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FIA SHORTFORM GUIDANCE ON TEST PROCEDURES

(Attenuation of installed optical fibre cabling)

Introduction

There are three FIA Technical Support Documents (available free-of-charge to FIA members) which address the procedures for measuring the attenuation of installed optical fibre cabling. These are:

- FIA-TSD-2000-4-2-1: LSPM;
- FIA-TSD-2000-4-2-2: OTDR;
- FIA-TSD-2000-4-2-3: Specification, procurement and use of test cords.

These documents support the use of the following national, European and international standards which can be purchased online from the BSI link on the FIA web-site home page:

- *[BS EN] IEC 61280-4-1:2009*	*Fibre optic communication subsystem test procedures - Installed cable plant - Multimode attenuation measurement*
- *[BS EN] IEC 61280-4-2:2014*	*Fibre optic communication subsystem basic test procedures - Part 4-2: Fibre optic cable plant - Single-mode fibre optic cable plant attenuation*
- *[BS EN] IEC 61300-3-35*	*Fibre optic interconnecting devices and passive components. Basic test and measurement procedures. Examinations and measurements. Fibre optic connector endface visual and automated inspection*
- *[BS PD] IEC TR 62627-01*	*Fibre optic interconnecting devices and passive components. Fibre optic connector cleaning methods*

For technical reasons explained in detail in the above TSDs, the FIA cannot support the application of the following international standard:

ISO/IEC 14763-3 Ed.1.1:2014 including Amendment 1:2016	*Information technology - Implementation and operation of customer premises cabling - Testing of optical fibre cabling*

even though it is referenced from the current edition of [BS] EN 50346 which references test methods for installed cabling. It should be noted that [BS] EN 50346 is scheduled for withdrawal in 2016/2017.

LSPM testing

There are many incorrect methods of undertaking LSPM measurements so to be clear:

- for multimode optical fibre cabling, the FIA requires any installer to apply the correct launch conditions, use the correct n-Cord Reference test method for the cabling under test and, if reference grade terminations are used on the test cords, apply the correct (modified) test limits;
- for singlemode optical fibre cabling, the FIA requires any installer to use the correct n-Cord Reference test method for the cabling under test and, if reference grade terminations are used on the test cords, apply the correct (modified) test limits.

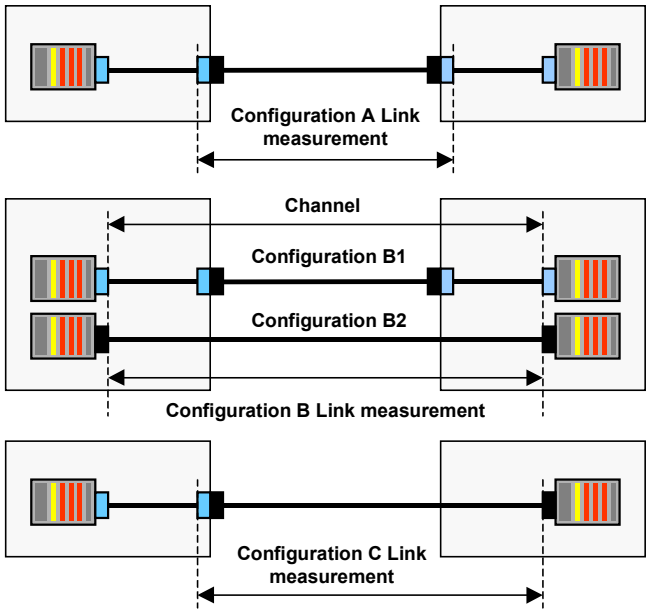
The FIA cannot support any installer who deviates from these requirements and then subsequently is involved in dispute with their client. The diagrams overleaf provide a reminder as to the appropriate n-Cord Reference method to be applied.

Configuration A is the conventional adapter-to-adapter (or "panel to panel") approach where the installed cable is terminated within closures requiring an equipment cord at each end to create the channel.

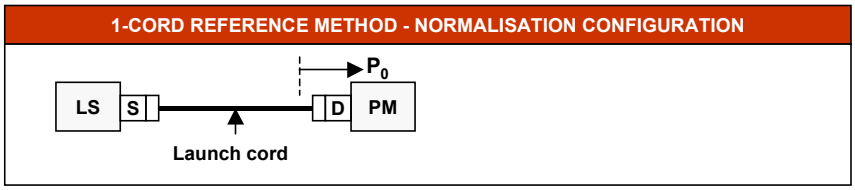
Configuration B has the installed cable is terminated in free plugs at each end. In such a situation either:

- the equipment cords are already attached to a Configuration A (or Configuration C) link - for the purposes of this document this is termed Configuration B1;
- no equipment cords are required to create the channel i.e. the link performance is identical to the channel performance - more common in singlemode systems where there panels are removed in order to reduce the light reflected back into the transmission equipment - for the purposes of this document this is termed Configuration B2.

Configuration C is a combination of Configuration A and Configuration B in which the installed cable is terminated within a closure at one end, requiring an equipment cord at that end to create the channel, but the other end is terminated in a free plug. This configuration may be found in specialist environments such as secure optical fibre telephone circuits where the exchange is the panel and the telephones are directly connected to the free plug.

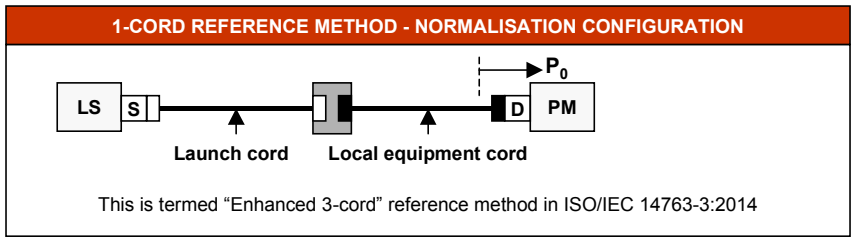


The 1-Cord Reference method is the preferred approach for **Configuration A** cabling. If this is not possible (see NOTE 1) then a 3-Cord Reference method may be used (but with greater measurement uncertainty and the risk of negative loss results).

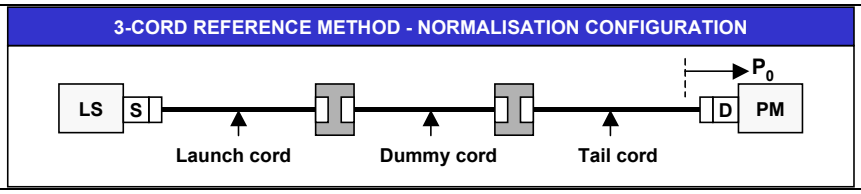


Configuration B1 shall adopt the 1-cord Reference method shown - which additionally uses the equipment cord local to the light source - provides the lowest measurement inaccuracy.

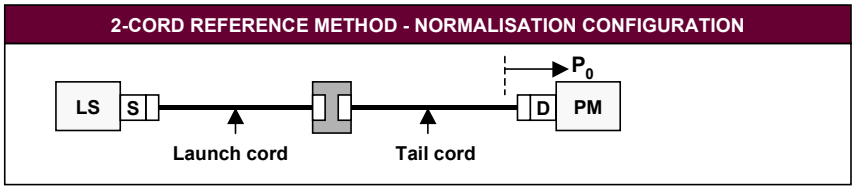
This is termed the "Enhanced 3-Cord" method of ISO/IEC 14763-3 but is not actually a 3-cord referencing procedure. It actually only uses 1 test cord but relies on the equipment cord for its process (hence 1-cord in this document).



Configuration B2 cabling terminated in fixed plugs or Configuration B1 which cannot physically be tested (see NOTE 2) using the 2-cord method above) shall adopt the 3-cord Reference method.



A 2-Cord Reference method shall only be applied to **Configuration C** cabling.



NOTE 1: there is at least one specific situation where it is not possible to apply a 1-Cord Reference method - where the power meter (PM) does not have an interchangeable adaptor, thereby restricting the choice of connector style on the launch cord that can be attached. In this situation the 1-cord method can only be used where the adapter at the local panel (or closure) is the same style as that of the power meter. In such cases a 2-cord referencing approach SHALL NOT be used – but a 3-cord referencing approach may be applied provided that the risk of greater measurement uncertainty and that of negative loss results is acceptable.

NOTE 2: there is at least one specific situation where it is not possible to apply the modified 1-Cord Reference method which uses the local equipment cord as part of the reference measurement - where the power meter (PM) does not have an interchangeable adaptor, thereby restricting the choice of connector style on the local equipment cord that can be attached. In this situation the 1-cord method can only be used where the adapter at the local panel (or closure) is the same style as that of the power meter. In such cases a 1-cord referencing approach SHALL NOT be used – but a 3-cord referencing approach may be applied provided that the risk of greater measurement uncertainty and that of negative loss results is acceptable.

OTDR testing

There are many incorrect methods of undertaking and interpreting OTDR measurements so to be clear:

- for multimode optical fibre cabling, the FIA requires any installer to apply the correct launch conditions and, if reference grade terminations are used on the test cords, apply the correct (modified) test limits;
- for singlemode optical fibre cabling, the FIA requires any installer to, if reference grade terminations are used on the test cords, apply the correct (modified) test limits.

The FIA cannot support any installer who deviates from these requirements and then subsequently is involved in dispute with their client.

The importance of launch conditions for testing of multimode optical fibre cabling

The principle reason for variation between results obtained using different light sources lies in the distribution of power among the modes within the optical fibre within the launch test cord at the point where it connects into the cabling under test.

While it was well documented that LASER and VCSEL sources tended to produce lower attenuation results than LEDS, most people failed to recognise that that, although many LED-based light sources provided well filled modal distributions, some equipment generated predominantly high order modes, producing higher results, whereas others mimicked low order modal distributions seen in VCSELS.

The use of mandrels was an attempt to control how much of the available power was concentrated in which mode groups. Both ISO/IEC 14763-3:2014 and [BS EN] IEC 61280-4-1:2009 have moved away from dowels and curly bits of plastic and taken a technical view of the requirement.

Because there had been no standard to define launch conditions, a great deal of work went into the development of an agreed metric - following which a further substantial debate took place with regard to the actual modal power distribution. ISO/IEC 14763-3:2006 adopted a metric called “modal power distribution” but this has been superseded in ISO/IEC 14763-3:2014 and [BS EN] IEC 61280-4-1:2009 by “encircled flux” (EF).The required EF profile differs with core diameter and wavelength.

EF boundaries for 50/125 um and 62,5/125 um optical fibre types (at 850 nm and 1300nm).

How to obtain the correct launch conditions?

Now that the standards have defined the correct launch conditions, how do installers know that they have achieved them? The good news is that two approaches exist.

The first is to purchase LSPM or OTDR equipment that is known to deliver the correct EF profiles, possibly using existing or modified mandrels and tightly-specified test cords. A small number of test equipment suppliers have confirmed the EF performance of their light sources. The FIA is developing a list of equipment that is claimed to be conformant together with the associated test cord hardware necessary to maintain compliance (go to www.fia-online.co.uk/etest-equipment.htm).

However, not all installers will want to purchase new test equipment – even when more manufacturers catch up and start taking the matter of EF seriously – so the second approach of a “mode controller cord” which may be used with a wide range of test equipment may be an attractive alternative.

Indeed, it was the work by the FIA in supporting the development of such cords that identified the original launch condition problems. The FIA sponsored the development of such cords and are now able to provide FIA members with discounted commercial terms for these cords (for a limited time only). More information is to be found at www.fia-online.co.uk/etest-mcc.htm.