Fibre Optic Connector and Component Standards

Developments & Key Issues in IEC & CENELEC

Philip C Longhurst
Corporate Fibre Optic R & D Manager

Outline

- CENELEC TC86BXA work programme
- IEC SC86B WG 6 and WG4 work programmes
- Key issues
- BSi Fibre Optic Groups and input to International standards

CENELEC TC86BXA - Scope

- To prepare and maintain European Standards and specifications for fibre optic interconnect, passive and connectorised components.
  - Scope has recently been enlarged to include tubes for blown fibre.
- Products:
  - Main group: Connector sets, attenuators, mechanical splices,
  - Sub group: closures, blown fibre tube connectors, splice protectors, wall boxes
- Cenelec produces product specifications that may form part of a purchasing contract
- These give details of real products that are already in the market.
- Committee size: main:18 people from 10 countries

  sub: 23 people from 6 countries

CENELEC TC86BXA

- Work programme topics
  - Product specifications for Connectors Passive Components and Closures
  - Product specifications for Mechanical splices
  - Plastic Optical Fibres
  - Industrial connectors
- Key Issues
  - Plug Style SC/PC and SC/APC attenuator Technical Report CLC / FprTR 50378-2-1 (see next slide)
  - LC Plug style attenuator product specifications not being developed (partly due to the difference in the total length of the two different attenuators types in the market place)
  - Liaison between CLC TC86A and CLC86BXA.
  - Lack of Marketing of Standards

CENELEC TC86BXA

Conclusions from CLC / prTR 50378-2-1 Plug Style SC/PC and SC/APC attenuator Technical Report

- Larger than expected variations for spectral attenuation, especially in 1310 nm window.
- Physical phenomena like modal noise interference influencing repeatability of results, even when measurements performed with reference components
- In random mating conditions measurement variations much larger, especially in 1310 nm region. Spectral loss values up to 19 dB measured for a 15 dB attenuator.
- PDL measurements show a larger variation of values in 1 310 nm window.
- Analysis of mechanical intermateability behaviour of the SC/APC attenuator proved that the functional performance of the product cannot be assured
- Conclusion: with the dimensions and tolerances in the current IEC SC mechanical interface and CENELEC SC documents for attenuator, connector and adapter, it is not possible to make a plug style attenuator which guarantees intermateability in all applications.
- Active transceivers with fixed ferrules should never be connected with a plug style attenuator made according to EN 50377-4-4 mechanical interface.

SC86B

- Scope: To prepare international standards for fibre optic interconnecting devices and passive components, embracing all types of communications applications - includes:
  - terminology and characteristics
  - related test and measurement methods
  - functional interfaces, including all mechanical, environmental and optical requirements to ensure interoperability and reliable performance of fibre optic interconnecting devices and passive components.
- Three working groups:
  - WG4 Standard tests and measurement methods for fibre optic interconnecting devices and passive components (45 members)
  - WG6 Standards and specifications for fibre optic interconnecting devices and related components (50 members)
  - WG7 Standards and specifications for fibre optic passive components (32 members)

IEC SC86B WG6

- Work programme topics
  - Interface Standards
  - Performance Standards
  - Optical Interface Standards
  - Closures
  - Reliability
- Key issues
  - Reliability
  - Multimode Optical Interface
  - Optical interface for multiway rectangular ferrules (MT Task Group)
  - Industrial connectors
    - MICE vs Category I
  - Multimode Launch conditions
  - POF optical interface
  - Cleaning and cleanliness requirements

IEC SC86B WG6

Reliability

- The IEC SC86B working group on reliability (WG5) has been disbanded due to lack of support.
- This means that many reliability documents within SC86B have been transferred into WG6 and WG7,
- TC 86 Reliability Coordination Group.
  - To expand the Reliability Guidance Document; guidance of procedure to prepare the reliability and quality documents by WGs
  - To establish a mechanism to get participation and support from each relevant WGs.

IEC SC86B WG6

Issues in reliability standards:

- No consistent approach between standards: definitions, formats
- Clear definitions of reliability and qualification required
- More severe short term tests are not the answer
- Pass/failure criteria are not properly defined
- Must consider the technologies involved without being too prescriptive
- Should provide guidelines on how to identify degradation mechanisms and failure modes, how to design experiment to determine acceleration factors, and how to estimate reliability.
- There is a need to educate the end-users of these issues. Their buy-in for the better reliability standards is critical since a standard is useless if it is not used

IEC SC86B WG6 New WGs assignment proposal

IEC ref	Document name	New WGs
62005-1	Introductory guide and definitions	TC86 RCG
62005-2	Quantitative assessment of reliability based on accelerated ageing test - Temperature and humidity; steady state	TC86 RCG
62005-2-1	Example of quantitative assessment of reliability based on accelerated ageing tests - Design of an acceptance test for fibre pistioning failure of connectors during temperature humidity cycling	WG6
62005-3	Relevant tests for evaluating failure modes and failure mechanisms for passive components	TC86 RCG checked by WG6 and WG7.
62005-4	Product screening	TC86 RCG checked by WG6 and WG7.
62005-5	Relating accelerated tests to standardized service environments	WG6 or WG7 (checking contents)
62005-7	Life stress modelling	TC86 RCG checked by WG6 and WG7.
62005-9-1	Reliability qualification for passive optical components	WG7
62005-9-2	Reliability qualification for optical connectors (single fibre, cylindrical ferrule PC)	WG6
62005-9-3	Reliability qualification for optical connectors (multi fibre, rectangle ferrule)	WG6
62005-10	High optical power reliability qualification	Either WG6 or WG7 (checking contents)

IEC SC86B WG6

Multimode Launch Conditions 61280-4-1

- There is some considerable discussion within the “standards bodies” over this document, which is being developed by IEC SC86C
- SC86B WG 6’s concerns are:
  - Calculated values do not suit SC86B’s requirements or take into account the request to have the same IL performance across single connectors at both 850nm and 1300nm.
  - The document has some confusion over reference connectors and reference patchcords clarification of the launch lead is required.
  - There is contrary advice on bi-directional OTDR measurement which needs to be clarified and unified
- This document is critical to the development of the Multimode optical interface.

IEC SC86B WG6

Multimode Optical interface

The following are required to complete the task:

- Defined near field and far field launch conditions
- Loss models for lateral and angular misalignment
- Define insertion loss grades
- Typical fibre waveguide and dimensional characteristics
- Typical connector ferrule dimensional characteristics
- Typical adaptor sleeve dimensional characteristics
- End face geometry models
- Laboratory verification of loss and end face models

IEC SC86B WG6 MT Task Group

The work to date includes:

- Review of geometry checklist
- Review of friction between guide pin and hole – friction has a large impact on the analysis
- Moment arm
- Experimental results on coefficient of friction
- Rotational stiffness experiment in both X and Y axis
- One fibre contacts and then there is rotation around that point.
- Model now exists for how the two end faces come together.

- Conclusions:
  - Model will be used to establish requirements for fibre height, minus-coplanarity, adjacent fibre height differential, fibre tip radii, and end face angles.
  - Parameters such as minus-coplanarity or end face angle could have different tolerance limits depending on fibre count and material.
  - Minimum fibre height and calculated minus-coplanarity limit will need to be adjusted for Category C, U, and O climatic conditions and material.
  - End face angle tolerances may need to be reduced from PAS values to assure worst-case functionality.
- Next steps:
  - Validate system model with physical testing.
  - Estimate parameter tolerance limits based on model simulations.
  - Coordinate with WG4 to ensure harmonized measurements.

IEC SC86B WG4

Key Issues

- Introduction of measurement uncertainty for all measurement methods.
- Visual inspection, new method, inspection requirements in 61300-3-35 and related calibration artefact.
- Re-write of all attenuation and return loss related documents regarding the launch condition. launch condition only in 61300-1.
- Study group and round robin on measurement uncertainty for attenuation measurement related to the influence of the ferrule material.
- Study group of interferometer manufacturers to improve the measurement methods related to the end face geometry of rectangular ferrules.

IEC SC86B WG4

Visual Inspection – IEC 61300-3-35 (CDV & PAS)

- Division into scratches and defects only
- 3 methods: direct view, video microscopy, automated analysis
- High and low resolution systems:
  - High – factory (low contrast defect 0.5 um wide)
  - Low – field (low contrast defect 2 um wide)
- Calibration artefact for each resolution
- Circular ferrule divided in to 4 regions: core, cladding, adhesive, contact (to 250um)
- Rectangular ferrule divided into 2 regions: core, cladding
- Scratches and defects defined for a number of connector endfaces (singlemode, multimode, PC, APC)

High res artefact

BSi / UK involvement

- BSi has 1 Committee and 3 Sub-Committees that mirror the work of IEC and CENELEC
  - GEL 86 (IEC TC86)
  - GEL 86/1 (IEC SC86A & CLC/TC86A)
  - GEL86/2 (IEC SC86B & CLC/TC86BXA)
  - GEL 86/3(IEC SC86C)
- These Committees provide input and comment on documents and UK experts at International meetings.
- Membership of the BSi Committees is free and partial funding is provided for overseas attendance.
- More experts / contributors are needed from the UK from both Users and Manufactures