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TECHNICAL REPORT

colour inside

Environmental declaration –
Part 1: Wires, cables and accessory products – Specific rules

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ENVIRONMENTAL DECLARATION –

Part 1: Wires, cables and accessory products – Specific rules

FOREWORD

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IEC TR 62839-1, which is a technical report, has been prepared by IEC technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

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

Enquiry draft	Report on voting
46/496/DTR	46/528/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.

A list of all parts in the IEC 62839 series, published under the general title *Environmental declaration*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

ENVIRONMENTAL DECLARATION –

Part 1: Wires, cables and accessory products – Specific rules

1 Scope

This part of IEC 62839 specifies the PSR (product specific rules) for wires and cables used for communication, data, control and command. This PSR covers the use, installation and end-of-life stages and provides methodological precisions to PEP/PCR writing for “wires and cables and accessories” products used for communication, data, control and command. PSR and general rules all together form the product category rules.

ISO 14025:2006 establishes the principles and specifies the procedures for developing Type III environmental declaration programmes and Type III environmental declarations. It specifically establishes the use of the ISO 14040 series of standards in the development of Type III environmental declaration programmes and Type III environmental declarations. It establishes principles for the use of environmental information, in addition to those given in ISO 14020:2000.

Type III environmental declarations as described in ISO 14025:2006 are primarily intended for use in business-to-business communication, but their use in business-to-consumer communication under certain conditions is not precluded. These environmental declarations, referred here after as PEP, follow a specific set of rules and requirements specified in product category rules declaration that are referred here after as “PEP/PCR”.

Three categories of wires and cables are covered:

– communication and data wires and cables, which may have metal or optical fiber conductors;
– control and command wires and cables , which can have metal or fiber optical conductors;
– accessories.

This document only deals with the “wires and cables“ products. “Accessories products” are for further study.

This document is primarily intended for:

– environment and/or product managers;
– LCA (life cycle assessment) experts in companies, in charge of PEP/PCR development;
– verifiers in charge of PEP/PCR conformity assessment in accordance with the defined rules.

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 60793 (all parts), *Optical fibres*

IEC 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60794 (all parts), *Optical fibre cables*

IEC 61156 (all parts), *Multicore and symmetrical pair/quad cables for digital communications*

IEC 61156-5, *Multicore and symmetrical pair/quad cables for digital communications – Part 5: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Horizontal floor wiring – Sectional specification*

IEC 61156-7, *Multicore and symmetrical pair/quad cables for digital communications - Part 7: Symmetrical pair cables with transmission characteristics up to 1 200 MHz - Sectional specification for digital and analog communication cables*

ISO/IEC 15018, *Information technology – Generic cabling for homes*

ISO 14020:2000, *Environmental labels and declarations – General principles*

ISO 14025:2006, *Environmental labels and declarations – Type III environmental declarations – Principles and procedures*

ISO 14040:2006, *Environmental management – Life cycle assessment – Principles and framework*

ISO 14044, *Environmental management – Life cycle assessment – Requirements and guidelines*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
functional unit
quantified performance of a system of products intended to be used as a reference unit in a life cycle assessment

[SOURCE: ISO 14040:2006, 3.20, modified – modified for fitting with the specific category of products that are covered in this document]

3.2
product specific rules
PSR
set of specific rules, requirements and guidelines for developing Type III environmental declarations for a product category

3.3
product category rules
PCR
set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories

[SOURCE: ISO 14025:2006, 3.5]

3.4
product environmental profile
PEP
declaration indicating the environmental aspects of a product established in compliance with the PEP ecopassport program according to ISO 14025, ISO 14040 and ISO 14044

3.5
reference product
product or products system modeled in the LCA and representative of a homogeneous environmental family

3.6
reference flow
measure of the outputs from processes in a given system required to fulfill the function expressed by the functional unit

[SOURCE: ISO 14040:2006, 3.29, modified – modified for fitting with the specific category of products that are covered in this document]

3.7
life cycle assessment
LCA
compilation and evaluation of inputs, outputs and the potential environmental impacts of a product system throughout its life cycle

[SOURCE: ISO 14040:2006, 3.2]

3.8
system boundary
set of criteria that specify which elementary processes are part of a system of products

[SOURCE: ISO 14040:2006, 3.32, modified – modified for fitting with the specific category of products that are covered in this document]

4 Communication and data wires and cables

4.1 Functional unit and reference flow description

Subclause 4.1 specifies for communication and data wires and cables category the chapter ”Functional unit and reference flow description” of the PEP/PCR by defining more accurately the functional unit of this product category.

To define the functional unit of the communication and data wires and cables, manufacturers shall use the following sentence.

“Transmit a communication signal on 1 m according to XX protocol, YY category, during X years and a Y % use rate in accordance with the standards in force.”

Lifetime and use rate match the Z application defined in Table A.1 of “Wires, cables and accessories products specific rules“.

The determination of the number of years X depends on the application and is explained in 5.2.2. “Use phase”.

To the functional unit corresponds a reference flow, expressed in metres and which includes:

– the reference product;
– the reference product packaging;

– products and items necessary for the installation which are integrated in the field of the study.

4.2 System boundaries

4.2.1 Overview

As described in the PEP/PCR, the following life cycle phases are to be recorded:

- the manufacturing phase: from the natural resources extraction to product manufacturing and its disposal to the producer's last logistic platform;
- the distribution phase: from the producer's logistic platform until its arrival at the place of implementation;
- the installation phase;
- the use phase of the product including its use, and maintenance necessary to ensure the service ability;
- the end of life phase which takes into account the product end of life transportation to a treatment centre or dump.

4.2.2 Installation phase

Concerning communication and data wires and cables, due to the wide range of possible installation of these products, the installation phase is excluded from the PEP/PCR perimeter. The impact determination of the installation will be performed by the PEP users according to the product use context.

So, in the chart of the environmental impacts, the installation column will include the reference "has to be determined by the user" indicating that the assessment of the installation phase impact has not been carried out and has to be treated by the PEP user.

4.2.3 Use phase

4.2.3.1 Overview

Subclause 4.2.3 completes PEP/PCR "use phase" for communication and data wires and cables category. It gives the hypothesis for the calculation of the use phase impact.

There are three types of communication and data transmission cables:

- twisted pair cables;
- coaxial cables;
- optical fibre cables.

In the case of communication wires and cables, the impact of the product use phase on the product total life cycle is low.

The energy consumed in the use phase by communication and data cables is related to the cable attenuation for the transmitted signals. This attenuation is due to the signal energy loss along the conductors.

NOTE On metal conductors, resistive losses and electromagnetic emission occurring at high frequency induce attenuation. Attenuation increases with conductors' length and frequency of emitted signal.

On optical fiber cables, attenuation depends on the type of fibers, on the used wavelength and on the optical fiber length .The attenuation measurement (in dB) expresses the ratio between the emitted energy and the received energy: the smaller the measured value, the better the link.

The energy consumption during use phase will correspond, in order of preference, to growing energy consumption:

– Either to be measured. (The following paragraphs “Use phase losses determined by measurement” describe the losses measurement methods.)
– Or will reference the losses maximum values as specified in the respective standards. (The following paragraphs “Use phase losses determined by standards” describe how to calculate the losses.)

In all cases, the determination of loss method used shall be specified in the PEP/PCR and justified in the LCA report.

4.2.3.2 Twisted pair cables

Twisted pair cables are mainly used for computers networking and telephony.

Networks are defined in the standards, such as being links of length up to 100 m maximum, consisting of 90 m of horizontal cables and 2 times 5 m of patchcords. In business, installed horizontal cables can vary from 10 m to 90 m. The average length usually found on a set of connections is 40 m. This average length of 40 m is used to calculate the energy loss at the frequency of considered protocol because attenuation is not proportional to the length but has an exponential behaviour. Indeed, we know that more than 50 % of the energy is consumed in the first 20 m of cable.

The energy loss is calculated using a 40 m cable, and the consumed power is then reduced to the functional unit (1 m of cable).

a) Use phase losses determined by measurement

For the use phase losses measurement, the following formulas from physics of transmission will be used:

$$P_{\text{lost}} = \frac{(P_{\text{e}} - P_{\text{s}}) \times Nb_{\text{pair}}}{L_{\text{average}}}$$

$$P_{\text{e}} = \frac{U^2}{Z} = Z \times I^2 = UI$$

$$P_{\text{s}} = P_{\text{e}} \times 10^{-\frac{Att}{10}}$$

where

P_{lost} is the consumed power in watts/meter of cable;
P_{e} is the power input in watts;
Z is the resistance in ohms;
U is the voltage in volts;
I is the intensity in amperes;
P_{s} is the watt output power;
Att is the linear attenuation in dB of the cable at the frequency of the maximum amplitude of the spectrum used in the communication protocol for an average length (L_{average}) used in meters. The frequencies to be used are mentioned in Table 1. The measurement method of linear attenuation is described by IEC 61156-1;
Nb_{pair} is the the number of pairs used in the communication protocol;
L_{average} is the average length in meters of an installed cable.

In all cases, the obtained value in watts has to be multiplied by the lifetime and use rate of the corresponding application to obtain the energy consumed in Wh or joules (see Annex A).

Generally, choices will be identified in the PEP/PCR and justified in the LCA report.

b) Use phase losses determined by standards

Used network protocols set the frequency range of transmitted signals. For the losses calculation, we will use the frequency value at the maximum spectral amplitude used in the communication protocol. The frequencies to be used are mentioned in Table 1.

To meet the requirements of these protocols, the cables are divided into categories. For each category is assigned an attenuation value according to the central frequency of the relevant protocol. This maximum attenuation by category is defined in the IEC 61156 standard corresponding to the cable category.

Table 1 includes all the data to use for horizontal cables complying with the reference standards (performance standard cable IEC 61156 and Ethernet IEEE standard 802.3).

Table 1 – Twisted pair cables

Twisted pair copper cables			
Protocol	**Frequency** MHz	**Category**	**Power consumption**
Ethernet 100 M BP(*)=100 MHz	31,25	Cat.5 according to IEC 61156-5	4,54 dB/40 m at 31,25 MHz Injected power = 14 Mw leading to **0,454 mW/m** of cable on 2 pairs
1 G Ethernet BP (*) = 250 MHz	83	Cat. 6 according to IEC 61156-5	7,16 dB/40 m at 83 MHz Injected power = 14 mW leading to **0,565 mW/m** of cable on 2 pairs
10G Ethernet BP (*) = 500 MHz	400	Cat. 6a according to IEC 61156-5	15,85 dB/40 m at 400 MHz Injected power = 14 mW leading to **1,364 mW/m** of cable on 4 pairs
10G Ethernet BP(*)=600 MHz	400	Cat. 7 according to IEC 61156-5	15,8 dB/40 m at 400 MHz Injected power = 14 mW leading to **1,363 mW/m** of cable on 4 pairs
10G Ethernet BP(*)=1 000 MHz	400	Cat. 7a according to IEC 61156-5	15,04 dB/40 m at 400 MHz Injected power = 14 mW leading to **1,356 mW/m** of cable on 4 pairs
10G Ethernet BP(*)=1 200 MHz	400	Cable according to IEC 61156-7 to be used in BCT applications according to ISO/IEC 15018	14,56 dB/40 m at 400 MHz Injected power = 14 mW leading to **1,351 mW/m** of cable on 4 pairs
(*) BP: cable bandwidth			

4.2.3.3 Coaxial cables

For television modulated from 47 MHz to 2 500 MHz, the used power doesn't exceed the 85 dBµV, meaning 18 mV on 75 Ω. Lost power is around 0,26 µW. This lost power is considered negligible by comparison with the impacts of the manufacturing, distribution and end of life product phases.

For mobile telephony networks, 50 Ω coaxial cables inside antennae transmitter equipping antenna-relay are powered by a maximum electric power of 10 W to 40 W for antennas. The emission frequency varies from 1,8 MHz to 3 GHz.

With different diameters of coaxial cables and attenuations depending on the size of coaxial cables, it is difficult to establish a general rule. The determination of losses such as defined for twisted pair cables is used with the value 1 for the Nb_{pair} parameter.

In all cases, the value obtained in watts is multiplied by the lifetime and use rate of the corresponding application for the energy consumed in Wh or joules (see Annex A).

Moreover, the choices will be identified in the PEP/PCR and justified in the LCA report.

4.2.3.4 Optical fibre cables

Optical fiber cables are mainly used for computers networking on medium-sized to large distances.

Used network protocols establish optical fiber type: either the multimode fiber, or the single-mode fiber. In optics, attenuation depends on the wavelength.

The distances of multimode fiber optical local networks are from 300 m to maximum 2 000 m. 150 m length is used, consensually, to calculate the optical signal attenuation at the wavelength of the considered protocol because it represents the worst case.

Distances in single-mode fiber optical local networks are less than 10 km. 500 m length is used consensually to calculate the optical signal attenuation in the wavelength of the considered protocol because it represents the worst case.

The attenuation is not proportional to the length but is exponentially related. This value is then reduced to the chosen functional unit, 1 m of cable.

For the optical signal losses calculation, we will use the most impacting wavelength for attenuation for both types of optical fibers (as we don't know which one will be used by the final customer), that is to say 850 nm for multimode fibers (OM) and 1 310 nm for the single-mode fibers (OS).

Average lengths to estimate line losses are identified in Table 2.

a) Use phase losses determined by measurement

For the use phase losses determined by measurement, the formula issued from physics of transmission will be used:

$$P_{\text{lost}} = \frac{(P_{\text{e}} - P_{\text{s}}) \times Nb_{\text{Fo}}}{L_{\text{average}}}$$

$$P_{\text{s}} = P_{\text{e}} \times 10^{-\frac{Att}{10}}$$

Conversion mW in dBm:

$$P(\text{mW}) = 10^{\frac{P(\text{dBm})}{10}}$$

where

P_{lost} is the loss of optical signal in watts/meter of cable;

P_{e} is the input power in watts;

P_{s} is the output power in watts;

Att is the cable attenuation in dB at a used wavelength for an average length (L_{average}) in meters. Wavelengths and installation average length are specified in the chart above. The measurement method of linear attenuation is described by IEC 60794;

Nb_{Fo} is the number of optical fibers in the cable;

L_{average} is the average length of installed cables in meters.

In all cases, the value obtained in watts has to be multiplied by the lifetime of the corresponding application for the power in Wh or joules (see Annex A).

Generally, choices will be identified in the PEP/PCR and justified in the LCA report.

b) Use phase losses determined by standards

The maximum attenuation values at the reference wavelength are 3,5 dB/km (IEC 60793-2-10) for multimode fibers and 0,4 dB/km for single-mode fibers.

Table 2 includes all the data to use for the optical cables from reference standards (cable performance standard IEC 60793, IEC 60794 and Ethernet IEEE standard 802.3).

Table 2 – Optical cables

Optical fiber cables					
Protocol	**Optical fiber type**	**Wavelength** nm	**Maximum distance**	**Average length** m	**Power consumption**
10GBASE-SR	Multimode	850	< 300 m	150	Attenuation at 850 nm: 3,5 dB/km Injected power=0 dBm leading to 1 mW Leading to 0**,76 mW/km** or **0,76 µW/m** of 1FO
1000BASE-SX			500 m		
10BASE-FL			2 km		
100BASE-LX	Single mode	1 310	2 km to 3 km	500	Attenuation at 1 310 nm: 0,4 dB/km Injected power=0 dBm leading to 1 mW Leading to **0,09 mW/km** or **0,09** µ**W/m** of 1FO
1000BASE-LX			2 km		
10GBASE-LR			10 km		

4.2.4 Lifetime and use rates

The lifetime and use rate of communication and data wires and cables were consensually determined by all the technical experts of the profession for the different possible application areas. This hypothetical lifetime is always less than the product real life.

Any wire or cable, according to standards to which it corresponds to, belongs to a single application.

Table A.1 includes the different fields of application covered for wires and cables, and specifies the products lifetime and their use rate leading to use time to take into account in the calculations.

In the exceptional case an application is not described by Table A.1, and to ensure the PEP/PCR comparability, a 5 years lifetime with a 100 % use rate will be considered by default.

4.2.5 End of life phase

Subclause 4.2.5 completes chapter 2.2.5 of the PEP/PCR “End of life phase” for communication and data wires and cables category, describing the steps to be considered in the assessment of the end of life phase.

To ensure PEP/PCR comparability, the end of life phases to be taken into account are:

- transportation, assuming local transport as described in the PEP/PCR;
- a stage of grinding/separation of metals and plastics;
- recycling of 100 % for metals, linked to the economic value of these materials;
- landfilling of other materials.

NOTE In the case of other end of life scenarii are known (example re-use of other material), those scenarii will be used and will be well justified and documented in the PEP and LCA report.

5 Control and command wires and cables

5.1 Functional unit and reference flow description

Subclause 5.1 specifies for control and command wires and cables category the chapter “Functional unit and reference flow description” of the PEP/PCR, so as to provide a more precise definition of the functional unit of this product category.

To define the functional unit of the control and command wires and cables, manufacturers shall use the following sentence.

“Transmit data and signals on a distance of 1 m during X years and a Y % use rate to control, measure and regulate equipments.”

The lifetime and the use rate correspond to the Z application defined in Table A.1 of “Wires, cables and accessories products specific rules“.

The determination of X number of years and Y use rate depends on the application and is explained in 4.2.2, “Use phase”.

To the functional unit corresponds a reference flow, expressed in meters and which includes as described in the PEP/PCR:

- the reference product;
- the reference product packaging;
- products and items necessary for the installation which are integrated in the field of the study.

5.2 System boundaries

5.2.1 Overview

As described in the PEP/PCR, the following life cycle phases are to be included:

- the manufacturing phase: from the natural resources extraction to product manufacturing and its disposal to the producer’s last logistic platform;
- the distribution phase: from the producer ’s logistic platform until its arrival at the place of implementation;
- the installation phase;
- the use phase of the product including its use, and maintenance necessary to ensure the service ability;
- the end of life phase which takes into account the product end of life transportation to a treatment centre or dump.

The following subclauses complete, for the installation, use and end life phases, the respective chapters of the PEP/PCR.

5.2.2 Installation phase

Subclause 5.2.2 replaces chapter of the PEP/PCR “Installation phase” for the control and command wires and cables category, in justifying its exclusion from the PEP/PCR perimeter.

Concerning control and command wires and cables, due to the wide range of possible installation of these products, the installation phase is excluded from the PEP/PCR perimeter. The impact determination of the installation will be performed by the PEP users according to the product use context.

So, in the chart of the environmental impacts, the ”installation” column will include the reference “has to be determined by the user”, indicating that the installation phase impact assessment has not been carried out and has to be treated by the PEP user.

5.2.3 Use phase

Subclause 5.2.3 specifies chapter of the PEP/PCR “Use phase” for control and command wires and cables, justifying that the impact of the phase is negligible compared to the impact of the total product life cycle.

The environmental impacts of joules effect losses for control and command wires and cables are negligible compared to other phases impacts (manufacturing, distribution and end of life).

In fact, they are using currents of intensity around a few tens of mA, either because the transported currents are low in intensity (measure cables), or because the voltage and current are applied in a sporadic way (control cables).

So, in the environmental impacts chart, the use column should include the reference “negligible”, indicating that the impact assessment of this phase is negligible by comparison with the other life cycles stages of these products.

5.2.4 End of life phase

Subclause 5.2.4 completes chapter of the PEP/PCR “End of life phase” for control and command wires and cables category, fixing the perimeter of the end of life phase.

To ensure PEP/PCR comparability, the end-of-life phases to be taken into account are:

- transportation, assuming local transport as described in the PEP/PCR;
- a stage of grinding/separation of metals and plastics;
- recycling of 100 % for metals, linked to the economic value of these materials;
- landfilling of other materials.

NOTE In the case of other end of life scenarii are known (example re-use of other material), those scenarii will be used and will be well justified and documented in the PEP and LCA report.

6 Accessories FFS

Void.

Annex A
(informative)

Applications

Table A.1 – Table of applications

AREAS APPLICATIONS	Applications	Lifetime (years)	Use rate %	Used time (years)
INFRASTRUCTURES				
	Railway networks	30	100	30
	Telecom networks (fixed and mobile phones)	20	100	20
INDUSTRIAL APPLICATIONS	Oil, gas and petrochemicals	30	100	30
	Handling	10	50	5
	Automation	5	100	5
	Nuclear	40	100	40
	Wind turbines	20	30	6
	Photovoltaic power plants	10	50	5
	Airports	20	100	20
ONBOARD SYSTEMS	Civil aeronautics	15	80	12
	Shipbuilding and marine	30	80	24
	Rolling stock	30	50	15
	Automotives (cars and trucks)	10	10	1
BUILDING	Residential/tertiary/industrial	30	70	21
	Data centers	10	100	10
	LAN: residential	10	17	1,7
	LAN: tertiary	10	25	2,5
	LAN: industrial (factories, warehouses)	10	100	10

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