PD IEC/TR 62690:2014

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Hydrogen effects in optical fibre cables — Guidelines

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National foreword

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The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/1, Optical fibres and cables.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2014

ISBN 978 0 580 72082 6
ICS 33.180.10

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 July 2014.

Amendments/corrigenda issued since publication

Date	Text affected

IEC TR 62690

Edition 1.0 2014-06

TECHNICAL REPORT

colour inside

Hydrogen effects in optical fibre cables – Guidelines

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE J

ICS 33.180.10

ISBN 978-2-8322-1657-6

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HYDROGEN EFFECTS IN OPTICAL FIBRE CABLES – GUIDELINES

FOREWORD

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IEC TR 62690, which is a technical report, has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
86A/1586/DTR	86A/1605/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability dateindicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

There is extensive application of optical fibre cables worldwide, both for terrestrial and submarine environments, with the provision of stable transmission characteristics over many years.

In the early 1980s, it was established that some optical fibre designs in certain cable constructions were prone to hydrogen-induced attenuation increases. The mechanism of the hydrogen induced loss was quickly established and after extensive research and development programs, fibre designs were optimized to minimize the effects. Cable designers established suitable design rules and optimized the selection of cable materials so as to also minimize the effects of hydrogen induced attenuation increases during service life.

HYDROGEN EFFECTS IN OPTICAL FIBRE CABLES – GUIDELINES

1 Scope

The purpose of this technical report is to provide information concerning the behaviour of fibres and cables when exposed to hydrogen effects.

The application of multimode fibres is very rarely subject to hydrogen effects. For that reason, this technical report only highlights the effects of hydrogen to single-mode fibres.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60794-3, *Optical fibre cables – Part 3: Sectional specification – Outdoor cables*

IEC 60794-4, *Optical fibre cables – Part 4: Sectional specification – Aerial optical cables along electrical power lines*

IEC 60794-5,*Optical fibre cables – Part 5: Sectional specification – Microduct cables for installation by blowing*

3 General

The magnitude of any hydrogen induced effect depends on the cable type (including fibre design) and its operational environment.

In the case of suitably designed, single-mode fibre cables for terrestrial applications, there is sufficient experience to not require any test in cables for significant concentrations of hydrogen which could cause an increase in optical attenuation.

The induced loss for single-mode fibre due to hydrogen at a partial pressure of up to $1{,}0 \times 10^4$Pa ($9{,}9 \times 10^{-2}$ atm) is no greater than 0,03 dB/km and 0,06 dB/km, at 1 310 nm and 1 550 nm, respectively. The dynamic equilibrium pressure or balance of hydrogen within a terrestrial cable with no hermetic barrier will be significantly less than $1{,}0 \times 10^4$Pa, and therefore, optical reliability is ensured. Typical values of 40,5 Pa equivalent to $4{,}0 \times 10^{-4}$ atm have been measured for duct cable several years after installation [1][1]. At these partial pressures, the attenuation increase is insignificant.

4 Evaluation of hydrogen induced effects

Depending on the cable type and its planned operational environment, an evaluation of hydrogen induced effects [2] may or may not be warranted. Table 1 offers a guide to the necessity to evaluate cables for hydrogen induced attenuation increases.

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1 Numbers in square brackets refer to the Bibliography