TECHNICAL SUPPORT DOCUMENT

FIA-TSD-2000-5-1

OPTICAL POWER
-
SAFETY LEVELS

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The Fibreoptic Industry Association
-
An introduction for the new millennium

The past decade has been a time in which there has been a vast increase in the use of optical fibre - primarily driven by the need to provide a quality, high-speed transmission media for digital trunk telephony services. The specifications for these systems have typically been produced by large national telecommunications service providers. This has resulted in clear standards and specifications exist to which all suppliers to the WAN telecommunications industry must adhere.

In parallel there has been a significant growth in optical fibre systems being installed in private data, entertainment and telecommunications networks which are separate from the national telephony and data carrier systems. This part of the industry is characterised by having a large number of relatively small company participants albeit supplying large corporate customers with products and services. The use of optical fibres in private, local area data and sensor networks has increased rapidly throughout the 1990's. In order to support this rate of growth, an organizational focus is required for both suppliers and users in the industry in order to ensure the quality and reliability of network design, installation practice and methods of training.

The **Fibreoptic Industry Association** provides such a focus as a Trade Association to which companies, organizations and individuals involved with, or planning an involvement with, fibre optics can subscribe. In addition, by means of seminars, publications, newsletters, press promotion and similar activities, the **Fibreoptic Industry Association** is dedicated to raising the profile of the industry and highlighting its many benefits in order to increase its growth and thus provide direct benefits for members.

Our overall aims can be summarised as follows:

- to promote an awareness of the benefits and applications of fibre optic technology as an adjunct to - or as a replacement for - conventional copper communications technology;
- to promote an awareness of the existence of a professional fibre optics industry fully capable of meeting the needs of users or, so benefiting both suppliers and their customers;
- to promote and adopt standards to which professional participants within the fibre optic industry should be expected to adhere;
- to provide a central source for information on wide ranging aspects of the fibre optic industry;
- to provide a single voice to promote and represent the interests of the industry obtained by consensus and debate amongst FIA members;
- to develop and promote codes of practice within the industry - both operational and ethical - to which members will be expected to adhere and thus offer an assurance that the highest quality of service will be provided.

FIA TECHNICAL SUPPORT DOCUMENTS

This document is one a series of FIA Technical Support Documents. During the year 2000 all the existing FIA documents will be re-written or re-published in the format used throughout this document.

More importantly, the way in which these Technical Support Documents is published has also changed.

These documents are now **free** to **FIA members** via downloads from the FIA web-site (www.fibreoptic.org.uk). Non-members are also able to purchase these documents either by contacting the Secretariat (address shown below) or by on-line purchase.

Members and non-members unable to benefit from this service may receive the documents in hard-copy or diskette/CD ROM by contacting the FIA Secretariat (contact details are shown at the bottom of each text page in this document). However, the rapidly changing nature of our technology means that web-based documents can be amended and revised easily and it is the responsibility of the reader to ensure that the latest issue of a document is used.

The FIA web-site will indicate the issue status of each document and will have links to previous issues in order that changes made will be clear to readers.

The complete list of FIA Technical Support Documents is shown in the Table below.

TOPIC	FIA-TSD-	TITLE
DESIGN	2000-1-1	OPTICAL FIBRE CABLING: LAN APPLICATION SUPPORT GUIDE
COMPONENT SELECTION	2000-2-1	OPTICAL FIBRE CABLING: CABLE SELECTION GUIDE
OPERATION	2000-3-3	OPTICAL FIBRE CABLING: POLARITY MAINTENANCE
INSTALLATION	2000-4-1-1	OPTICAL FIBRE CABLING: INSTALLATION PRACTICE: SPLICING
	2000-4-2-1	OPTICAL FIBRE CABLING: TESTING OF INSTALLED CABLING LSPM equipment
	2000-4-2-2	OPTICAL FIBRE CABLING: TESTING OF INSTALLED CABLING OTDR equipment
	2000-4-2-3	OPTICAL FIBRE CABLING: TESTING OF INSTALLED CABLING Specification, procurement and use of test cords
SAFETY	2000-5-1	OPTICAL POWER: SAFETY LEVELS
	2000-5-2	OPTICAL FIBRE: HANDLING OF PROCESSING CHEMICALS
	2000-5-3	OPTICAL FIBRE: DISPOSAL OF WASTE

FOREWORD

"Health and Safety" - not the most glamorous of subjects, but nonetheless a vital one.

We all want to work in a safe environment and there is a general expectation that this will be the case. Indeed the expectation is backed by a rigorous regime of regulation that employers must observe and work in accordance with. If they do not, they expose themselves to the possibility of claims both for compensation from employees, who suffer injury during the course of their employment, and legal action from the authorities for non-compliance with their legal obligations.

However, assembling all the information needed to implement a comprehensive set of documented workplace safety policies is not so easy, especially in the multi-discipline world of fibre optics. Whilst the required standards almost always are already in existence, the task of determining which ones are relevant and how they should be applied can be extremely time-consuming.

Only the larger companies can afford to employ a dedicated safety officer who could be expected to become familiar with the range of subjects and documents involved.

To assist all types of member organizations, the FIA has set out to produce a set of documents that define, for specific areas of activity, the appropriate references to existing standards. In most cases, the FIA is not seeking to create new requirements. Instead we seek to provide a comprehensive and detailed summary of the source documents. In addition to this, the FIA documents offer additional interpretation of the ways in which the standards may be implemented.

This document addresses the latest developments in the definition of Classes of the LED and LASER devices that are used in optical transmission systems based on the information contained in [BS EN] IEC 60825-1:2007 and BS EN 60285-2(2004)+A2(2010) – which is equivalent to IEC 60825-2:2007 (Edition 3.1) + A2(2010).

The document also explains why the different Classes are needed. It is not simply an issue of the optical power involved, although this is a key consideration. The nature of the issue is affected by the transparency of the cornea, which varies over the wavelength range in question. At some wavelengths the cornea is transparent, so the radiation will penetrate to the retina. This may be damaged it if the power levels are excessive. At others the cornea is opaque, so it will be here that the optical energy will be dissipated. Also, if the light is in the visible part of the spectrum, the eye may be protected by the 'blink' reaction.

Methods of providing protection range from defining work areas, such that only trained individuals are permitted to access areas defined as hazardous, through the design of equipment such that dangerous light levels are not accessible (shutters, etc), to individual protection by the wearing of goggles.

We at the FIA believe that this document offers a great deal of help to companies operating in the field of optical fibre communications. I can wholeheartedly recommend it to you.

Paul Bateson
Chairman of the FIA

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INTRODUCTION

The installation of optical fibre cabling brings with it a number of health and safety issues. Specifically, these are the risks associated with optical power together with the processing chemicals used and the optical fibre waste created during the installation process.

There are also other health and safety issues raised by the presence of metallic elements within some designs of optical fibre cables. In some cases these elements are part of the construction of the cable and, in the UK, are treated as extraneous metal within BS 7671 thereby requiring appropriate earthing to prevent electric shock – addressed in BS 6701 and the [BS] EN 50174 series of standards. In other cases, the metallic elements take the form of conductors and are used to provide either power and/or signal transmission. In such circumstances a complex array of rules apply within which safety vies with electromagnetic interference - albeit with safety always coming out on top.

In the UK there are a number if existing standards and elements of legislation which cover the issues of safety in relation to optical fibre technology.

Cabling issues are covered by:

- BS 6701:
- BS 7671;
- BS 7718 (now withdrawn but historically important);
- the [BS] EN 50174 series of standards;
- ISO/IEC 14763-2;
- the Control of Substances Hazardous to Health (COSHH) legislation;
- the Control of Artificial Optical Radiation at Work Regulations.

Optical power safety issues within systems are addressed in [BS EN] IEC 60825-1 and [BS EN] IEC 60825-2.

This FIA Technical Support Document collates the available requirements and recommendations in relation to the management of optical fibre power hazard.

1 SCOPE

This document defines appropriate references to, and provides additional interpretation of, existing standards in relation to the management of optical fibre power hazard and are written in support of correct practices in relation to The Control of Artificial Optical Radiation at Work Regulations in operation in the United Kingdom.

2 REFERENCES

2.1 Standards

ANSI/TIA/EIA-568-C.1	Commercial building telecommunications cabling standard
BS 6701:2010	Telecommunications equipment and telecommunications cabling - Specification for installation, operation and maintenance
BS 7671:2008 + A1:2011	Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition
BS 7718	Code of Practice for the installation of fibre optic cabling (now withdrawn but historically important)
[BS] EN 50173-2:2009 + A1:2010	Information technology - Generic cabling systems - Part 2: Office premises
[BS] EN 50173-3:2009 + A1:2010	Information technology - Generic cabling systems - Part 3: Industrial premises
[BS] EN 50173-4:2009 + A2:2012	Information technology - Generic cabling systems - Part 4: Homes
[BS] EN 50173-5:2009 + A2:2012	Information technology - Generic cabling systems - Part 5: Data centres
[BS] EN 50173-6:2013	Information technology - Generic cabling systems - Part 6: Distributed building services
[BS] EN 50174-1:2009 +A1:2011	Information technology - Cabling installation - Part 1: Installation specification and quality assurance
[BS] EN 50174-2:2009 +A1:2011	Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings
[BS] EN 50174-3:2013	Information technology - Cabling installation - Part 3: Installation planning and practices outside buildings
[BS EN] IEC 60825-1:2007	Safety of Laser Products - Part 1: Equipment classification, requirements and users guide
BS EN 60825-2:2004 + A2:2010 or IEC 60825-2:2007 (Edition 3.1) + A2(2010).	Safety of Laser Products - Part 2: Safety of optical fibre communication systems
ISO/IEC 11801	Information technology - Generic cabling for customer premises
ISO/IEC 24702	Information technology - Generic cabling - Industrial premises
ISO/IEC 24764	Information technology - Generic cabling systems for data centres
ISO/IEC 14763-2:2012	Information technology - Implementation and operation of customer premises cabling - Part 2: Planning and installation
FIA-CCP-1/91	Code of Practice for the installation of fibre optic cabling (withdrawn when BS 7718 published)

2.2 Regulations

The Control of Artificial Optical Radiation at Work Regulations 2010	http://www.legislation.gov.uk/uksi/2010/1140/contents/made
Reporting of Injuries, Diseases and Dangerous Occurrences Regulations: 1995	http://www.hse.gov.uk/riddor/

3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

For the purpose of this Technical Support Guide the following definitions apply:

None required

3.2 Abbreviations

For the purpose of this Technical Support Guide the following definitions apply:

APR	Automatic Power Reduction
HSE	Health and Safety Executive
LASER	An optical device delivering Light Amplification by Stimulated Emission of Radiation
LED	Light Emitting Diode
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations

4 CONFORMANCE

This document provides guidance and does not seek to modify or replace the requirements of any of standards referred to in clause 2 above. There are no specific conformance requirements.

5 THE HAZARD

5.1 Optical power: its source

The level of optical power hazard within optical fibre infrastructures depends upon the type and power output of the optical source in the transmission equipment.

Transmission equipment may contain LED and LASER devices that are categorized in terms of their Class. The Class of a device is defined in IEC 60825-1 which was first published in 1993. In the UK IEC 60825-1 is published as BS EN 60825-1. The latest versions of these standards are [BS EN] IEC 60825-1:2007. .

The following classes exist for devices used within optical fibre systems:

- Class 1- devices that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing;
- Class 1M - devices emitting in the wavelength range from 302,5 nm to 4 000 nm which are safe under reasonably foreseeable conditions of operation, but may be hazardous if the user employs optics within the beam.
- Class 3R - devices that emit in the wavelength range from 302,5 nm to 1,000,000 nm where direct intrabeam viewing is potentially hazardous but the risk is lower than for Class 3B devices;
  NOTE: Class 3R was introduced in IEC 60825-1:1993 A.1(BS EN 60825-1 A1). A conservative approach is to assume that equipment carrying a Class 3A label (in accordance with earlier editions of IEC 60825-1) shall be considered to be of Class 3R.
- Class 3B - devices that are normally hazardous when direct intrabeam exposure occurs but viewing diffuse reflections is normally safe;
- Class 4 - devices that are also capable of producing hazardous diffuse reflections. They may cause skin injuries and could also constitute a fire hazard. Their use requires extreme caution.

A functioning optical fibre system represents no risk since, in order to function, all the connections have to be made and the optical fibre has to be continuous. However, disconnection at any interface or a break in the cable can cause a hazard to exist.

IEC 60825-2 defines practices to be observed within optical fibre systems based upon a Hazard level that can be as high as the Class of the device attached to the cabling (taking into account the reduction in the power due to cabling attenuation). A fail-safe approach assumes that the Hazard level at all points within a channel are as high as the equipment Class.

IEC 60825-2 was first published by IEC in 1993. In the UK IEC 60825-2 is published as BS EN 60825-2. The latest versions of this standard is BS EN 60825-2:2004 + A2:2010 which is equivalent to IEC 60825-2:2007 (Edition 3.1) + A2(2010)..

5.2 Optical power: the problem

The transmission wavelengths of optical fibre systems (850 nm, 1300/1310 nm and 1550 nm) are in the infra-red sector of the electromagnetic spectrum. The type of injury that can result from exposure to the radiation depends upon its wavelength and the Class of the device.

- infra-red A (780 nm to 1400 nm): cataract burn, retinal burn, skin burn
- infra-red B (1400 nm to 3000 nm): aqueous flare, cataract corneal burn, skin burn

For LASER devices operating at the above optical fibre transmission wavelengths, the power in an optical fibre cannot be detected by the human eye. There is no blink reaction that, for visible light, reduces the risk of injury. For these reasons, installers and users have to adopt specific practices to manage the risk of injury.

6 EXISTING STANDARDS

6.1 References to BS EN 60825

6.1.1 References from British Standards

The first cabling standard to contain recommendations for the management of optical fibre power was BS 7718.

Section 4.4.2 of BS 7718: 1996 stated
"*Under no circumstances should a connector end-face, prepared optical fibre or fractured optical fibre be viewed directly unless the power emitted from the optical fibre is known to be safe (as defined within BS EN 60825) and under local control. This allows inspection of components using locally injected visible light but prevents the inspection of components using light injection from a remote non-controlled location.*"

Section 4.4.3 of BS 7718: 1996 stated
"*The provision of the correct safety labelling is mandatory requirement on all products where transmission equipment features an optical hazard as defined within BS EN 60825. All potential hazard areas must be similarly marked.* "

Section 4.4.4 of BS 7718: 1996 stated
"*Labels in accordance with BS EN 60825 should be applied adjacent to all accessible optical interfaces (see 4.4.2).*"

Section A2.1 of BS 7718: 1996 stated
"Continuity testing maybe undertaken using either visible or infra-red radiation. The wavelength dependence of attenuation coefficient values may render continuity testing of extended lengths of optical fibre impractical using visible radiation. In such cases infra-red sources and suitable detectors (including sensitive papers) may be used. Under no circumstances should the sources used for optical continuity testing contravene safety standards as defined within BS EN 60825."

Section B8.2.8 of BS 7718: 1996 stated
"Optical safety labels in accordance with BS EN 60825 should be applied adjacent to all accessible optical interfaces (see 4.4.2)."

BS 6701:2010 mandates the application of the [BS] EN 50174 series of standards (see 6.1.2) but has additional requirements.

Section 4.2 (Requirements for owners of premises housing telecommunications systems: Operating procedures) states:
"*The selection and operation of optical fibre telecommunications equipment, test equipment and optical fibre telecommunications cabling shall be in accordance with BS EN 60825-2.*"

Section 5.1.4.1 (*Requirements for installers of telecommunications equipment and telecommunications cabling: Optical fibre telecommunications equipment and telecommunications cabling*) states:
"The operation of optical fibre test equipment shall be in accordance with BS EN 60825-2."

6.1.2 References from European Standards

[BS] EN 50174-1:2009 (including A1:2011) was written in CENELEC but large parts of the text were based upon BS 7718 and early versions of BS 6701.

Section 4.1.1.2 (Installation specification: Safety) of [BS] EN 50174-1: 2009 +A1:2011 states
"*The technical specification shall (with reference to EN 50174-2 and EN 50174-3):*
a) identify and classify any hazardous areas within the pathways and at termination points;
b) detail the boundaries of hazardous, or potentially hazardous areas."

[BS] EN 50174-2:2009 (including A1:2011) was written in CENELEC but large parts of the text were based upon BS 7718 and early versions of BS 6701.

Section 4.1.3 (Installation planning: Safety) of [BS] EN 50174-2: 2009 +A1:2011 states
"The hazard classification of areas containing optical fibre information technology equipment and optical fibre information technology cabling shall be undertaken in accordance with EN 60825-2 in order to define appropriate installation and labelling practices.

Section 5.1.1.3 (Installation practice: Safety) of [BS] EN 50174-2: 2009 +A1:2011 states
"*The following practices shall be adopted:*
a) exposed optical fibre ends shall be kept away from the skin and eyes;
b) the quantity of optical fibre waste shall be minimised;
c) waste fragments shall be treated with care and collected (not by hand) and disposed of in suitable containers via an approved agency or according to local regulations;
d) connector end faces, prepared optical fibres or fractured optical fibres shall not be viewed directly unless the power emitted from the optical fibre is known to be safe (as defined within series EN 60825) and under local control.

Installation practice shall be in accordance with the requirements and recommendations of EN 60825-2 for the relevant hazard classification (see 4.1.3)."

Section 5.3.5.4 (Installation practice) of [BS] EN 50174-2: 2009 +A1:2011 states
"Closures containing optical fibre terminations or joints shall be labelled in accordance with EN 60825-2 for the relevant hazard classification (see 4.1.3)."

[BS] EN 50174-3:2013 was written in CENELEC but large parts of the text were based upon BS 7718 and early versions of BS 6701.

Section 4.1.3 (Installation planning: Safety) of [BS] EN 50174-3: 2013 states
"*The hazard classification of areas containing optical fibre information technology equipment and optical fibre 464 information technology cabling shall be undertaken in accordance with EN 60825-2 in order to define 465 appropriate installation and labelling practices."*

Section 5.1.1.3 (Installation practice: Safety) of [BS] EN 50174-3: 2013 states
"*The following practices shall be adopted:*
a) exposed optical fibre ends shall be kept away from the skin and eyes;
b) the quantity of optical fibre waste shall be minimised;
c) waste fragments shall be treated with care and collected (not by hand) and disposed of in suitable containers via an approved agency or according to local regulations;

d) connector end faces, prepared optical fibres or fractured optical fibres shall not be viewed directly unless the power emitted from the optical fibre is known to be safe (as defined within series EN 60825) and under local control.

Installation practice shall be in accordance with the requirements and recommendations of EN 60825-2 for the relevant hazard classification (see 4.1.3).”

Section 5.3.7.10 (Installation practice) of [BS] EN 50174-3:2013 states
“Closures containing optical fibre terminations or joints shall be labelled in accordance with EN 60825-2 for the relevant hazard classification (see 4.1.3).”

6.1.3 References from international Standards

ISO/IEC 14763-2 was written by an international standards body but large parts of the text were based upon the EN 50174 series of standards. It is not endorsed by BSI due the existence of the EN 50174 series of standards. Nevertheless, it is an international standard and may be referenced in contracts.

Section 5.3.2 (Technical specification: Safety requirements) of ISO/IEC 14763-2 states:
“*The technical specification shall identify and classify any hazards within the pathways and at termination points,*
NOTE The hazard classification of areas containing, or intended to contain, optical fibre information technology equipment and optical fibre information technology cabling is described in IEC 60825-2 and is used to define appropriate installation and labelling practices.”

Section 7.3.2 (Installation planning: Safety) of ISO/IEC 14763-2 states:
“*The hazard classification of areas containing optical fibre information technology equipment and optical fibre information technology cabling shall be undertaken in accordance with IEC 60825-2 to define appropriate installation and labelling practices.*”

Section 8.2.4 (Installation practices: Safety) of ISO/IEC 14763-2 states:
“*Installations shall be carried out in accordance with IEC 60825-2 as applicable according to the relevant hazard classification of each installation location including*
• exposure of optical fibre ends to the skin and eyes,
• the quantity of optical fibre waste,
• the collection and disposal of waste fragments,
• the viewing of connector end faces, prepared optical fibres or fractured optical fibres.”

Section 8.8 (Installation practices: Closure installation) of ISO/IEC 14763-2 states:
“*Closures shall be fixed or mounted in position using the recommended fittings and labelled and identified according to the installation specification (see 9.2).*
Closures containing optical fibre terminations or joints shall be labelled in accordance with IEC 60825-2 as appropriate to the hazard classification of the location (see 5.3.3 and 7.2.3).
Optical fibre adaptors shall be fixed or fitted with suitable protective caps to prevent the ingress of foreign material.”

Section 14 (Repair) of ISO/IEC 14763-2 states:
“*The fault detection and repair process shall be documented describing*
• the process to be used to identify the nature and location of the fault,
• the safety procedures to be applied (e.g. for optical fibre cabling, see IEC 60825-2,”

6.2 Requirements of [BS EN] IEC 60825

[BS EN] IEC 60825-1 defines the limits for the Classes of device defined in 5.1. It also defines the labelling required for each Class as detailed in Table 1. [BS EN] IEC 60825-2 states the requirements, based upon the device Class, within areas served

by optical fibre communications systems. The rules concerning design and labelling of interfaces and closures depend upon the designation of each location.

The definitions applied are:

- **unrestricted**: an accessible location where there are no measures restricting access to members of the public – examples are given in the standard as follows:
  - domestic premises;
  - services industries that are open to the general public (shops and hotels);
  - public areas on trains, ships and other vehicles;
  - open public areas such as parks, streets etc.;
  - non-secured areas within business/industrial/commercial premises where members of the public are permitted to have access, such as some office environments.
- **restricted**: an accessible location that is normally inaccessible by the general public by means of any administrative or engineering control measure but that is accessible to authorised personnel who may not have laser safety training – examples are given in the standard as follows:
  - secured areas within industrial premises not open to the public;
  - secured areas within business/commercial premises not open to the public (e.g. telephone PABX rooms, computer systems rooms etc.)
  - general areas within switching centres;
  - delimited areas not open to the public on trains, ships and other vehicles.
- **controlled**: an accessible location where an engineering or administrative control is present to make it inaccessible except to authorised with appropriate laser safety training – examples are given in the standard as follows:
  - cable ducts;
  - street cabinets;
  - dedicated and delimited areas of distribution centres;
  - test rooms in cable ships.

These definitions are somewhat vague (although the examples are clear) and the FIA has defined its own analysis in to protect its members and their clients.

7 FIA REQUIREMENTS

7.1 Classification of locations within premises

For the purposes of this document the Fibreoptic Industry Association has selected the recommendation and requirements of the [BS EN] IEC 60825 series of standards to be the foundation of its requirements.

In order to determine the specific FIA requirements, premises are designated as follows:

- open office areas are deemed “unrestricted access” areas;
- secure IT rooms (i.e. distributors in the BS EN 50173 series of standards) are deemed either “restricted access” or “controlled” areas. The Classes of equipment, the associated Hazard levels and operating practices allowed within “restricted” and “controlled” areas differ. For this reason it is possible to have a designated “controlled” area within a “restricted” area provided that operating procedures prevent unauthorized access.

An example of this would be an IT Room comprising cabinets containing low Hazard level equipment serving the internal building infrastructure but containing one or more cabinets contain higher Hazard level equipment connected to the external cabling network. This designation represents a fail-safe approach to the guidelines.

Class	Label
1	CLASS 1 LASER PRODUCT or CLASS 1 LED PRODUCT
1M	INVISIBLE LASER RADIATION or INVISIBLE LED RADIATION DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS CLASS 1M LASER PRODUCT
3R	INVISIBLE LASER RADIATION or INVISIBLE LED RADIATION AVOID DIRECT EYE EXPOSURE or AVOID EXPOSURE TO BEAM CLASS 3R LASER PRODUCT
3B	INVISIBLE LASER RADIATION or INVISIBLE LED RADIATION AVOID EXPOSURE TO BEAM CLASS 3B LASER PRODUCT
4	INVISIBLE LASER RADIATION or INVISIBLE LED RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION CLASS 4 LASER PRODUCT

Table 1: Warning labels

INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY WITH
OPTICAL INSTRUMENTS
CLASS 1M HAZARD

Figure 1: Class 1M hazard label

INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY WITH
OPTICAL INSTRUMENTS
CLASS 3R HAZARD

Figure 2: Class 3R hazard label

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INVISIBLE LASER RADIATION
AVOID DIRECT EXPOSURE
TO THE BEAM
CLASS 3B HAZARD

Figure 3: Class 3B hazard label

7.2 General installation requirements

The following practices **shall** be adopted during installation:

- do not stare at the ends of optical fibres or unprotected interfaces with unprotected eyes or with any optical instrument (unless it contains appropriate filters);
- do not point the ends of optical fibres or unprotected interfaces at other persons;
- unterminated optical fibres within closures should be covered with tape to prevent accidental exposure during any subsequent installation or repair phases;
- only prepare and/or joint un-separated ribbon optical fibres if authorization has been obtained from the relevant system designer/operator;
- when using test equipment and if the test method allows, always connect the test cord such that the connection to the light source is the last connection mated and the first to be un-mated;
- do not make any unauthorized modifications to any cabling or equipment connections;
- report any missing optical safety labels (see 7.3, 7.4 and 7.5).

7.3 Installation requirements within unrestricted areas (open office in normal use)

The following practices **shall** be adopted during installation:

a) the only equipment to be used within, or to, an unrestricted area without additional safeguards **shall** be Class 1;
b) it is allowed to use equipment of Class 1M within, or to, an unrestricted area if the connection system in the area prevents accidental eye contact (by means of their design or by a requirement for tools only access);.
c) all outlets in open office, unrestricted, areas **should** carry labels of the type shown in Figure 1 indicating the possible presence of optical power of no greater than Hazard Level 1M
d) magnified inspection of optical fibre end faces **shall** only be undertaken with microscopes that contain suitable and calibrated attenuators/filters to allow the viewing of Class 1M outputs;
e) unterminated optical fibre ends **shall** be individually or collectively covered when not being worked on;
f) all interfaces **shall** be “capped” when not in use;
g) when test equipment above Class 1M is used the following safety practices shall be implemented:
   - both ends of the cabling shall in effect be made into restricted access areas (by means of temporary access control and labelling advising of the potential Hazard level);
   - the remote ends of the cabling under test or the free ends of tail leads shall be capped to restrict optical output.

7.4 Installation requirements within restricted areas (IT Rooms)

The following practices **shall** be adopted during installation:

a) the only equipment to be used within, or to, a restricted area without additional safeguards **shall** be Class 1 or 1M;
b) it is allowed to use equipment of Class 3R within, or to, a restricted area if the connection system in the area prevents accidental eye contact (by means of their design or by a requirement for tools only access) or if the equipment controls its

Class by means of automatic power reduction (APR) which reduces the equipment to Class 1M upon detection of an "open circuit";

c) all closures within restricted areas **shall** carry labels as shown in Figure 2 indicating the possible presence of optical power of no greater than Hazard Level 1M but it is recommended that all closures within restricted areas **should** carry labels of the type shown Figure 2 indicating the possible presence of optical power of no greater than Hazard Level 3R;
d) magnified inspection of optical fibre end faces **shall** only be undertaken with microscopes that contain suitable and calibrated attenuators/filters to allow the viewing of Class 1M outputs;
e) unterminated optical fibre ends **shall** be individually or collectively covered when not being worked on;
f) all interfaces **shall** be "capped" when not in use;
g) the devices within test equipment **shall** not exceed Class 3R;
h) when test equipment above Class 1M is used the following safety practices **shall** be implemented:
- both ends of the cabling **shall** in effect be made into restricted access areas (by means of temporary access control and labelling advising of the potential Hazard level);
- the remote ends of the cabling under test or the free ends of tail leads **shall** be capped to restrict optical output.

7.5 Installation requirements within controlled areas (IT Rooms)

The following practices **shall** be adopted during installation:

a) the only equipment to be used within, or to, a controlled area without additional safeguards **shall** be Class 1 or 1M;
b) it is allowed to use equipment of Class 3R and 3B within, or to, a controlled area if the connections system in the area prevent accidental eye contact (by means of their design or by a requirement for tools only access);
c) or if the equipment controls its Class by means of automatic power reduction (APR) which reduces the equipment to Class 1M upon detection of an "open circuit";
d) all closures within restricted areas **shall** carry labels of the type shown in Figure 3 indicating the possible presence of optical power of no greater than Hazard Level 3B;
e) magnified inspection of optical fibre end faces **shall** only be undertaken with microscopes that contain suitable and calibrated attenuators/filters to allow the viewing of Class 1M outputs;
f) unterminated optical fibre ends **shall** be individually or collectively covered when not being worked on;
g) all interfaces **shall** be "capped" when not in use;
h) the devices within test equipment **shall** not exceed Class 3B;
i) when test equipment above Class 1M is used the following safety practices **shall** be implemented:
- both ends of the cabling **shall** in effect be made into restricted access areas (by means of temporary access control and labelling advising of the potential Hazard level);
- the remote ends of the cabling under test or the free ends of tail leads **shall** be capped to restrict optical output.

j) when test equipment above Class 3R is used the following safety practices **shall** be implemented:
- both ends of the cabling shall in effect be made into controlled access areas (by means of temporary access control and labelling advising of the potential Hazard level);
- the remote ends of the cabling under test or the free ends of tail leads shall be capped to restrict optical output.

7.6 Operational requirements

Upon completion of an installation, installers shall strongly recommend to users that they implement the following operational instructions:

a) records **shall** be kept of all optical fibre transmission equipment, to be connected to the IT cabling infrastructure within and between premises, together with its output power Class;
b) in general, transmission equipment contained in an area **shall** take into consideration the designation of that area and that of the remote areas served by that equipment in accordance with the rules defined in 7.3, 7.4 and 7.5.
c) for cabling infrastructures in accordance with the BS EN 50173 series of standards and those associated with ISO/IEC 11801 and ANSI/TIA/EIA-568-C, transmission equipment contained in an area **shall** comply with clause 8;
d) usage of wavelength division multiplexing technology within transmission systems **shall** be assessed for total power contribution prior to installation;
e) transmission equipment contained in an area **shall** not modify the designation of that area or that of the area served by the transmission equipment (unrestricted or restricted) without appropriate actions being taken;

f) magnified inspection of optical fibre end faces **shall** only be undertaken with microscopes that contain suitable and calibrated attenuators/filters to allow the viewing of Class 1M outputs;
g) all interfaces **shall** be "capped" when not in use.
h) strict key control **shall** be applied to restricted and controlled areas;
i) a procedure **shall** be introduced to ensure the rapid rectification of failed APR controls.

8 CABLING IN ACCORDANCE WITH GENERIC CABLING STANDARDS

In Europe generic cabling standards which use optical fibre cabling are within the EN 50173 series. Specifically:

- EN 50173-2: Office premises;
- EN 50173-3: Industrial premises;
- EN 50173-4: Homes;
- EN 50173-5: Data centres.

These standards, except for homes, are reflected in the international (ISO/IEC) standards:

- ISO/IEC 11801: Office premises;
- ISO/IEC 24702: Industrial premises;
- ISO/IEC 24764: Data centres.

ANSI/TIA-568-C is the basis for North American implementations of generic cabling. The optical fibre aspects are covered at the component level in ANSI/TIA-568-C.3 when used within the premises-specific standards as follows:

- ANSI/TIA-568-C.1: Office premises;
- ANSI/TIA-1005: Industrial premises;
- ANSI/TIA-942-A: Data centres.

The office and industrial premises standards support optical fibre to Telecommunications Outlets distributed throughout the premises. These connectors are not required to have physical means of shuttering in either the plugs or the bulkhead adaptors (although some manufacturers do supply shuttered products). As a result, there is no guaranteed mechanism to prevent accidental exposure (for example, by viewing the end of an equipment cord).

For this reason "fibre-to-the desk" and equivalent systems would be limited to Class 1 transmission equipment since the desk is in an unrestricted environment. Therefore, the restricted areas of the IT Rooms at either end of the backbone cabling are effectively restricted to the use of Class 1M transmission equipment. Class 3R transmission equipment may be installed but the special precautions outlined in [BS EN] IEC 60825-2 concerning restrictions on output power (APR) to Class 1M must be implemented.

Within data centres the cabling runs between cabinets, frames or racks. The security features of these cabinets together with the conditions of the internal optical fibre access could result in these structures being defined as unrestricted, restricted or controlled environments.

9 RESPONSIBILITIES OF CABLE, CONNECTING HARDWARE AND CLOSURE SUPPLIERS

Cables and connecting hardware are supplied without knowledge of their intended application in terms of location or optical power to be supported.

In general, the labelling of closures is also not the responsibility of suppliers since patch panels, for example, may be used in all types of designated areas. However, it is now considered that patch panels or other closures containing multimode MPO connecting hardware should be labelled with a Class 1M hazard label since the 100GBASE-SR10 application using an array of ten VCSELs is recognised by IEEE as a Class 1M device – it is therefore reasonable to assume that MPO connections may support that application.

Subject to the above consideration, the choice of labelling to be applied during an installation shall be the responsibility of the installer based upon the operating instructions agreed with and provided to the user. If the user modifies the application of the

cabling and the safety designation of the location in which the cabling is situated, the responsibility for labelling is transferred to the user.

This requires that the safety designation of areas within premises shall be agreed in advance between the user and the installer, preferably within the Quality Plan as defined in BS EN 50174-1. In the absence of any agreement to the contrary, installers shall assume that the premises are designated as unrestricted areas.

10 RIDDOR

If you are an employer, self-employed or in control of work premises, you are required under RIDDOR (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995) to report some work-related accidents, diseases and dangerous occurrences.

Reporting accidents and ill health at work is a legal requirement. The information enables the Health and Safety Executive (HSE) and local authorities to identify where and how risks arise and to investigate serious accidents.

All the following shall be reported:

- a death or major injury;
- an over-three-day injury (that is when an employee or self-employed person has an accident at work and is unable to work for over three days, but does not have a major injury);
- a work-related disease; and
- a dangerous occurrence (this is when something happens that does not result in a reportable injury, but which clearly could have done).

More information can be found at www.RIDDOR.gov.uk.

11 TRAINING

Training regarding optical power safety is available from a number of specialist organisations. [BS EN] IEC 60825-2 specifies that personnel working within controlled areas shall have received specialist and appropriate training in optical fibre communications and the associated safety risks.

A list of FIA members providing training is available in the Members e-Guide which can be downloaded from **www.fia-online.co.uk**.

A list of companies meeting the requirements for FIA Approved Training Providers can be accessed at **www.fia-online.co.uk/eatps02.htm**.