Common Mistakes Made in Certification Specifications and Testing

Jim Davis
Regional Marketing Engineer
Fluke Networks
Common Mistake #1

Failing to specify a Permanent Link test
#1 Permanent Link or Channel?

- Kevin our tech “Tested to Cat 6A per ANSI/EIA/TIA-568” ANSI/TIA-568-C.2
#1 Permanent Link or Channel?

- Kevin knows that a Channel test is easier to PASS
- Test spec did not specify Permanent Link or Channel

The test report says Cat 6A, so we’re good right?
Common Mistake #2

Not agreeing if PASS* (marginal result) is acceptable
#2 Not agreeing if PASS* is acceptable

- Field tester standard ANSI/TIA-1152
  - Any fail or fail* shall result in an overall fail. In order to achieve an overall pass condition, all individual results shall be pass or pass*.

Unless you specified otherwise, this is a **PASS**.

Although the tester has identified four connections.
#2 Not agreeing if PASS* is acceptable

- Field tester standard ANSI/TIA-1152 - deviation
  - Technically should be displayed as a PASS. But test equipment vendors have been asked to make it more obvious the Autotest contains one or more marginal results
Do You Accept These Results?

<table>
<thead>
<tr>
<th>Pair</th>
<th>Limit [ns]</th>
<th>Limit [ns]</th>
<th>Limit [ohms]</th>
<th>Limit [ohms]</th>
<th>Result (dB)</th>
<th>Limit (dB)</th>
<th>Limit (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-8</td>
<td>5.5</td>
<td>17.8</td>
<td>1</td>
<td></td>
<td>28.9</td>
<td>31.1</td>
<td>250.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28.7</td>
<td>31.1</td>
<td>250.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26.0</td>
<td>28.8</td>
<td>218.5</td>
</tr>
</tbody>
</table>

**Worst Margin**

<table>
<thead>
<tr>
<th>Pair</th>
<th>Margin (dB)</th>
<th>Freq. Limit (MHz)</th>
<th>Margin (dB)</th>
<th>Freq. Limit (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-8</td>
<td>0.7</td>
<td>185.5</td>
<td>5.1</td>
<td>187.5</td>
</tr>
<tr>
<td></td>
<td>5.8</td>
<td>37.5</td>
<td>5.1</td>
<td>37.4</td>
</tr>
</tbody>
</table>

**Generic Results Management Software**

- **Cable ID**: 012
- **Headroom**: 0.7 dB (NEXT 45-78)
- **Test Limit**: TIA Cat 6a Perm. Link
- **Limits Version**: V4.0
- **Date / Time**: 12/28/2015 11:09:41 AM
- **Software Version**: V6.0 Build 3

**Project Debateable Test Result**

- **Operator**: Jim
- **Tester Main S/N**: 12345
- **Tester Smart Remote S/N**: 54321
- **Calibration Date**: 01/21/2015 (Main), 01/21/2015 (Remote)
Common Mistake #3

Failing to specify which parameters are to be tested
#3 What parameters are to be tested?

- Field testers are covered by ANSI/TIA-1152
- **Myth:** Covers all the test parameters in ANSI/TIA-568-C.2
- **Scope:** *This Standard includes requirements for field test instruments that are used to test balanced twisted-pair cabling as specified in the ANSI/TIA-568-C series of structured cabling standards. This Standard specifies the reporting and accuracy performance requirements of field testers for balanced twisted-pair cabling measurements.*
- **Fact:** You need to specify the parameters to be tested
#3 What parameters are to be tested?

- Some are missing

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ANSI/TIA-568-C.2 (Cabling System Standard)</th>
<th>ANSI/TIA-1152 (Field Tester Standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire Map</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Length</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Propagation Delay</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Delay Skew</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DC Loop Resistance</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DC Resistance Unbalance within a pair</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>DC Resistance Unbalance between pairs</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>NEXT, PS NEXT</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Return Loss</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ACR-F, PS ACR-F</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>TCL, ELTCTL</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>PS ANEXT, PS AACR-F 1)</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

1) Category 6 A only

Important for PoE “Optional” in “A” revision of 1152
“Normal” Category 5e AUTOTEST

• The customer’s control panel was having issues
“Full” Category 5e AUTOTEST

- The customer’s control panel was having issues
- Mode of failure: **DC Contact Resistance issue**
Common Mistake #4

Failing to specify plot (graphical) data
#4 Failing to specify plot (graphical) data

- Not a requirement in any of the cabling standards
- Without plot data, your reports will look a little empty
#4 Failing to specify graphical data

- Without Plot Data, Fault Identification in the Frequency Domain is a Challenge
- Is this Cable, Connector, or Installation?

<table>
<thead>
<tr>
<th></th>
<th>Worst Case Margin</th>
<th>Worst Case Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAIL</strong></td>
<td><strong>MAIN</strong></td>
<td><strong>SR</strong></td>
</tr>
<tr>
<td>Worst Pair</td>
<td>36-45</td>
<td>12-78</td>
</tr>
<tr>
<td><strong>NEXT (dB)</strong></td>
<td>-7.7F</td>
<td>-6.1F</td>
</tr>
<tr>
<td>Freq. (MHz)</td>
<td>88.8</td>
<td>10.8</td>
</tr>
<tr>
<td>Limit (dB)</td>
<td>42.7</td>
<td>57.3</td>
</tr>
<tr>
<td>Worst Pair</td>
<td>36</td>
<td>78</td>
</tr>
<tr>
<td><strong>PS NEXT (dB)</strong></td>
<td>-6.6F</td>
<td>-4.5F</td>
</tr>
<tr>
<td>Freq. (MHz)</td>
<td>88.8</td>
<td>10.9</td>
</tr>
<tr>
<td>Limit (dB)</td>
<td>40.2</td>
<td>54.9</td>
</tr>
</tbody>
</table>
#4 Failing to specify graphical data

- With plot data, TDR Can Help to Find the Cause of Failing Results
- We able to confirm there was a cable issue
#4 Failing to specify graphical data

- Alien Crosstalk requires plot data from your in-channel tests
- Without plot data, you’ll be re-testing those links
Common Mistake #5

Failing to agree on Alien Crosstalk testing
#5 Failing to agree on Alien Crosstalk testing

- **Myth:** ANSI/TIA specifies Alien Crosstalk testing, but it’s optional

- **Reality check #1:**
  - Most cabling vendors offering a warranty do not require it

- **Reality check #2:**
  - Unless the test specification explicitly states that Alien Crosstalk is not required, the end user has a right to demand it, even if the cabling vendor does not require it for their warranty program (we have seen this happen)

- **Reality Check #3:**
  - This test will be required for Category 8 installations
Common Mistake #6

Failing to agree on a sampling plan for Alien Crosstalk testing
#6 Failing to agree on a sampling plan

• ANSI/TIA does not specify a sampling plan
• You have to look to ISO/IEC 14763-2:
  • Equal selection of
    – short, medium & long in length links
• Failure to do so could result in 100% alien crosstalk testing be demanded

<table>
<thead>
<tr>
<th>Total no. of links/channels(N)</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-150</td>
<td>3 or 0.1 x N (whichever is the greater)</td>
</tr>
<tr>
<td>151 – 3,200</td>
<td>33^a</td>
</tr>
<tr>
<td>3,201 – 35,000</td>
<td>126^a</td>
</tr>
<tr>
<td>35,001 – 150,000</td>
<td>201^a</td>
</tr>
<tr>
<td>150,001 – 500,000</td>
<td>315^a</td>
</tr>
</tbody>
</table>

^a Equivalent to acceptance quality level (AQL) of 0.4 %, normal inspection, general inspection level I as defined in ISO 2859 series for populations of up to 500,000 links.
Fiber Mistakes
A COMMENT ON FIBER CLEANING
#1 Problem: Dirt!

- Contaminated connector end-faces: Leading cause of fiber link failures
- Particles of dust and debris trapped between fiber end faces cause signal loss, back reflection, and damaged equipment
- Many Sources of contamination:
  - Equipment rooms & Telecommunication rooms in filthy environments
  - Improper or insufficient cleaning tools, materials, procedures
  - Debris and corrosion from poor quality adapter sleeves
  - Hands of technicians
  - Airborne
Inspection images

- **Good Connector**
- **Fingerprint on Connector**
- **Dirty Connector**

Real images
A Clean Connector
Connector with a Finger Print
This part of the presentation is only for those >17 years old
Notice the ring where the contact occurred in the center.
Fiber Inspection

• We all know how important it is
• It is rare that calls to our Technical Assistance Center from techs have ANY inspection equipment – but they tell us they have cleaned it
• Cleaning without inspection can result in this:

• Solvent pens are better than IPA
How Automated Analysis Works

IEC 61300-3-35 UPC Multimode Specification

<table>
<thead>
<tr>
<th>Zone Name</th>
<th>Scratches</th>
<th>Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>No limit &lt;= 3 um</td>
<td>2 &lt;= 3 um</td>
</tr>
<tr>
<td></td>
<td>0 &gt; 3 um</td>
<td>None &gt; 3 um</td>
</tr>
<tr>
<td>Cladding</td>
<td>No limit &lt;= 5 um</td>
<td>No limit &lt; 2 um</td>
</tr>
<tr>
<td></td>
<td>0 &gt; 5 um</td>
<td>5 from 2 um to 5 um</td>
</tr>
<tr>
<td>Adhesive</td>
<td>No limit</td>
<td>No limit</td>
</tr>
<tr>
<td>Contact</td>
<td>No limit</td>
<td>No &gt;= 10 um</td>
</tr>
</tbody>
</table>
Cleaned *and* Inspected
Common Mistake #7

Not being Encircled Flux compliant
#7 Not being Encircled Flux compliant

- Did you agree to ANSI/TIA-568.3-D or ISO/IEC 11801?
- Then you agreed to be Encircled Flux compliant
- Annex E, Section 2.2 of ANSI/TIA-568.3-D
  - For multimode cabling, cabling standards describe that attenuation measurements are taken according to ANSI/TIA-526-14-C.
  - TIA 526-14-C specifies that the output of the launch cord meet specific launch conditions. For example, the encircled flux launch condition can be achieved by using a universal controller or a matched controller (see TSB-4979).
Encircled Flux Improves Precision

- **EF compliant** = just enough light
  - Measure the right loss
  - Passes good links
  - Fails bad links

- **Overfilled** = too much light near the edge
  - Measures high loss
  - Fails good links

- **Underfilled** = not enough light near the edge
  - Measures low loss
  - Passes “everything”
Common Mistake #8

Failing to specify a reference method
#8 Failing to specify a reference method

- **Myth:** ANSI/TIA-568.3-D requires a 1 jumper reference
- **Section 7.3.1**
  - The one cord reference method is preferred for both multimode and single-mode links. Other methods as detailed in the above standards may be applied. Test documentation should include the test method applied.
- If you want a 1 jumper (one cord) reference, you must specify it in your test specification.
- Most cabling vendors will reject other reference methods.
1 Jumper Reference

Direct connection (No bulkhead adapter!)

Optical Loss Measured

All connections are included in the loss measurement
2 Jumper Reference

Reference is carried out through a bulkhead adapter

Since one connection has been referenced out, you are only measuring one connection here

Optical Loss Measured
3 Jumper Reference

First and last connections excluded from measurement

Optical Loss Measured
Common Mistake #9

Failing to specify test reference cords
#9 Failing to specify test reference cords

- ANSI/TIA-568.3-D
  - ANSI/TIA-526-7-A and ANSI/TIA-526-14-C recommend the use of reference-grade terminations on test cords

- ANSI/TIA-526-7-A (Singlemode)
  - 0.2 dB for a reference grade to reference grade connection

- ANSI/TIA-526-14-C (Multimode)
  - 0.1 dB for a reference grade to reference grade connection
Common Mistake #10

Failing to document test reference cord losses
#10 Failing to document test reference cord losses

- Test reference cords will “wear out” with use
- Poor/damage cords will destroy your installation

- If you have specified a 1 jumper reference
  - Require them to be verified every 288 tests
  - Verification of test reference cords to be saved and submitted

Inspected to IEC 61300-3-35
Verification of “Known Good” Leg of TRC

Expected Test Results are:

- 0.1 dB for Multimode
- 0.2 dB for Single-Mode
Common Mistake #11

*Specify negative losses are to be rejected*
#11 Specify neg. losses are to be rejected

- ANSI/TIA-568.3-D
  - No text specifically stating a negative loss result is to be classified as a FAIL
  - Consult the equipment manual to determine the sign of power loss readings, as a reading of the wrong sign is often an indication of improper setting of the reference power level.

Tester A
Warning given

Tester B
Warning & fail given
Common Mistake #12

Failing to specify bi-directional averaging for OTDRs
#12 Failing to specify bi-directional averaging for OTDRs

- A mismatch in backscatter between the test and installed fiber can cause a negative loss event and/or a false failure

Test Summary: FAIL
#12 Failing to specify bi-directional averaging for OTDRs

- Bi-directional averaging resolves any mismatches

[Diagram showing test results with mismatched and matched loss and reflectance values indicated by red and green boxes respectively.]

Test Summary: PASS
Common Mistake #13

Failing to agree on a reflectance limit
#13 Failing to agree on a reflectance limit

- OTDR loss event measurements heavily rely on good reflectance
- Poor reflectance can result in
  - Optimistic / negative loss readings
  - Errors when the application runs
- Agree on a reflectance limit
- As a guide (talk to your vendor)
  - -35 dB for multimode
  - -40 dB for singlemode
  - -55 dB for APC singlemode

Same link tested
Twisted pair lessons learned today

• Ensure your standards reference are current
  – Look to www.ihs.com for the latest versions – invest in copies
• Specify Permanent Link or Channel testing
  – Permanent Link required by most cabling vendor warranty programs
• Call out what tests are to be conducted
  – Find potential DC contact resistance issues during the installation process
• Require graphical data
• Specify whether marginal passes are acceptable or not
• State whether Alien Crosstalk testing is required or not
  – If required, agree on a sampling plan in writing
Fiber lessons learned today

• If you are testing to ANSI/TIA or ISO/IEC, you must be EF compliant
• Specify a fiber reference method
• Specify negative losses are to be retested
• Test reference cords:
  – Specify them and verify their performance every 288 tests
• If OTDR testing:
  – Specify bi-directional averaging and agree on a reflectance limit
Final word

• It is much easier to argue your point when you have a copy of the standard in your hand – please invest in copies of standards

www.ihs.com

www.iso.org
Thank you for your time

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