The author

Mike Gilmore, Senior Partner of The Cabling Partnership, is involved at the highest level in UK and European cabling standardisation. Mike is Chairman of the BSI Premises Cabling Experts Panels (TCT7/-/1 and TCT7/-/3) and Convenor of CENELEC TC215 Working Group 1 (its European partner). The two groups control the development of UK and European standards for the design and installation of telecommunications cabling. Mike also acts as the Technical Director of the UK Fibreoptic Industry Association. He can be contacted at mike.gilmore@btinternet.com.

The Cabling Partnership

The IT cabling infrastructure division of e-Ready Building Limited

The IT cabling consultants

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Next generation IT infrastructures

Cabling standards – nearing the end of the road

Introduction

When an international standard reaches the FDIS (Final Draft International Standard) stage, it is deemed to have become technically stable and only editorial changes are allowed before final publication. The same is true for a European (CENELEC) standard at the 3MV (3 Month Vote) stage. After almost five years of development the second editions of ISO/IEC 11801 and EN 50173 (to be published as EN 50173-1) have now reached these respective stages.

It is therefore appropriate to have a good look at the requirements of these standards and how they compare with the ANSI/TIA/EIA-568-B series of standards in the USA, particularly as the US addendum to 568-B.2 covering Category 6 components and installed cabling is also nearing publication.

There are a number of cosmetic differences between the ISO/IEC and CENELEC documents but the technical requirements of the two standards are the same. There are four obvious changes between the first and second editions. The first appears minor but has considerable impact - the presence of the consolidation point in place of the transition point of earlier editions. The second is the presence of new cable and connecting hardware specifications for balanced cabling. Termed Category 5 (2002), Category 6 and Category 7, these component specifications are intended to be identical within the ISO/IEC and CENELEC standards. The third change is the inclusion of Class D (2002), Class E and Class F specifications for installed cabling that correspond to specific "reference implementations" of the Category 5 (2002), Category 6 and Category 7 components. The fourth is the introduction of Categories to cover the performance of optical fibre (OM1, OM2, OM3 and OS1) and the associated installed cabling Classes (OF-300, OF-500 and OF-2000).

This article is one of a series that will look at the details of the new standards as they affect specifiers and installers of the new cabling. Future publications will contain information on the move towards the much more detailed design rules of the new reference implementations and the changes to testing philosophies contained within the revised ISO/IEC 11801 and EN 50173-1 standards. This article covers the general requirements for installed cabling within the second editions of the ISO/IEC 11801 (and EN 50173-1) and summarises the differences between the requirements of these and the US standards.

Cabling concepts

Before entering into a detailed analysis it is important to introduce a number of basic concepts that are common to all the standards. The first of these concepts is the channel: defined as the "*end-to-end transmission path connecting any two pieces of application-specific equipment (equipment cords and work area cords are included in the channel)*" and shown in Figure 1.

The Cabling Partnership
P. O. Box MT 65, LEEDS, West Yorkshire, LS17 8YD, England
Telephone: +44 (0) 113 232 3721 Fax: +44 (0) 113 293 2632

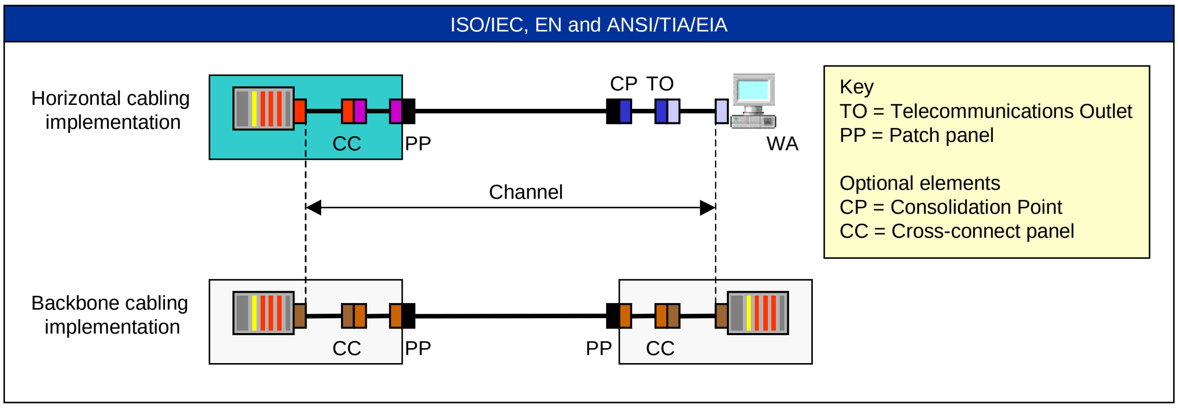

Figure 1: The installed cabling "channel"

Then there is the permanent link - a term introduced in the existing ISO/IEC 11801 and EN 50173 standards and since adopted within ANSI/TIA/EIA-568-B series of standards. The permanent link is shown in Figure 2 and is typically the cabling configuration that installers will have to test to prove compliance with the requirements of the standards. In some cases, installers will have to test between the consolidation point and the patch panel. This “CP link” is not addressed in the ANSI/TIA/EIA-568-B series of standards but given significant consideration in the ISO/IEC and CENELEC documents.

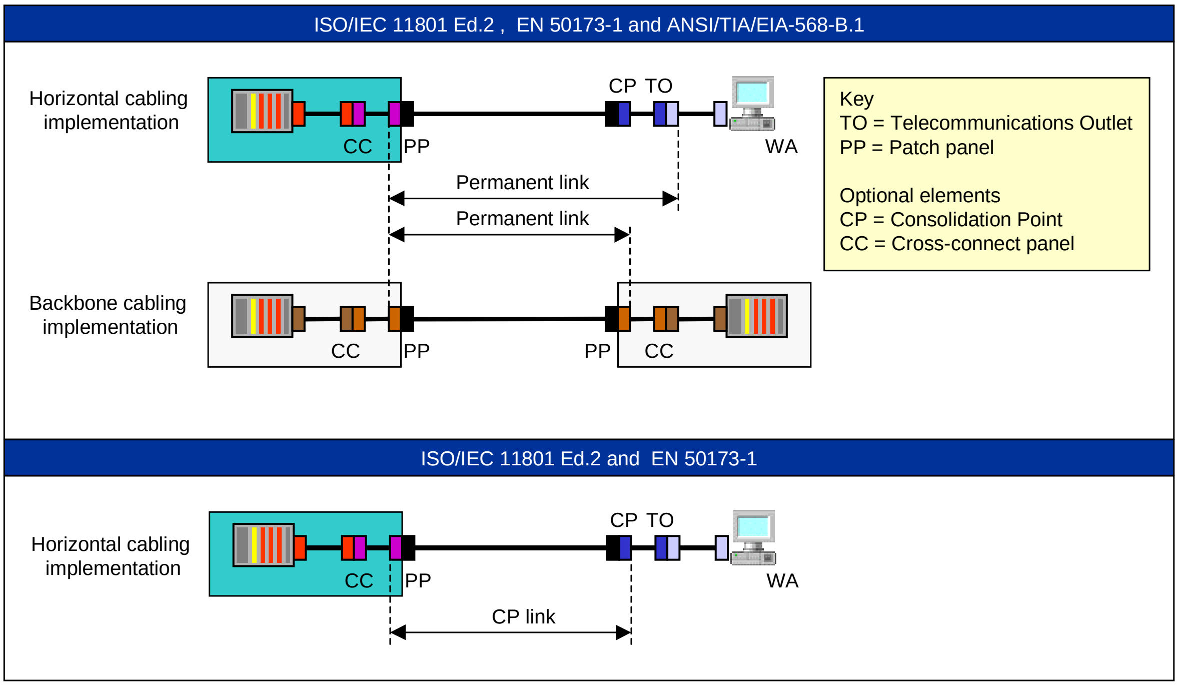

Figure 2: The installed cabling “permanent link”

Classes and Categories

A common area of misunderstanding is that concerning Class and Category. This was reflected in the contributions to a recent NCN Forum covering the topic. In all the standards, balanced cabling components are defined in terms of Category (although, as will be seen later, the ISO/IEC and CENELEC Categories are more stringent than their US counterparts). Installers will purchase cables and connecting hardware against the requirements of a specific Category.

However, installers will rarely measure the performance of a component. Instead they will install permanent links and CP links that are required to have a defined minimum performance in support of the transmission

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Telephone: +44 (0) 113 232 3721 Fax: +44 (0) 113 293 2632

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Company Registration No. 4432595 Registered Office - Emery House, 192 Heaton Moor Road, Stockport, Cheshire, SK4 4DU.

equipment that is connected to the resulting channels. Link and channel performance is defined in terms of a Class in ISO/IEC and CENELEC and Category in the US standards.

It would perhaps be simpler if the standards communities adopted a single term (Category or Class). However, ISO/IEC and CENELEC adopted "Class" as opposed to Category for the performance of **installed cabling** because they were concerned that to assess a channel or link as, for example, "Category 6" would lead users to infer that the components used were indeed "Category 6". Such an assumption cannot and should not be made since it is almost impossible to assess the Category of the components within a link or channel.

Independent of the merits of the arguments on both sides, this particular aspect harmonization of terms is essentially a sideshow since, as will be seen below, the requirements of the ISO/IEC and CENELEC Classes are different and in general more severe than those of the US standards. Also, there are no US equivalents for Class F balanced cabling or the optical fibre Classes.

Conformance to the standards

Proving compliance of a channel, permanent link or CP link against the Class requirements of the ISO/IEC and CENELEC or the Category requirements of the US standards requires the measurement of a large number of parameters. These are summarized in Table 1. It will be noticed that all the standards define requirements for most of the parameters. There are three areas of exception to this general statement: length, ACR and power feeding characteristics.

	ISO/IEC 11801	EN 50173-1	ANSI/TIA/EIA 568-B series
Balanced			
Return loss	YES	YES	YES
Attenuation	YES	YES	YES
NEXT	YES	YES	YES
PSNEXT	YES	YES	YES
ACR	YES	YES	NO
PSACR	YES	YES	NO
ELFEXT	YES	YES	YES
PSELFEXT	YES	YES	YES
Delay	YES	YES	YES
Delay skew	YES	YES	YES
Length	NO	NO	YES
Loop resistance	YES	YES	NO
Loop resistance unbalance	YES	YES	NO
Voltage capacity	YES	YES	NO
Power capacity	YES	YES	NO
Optical fibre			
Attenuation	YES	YES	YES
Length	YES	YES	NO

Table 1: Installed cabling parameters

The US standard states maximum lengths for channels and permanent links (for horizontal balanced cabling) of 100 metres and 90 metres respectively. The ISO/IEC and CENELEC standards do not state maximum lengths since exceeding a specific length does not cause a network to fail - rather it is the effect of that length on attenuation, ACR, PSACR, delay, delay skew and loop resistance that creates the fault. As all these parameters are defined separately, there is no reason to define a specific requirement for length. There also is a practical reason for not doing so. Length is a difficult parameter to determine since it depends upon the measurement of the delay along the cable (which can be undertaken very accurately) that is subsequently involved in a calculation using the assumed NVP of the cable (which is entered into the test equipment by the installer). This prone to all manner of technical and administrative errors that can lead to "failed" results for installed cables at, or near, the limits.

For optical fibre, the situation is regarding length is somewhat different. It is not feasible to undertake measurement on the key length-related transmission parameter - bandwidth - and so length is an important factor for the definition of the optical fibre Classes in the ISO/IEC and CENELEC standards. These have not yet been incorporated into the ANSI/TIA/EIA-568-B standards. Fortunately, the likely measurement error is also much lower for optical fibre than for balanced cabling

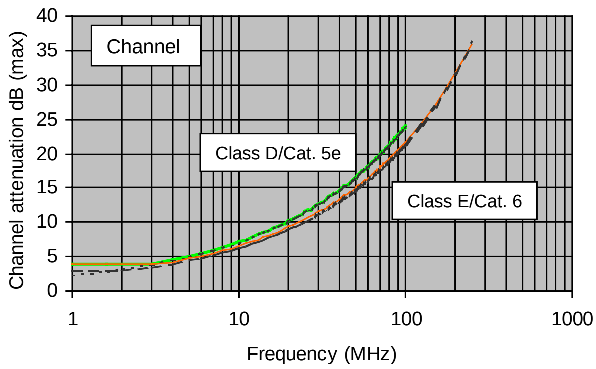
For balanced cabling, requirements for ACR and PSACR are not defined in the ANSI/TIA/EIA-568-B series of standards since if the cabling meets the attenuation limits and those for NEXT and PSNEXT then it will automatically conform to the limits for ACR and PSACR. The ISO/IEC and CENELEC standards take a slightly different stance. Short lengths of installed cabling have been known to fail NEXT/PSNEXT requirements and in such circumstances it is the ACR/PSACR of the installed cabling that is relevant to the application. Hence, in certain circumstances ACR/PSACR takes precedence over NEXT/PSNEXT within the ISO/IEC and CENELEC standards.

Finally, a set of new parameters has been created by the new work undertaken in IEEE for the supply of power to the NIC using the balanced cabling. These new d.c. parameters (loop resistance, loop resistance unbalance, voltage capacity and power capacity) are included in the ISO/IEC and CENELEC standards but are yet to be incorporated into the ANSI/TIA/EIA-568-B standards.

In summary, the ISO/IEC and CENELEC standards are more “up-to-date” and, in some cases, are more “installation- and installer-friendly” that those of the US. However, there are more detailed differences that render the ISO/IEC and CENELEC standards more severe than those of the United States.

Balanced cabling - deviations between the standards

The channel is what the networking equipment “sees” and as all the cabling standards seek to support the same networks then it would be a safe bet to assume that all the standards have a common requirement for channel performance. The graphs and Tables of Figure 3 show that the attenuation requirements of a Class D (2002) and a Category 5e channel are effectively identical and the same is true, although to a slightly reduced extent, for Class E/Category 6.

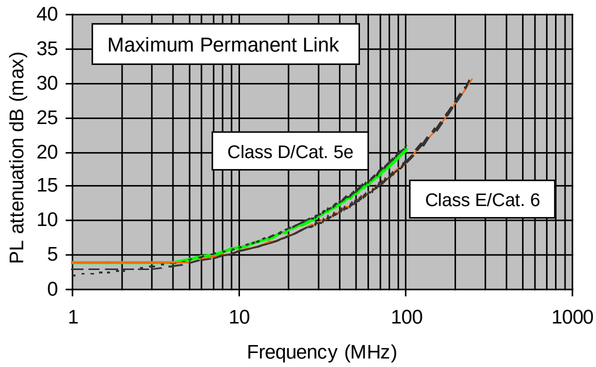


	Class D	Cat. 5e
f	dB	dB
16	9,1	9,1
100	24,0	24,0

	Class E	Cat. 6
f	dB	dB
16	8,3	8,0
100	21,7	21,3
200	33,9	33,8
250	35,9	36,0

Figure 3: Channel attenuation comparisons

A greater deviation between the requirement of the standards is uncovered when we come to discuss the permanent link. The underlying difference lies in the cords that are attached to the permanent link to create the channel and is based upon the decision to fully support screened cabling within the international and European standards. In the ISO/IEC and CENELEC standards, the calculation of the worst-case permanent link performance assumes the use of cords within which the cable attenuation is up to 50% higher than that in the fixed cable whereas the ANSI/TIA/EIA-568-B standards assume only 20%. The total length of the cords is assumed to be 10 metres in both cases. As the channel requirements are virtually identical then the difference has to appear within the permanent link requirements.



	Class D	Cat. 5e
f	dB	dB
16	7,7	7,9
100	20,4	21,0

	Class E	Cat. 6
f	dB	dB
16	7,0	7,1
100	18,5	18,6
200	27,1	27,4
250	30,7	31,1

Figure 4: Maximum permanent link attenuation comparisons

As a result, the requirements for permanent link attenuation and all parameters related to attenuation (i.e. ACR, PSACR, loop resistance) are more severe in the ISO/IEC and CENELEC standards. This is exemplified by the attenuation comparisons as shown in Figure 4. This has a knock-on effect for the cable specifications in that the Category 5 cables of ISO/IEC 11801 (2002) and EN 50173-1 are more tightly specified than those of the US Category 5e. Also, when the US publish their final requirements for Category 6, there will be a similar difference to those of the ISO/IEC and CENELEC standards.

That being said, the requirements of all the standards for the “noise” parameters such as return loss, NEXT and ELFEXT of the channels and permanent links are, in reality, identical.

Summary

The new international and European standards contain requirements for installed cabling that are missing from the equivalent US standards. Where comparable requirements for permanent links exist, certain parameters are more strictly specified in the new international and European standards. As a result, any specifier wishing to have a more fully, “better”, specified cabling infrastructure should refer to the FDIS 11801 Ed.2 or EN 50173-1 (available Q2, 2002). This is particularly true for the UK since the EN 50173-1 will become BS EN 50173-1.

That being said, the differences, although clearly demonstrable in print, are relatively minor and would only cause consternation where the lengths of the installed cabling approached 90 metres.

The choice lies with the specifier - the important thing is for the specifier and the installer to understand the contents of the standard they have chosen to work to, use the correct design rules and test the cabling according to the appropriate limits.

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