



# Proposal for Ethernet IEEE802.3 isolation requirements Rev.1

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# Review current IEEE isolation based on Dylan Presentation

	Isolation from all MDI leads to	AC & DC tests			Impulse test			Pass/Fail criteria	
		Vrms	Vdc	Test method	Wave shape	Application	Defined	During	After
10BASE-T (w/o PI) (14.3.1.1)	DTE Physical Layer circuits including frame ground	1500V	2250V	5.2.2 of IEC 60950-1:2001	2400V 1.2/50 μs	10 of alternating polarity	IEC 60950-1:2001 Annex N	no insulation breakdown per 5.2.2 of IEC 60950-1:2001	resistance shall be at least 2 MΩ, measured at 500 V dc
10BASE-T (w/ PI) (33.4.1)	all accessible external conductors, including frame ground (if any) [Accessible external conductors are specified in subclause 6.2.1 b) of IEC 60950-1:2001]	1500V	2250V	5.2.2 of IEC 60950-1:2001	1500V 10/700 μs	10 times	IEC 60950-1:2001 Annex N	no insulation breakdown per 5.2.2 of IEC 60950-1:2001	resistance shall be at least 2 MΩ, measured at 500 V dc
100BASE-TX (w/o PI) (25.4.6)	frame ground	1500V	2250V	5.2.2 of IEC 60950-1:2001	2400V 1.2/50 μs	10 of alternating polarity	IEC 60950-1:2001 Annex N	no insulation breakdown per 5.2.2 of IEC 60950-1:2001	resistance shall be at least 2 MΩ, measured at 500 V dc
100BASE-TX (w/ PI) (33.4.1)	all accessible external conductors, including frame ground (if any) [Accessible external conductors are specified in subclause 6.2.1 b) of IEC 60950-1:2001]	1500V	2250V	5.2.2 of IEC 60950-1:2001	1500V 10/700 μs	10 times	IEC 60950-1:2001 Annex N	no insulation breakdown per 5.2.2 of IEC 60950-1:2001	resistance shall be at least 2 MΩ, measured at 500 V dc
1000BASE-T (w/o PI) (40.6.1.1)	port device circuits, including frame ground (if any)	1500V	2250V	5.2.2 of IEC 60950-1:2001	2400V 1.2/50 μs	10 of alternating polarity	IEC 60950-1:2001 Annex N	no insulation breakdown per 5.2.2 of IEC 60950-1:2001	resistance shall be at least 2 MΩ, measured at 500 V dc
1000BASE-T (w/ PI) (33.4.1)	all accessible external conductors, including frame ground (if any) [Accessible external conductors are specified in subclause 6.2.1 b) of IEC 60950-1:2001]	1500V	2250V	5.2.2 of IEC 60950-1:2001	1500V 10/700 μs	10 times	IEC 60950-1:2001 Annex N	no insulation breakdown per 5.2.2 of IEC 60950-1:2001	resistance shall be at least 2 MΩ, measured at 500 V dc

What requirements are specified in IEEE 802.3 Isolation clause ?

- **1. Isolation from MDI leads to...**
- Can this requirements to be harmonized to all IEEE802.3? Need to be discussed
- **2. Steady state isolation test-**
- Same in all IEEE 802.3 clauses for isolation and change is required just in specifying correctly latest revisions of IEC60950 -1 and add IEC62368-1
- **3. Impulse test –**
- Different requirements for different parts of IEEE 802.3 isolation clauses and need to fixed
- **4. Acceptance criteria-**
- Need to be fixed since it specifies mix of acceptance criteria for steady state and impulse testing , however for steady stay testing is a one criteria and for impulse testing is another criteria.
- It does not provide guidance what to do in case of SPD bridging insulation-very important part of testing.
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## Review current IEEE802.3 isolation requirements-cont.

- Customers may argue (and we have many such cases) that product meet UL/IEC electrical isolation requirements but does not meet IEEE802.3. Customers believes that IEEE802.3 requirements are more stringent than UL/IEC and does not allow to remove protective components as it allowed in IEC 60950-1 5.2.2 Note 4 as follows:

“NOTE 4 Components providing a d.c. path in parallel with the insulation to be tested, such as discharge resistor for filter capacitors, voltage limiting devices or surge suppressors, should be disconnected.”

The requirements which allow to remove components as in Note 4 should be added to IEEE specs or at least IEEE802.3bt should have clear referral on this subject to IEC60950 or IEC62368.

- What are the options:
  - All IEEE 802.3 isolation requirements are based on IEC 60950-1 or IEC62368-1. This standards specify in very details methods of performing testing, compliance criteria, what to do in cases if there are devices which cross insulation and etc.
  - IEEE802.3 isolation requirements do no bring any new requirements which are different from safety agencies. However, avoiding mentioning some details as existing components across insulation, definition of insulation breakdown, gives false impression of higher level requirements than UL/IEC safety standards.
  - Should not we just make clear referral to IEC 60950-1 or IEC62368-1 instead of copy all requirements in IEEE802.3?

# Option1 (changes in green) - The most simply and comprehensive

Current text:

PDs and PSEs shall provide isolation between all accessible external conductors, including frame ground (if any), and all MDI leads including those not used by the PD or PSE. Any equipment that can be connected to a PSE or PD through a non-MDI connector that is not isolated from the MDI leads needs to provide isolation between all accessible external conductors, including frame ground (if any), and the non-MDI connector.

Accessible external conductors are specified in subclause 6.2.1 b) of IEC 60950-1 and subclause 5.4.10.1 b) of IEC 62368-1.

*“This electrical isolation shall withstand at least one of the following electrical strength tests:*

*a) 1500 V rms at 50 Hz to 60 Hz for 60 s, applied as specified in subclause 5.2.2 of IEC 60950-1 or IEC 62368-1.*

*b) 2250 V dc for 60 s, applied as specified in subclause 5.2.2 of IEC 60950-1 or IEC 62368-1.*

*c) An impulse test consisting of a 1500 V, 10/700  $\mu$ s waveform, applied 10 times, with a 60 s interval between pulses. The shape of the impulses shall be 10/700  $\mu$ s (10  $\mu$ s virtual front time, 700  $\mu$ s virtual time of half value), as defined in IEC 60950-1 or IEC 62368-1 Annex N.*

*There shall be no insulation breakdown, as defined in subclause 5.2.2 of IEC 60950-1 and IEC 62368-1, during the test. The resistance after the test shall be at least 2 M $\Omega$*

Proposed option:

PDs and PSEs shall provide isolation between all accessible external conductors, including frame ground (if any), and all MDI leads including those not used by the PD or PSE. Any equipment that can be connected to a PSE or PD through a non-MDI connector that is not isolated from the MDI leads needs to provide isolation between all accessible external conductors, including frame ground (if any), and the non-MDI connector.

Accessible external conductors are specified in subclause 6.2.1 b) of IEC 60950-1:2005-12 and subclause 5.4.10.1 b) of IEC 62368-1:2014

**Verification of the electrical isolation shall be performed according to test procedures and compliance criteria's in sub clauses 5.2 .2 and 6.2.2 of IEC60950-1:2005-12 or 5.4.9 and 5.4.10.2 IEC62368-1:2014**

Note:

- Full name of latest IEC60950-1 is IEC 60950-1:2005+AMD1:2009+AMD2:2013 CSV

## Option2 (changes in green)

- Current text:

*“This electrical isolation shall withstand at least one of the following electrical strength tests:*

*a) 1500 V rms at 50 Hz to 60 Hz for 60 s, applied as specified in subclause 5.2.2 of IEC 60950-1 or IEC 62368-1.*

*b) 2250 V dc for 60 s, applied as specified in subclause 5.2.2 of IEC 60950-1 and IEC 62368-1.*

*c) An impulse test consisting of a 1500 V, 10/700  $\mu$ s waveform, applied 10 times, with a 60 s interval between pulses. The shape of the impulses shall be 10/700  $\mu$ s (10  $\mu$ s virtual front time, 700  $\mu$ s*

*virtual time of half value), as defined in IEC 60950-1 or IEC 62368-1 Annex N.*

*There shall be no insulation breakdown, as defined in subclause 5.2.2 of IEC 60950-1 or IEC 62368-1, during the test. The resistance after the test shall be at least 2 M”*

- Proposed option:

*“This electrical isolation shall withstand at least one of the following electrical strength tests:*

*a) 1500 V rms at 50 Hz to 60 Hz for 60 s, applied as specified in subclause 5.2.2 of IEC 60950-1:2005-12 or 5.4.9 of IEC 62368-1:2014*

*b) 2250 V dc for 60 s, applied as specified in subclause 5.2.2 of IEC 60950-1:2005-12 and IEC 62368-1:2014.*

*c) An impulse test consisting of a 1500 V, 10/700  $\mu$ s waveform, applied 10 times, with a 60 s interval between pulses. The shape of the impulses shall be 10/700  $\mu$ s (10  $\mu$ s virtual front time, 700  $\mu$ s virtual time of half value), as defined in IEC 60950-1:2005-2012 and IEC 62368-1:2014 Annex N.*

*Note : Components providing a d.c. 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 according to Note 4 of subclause 5.2.2 IEC60950:2005-12 or subclause 5.4.11.3 IEC62368-1:2014*

***There shall be no insulation breakdown, as defined in subclause 5.2.2 of IEC 60950-1:2005-12 or 5.4.9 .2 of IEC 62368-1:2014, during the test for cases a) and b). For impulse test c) compliance criteria according to sub clause 6.2.2.3 of IEC60950-1:2005-12 or subclause 5.4.10.3 of IEC62368-1:2014***

# **Annex A. Backup slides**

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# Review current IEEE802.3 Isolation requirements

## 145.4.1 Isolation

PDs and PSEs shall provide isolation between all accessible external conductors, including frame ground (if any), and all MDI leads including those not used by the PD or PSE. Any equipment that can be connected to a PSE or PD through a non-MDI connector that is not isolated from the MDI leads needs to provide isolation between all accessible external conductors, including frame ground (if any), and the non-MDI connector. Accessible external conductors are specified in subclause 6.2.1 b) of IEC 60950-1 and subclause 5.4.10.1 b) of IEC 62368-1.

This electrical isolation shall withstand at least one of the following electrical strength tests:

- a) 1500 V rms at 50 Hz to 60 Hz for 60 s, applied as specified in subclause 5.2.2 of IEC 60950-1 or subclause 5.4.9 of IEC 62368-1.
- b) 2250 V dc for 60 s, applied as specified in subclause 5.2.2 of IEC 60950-1 or subclause 5.4.9 of IEC 62368-1.
- c) An impulse test consisting of a 1500 V, 10/700  $\mu$ s waveform, applied 10 times, with a 60 s interval between pulses. The shape of the impulses shall be 10/700  $\mu$ s (10  $\mu$ s virtual front time, 700  $\mu$ s virtual time of half value), as defined in IEC 60950-1 Annex N or subclause 5.4.10 of IEC 62368-1.

There shall be no insulation breakdown, as defined in subclause 5.2.2 of IEC 60950-1 or subclause 5.4.9 of IEC 62368-1, during the test. The resistance after the test shall be at least 2 M $\Omega$ , measured at 500 V dc.

Conductive link segments that have differing isolation and grounding requirements shall have those requirements provided by the port-to-port isolation of network interface devices (NID).

In a multiport system, the implementer should maintain DC isolation through the termination circuitry to eliminate cross-port leakage currents.

# Transition from IEC60950 to IEC 62368

IEC62368 Covers Scopes of previous (legacy) standards: **IEC 60065**, Audio, Video & Similar Electronic Apparatus –Safety and **IEC 60950-1**, Information Technology Equipment – Safety

**IEC62368 is Not** a simple merger of IEC 60065 & 60950-1! Although many common elements...

## Likely EU/NA Transition (subject to change) : Legacy AV/ICT Standards → 62368-1

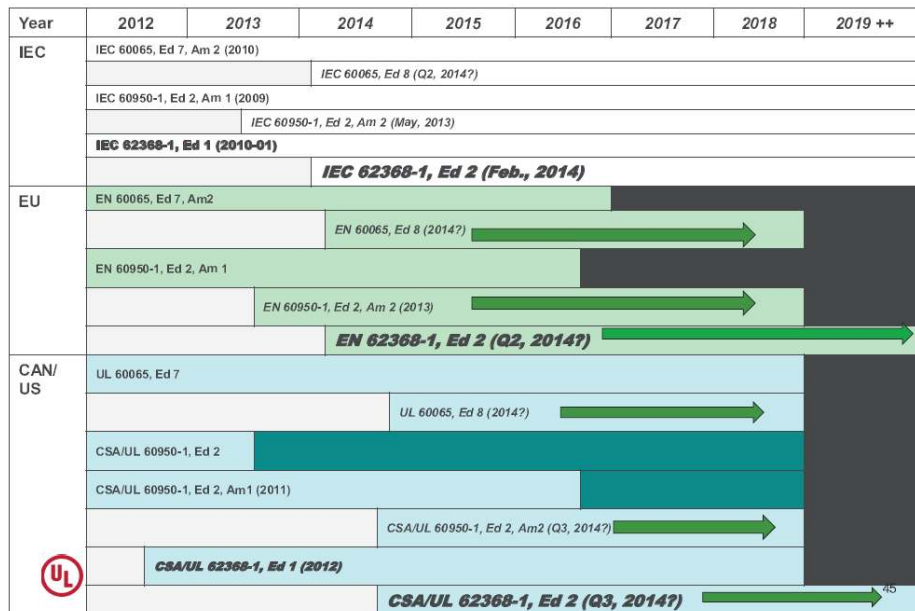


Table III.1 Safety equivalence of IEC 60950-1 and IEC 62368-1

IEC 60950-1	IEC 62368-1
SELV	ES1
TNV-1	ES1 External circuits have impulse testing see NOTES 1 through 3
TNV-2	ES2
TNV-3	ES2 External circuits have impulse testing see NOTES 1 through 3

NOTE 1 Paired conductor (shielded or unshielded) - tested with 1500 V, 10/700.  
Only differential if one conductor is earthed in the equipment  
NOTE 2 Any other conductors – tested with mains transient or known external circuit overvoltage impulse whichever is higher. The external circuit is not earthed at either end, but there is an earth reference  
NOTE 3 Cable distribution network coaxial cable – tested with 4000 V, 10/700 centre conductor to shield cable (shield is earthed at the equipment).  
Not applicable to power-fed coaxial repeaters.



# Comparison of sub clause 6.2.1b) IEC60950 and 5.4.10.1 b) IEC62368-1

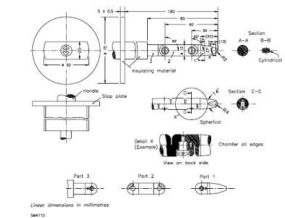
## Sub clause 6.2.1b) IEC60950-1

### 6.2 Protection of equipment users from overvoltages on telecommunication networks

#### 6.2.1 Separation requirements

Equipment shall provide adequate electrical separation between a TNV-1 CIRCUIT or a TNV-3 CIRCUIT and the following parts of the equipment.

b) Parts and circuitry that can be touched by the test finger, Figure 2A (see 2.1.1.1), except contacts of connectors that cannot be touched by the test probe, Figure 2C (see 2.1.1.1).



Tolerances on dimensions without specific tolerances:

- 14° and 33° angles:	± 0.1°
- on radii:	± 0.1 mm
- on linear dimensions:	
0 to 16 mm:	± 0.1 mm
> 16 mm to 25 mm:	± 0.1 mm
> 25 mm:	± 0.2 mm

Material of finger: heat-treated steel, for example.

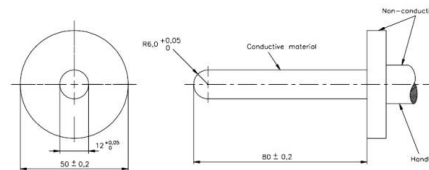
Both points of this finger can be bent through an angle of 100° (±10°) but in one and the same direction.

NOTE 1: Using the pin and probe holder in only one of the possible alternatives in order to test the equipment.

NOTE 2: Dimensions in parentheses are for information only.

NOTE 3: The test finger is taken from Figure 2, test probe B of IEC 60950-1. In this figure, the lengths are different.

Figure 2A – Test finger



Dimensions in millimetres

SM430E

Figure 2C – Test probe

Figure 2C – Test probe

## Sub clause 5.4.10.1 b) IEC62368-1

### 5.4.10 Safeguards against transient voltages from external circuits

#### 5.4.10.1 Requirements

Adequate electrical separation shall be provided between **external circuits** of equipment as indicated in Table 14, ID number 1, Figure 30 and:

b) **accessible** parts and circuitry, except for the pins of connectors. However, such pins shall not be **accessible** under **normal operating conditions** by the blunt probe of Figure V.3;

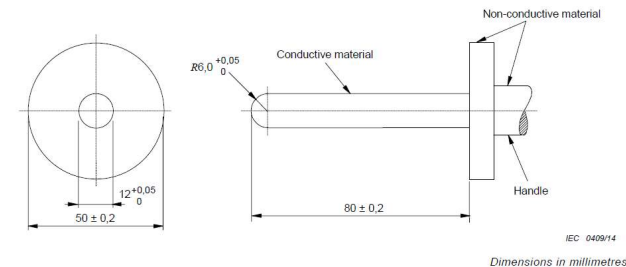


Figure V.3 – Blunt probe

IEC 0409/14  
Dimensions in millimetres

# Compliance criteria's from IEC60950-1 and IEC62368-1 for Steady state test

- **From 5.2.2 IEC60950-1**  
**Compliance criteria for steady stay test**

*There shall be no insulation breakdown during the test.*

*Insulation breakdown is considered to have occurred when the current that flows as a result of the application of the test voltage rapidly increases in an uncontrolled manner, that is the insulation does not restrict the flow of the current. Corona discharge or a single momentary flashover is not regarded as insulation breakdown.*

## **From 5.4.9.2 IEC62368-1 Compliance criteria for steady stay test**

*There shall be no insulation breakdown during the test. Insulation breakdown is considered to have occurred when the current that flows as a result of the application of the test voltage, rapidly increases in an uncontrolled manner, that is, the insulation does not restrict the flow of the current. Corona discharge or a single momentary flashover is not regarded as insulation breakdown.*

# Compliance criteria's from IEC60950-1 and IEC62368-1 for impulse test

## ▪ From 6.2.2.3 IIEC60950-1 Compliance criteria for impulse test

*For impulse tests, damage to insulation is verified in one of two ways, as follows:*

- during the application of the impulses, by observation of oscillograms. Surge suppressor operation or breakdown through insulation is judged from the shape of an oscillogram.*
- after application of all the impulses, by an insulation resistance test. Disconnection of surge suppressors is permitted while insulation resistance is being measured. The test voltage is 500 V d.c. or, if surge suppressors are left in place, a d.c. test voltage that is 10 % less than the surge suppressor operating or striking voltage. The insulation resistance shall not be less than 2 MΩ.*

## From 5.4.10.3 IEC62368-1 Compliance criteria for impulse test

*For the impulse tests, insulation breakdown is verified in one of the following two ways:*

- during the application of the impulses, by observation of oscillograms, surge suppressor operation or breakdown through insulation is judged from the shape of an oscillogram.*
- after application of all the impulses, by an insulation resistance test. Disconnection of surge suppressors is permitted while insulation resistance is being measured. The test voltage is 500 V d.c. or, if surge suppressors are left in place, a d.c. test voltage that is 10 % less than the surge suppressor operating or striking voltage. The insulation resistance shall not be less than 2 MΩ .*

# Compliance criteria

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## Comment:

In the text“ *There shall be no insulation breakdown, as defined in subclause 5.2.2 of IEC 60950-1 and IEC 62368-1, during the test. The resistance after the test shall be at least 2 M ohm, measured at 500 V dc*“ there is following issue:

This compliance criteria applies for a) and b) and c) electrical test procedures . However a) and b) compliance requirements for steady stay tests are different than for c) impulse test.

Requirements a) and b) compliance criteria per paragraph 5.2.2 IEC60950:

*"There shall not be insulation breakdown during test. Insulation breakdown is considered to have occurred when the current that flows as a result of the application of the test voltage rapidly increases in an uncontrolled manner, that is the insulation does not restrict the flow of current"*.

# Compliance criteria

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For requirements c) compliance per paragraph 6.2.23 IEC60950-1:

*"For impulse tests, damage to insulation is verified in one of two ways, as follows:*

- during the application of the impulses, by observation of oscillograms. Surge suppressor operation or breakdown through insulation is judged from the shape of an oscillogram.*
- after application of all the impulses, by an insulation resistance test. Disconnection of surge suppressors is permitted while insulation resistance is being measured. The test voltage is 500 V d.c. or, if surge suppressors are left in place, a d.c. test voltage that is 10 % less than the surge suppressor operating or striking voltage. The insulation resistance shall not be less than 2 MΩ."*

Therefore IEEE requirements that *" The resistance after the test shall be at least 2 Mohm , measured at 500 V dc"* should refer just to impulse test c) and not to steady stay tests a) and b).

# IEC62368-1 Edition 3 (Target Publication Date -> Q3 2018)

## Ed. No. 3 of IEC 62368-1: Anticipated Changes



- **IEC 60950-21** (RFT) requirements being incorporated into new **IEC 62368-3, DC power transfer through communication cables or ports**, with expansion to cover both **RFT & USB/PoE/etc** interfaces...

