Rationale and Background for comments on Annex J of Draft Amendment to IEEE Std 802.3-2018 IEEE Draft P802.3cr/D3.0

IEEE P802.3cr Maintenance #14: Isolation Task Force 3rd June 2020

The Isolation test criteria have been a mainstay of IEEE 802.3 for many years and has provided a high level of functional reliability against electrical transients for Ethernet and PoE interfaces when equipment complied with the isolation criteria. There is significant concern that the changes in Annex J1 (although intended to simply harmonize with IEC 62368-1 rather than IEC 60950-1) will have devastating effects on the reliability of IEEE 802.3 interfaces if adopted as proposed in this draft. The main harmful effect is that the references will explicitly allow the removal of components and transient suppressors during the isolation test, which totally defeats the entire concept of isolation. Also the way J2 is implemented is inappropriate. The changes suggested in the comment form accomplish the same technical goal, but meet the intent, do not require the purchase of an expensive IEC standard, and is more appropriately implemented so solve all the problems discussed below.

The following is from an Email to David Law on this subject matter, and Mr. Law's response was a request to file a comment form and provide this information to the committee as soon as possible.

Email Excerpt:

I don't know if you remember me and some discussions you set up with myself and Mick Maytum and some of the IEEE 802 team members several years ago when Mick and I were concerned about the references to 60950-1 in the isolation test possibly allowing components (in particular TVS devices) to be removed during the references procedures, **which totally invalidates the concept of isolation**. We had hoped for clarification in 802.3 that "isolation" means just that, and components cannot be removed from the products when being tested to 802.3" isolation tests". Nothing really happened, but if you really followed the 60950-1 references, you really should not be removing the TVS's regardless of the misinterpretations. 62368-1 will clearly let you remove components during their "insulation testing", but they are testing something totally different.

Recently I was informed that your team is improving the isolation test requirements, and I applaud the idea of centralizing the myriad of isolation tests into an annex. This simplifies and harmonizes things greatly.

I was provided this proposed annex and wanted to provide some comments as I think the conversion to 62368-1 references (although it might seem like a good idea), will have some serious and harmful effects on the reliability of ethernet and PoE equipment. I can state this definitively as a manufacturer who has studied the field returns and how the isolation test if implemented is critical to these ports surviving in the real world.

I also am the team adhoc leader in TC-108 for classifying communications interfaces for IEC TR 62102. TC-108 is the body that writes the 60950-1 and 62368-1 safety standards. I also was recently put in charge of a project team in TC-108 to re-write IEC 62368-3 which has a direct bearing on the safety requirements for PoE. And is used by IEC 62368-1 now. I also am a participating member of the TC-108 for the normal 62368-1 so I have intimate familiarity with it. I also am an ATIS member who co-authored "ATIS-0600012.05 Electrical Protection For Ethernet Systems", which strongly requires the concept of isolation of 802.3 interfaces to be reliable and not get damaged by even small electrical transients.

With that in mind, I feel I need to reach out and express my concerns and provide solutions, which may make your new Annex vastly more clear, and useable, and technically appropriate/accurate, without having to reference a very complex 62368-1 standard that has a myriad of twist and turns and exemptions, and conditions when doing the referenced tests. **More importantly, try to assist in trying to prevent what will be a catastrophic reduction in field reliability of ethernet and PoE ports if implemented as in the J1 proposal I was shown.**

1.) Annex J1 is an "isolation test", and this is very important that the line interface be isolated from ground and the circuitry in the equipment by the levels you have defined, and as described in ITU-T K series and ATIS standards for Ethernet protection, these levels may still be too low. But, as a baseline they are generally adequate.
2.) These levels have nothing to do with safety and PoE and Ethernet pose no safety threat that the isolation tests would address. The importance on the isolation tests are transient resistance, to prevent the PHY or other circuitry from being damaged by common mode electrical stresses which can be quite large.
3.) The tests in 62368-1 and 60950-1 are "insulation tests and as such components can be removed as all that is being evaluated is trace spacings and component spacings, and transformer insulation design, etc. "isolation tests", by definition, can never have components removed. Just like if you are in quarantine for a virus, you cannot have the isolation removed, otherwise the quarantine is useless.
4.) As such, there really is no reason to reference 62368-1 at all "for isolation". 62368-1 DOES NOT DO ANY "isolation testing". So the reference to insulation testing in 62368-1 is inappropriate. **More importantly it TOTALLY DEFEATS this whole "isolation" concept, and what it has been doing to protect equipment from damage(intentionally or unintentionally)!!!!!!**. In addition there are twists and turns and exemptions in 60950-1 and 62368-1 that have nothing to do with ethernet ports and isolation, but rather safety of equipment systems.
5.) There is an unrelated requirement for TVS components in 62368-1 on an ethernet or PoE to ground to be at least 360 VDC plus the components margin, but not in your references. So the port can in theory could have only 500V of isolation (it would have to pass the 500V insulation resistance test) and meet J1 if you follow the procedures you reference in 62368-1. Surely, that is not the intent!
6.) Also it would be inappropriate to require the equipment system to comply with IEC 62368-1:2018,
    a. Many systems with these ports are exempt from IEC standards and only need to meet UL/CSA, AS/NZS, EN or one of the other national variants. Thus it imposes a huge

burden to require conformance with the IEC version. Actually many systems for years to come will still be 60950-1 and some countries still require 60950-1

b. Many equipment systems are exempt from listings or safety approvals altogether, for a variety of reasons such as being exempt from the LVD, or exemptions in the U.S./Canadian National Electrical Code. Etc. For example Central office equipment, or equipment on ships, or in substations etc. As such there would be no evaluation or way of knowing if this 62368-1 criteria in IEEE 802.3 J1 would be met.
c. 62368-1 only applies to ICT systems, and other safety standards apply to industrial equipment, or other equipment that could have 802.3 ports (i.e. washing machine or refrigerator), but the system is not ICT so would never be evaluated to 62368-1 or any country variant.
d. Lastly it could be considered inappropriate to impose a system level conformance criteria in a standard defining an interface port. It can be suggested or recommended, but would probably be unprecedented to require conformance to a system level safety standard when defining a test criteria of any kind in an interface specification.
e. So a proposal to remedy this is provided below.

The "isolation" concept as you might know is what (by design or accident) prevents that vast majority or ethernet and PoE functional damage from transients. We have tons of data on this within ADTRAN. And I have given several presentations on this as has Mick. I even helped author an ATIS standard "ATIS-0600012.05 Electrical Protection For Ethernet Systems" and in it, it discusses the importance of isolation and as a minimum the isolation criteria in IEEE 802.3.

All of this above has discussed how the surge suppressors used in non-compliant equipment (or externally) violate the concept of isolation and cause mass field failures (feedback from customers and lab testing comparing ADTRAN's isolation designs to other vendors non-isolated designs, as well as round robin testing and analysis of other vendors equipment). In some part I think this is due to the ground reference being such a high impedance in the real deployments, while very low in the lab. But asymmetrical operation and in some cases driving currents through the transformer windings on center tap TVS protection is also a major failure point. Lack of isolation simply kills PHY's when electrical transients are present, period.

Considering what is discussed and known above, I have put together a suggestion that resolves all this. It does not require referencing other expensive standards that are almost impossible to interpret and vary dramatically in procedure based on system characteristics that may have nothing to do with the 802.3 port.

For IEEE 802.3 isolation all you need is the following or something similar and it would never need to be updated. But with the references in the proposed J1, **there will never be isolation**, and you simply will create a total lack of isolation resulting in all kinds of dead interfaces. That is very scary. But it really is as simple as below!

Electrical isolation and general safety

J.1 Electrical Isolation

Electrical isolation between the electrical conductors of the 802.3 interface under test and: PE, Mains input ports, any conductive surface, and any other interface ports on the system shall withstand at least one of the following electrical isolation ~~strength~~ tests:

a) 1500 V rms at 50 Hz to 60 Hz, for 60 seconds ~~applied as specified in Section 5.4.9.1 of IEC 62368-1:2018.~~

b) 2250 V dc, for 60 seconds ~~applied as specified in Section 5.4.9.1 of IEC 62368-1:2018.~~

c) A sequence of ten 2400 V impulses of alternating polarity, applied at intervals of not less than 1 s.

The shape of the impulses is 1.2/50 µs (1.2 µs virtual front time, 50 µs virtual time or half value), or a 1.2/50 µs x 8/20 µs as

defined in ITU-T K.44~~in Annex D of IEC 62368-1:2018.~~

There shall be no insulation breakdown, ~~as defined in Section 5.4.9.1 of IEC 62368-1:2018~~, during the test. Insulation breakdown is defined as a sudden increase in current caused by a failure of the isolation. Typically the breakdown of the isolation barrier will be in components, on a PCB, in a jack/connector, etc.

The resistance after the test ~~with the replacement of any components removed for AC or DC voltage testing~~

shall be at least 2 MΩ, measured at 500 V dc ~~as specified in Table 23 of IEC 62368-1:2018~~.

J.2 General safety

All equipment meeting this standard is intended to ~~shall~~ conform to the relevant safety standard for the equipment system that contains the IEEE 802.3 interface(s), such as the applicable sections of IEC 62368-1:2018.

Most importantly, for the continued proper design and reliability of 802.3 interfaces, you need to find a way to maintain the isolation criteria, and not allow the removal of ANY components during an isolation test. Otherwise why have an isolation test at all???? Even with the 500V insulation test afterward at most you would only have 500V peak of isolation to comply. Removal of components defeats the entire isolation concept!!!

And of course if you can avoid un-necessarily referencing a very expensive IEC standard (with many expensive and varying national versions) when all you need is a few of your own words, it mitigates outdated or changing references, and prevents people from being upset with your standard for making them buy an expensive and very confusing one. Frankly even safety experts like myself struggle every day sorting out what 62368-1 is saying and I am on the committee that writes it and is trying to fix it.

If you would like to setup a conference call at some point, please feel free to reach out, and I would be glad to assist.

Best regards,

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