OPTICAL FIBER CLASSIFICATIONS UNDER ISO 11801 & EN 50173:

OP, OH, OM & OS

White paper
by Multimedia Connect

INTRODUCTION

Amendment 2.0 to ISO 11801 is currently being finalized and should come into effect in mid 2010. It is eagerly awaited as it outlines the requirements for Category 6A components, but the amendment will also have significant repercussions for fibre optics, as it includes a section on OM4 fibres.
In the section on the EN European standard, the modifications involve amendment AA:2010 to EN50173, which is already available.
This guide will provide a comprehensive overview of usable fibre optics, including some undervalued or seldom used categories.
These categories include plastic fibre optics used in industrial networks such as Interbus and Profibus.
The second part of this guide focuses on the new OM4 fibre and OS2 fibre requirements.

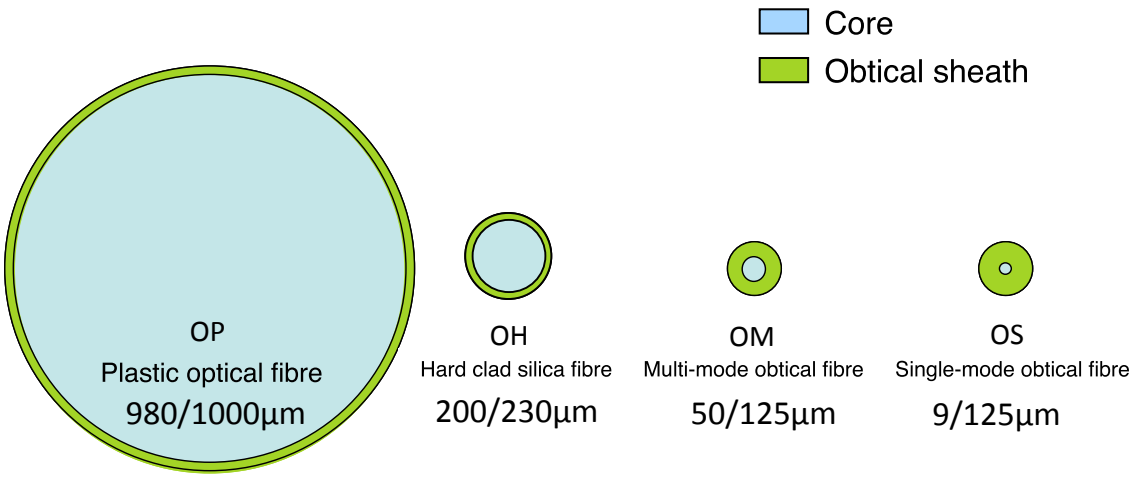
NORMATIVE REFERENCES

AMD1.0 and AMD2.0 (draft) to ISO 11801 for international fibre optic performance. EN50173-1:2010 (draft) for European fibre optic performance.
EIA/TIA 568-C.3 - recently approved (2009) for North American fibre optic performance.

DESIGNATIONS

OP: Plastic Fibre
OH: Glass core/plastic sheath fibre
OMx: Multi-mode glass fibre
OSx: Single-mode glass fibre

SIZE RATIOS

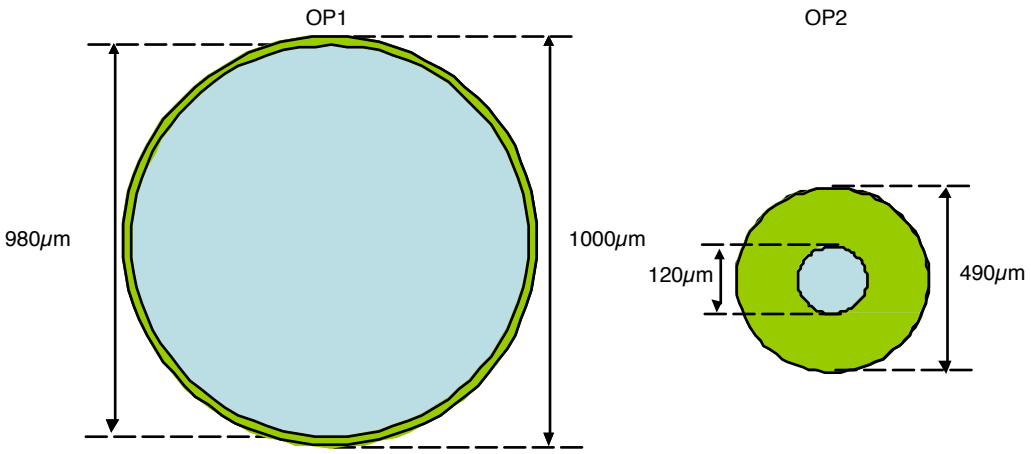


THE FIBRES IN DETAIL
OP PLASTIC FIBRES

Plastic Optical Fibres (POF) are made from highly transparent polymers and quality light transmission while being more durable than glass fibre.

Transmission loss is 100 times greater than in glass fibres, therefore their use is restricted to short distances. Already used for some time in fibre optic endoscopy, laser surgery, or even angioplasties, plastic fibre optics first appeared in local industrial and residential networks from the year 2000, and remains little used.

The fibre core is made from an acrylic (polymethyl methacrylate, or PMMA), while the optic sheath is made from a fluoride compound that condenses the light signal near the core.
ISO/EN standards define two categories of plastic fibre optics: OP1 and OP2.



CATEGORY A	TRANSMISSION LOSS (dB*km)			BANDWIDTH		
	650 nm	850 nm	1300 nm	650 nm	850 nm	1300 nm
OP1	180	-	-	4	-	-
OP2	100	33	33	80	188	188

APPLICATIONS

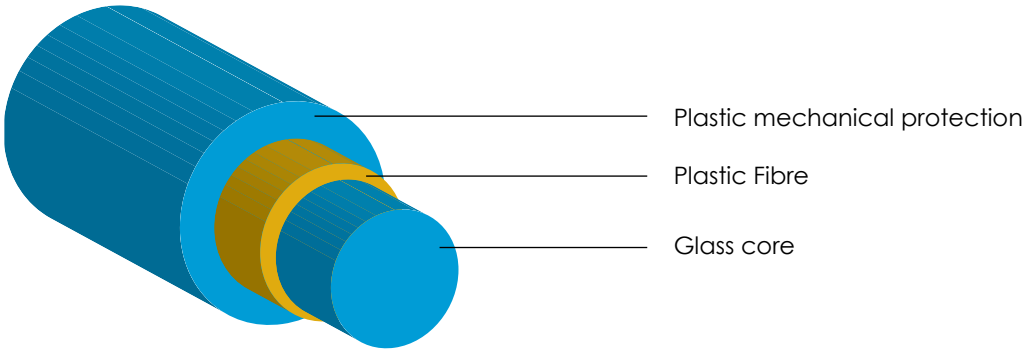
Applications	Wavelength	OP1		OP2	
		Max loss	Length	Max loss	Length
Profibus V2.0 1999	650 nm	9.0	25 m	-	-
Profibus (amélioré) V2.0 1999	650 nm	14.0	50 m	-	-
Interbus-S 2000	650 nm	17.2	50 m	-	-

Be aware that as OP2 fibres are newly approved, standardized applications do not yet exist. However, its transmission quality,
especially at 850nm/1300nm, may, in the next few years, become an extension of multi-mode glass fibres.

OH MIXED FIBRES

OH mixed fibres are a combination of a glass core and a sheath made from plastic compounds. These fibres are known as Hard Clad Silica Fibres (HCSF). The advantage of these fibres is the combination of a glass core with excellent optical performance with thermoplastic protection (more hardwearing than glass).
Just as with plastic fibres, OH fibres suffer from significant transmission loss over long distances, and are used in industrial applications (sensors, spectophotometres, chromatographs, etc.) and medical devices (dermatological lasers, hair removal lasers, etc.).

The core measures around 200µm while the plastic optical sheath measures 230 µm. The optical fibre is also protected by a tetrafluoroethylene compound coating, such as TEFZEL®.



CATEGORY A	TRANSMISSION LOSS (dB*km)			BANDWIDTH		
	650 nm	850 nm	1300 nm	650 nm	850 nm	1300 nm
OH1	-	10	-	-	5	-

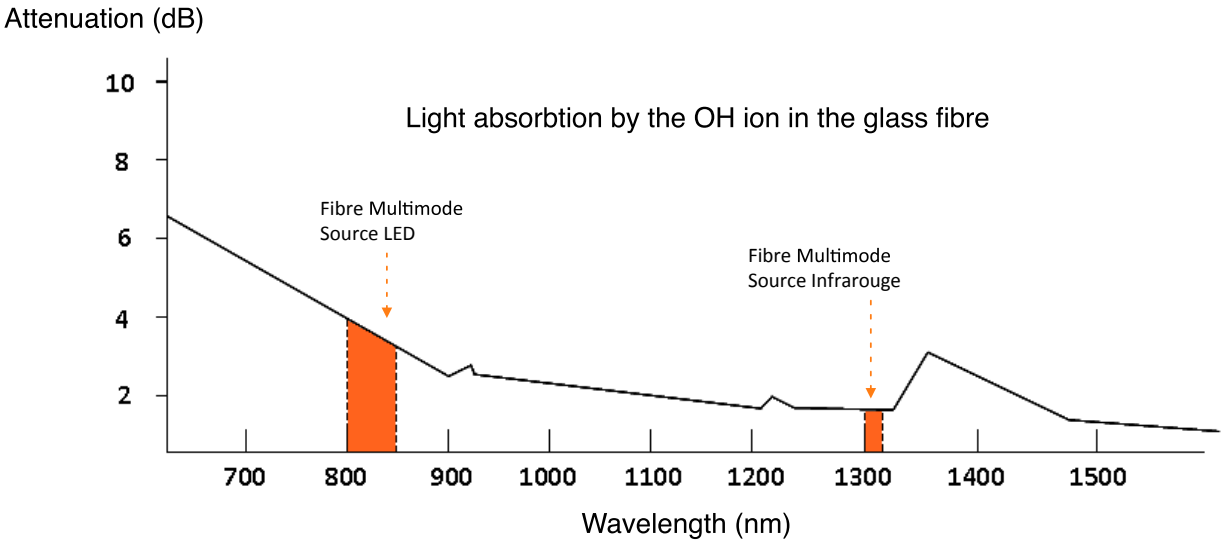
There are no standardized applications for communication networks using this type of fibre optics. However, with transmission loss of 10dB/km at 850nm, this optical fibre will undoubtedly be a smash hit for multi-mode fibre applications in environments where mechanical performance is essential.

OM MULTI-MODE GLASS FIBRE

A lot better known and more widely used than plastic fibre optics, these glass fibres are special in that they can carry several light signals with different trajectories, hence the name “multi-mode”.
These optical fibres are made from a “preform”: a glass tube made up of a core and an optical sheath.

Manufacturing a preform in our TFO plant in Nanjing.

Transmission loss per kilometre is identical across all categories as it depends on the absorption of light rays by the silicon, and particularly the ion hydroxide (OH-).
Transmission loss varies with the wavelength used: either 850nm or 1300nm.



MULTI-MODE FIBRE PERFORMANCE

CATEGORY A	TRANSMISSION LOSS (dB*km)	
	850 nm	1300 nm
OM1	3.5	1.5
OM2	33	33
OM3	3.5	1.5
OM4	33	33

OM4 IN DETAIL

In October 2009, TIA TR42.12 (fibre optics) set the tone by publishing the specifications for a new multi-mode optical fibre, optimized for 850 nm LASER sources. This new optical fibre resembles OM4, although this name is generally used only for ISO documents.
With the coming publication of amendment 2.0, OM4 will be officially standardized.

OM4 fibre was developed for use in connections over 100 m long, for 40G/100G applications. Very long connections between distribution areas are not uncommon in large Data Centres. Its main characteristic is its bandwidth in the 850 nm range with restricted sources (e.g. VCSEL), which may reach 4700 MHz*km.

This level of performance is obtained by using very fine layers of refraction that guide rays of light to the centre of the optical fibre, for rays arriving at any angle. The limitations of Differential Mode Delay (DMD) make this fibre an investment in the future by significantly increasing the bandwidth at 850 nm.

CATEGORY	CORE DIAMETER µm	MINIMUM BANDWIDTH MHz*km		
		BANDWIDTH - source LED		LEDBANDWIDTH - source VCSEL
		850 nm	1300 nm	850 nm
OM1	50 ou 62.5	200	500	Not specified
OM2	50 ou 62.5	17.2	500	Not specified
OM3	50	1500	500	2000
OM4	50	3500	500	4700

SINGLE-MODE GLASS FIBRE OS

Single mode fibres are governed by two different regulatory documents: ITU-T standards or ISO/EN standards.
ITU-T telecommunications standards award a performance level to optical fibres according to their capacity to carry large amounts of data over long distances. There are over 15 different ITU-T fibres types, which differ in their optical optimization range or their flexibility.
The most used fibre is ITU-T G652 D due to its level of performance around 1310nm. It is the equivalent of an OS2 optical fibre.
The most recent fibre, the ITU-T G657 (Bending Insensitive Fibre) is used as a subscriber fibre in FTTH networks. Its extreme flexibility makes it perfectly suited to residential installations.

ISO/IEC standards define the backbone or campus transmissions up to a maximum of 10km. ISO/EN identifies two types of single mode fibres: OS1 fibres for transmissions up to two kilometres, and long distance OS2 fibres.

CATEGORY A	TRANSMISSION LOSS (dB*km)	
	1310 nm	1550 nm
OS1	1.0	1.0
OS2	0.4	0.4

OS2 fibre is the equivalent of the ITU-T G653 standard that acts as the benchmark for single mode fibres.

SUMMARY

Summary Table Max loss/length by optical fibre category

Max application LENGTH	CATEGORY	MAXIMUM CHANNEL TRANSMISSION LOSS				
		Multi-mode			Single	
		650 nm	850 nm	1300 nm	1300 nm	1550 nm
25 m	OP1	7.5	-	-	-	-
50 m	OP1	12.0	-	-	-	-
100 m	OP2	13.0	6.3	6.3	-	-
	OH1	3500	-	-	-	-
200 m	OP2	23.0	9.6	9.6	-	-
	OH1	-	5.0	-	-	-
300 m	OM1,OM2, OM3, OM4, OS1, OS2	-	2.55	1.95	1.8	1.8
500 m	OM1,OM2, OM3, OM4, OS1, OS2	-	3.25	2.25	2.0	2.0
2000 m	OM1,OM2, OM3, OM4, OS1, OS2	-	8.5	4.5	3.5	3.5
5000 m	OS2	-	-	-	4.0	4.0
10 000 m	OS2	-	-	-	6.0	6.0

Summary Table Optical fibre applications

Application	Wavelength (nm)	OP1	OM1	OM2	OM3	OM4	OS1	OS2
		980 µm	62.5 µm	50 µm	50 µm	50 µm	9 µm	9 µm
Improved Profibus V2.0	650	50 m	-	-	-	-	-	-
ATM 155	850 - 1310	-	1000 m	1000 m	1000 m	1000 m	2000 m	12500 m
ATM 622	850 - 1310	-	1000 m	1000 m	1000 m	1000 m	2000 m	12500 m
100 BASE SX	850	-	300 m	300 m	300 m	300 m	-	-
1000 BASE SX	850	-	220 m	550 m	550 m	550 m	-	-
1000 BASE LX	1300	-	550 m	550 m	1000 m	1000 m	2000 m	5000 m
10G BASE SX	850	-	32 m	86 m	300 m	550 m	-	-
10G BASE LW	1300	-	220 m	220 m	220 m	220 m	2000 m	10 000 m
10G BASE LX4	1310	-	300 m	300 m	300 m	300 m	2000 m	10 000 m
40G BASE SR4	850	-	-	-	-	100 m	125 m	-
100G BASE SR4	850	-	-	-	-	100 m	125 m	-
40G BASE LR4	1310	-	-	-	-	-	2000 m	10 000 m
100G BASE LR4	1310	-	-	-	-	-	2000 m	10 000 m