



The Fibreoptic Industry Association

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THE TRUTH ABOUT OS1 AND OS2

by

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There is a great deal of confusion about the purpose, and meaning, of the cabled optical fibre Categories OS1 and OS2. This confusion exists at all levels of the industry and affects, in equal measure, the suppliers of optical fibre and optical fibre cable, distributors, installers, customer and their consultants.

This White Paper explains the background to the topic and clarifies the subtle differences between the European specifications of OS1/OS2 and their international counterparts in ISO/IEC - and highlights the more fundamental differences between the international and European requirements and those of the US standards, specifically TIA-568-C.3 published in 2008.

As explained in other FIA White Papers such as:

- "An introduction to OM4"
- "Understanding OM1, OM2, OM3, OS1, OS2 and more!"

the European and international standards bodies apply **the OS terms to specify the performance of cabled optical fibres**.

As described in the FIA White Paper "An overview of singlemode optical fibre specifications" the original singlemode optical fibre for use within extended length LAN, MAN and access network systems was designated B1 in IEC (and EN) 60793-2-50.

In the 2002 versions of ISO/IEC 11801 and EN 50173-1, B1 optical fibre was used as the base for what is now called Category OS1 cabled optical fibre. The scope of ISO/IEC 11801 and EN 50173-1:2002 was office premises with dimensions not exceeding 2000 metres. A cabled optical fibre attenuation performance of 1,0 dB/km (max) at 1310 nm and 1550 nm was considered to be adequate and, equally importantly, did not discriminate between cable constructions. Indeed the 1,0 dB/km requirement for OS1 was a continuation of the requirement stated in the earliest versions of the ISO/IEC 11801 and EN 50173 standards published in 1995.

During the development of ISO/IEC 24702, published in 2006 and covering generic cabling for industrial premises, it was decided that premises of larger dimensions had to be considered. As the singlemode implementations of 1 Gigabit Ethernet (1000BASE-LX) and 10 Gigabit Ethernet (10GBASE-LR/LW) are specified to support transmission channels of 5000 metres and 10000 metres respectively, it was decided to consider these applications and dimensions as benchmarks. It was immediately obvious that a cable with attenuation of 1,0 dB/km (max) at 1310 nm would not support these applications over their maximum specified distances.

Therefore, it was decided to define a new Category of cabled optical fibre which was capable of meeting those benchmarks. Liaison with the optical fibre cable standards bodies advised that loose tube cable constructions (including blown fibre solutions) could achieve 0,4 dB/km (max) at both 1310 nm and 1550 nm. As a result, OS2 was defined with that cabled optical fibre performance. So, the difference in performance between OS1 and OS2 is therefore largely a matter of different cable construction rather than a technical leap in optical fibre performance. There are, nevertheless, differences in the optical fibres that are used to produce Category OS1 and OS2 cabled optical fibre.

By 2006, the optical fibre B1 had been separated into B1.1 and B1.3. B1.3 is physically compatible with B1.1 but has the advantage of having a low water peak at wavelengths in the region of 1383 nm. "Low water peak fibre" had become the production norm by 2006 and, within **ISO/IEC 24702**, it was agreed to specify **Category OS2 cabled optical fibre** as only being produced from **B1.3 optical fibre**. However, at international level the source specification for OS1 remained **ISO/IEC 11801** and this continued to specify as **Category OS1 cabled optical fibre** being produced from **B1 (allowing either B1.1 or B1.3)**.

In Europe, the complete revision of the EN 50173 series of standards in 2007 allowed the opportunity to review the situation from a wider perspective. EN 50173-1 contains all the cable specifications for the other EN 50173 documents and it was recognized that Category OS2 cabled optical fibre (being of an external style cable construction with low cabled attenuation) may frequently be jointed to Category OS1 cabled optical fibre (with a higher allowed attenuation more consistent with an in-building cable construction). It was therefore illogical to allow OS1 to be made from an optical fibre that did not have a specified performance at 1383 nm.

For this reason **EN 50173-1:2007** states that both **OS1 and OS2** cabled optical fibres can **only** be constructed from **B1.3 optical fibre of EN 60793-2-50**. A more recent edition of EN 50173-1 (approved for publication in late 2010 or early 2011) allows the use of both Type B1.3 and B6_a. B6_a is a less bend sensitive singlemode optical fibre which is similar to, and compatible with, B1.3.

Unfortunately, ISO/IEC has acted somewhat erratically and the most recent amendment of ISO/IEC 11801 (specifically Amendment 2:2010) has introduced both OS1 and OS2 as able to be constructed Types B1.1, B1.3 and B6_a. This creates a technically confusing area in that ISO/IEC 11801 and ISO/IEC 24702 apply two different sets of rules for the construction of OS2.

The overall situation is shown in Table 1. In reality, the presence of the B1.1 option in ISO/IEC 11801 Ed.2.2 is an irrelevance (since virtually all manufacturers will wish to sell B1.3 products) but it does allow for contractual complexity. A greater concern is that although B1.1, B1.3 and B6_a are intended to be compatible there are concerns over losses that may result when they are connected (which are highlighted in the EN and ISO/IEC standards). For more information see FIA Technical Support Document TSD-2000-4-1-1.

Table 1: Cabled singlemode optical fibre specifications

Cabled optical fibre Category	Optical fibre of EN/IEC 60793-2-50	Maximum attenuation (dB/km)		
		1 300 nm	1 383 nm	1 550 nm
OS1 (EN 50173-1:Ed.2:2010)	B1.3, B6_a	1,0	1,0	1,0
OS2 (EN 50173-1:Ed.2:2010)	B1.3, B6_a	0,4	0,4	0,4
OS1 (ISO/IEC 11801 Ed.2.2:2010)	B1.1, B1.3, B6_a	1,0	-	1,0
OS2 (ISO/IEC 11801 Ed.2.2:2010)	B1.1, B1.3, B6_a	0,4	0,4	0,4
OS2 (ISO/IEC 24702: 2006)	B1.3	0,4	0,4	0,4

Against this subtle difference of specification lies a more fundamental issue that can potentially cause real problems for installers. For some reason, the North American standard ANSI/TIA-568-C.3, which defines optical fibre components in support of generic cabling solutions, has not understood the fundamentals of the EN-ISO/IEC approach. They have assumed the performance figures in Table 1 relate to the optical fibre - not the cabled optical fibre. This allows cables to be specified with different performance to Table 1 whilst stating that they are OS1 or OS2 optical fibres. This misunderstanding has been exacerbated by a number of cable suppliers/distributors who confuse the matter so much that the installer has no information of the actual cable performance.

 <p>The Fibreoptic Industry Association www.fia-online.co.uk</p> <p>GUIDANCE</p>	<ul style="list-style-type: none"> • OS1 and OS2 are <u>cabled</u> optical fibre specifications; • Category OS1 is appropriate to internal tight buffered cable construction; • Category OS2 is appropriate to a loose tube or blown fibre solution (where the cabling process applies no stress to the optical fibres); • make sure that any performance specifications that are quoted are for the cables and not just the optical fibres contained within them; • be cautious about cables with internal constructions that claim OS2 performance – the suppliers may be confusing the designations OS1/OS2 with the pre-cabled optical fibre performance; • demand that the cables you purchase have either OS1 or OS2 performance but are constructed from B1.3 optical fibre (also known as ITU specification G.652c or G.652d).
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