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PLASTIC OPTICAL FIBRE
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IS IT FINALLY BECOMING A REALISTIC TELECOMMUNICATIONS MEDIUM?

by
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At their meeting in Los Cabos, Mexico of ISO/IEC JTC1 SC25 WG3 (23rd-27th March 2009) it was confirmed that the terms OM1, OM2 etc. applied to cabled optical fibre and also that they would be termed "Category". This latter aspect matches the terminology of EN 50173 standards since 2002. However, the application of the term Category to cabled optical fibres (rather than the optical fibres themselves - or to cables, which could contain optical fibres of different specifications) has led to amendments being required to all the generic cabling standards in the international and European areas. The change has even filtered down to current TIA activity in North America.

This White Paper is based on the information in a White Paper produced in October 2007 but has been updated to take account of the above confirmation and associated changes.

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For many years, plastic optical fibres have been used in a wide variety of non-mainstream telecommunications applications (remembering that the FIA view "telecommunications" to mean all forms of information transmission - not just long-haul operator networks). Two obvious examples are its applications for data networking within automobiles and in certain industrial process monitoring, control and automation (PMCA) networks. Domestic consumers are also familiar with plastic optical fibres in the audio-visual area where they are used to interconnect hi-fi subsystems and DVD equipment.

This "application-by-application" growth of plastic optical fibres has led to the creation of a plethora of different specifications. Many people may be surprised to find that there is an IEC standard covering these products but there is - IEC (and BS EN) 60793-2-40. There are currently nine different constructions/specifications specified in the standard and these are designated categories A4a to A4h (some categories have sub-categories e.g. A4a is split into A4a.1 and A4a.2). These are shown in the top table within Table 1. It will be noticed that there is a range of core/cladding solutions, operating wavelengths and conditions under which the parameters are to be measured.

However, until recently, plastic optical fibre has failed to break into what would be considered to the areas served by high-bit rate balanced cabling or all-silica optical fibre. This has started to change and this White Paper provides details of these changes.

The first references to plastic optical fibre within generic cabling standards came in ISO/IEC 24702 Ed.1 (2006): *Information technology - Generic cabling for industrial premises*. This specified two cabled plastic optical fibres designated as OP1 and OP2 (in the same way as ISO/IEC 11801 uses the terminology OM1, OM2 etc.) Category OP1 and OP2 cabled optical fibres were specified to be constructed from optical fibre categories A4d and A4f respectively. The cabling channels constructed from these products were of restricted length and were only expected to support relatively low data rates. Identical requirements are detailed in BS EN 50173-3:2007 (which was actually developed in advance of the international standard).

The inclusion of the plastic optical fibre in the standards reflected their use in the process monitoring, control and automation (PMCA) applications in industrial networks as discussed above - rather than a true expectation of future support. However, moves are underway to include two different selections from IEC 60793-2-40 within the residential environment via amendments to ISO/IEC 15018 which specifies generic cabling in homes). The two alternative selections actually push the performance requirements in opposite directions. OP1 will be re-specified to a lower bandwidth performance level using category A4a.2 but OP2 will be re-specified to the much better performing category A4g.

These changes are being reflected in an amendment to ISO/IEC 24702 (approved in 2009) and EN 50173-3 (amendment 1 expected in 2010).

We are now seeing claims in the cabling press of 1000Mb/s Ethernet transmission over 100 metres of plastic optical fibre - this suggests the use of A4f, g or h products since only they have the required bandwidth and correct operating wavelengths.

The key advantage exploited by plastic optical fibres has always been the ease of termination - when compared to all-silica optical fibres. However, within the 100 metre channel environment, the improved bandwidths provided by A4f, g and h make the technology an interference-free competitor for balanced cabling as well.

Table 1: Plastic optical fibres

IEC 60793-2-40:2006 as amended 2009

OF category	A4a1	A4a2	A4b	A4c	A4d	A4e	A4f	A4g	A4h
Core diameter (µm)	(Cladding diameter - 25) ± 10						200 ± 10	120 ± 10	62.5 ± 5
Cladding diameter (µm)	1000 ± 60	1000 ± 60	490 ± 10	500 ± 30	1000 ± 60	750 ± 45	490 ± 10	490 ± 10	245 ± 5
NA	0.5 ± 0.15	0.5 ± 0.03	0.5 ± 0.15		0.3 ± 0.05	0.25 ± 0.07	0.19 ± 0.015		
Attenuation (dB/100 m)									
@ 650 nm	-					-	≤ 10	≤ 10	
@ 650 nm overfilled	≤ 40	≤ 18	≤ 40						
@ 650 nm equilibirium	≤ 30	≤ 18	≤ 30						
@ 650 nm 0.3 NA	-				≤ 18				
@ 850 nm	-						≤ 4	≤ 3.3	≤ 3.3
@ 1300 nm	-						≤ 4	≤ 3.3	≤ 3.3
Bandwidth (MHz.100m)									
@ 650 nm	≥ 10				-		≥ 800	≥ 800	
@ 650 nm 0.3 NA	-	-	-	-	≥ 100	≥ 200			
@ 850 nm	-						≥ 1500	≥ 1880	≥ 1880
@ 1300 nm	-						≥ 1500	≥ 1880	≥ 1880

Generic cabling standards selection - original

Cabled OF Category	OP1	OP2
Attenuation (dB/100 m)		
@ 650 nm	≤ 20	≤ 10
@ 850 nm	-	≤ 4
@ 1300 nm	-	≤ 4
Bandwidth (MHz.100m)		
@ 650 nm	≥ 100	≥ 800
@ 850 nm		≥ 1500
@ 1300 nm		≥ 1500

Generic cabling standards selection - ISO/IEC 24702 A1:2009) and EN 50173-3 A.1 (expected in 2010).)

Cabled OF Category	OP1	OP2
Attenuation (dB/100 m)		
@ 650 nm	≤ 18	≤ 10
@ 850 nm	-	≤ 3.3
@ 1300 nm	-	≤ 3.3
Bandwidth (MHz.100m)		
@ 650 nm	≥ 10	≥ 800
@ 850 nm		≥ 1880
@ 1300 nm		≥ 1880

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