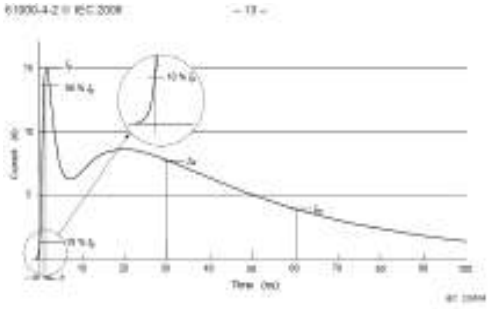


Figure 1 – Ideal contact discharge current waveform at 4 kV

Test waveform
IEEE-C37.90.3 vs. IEC 61000-4-2

Figure 2 in C37.90.3 is copied from Figure 2 of IEC 61000-4-2 (2008 Ed. 2) and its predecessors. (this is not OK)

Recommendation:
Delete the figure and incorrect 3-level test table and cite the IEC generator and levels as Normative.

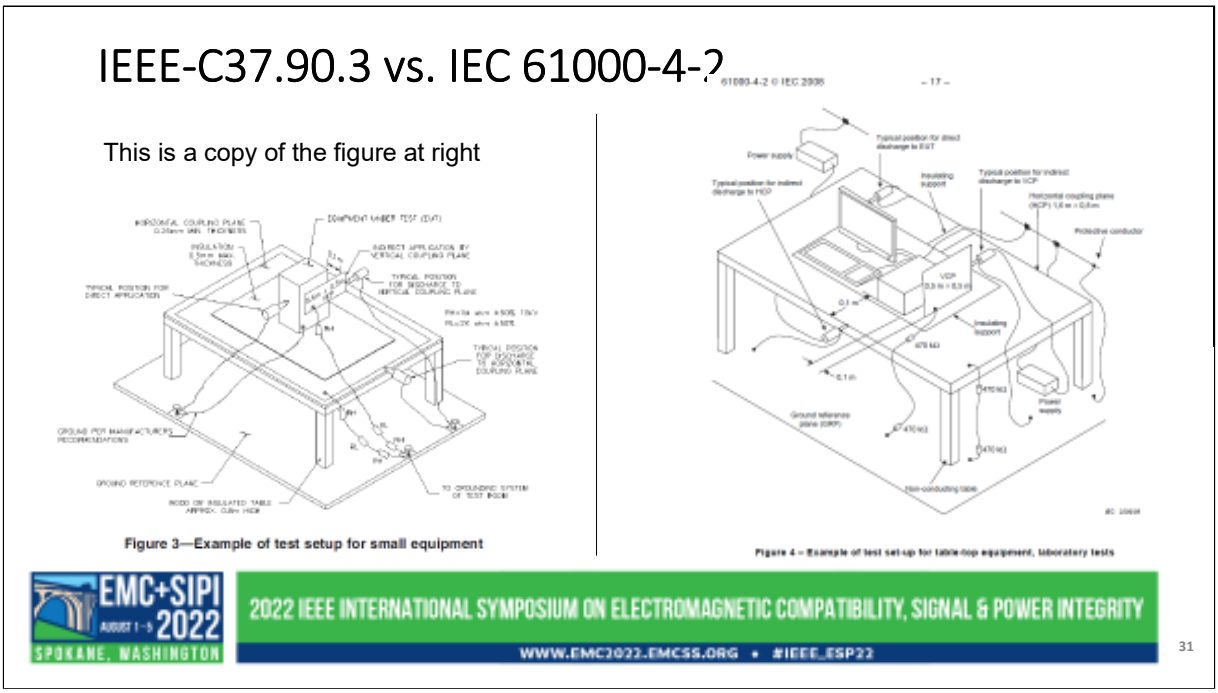
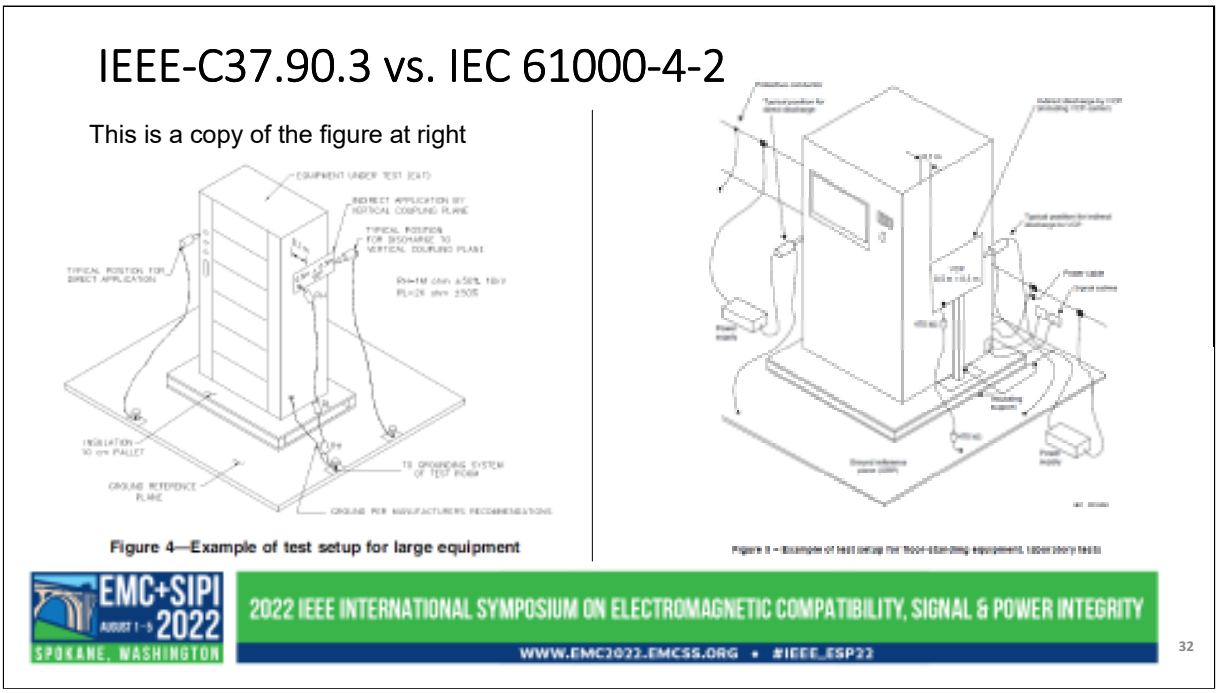


Table-top testing
IEEE-C37.90.3 vs. IEC 61000-4-2

We can't use the existing figure without permission from the IEC. (Probably won't be granted since we have copied their work)

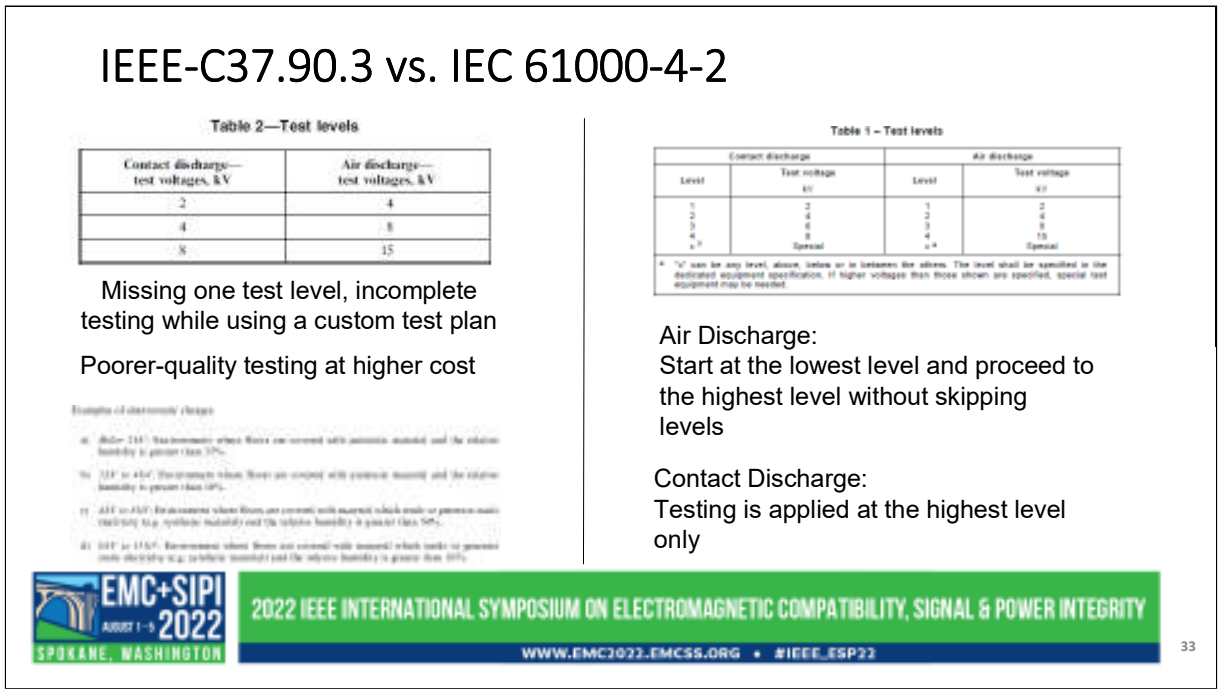
Recommendation:
Ask IEC for permission to use Fig. 4 of IEC 61000-4-2 (2008 Ed. 2) for table-top testing



Floor-standing testing
IEEE-C37.90.3 vs. IEC 61000-4-2

We can't use the old Figure 4 in C37.90.3 without permission from the IEC. (Won't be granted since we have copied their work)

Recommendation:
Ask IEC for permission to use Fig. 5 of IEC 61000-4-2 (2008 Ed. 2) or just call it out if needed. Most control equipment will be tested as table-top.



Floor-standing testing
IEEE-C37.90.3 vs. IEC 61000-4-2

Table 2 skips one test level, resulting in an incomplete test and a more expensive custom test procedure. (spend more, get less..) We even show examples in our Annex B of the four levels:

Examples of electrostatic charges in our Annex B:

a) Below 2 kV: Environments where floors are covered with antistatic material and the relative humidity is greater than 35%.

b) 2kV to 4kV: Environment where floors are covered with antistatic material and the relative humidity is greater than 10%.

c) 4kV to 8kV: Environment where floors are covered with material which tends to generate static electricity (e.g. synthetic material) and the relative humidity is greater than 50%.

d) 8kV to 15kV: Environment where floors are covered with material which tends to generate static electricity (e.g. synthetic material) and the relative humidity is greater than 10%.

Recommendation:
"For air discharge testing, the test shall be applied at all test levels in Table 1 up to and including the specified test level."

"For contact discharge testing, the test shall be applied at the specified test level only"
– IEC 61000-4-2 (2008) Ed. 2

IEEE-C37.90.3 vs. IEC 61000-4-2

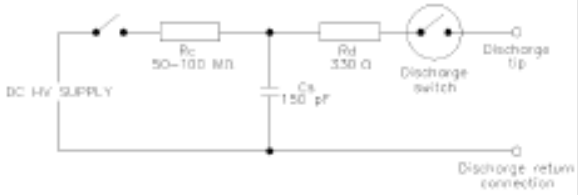
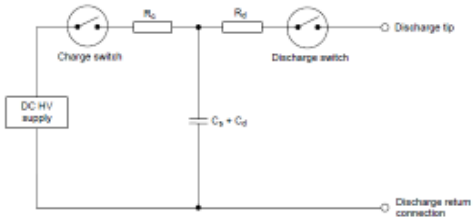


Figure C.1—Simplified diagram of the ESD generator

This is a copy of the figure at right



NOTE 1 C_d is a distributed capacitance which exists between the generator and its surroundings.

NOTE 2 $C_d + C_s$ has a typical value of 150 pF.

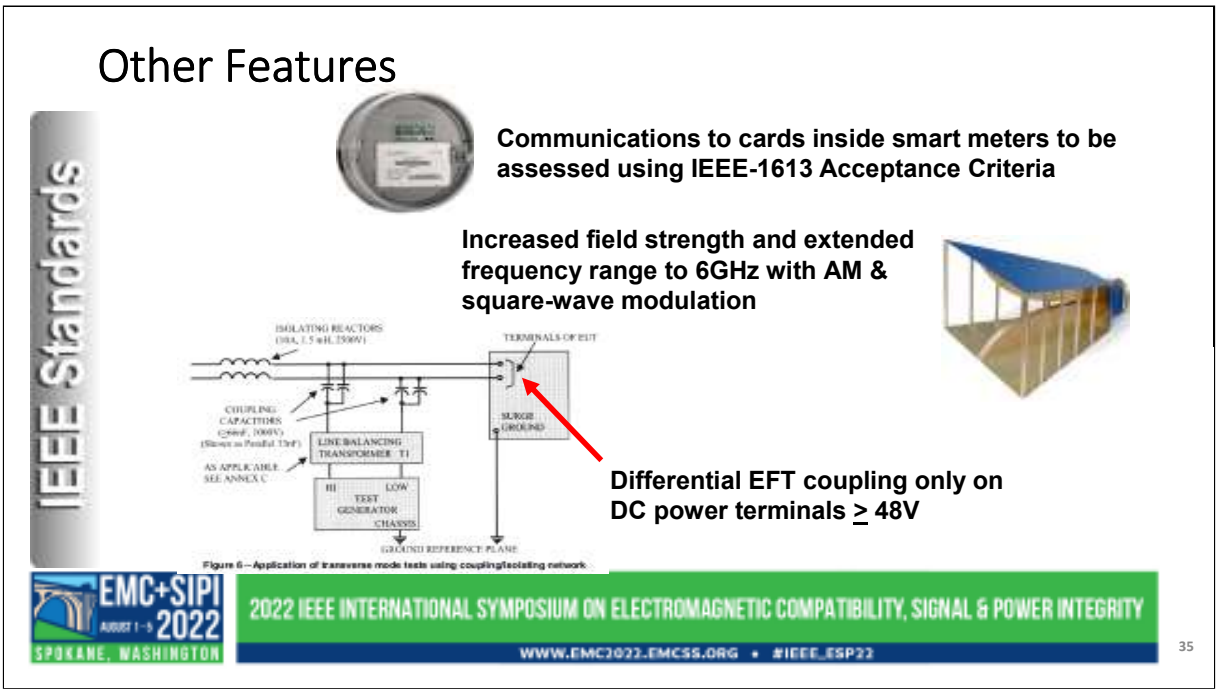
NOTE 3 R_d has a typical value of 330 Ω.

Figure 1 – Simplified diagram of the ESD generator

ESD Generator schematic
IEEE-C37.90.3 vs. IEC 61000-4-2

We can't use the existing figure without permission from the IEC. (will not be granted since we have copied their work)

Recommendation:
Ddelete the figure and just cite the IEC generator

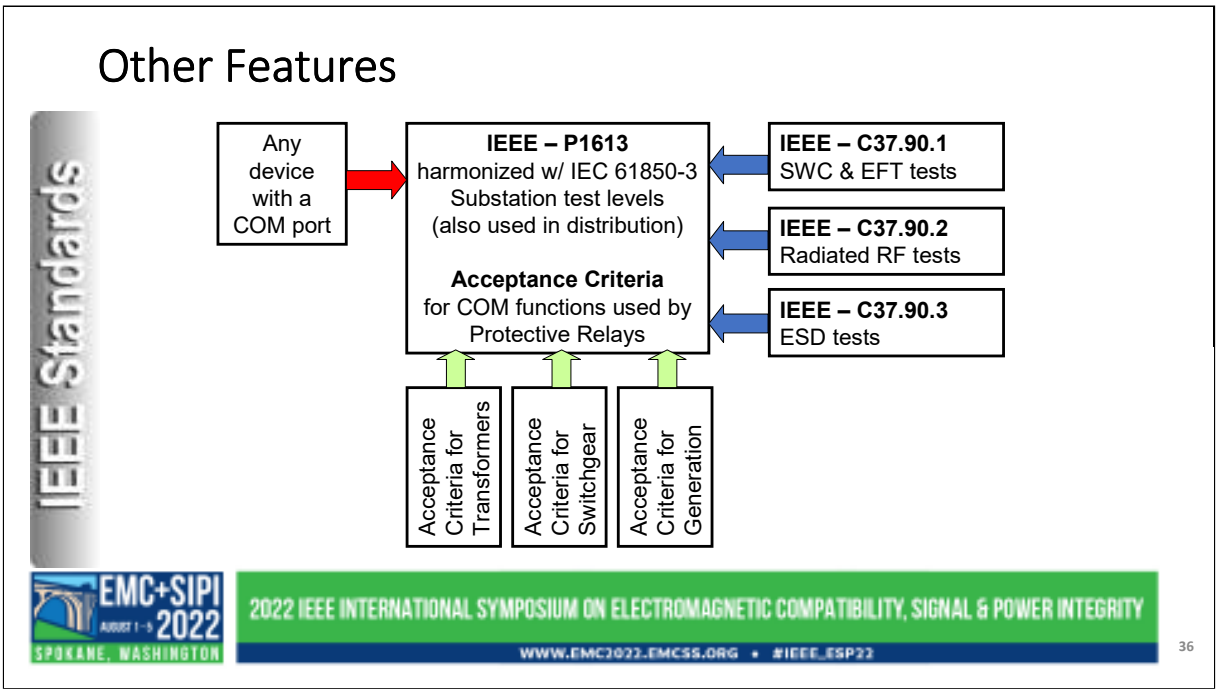


The draft **IEEE-P1613.1 Extension** to 1613 includes several **other features**:

•Communications to cards inside smart meters will be assessed using the IEEE - P1613 – 201x Acceptance Criteria

•Increased field strength and extended Radiated RF Immunity frequency range up to 6GHz with AM & square-wave modulation, and..

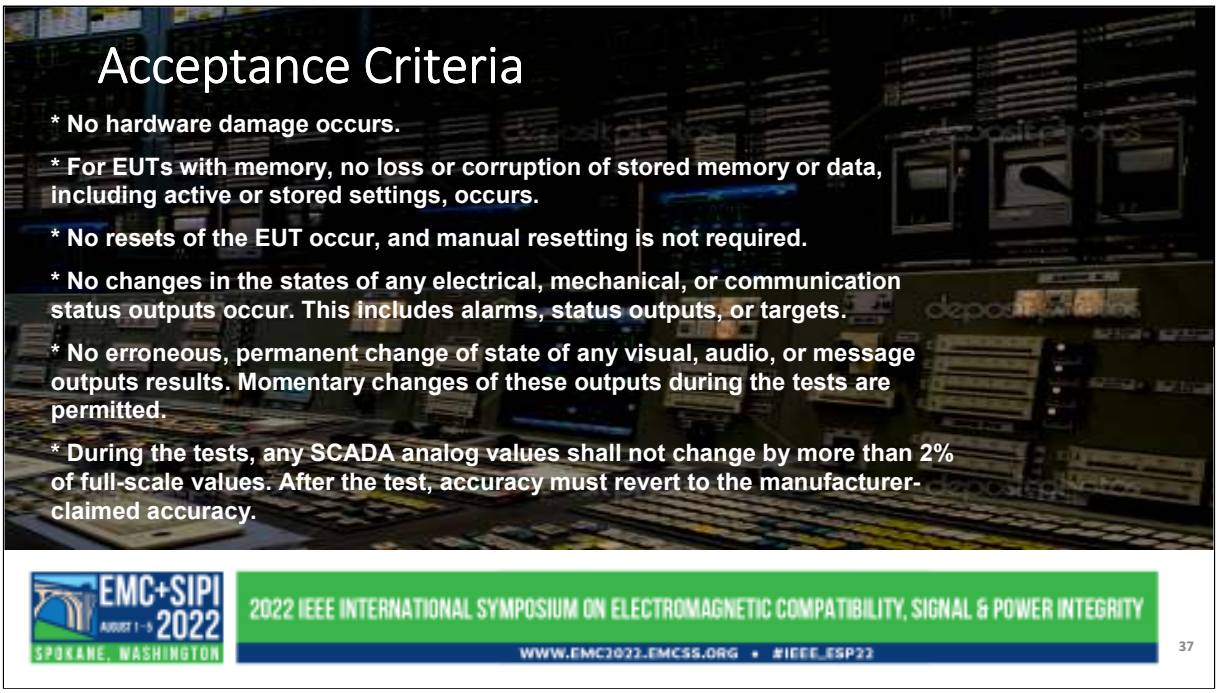
•Differential EFT coupling is only run on DC power terminals at or above 48 volts to simulate switched armature coils back-EMF arcing across the floating station-battery terminals. (A known source of disturbances originally addressed in C37.90.1-2002)



The proposed structure of P1613 (201x) is shown. The Scope and Purpose of the C37.90.x suite of Standards on the right were all recently harmonized with P1613. The P1613 Title was changed to read:

IEEE Standard for Environmental and Testing Requirements for Devices with Communications Functions used with Electric Power Apparatus

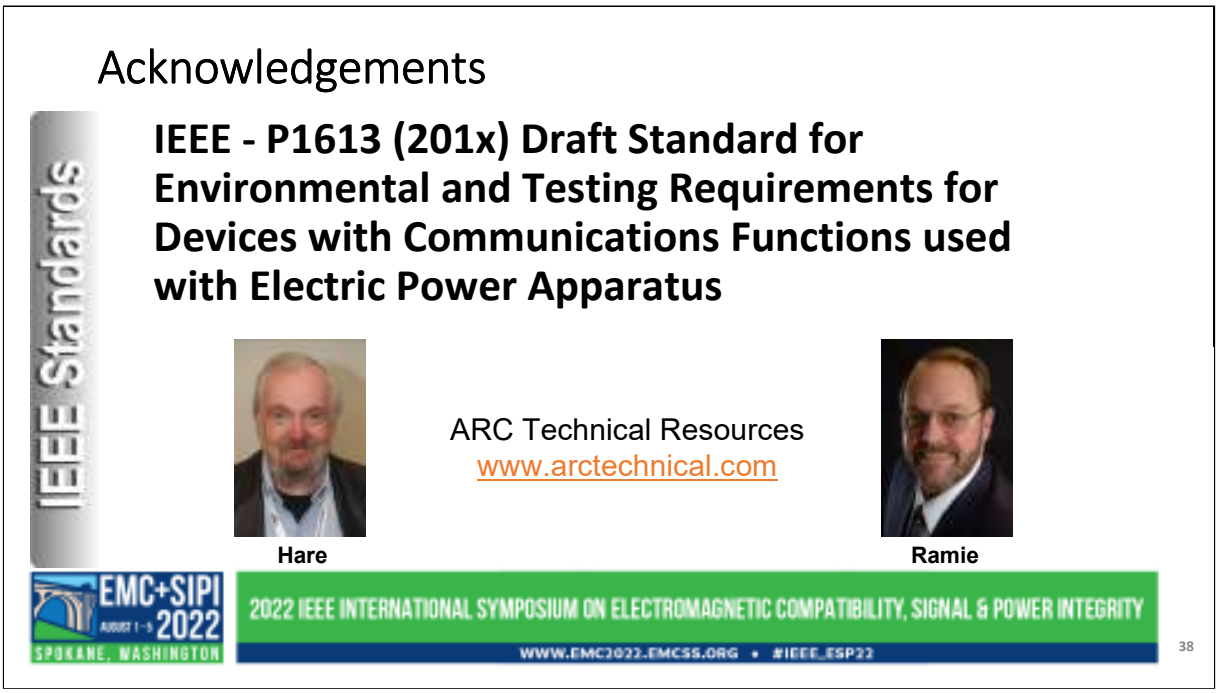
Most smart grid devices will communicate, including Communications Networking Equipment, Protective Relaying, Transformers, Switchgear, Generation plant, etc. The various functional committees for these areas of expertise can apply their own appropriate Acceptance Criteria for evaluating their immunity to the testing requirements called out in the draft P1613. Some committees will continue to use the Acceptance Criteria shown in P1613 they've used since 2002.



The draft P1613-202x uses the existing **Acceptance Criteria** from IEEE-1613-2009 almost exactly, which had been adopted in the IEC as well. These criteria apply for Class 1 devices (where recovered disruptions are allowed) and Class 2 devices. (where no disruptions are allowed, implying an optical connection) The EUT's intended use(s) and other functions are monitored for Acceptance during the immunity tests. Specifically, Acceptance requires that:

- No hardware damage occurs.
- For EUTs with memory, no loss or corruption of stored memory or data, including active or stored settings, occurs.
- No resets of the EUT occur, and manual resetting is not required.
- No changes in the states of any electrical, mechanical, or communication status outputs occur. This includes alarms, status outputs, or targets.
- No erroneous, permanent change of state of any visual, audio, or message outputs results. Momentary changes of these outputs during the tests are permitted.
- During the tests, any SCADA analog values shall not change by more than 2% of full-scale values. After the test, accuracy must revert to the manufacturer-claimed accuracy.

Any observed upsets of the intended use during the testing must be self-recovering and noted in the test report. These upsets are recorded in the test report and in the equipment documentation supplied with the product. It has to work for the purpose it was purchased, and it's nice if it works to do other things successfully as well.



I would like to thank the IEEE Power & Energy Society Power Systems Relaying Committee. Their enthusiasm in implementing the new "gap" immunity tests that were revealed when we harmonized this updated P1613 Standard with the newer IEC 61850-3-2013 Standard is greatly appreciated.

I also must acknowledge Ed Hare of the American Radio Relay League (ARRL) for the Use Cases implemented in the new C37.90.2 and the IEEE – EMC Society Standards Development and Education Committee (SDE-Com) for their support on this project. We look forward to continued cooperation on EMC Standardization between these two IEEE Societies.

These coordinated efforts have allowed us to continue the harmonization of EMC testing requirements for European and American utility equipment in both Transmission and Distribution environments. A greater variety of utility products with meaningful EMC immunity performance designed into them will be the result. I'm Jerry Ramie of ARC Technical Resources, Inc. Thank you for listening.

Jerry Ramie

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jramie@arctechnical.com