PEP ecopassport® PROGRAMME

PSR

SPECIFIC RULES FOR
CABLE MANAGEMENT SOLUTIONS

PSR-0003-ed1.1-EN-2015 10 16
According to PSR-modele-ed1-EN-20150320

Contents

1. Introduction

This reference document complements and explains the Product Environmental Profile (PEP) Drafting Rules defined by the PEP Ecopassport® Program (PEP-PCR ed.3-EN-2015 04 02), available at www.pep-ecopassport.org.

It defines the additional requirements applicable to cable management solutions. These requirements must be satisfied in order to:

- Qualify the environmental performance of these solutions on an objective and consistent basis,
- Publish PEP (Product Environmental Profile) that comply with PEP Ecopassport® and with international reference standards[1].

This document is mainly intended for:

- Manufacturers of cable management solutions wishing to provide reliable data concerning the environmental impact of their products, and in particular the departments involved in product design, development, and promotion.
- Users of such data who wish to find out how the information was produced so that they can use it better, particularly for assessing the Environmental Quality of Building (independent verifiers authorized by the PEP Ecopassport® Program, building owners, installers, specifiers/recommenders, design offices, architects, etc.)

This reference document was drawn up in compliance with the open, transparent rules of PEP Ecopassport® Program with the support of stakeholders and manufacturers of cable management solutions.

	www.pep-ecopassport.org
PSR reference	PSR-0003-ed1.1-EN-2015 10 16
Critical review	The third-party critical review was carried out by Solinnen SAS. The certificate of compliance published on 29/12/2011 is shown in Appendix 1
Availability	The critical review report is available on request from the PEP Association contact@pep-ecopassport.org
Scope of validity	The critical review report and the certificate of compliance remain valid within 5 years or until the PEP Drafting Rules, or the normative reference texts to which they refer, are modified.

Following the publication of the PCR Edition 3 (PEP-PCR-ed 3-EN-2015 04 02), this PSR was the subject of an impact analysis in 2015[2], which led to an editorial revision.

[1] ISO 14025, ISO 14040 and ISO 14044 standards

[2] Document available from the PEP Association on request : contact@pep-ecopassport.org

2. Scope

In accordance with the General Instructions of the PEP Ecopassport® program (PEP-General Instructions- ed 3.1-EN-2015 04 02) and in addition to the PCR, Product Category Rules (PEP-PCR ed.3-EN-2015 04 02) of the PEP Ecopassport® eco-declaration program, this document sets out the specific rules for cable management solutions and defines the product specifications to be adopted by manufacturers in the development of their PRODUCT ENVIRONMENTAL PROFILES (PEPs), particularly with regard to :

- the technology and its type of application,
- the reference life time taken into account for the Life Cycle Assessment (LCA),
- the conventional use scenarios to be adopted during the product use stage.

This reference document applies to all cable management solutions (lengths and accessories), wherever they are manufactured or whatever their target markets.

These solutions are divided into three separate families, for which particular rules apply to the conducting of Life Cycle Assessments (LCA) and the publication of PEP.

This segmentation is based on the main function fulfilled by these families, and refers to the international standards applicable to them. (Refer to the table below)

Table 1:

Definition and content of cable management solution families

Product Category CABLE MANAGEMENT SOLUTIONS		
Family 1 TRUNKING SYSTEMS & CONDUIT SYSTEMS	**Family 2 CABLE TRAY SYSTEMS & CABLE LADDER SYSTEMS**	**Family 3 OTHER CABLE MANAGEMENT PRODUCTS**
Lengths and accessories intended to accommodate and protect cables	Lengths and accessories intended to support and guide cables	Other products performing various functions (electrical distribution, protecting and guiding cables, etc.).
- Installation cable trunking system[3] : EN 50085 standard - Distribution cable trunking system[4]: EN 50085 standard - Cable ducting system: EN 50085 standard - Conduit system: EN 61386 standard	- Cable tray system: EN 61537 standard - Cable ladder system: EN 61537 standard	- Home entry technical trunking: EN 50085 standard - Floor boxes: EN 60670-23 + EN50085-2-2 standard - Service poles and service posts: EN 50085-2-4 standard - Slotted cable trunking systems for cabinets: EN 50085-2-3 standard - Articulated and flexible cable guide systems: EN 62549 standard

[3] Including mini-trunking and skirting systems

[4] Including trunking on cantilever brackets

3. Life Cycle Assessment of cable management solutions

3.1. Reference Life Time of cable management solutions

This paragraph complements and explains the Product Environmental Profile (PEP) Drafting Rules defined by the PEP Ecopassport® Program (PEP-PCR ed.3-EN-2015 04 02), defined in Section 2.1 'Functional unit and reference flow description'.
In the field of cable management solutions, system obsolescence cycles are strongly dependent on the type of building in which they are installed, the quality of their installation, and their conditions of maintenance and use.
Based on feedback from manufacturers in the sector and installation professionals, the reference life time of cable management solutions is 20 years[5]. This assumed reference life time is deliberately shorter than the actual service life of the cable management solutions usually observed on the market.

3.2. Functional Unit and reference flow of cable management systems

This paragraph complements and explains the Product Environmental Profile (PEP) Drafting Rules defined by the PEP Ecopassport® Program (PEP-PCR ed.3-EN-2015 04 02), in the sections on 'Manufacturing stage' and 'Installation stage'.
The reference flow of cable management solutions[6] must include the following, at least:

- The basic packaging of the various lengths and accessories that constitute the examined reference system, as well as the associated labels and instruction leaflets.
- Only when delivered and/or prescribed with the cable management solutions in the instruction manual, the assembly elements required to join the components of the system (e.g. screws required to secure the profile on the cantilever bracket), and earthing terminals where relevant (e.g. metal cable management systems),
- Only when delivered and/or prescribed with the cable management solutions in the instruction manual, devices used to fix the equipment on a frame (see EN 61537, definitions in sections 3.20 and 3.21 "external mounting device", such as screws, dowels, or adhesives required to secure cantilever bracket to the frame),
- Where applicable, the scraps related to the installation of the products and specified below.

The earthing cables (for metallic cable management systems) are considered outside the field of application of this PSR, because they are not supplied by the manufacturers and are covered by the "WIRES, CABLES AND ACCESSORIES" PSR. They are taken into account during the equipotential and earthing study.

[5] This working life is not related to the duration of the product guarantee or the actual lifetime of the installation, but it is representative of the working life of a cable management system in the installation or the device being analysed.

[6] The reference flow lists the elements to be counted in the LCA to fulfil the function expressed by the functional unit

3.2.1. Family 1: Trunking systems and conduit systems

This paragraph complements and explains the Product Environmental Profile (PEP) Drafting Rules defined by the PEP Ecopassport® Program (PEP-PCR ed.3-EN-2015 04 02), in the section on "Functional unit and reference flow description".

The function of these systems is to accommodate and protect cables for energy and communication systems. This function is determined by the enclosed volume of the profile, and is therefore directly related to the usable cross-section for cables.

3.2.1.1. Installation trunking systems

a. Functional unit

The functional unit (FU) of the installation trunking system must be expressed in terms of length measurement[7].The manufacturer must declare the FU as follows:

FU: **TRUNKING SYSTEMS**	Accommodate and protect the wiring and wiring accessories along 1 meter for a reference life time of 20 years. The X system with cross-section Y mm² includes the profile and accessories that are representative of standard use.
X = 'Installation trunking' OR 'Mini-trunking and skirting' Y = Usable cross sectional for wiring in the enclosed volume of the profile	

b. Reference flow

To determine the reference flow, the manufacturer must apply the basket of functions corresponding to the analysed system. He identifies and lists the Catalog Numbers of the components (lengths and accessories) that will satisfy the specified functions in both quantity and diversity.

These baskets of functions have been established by agreement and documented by all manufacturers to allow comparison of PEPs. The functions fulfil the requirements of the typical installations representing standard uses observed in the various intended markets (refer to the Detail and justification of baskets of functions in Appendix 3).

[7] The ISO 14040 standard defines the functional unit (FU) as 'the quantified performance of a system of products intended for use as a reference unit in a life cycle assessment'. For cable management products, the service performed to be quantified is associated with the wiring (e.g. Usable cross sectional of cables to be accomodated, weight of cables to be supported, etc.).

The reference flow of the installation trunking systems must satisfy the functions defined in the following baskets:

Basket of functions N°1 Installation trunking systems	
Functions to be fulfilled	**Total normalized to meters installed**
1 m length + 3% scrap rate	**1.03***
90° angle with plane change	**0.10**
90° angle in the plane	**0.10**
90° diversion in the plane	**0.00**
Junction	**0.29**
Termination of trunking	**0.19**
Single apparatus mounting	**0.19**
Double apparatus mounting	**0.19**

Basket of functions No.2 Mini-trunking & Skirting systems	
Functions to be fulfilled	**Total normalized to meters installed**
1 m length + 3% scrap rate	**1.03***
90° angle with plane change	**0.15**
90° angle in the plane	**0.20**
90° diversion in the plane	**0.00**
Junction	**0.20**
Termination of trunking	**0.10**
Single apparatus mounting	**0.15**
Double apparatus mounting	**0.05**

* 1.03 m of profiles taken into account to install 1 m of linear cable management function

3.2.1.2. Distribution trunking systems and conduit systems

a. Functional unit

The functional unit (FU) of distribution trunking systems and conduit systems must be expressed in terms of length measurements. The manufacturer must write the FU as follows:

FU: DISTRIBUTION TRUNKING & CONDUIT SYSTEMS	Accommodate and protect the wiring along 1 meter for a reference life time of 20 years. The X system with cross-section Y mm^2 includes the profile and accessories that are representative of standard use.
X = 'Distribution trunking' OR 'Trunking for distribution on cantilever brackets ' OR 'Rigid conduit' OR 'Surface-mounted or embedded flexible conduit' OR 'Buried underground conduit' Y = Usable cross sectional for wiring in the enclosed volume of the profile	

b. Reference flow

To determine the reference flow, the manufacturer must apply the basket of functions corresponding to the analysed system. He identifies and lists the Catalog Numbers of the components (lengths and accessories) that will satisfy the specified functions in both quantity and diversity.

These baskets of functions have been established by agreement and documented by all manufacturers to allow comparison of PEPs. The functions fulfil the requirements of the typical installations representing standard uses observed in the intended markets (refer to the Detail and justification of baskets of functions in Appendix 3).

The reference flows of distribution trunking systems and conduit systems must fulfil the functions defined in the following baskets:

Basket of functions No.3 'Distribution trunking systems'	
Functions to be fulfilled	**Total normalized to meters installed**
1 m length + 3% scrap rate	**1.03***
90° angle with plane change	**0.05**
90° angle in the plane	**0.05**
90° diversion in the plane	**0.00**
Junction	**0.38**
Termination of trunking	**0.11**
Single apparatus mounting	**0.00**
Double apparatus mounting	**0.00**

Basket of functions No. 4 Rigid conduit systems	
Functions to be fulfilled	**Total normalized to meters installed**
1 m length + 3% scrap rate	**1.03***
90° angle with plane change	**0.00**
90° angle in the plane	**0.36**
90° diversion in the plane	**0.00**
Junction	**0.00**
Termination of trunking	**0.00**
Single apparatus mounting	**0.00**
Double apparatus mounting	**0.00**
Wall mounting element	**1.27**

Basket of functions No.5 'Surface-mounted or embedded flexible conduits' OR 'Buried underground conduits'	
Functions to be fulfilled	**Total normalized to meters installed**
1 m length + 3% scrap rate	**1.03***
90° angle with plane change	**0.00**
90° angle in the plane	**0.00**
90° diversion in the plane	**0.00**
Junction	**0.00**
Termination of conduit	**0.00**
Single apparatus mounting	**0.00**
Double apparatus mounting	**0.00**
Mounting element	**0.00**

Basket of functions No. 6 Distribution on cantilever brackets	
Functions to be fulfilled	**Total normalized to meters installed**
1 m length + 3% scrap rate	**1.03***
90° angle with plane change	**0.04**
90° angle in the plane	**0.16**
Junction	**0.33**
Earthing terminal (for a metal trunking and if imposed by national regulations)	**0.10**
Cantilever bracket (including elements for fixing the length) - **span 1.5 m**	**0.66**

* 1.03 m of profiles taken into account to install 1 m of linear cable management function

3.2.2. Family 2: Cable tray systems and cable ladder systems

This paragraph complements and explains the Product Environmental Profile (PEP) Drafting Rules defined by the PEP Ecopassport® Program (PEP-PCR ed.3-EN-2015 04 02), in the section on "Functional unit and reference flow description".

The function of these systems is to support and guide cables for energy and communication systems. The function is determined and limited by the capacity to mechanically support the cables.

3.2.2.1. Cable tray systems:

a. Functional unit

The functional unit (FU) of cable tray systems must be expressed in terms of length measurements. The manufacturer must write the FU as follows:

FU: CABLE TRAY SYSTEMS	Support the wiring along 1 meter for a reference life time of 20 years. The cable tray system, capable of supporting a load (*) of Y kg per meter (**) on a span of 1.5 m, includes the profile and cable management and support accessories typical of standard use.
(*) = Safe Working Load as defined by the EN 61537 standard, Section 3.17 (**) = Indicate in terms of mass (kg) the information established by the manufacturer for the reference system	

b. Reference flow

To determine the reference flow, the manufacturer must apply the basket of functions corresponding to the analysed system. He identifies and lists the Catalog Numbers of the components (lengths and accessories) that will satisfy the specified functions in both quantity and diversity.

These baskets of functions have been established by agreement and documented by manufacturers to allow comparison of PEPs. The functions fulfil the requirements of the typical installations representing standard uses observed in the intended markets (refer to the Detail and justification of baskets of functions in Appendix 3).

The reference flow of cable tray systems must fulfil the following functions:

Basket of functions No.7 Cable tray systems	
Functions to be fulfilled	**Total normalized to meters installed**
1 m length + 3% scrap rate	**1.03***
90° angle with plane change	**0.04**
90° angle in the plane	**0.16**
Junction	**0.33**
Earthing terminal (for a metal trunking and if imposed by national regulations)	**0.10**
Cantilever bracket (including elements for fixing the length) - **span 1.5 m**	**0.66**

* 1.03 m of profiles taken into account to install 1 m of linear cable management function

3.2.2.2. Cable ladder systems:

a. Functional unit

The functional unit (FU) of cable ladder systems must be expressed in terms of length measurements and the environmental impacts must be normalized to 1 meter. The manufacturer must write the FU as follows:

FU: CABLE LADDER SYSTEM	Support the wiring along 1 meter for a reference service life of 20 years. The cable ladder system, capable of supporting a load (*) of Y kg per metre (**) on a span of 2 m, includes the profile and cable management and support accessories typical of standard use.
(*) = Safe Working Load as defined by the EN 61537 standard, Section 3.17 (**) = Indicate in terms of mass (kg) the information established by the manufacturer for the reference system	

b. Reference flow

To determine the reference flow, the manufacturer must apply the basket of functions corresponding to the analysed system. He identifies and lists the Catalog Numbers of the components (lengths and accessories) that will satisfy the specified functions in both quantity and diversity.

These baskets of functions have been established by agreement and documented by manufacturers to allow comparison of PEPs. The functions fulfil the requirements of the typical installations representing standard uses observed in the intended markets (refer to the Detail and justification of baskets of functions in Appendix 3).

The reference flow of the cable ladder systems must satisfy the functions defined in the following basket:

Basket of functions No.8 Cable ladder systems	
Functions to be fulfilled	**Total normalized to meters installed**
1 m length + 3% scrap rate	**1.03***
90° angle with plane change	**0.04**
90° angle in the plane	**0.16**
Junction	**0.33**
Earthing terminal (for a metal trunking and if imposed by national regulations)	**0.10**
Cantilever bracket (including elements for fixing the length) - **span 2 m**	**0.50**

* 1.03 m of profiles taken into account to install 1 m of linear cable management function

3.2.3. Family 3: Other cable management products

This category includes unequipped service poles, service posts and multi-outlet extensions (equipped or non-equipped), home entry technical trunking, and Articulated systems and flexible systems for cable guiding.

3.2.3.1. Non-equipped service poles, service posts and multi-outlets extension

a. Functional unit

For non-equipped service poles, service posts and multi-outlet extensions, the functional unit of this product family must be written as follows:

FU: UNEQUIPPED COLUMNS, POLES AND OUTLET BOXES	Connect a workstation remote from the wall to the energy and communication networks for 20 years, via X wiring accessories. X = Specify the number and, where appropriate, the type of wiring accessories that the reference product can accommodate (2 x 2P, 4 x 2P + GND, 2 RJ 45 connectors, etc.)

3.2.3.2. Pre-equipped service poles, service posts and multi-outlet extensions

a. Functional unit

For pre-equipped service poles, service posts and multi-outlet extensions, the functional unit of this product family must be written as follows:

FU: COLUMN, POLE AND OUTLET BOX ASSEMBLIES	Distribute the network(s) Y to the workstation via X wiring accessories(s) for 20 years. Y = Specify the type of flow: Electrical energy network OR communication network, or energy and communication networks X = Specify the number and type of wiring accessories equipping the reference product (2 x 2P, 4 x 2P + GND, 2 RJ 45 connectors, etc.)

3.2.3.3. Home entry technical trunking

a. Functional unit

For home entry technical trunking, the FU must be written as follows:

FU: HOME ENTRY TECHNICAL TRUNKING	Accommodate and protect wiring in three compartments*on a X height and allow installation of cabinets for 20 years. X = Standard trunking height: '2.6 m' (floor-to-ceiling installation) OR '1.5 m' (mid-height installation)

* Home entry technical trunking must accommodate and protect wiring in three compartments (energy supplier + energy distribution + communication) to the intended height.

b. Reference flow

To allow comparison of PEPs and in accordance with the applicable product standards, the following must be taken into account in the references flows for home entry technical trunking:

- The trunking body for the intended height of the reference product (1.5 or 2.6 m)
- All trunking covers for the intended height (if the home entry technical trunking is supplied with several covers, each cover should be taken into account)
- All the dividers for partition
- The scrap length generated during its installation. This is the difference between the length of trunking sold and the standard height of the typical installation (1.5 m or 2.6 m).
- An end cap when the home entry technical trunking is intended for a mid-height installation
- The other accessories and fasteners if they are supplied or prescribed with the product in the instruction manual (floor / ceiling junction, cable retainer, etc.).

3.2.3.4. Articulated and flexible systems for cable guiding

a. Functional unit

The functional unit for the reference articulated and flexible systems for cable guiding must be written as follows:

FU: ARTICULATED AND FLEXIBLE SYSTEMS FOR CABLE GUIDING	Guide the wiring along the last length to the workstation for 20 years.

4. Use scenario

4.1. Taking into account product energy consumption

These requirements only concern the “other cable management solutions” (family 3). They complement and explain the Product Environmental Profile (PEP) Drafting Rules defined by the PEP Ecopassport® Program (PEP-PCR ed.3-EN-2015 04 02), in the 'Use Stage' and 'Reference product use scenario' sections.

Although the energy consumption and losses via the Joule effect caused by “Other equipped cable management products” (family 3) are relatively small, they must be taken into account in the assessment of the environmental impact of the product.

“Other equipped cable management products” are considered as “passive products in non-continuous operation” [8].

In accordance with the Product Environmental Profile (PEP) Drafting Rules defined by the PEP Ecopassport® Program (PEP-PCR ed.3-EN-2015 04 02), the following is considered for their use:

- 30% of the rated current (In) flowing 30% of the time
- For a Reference Life Time of 20 years.

The calculation of this consumption must be documented in the LCA report. It is performed:

- Either by an actual measurement of the product’s impedance (Section 4.1)
- Or by a conventional estimation of the product’s impedance (Section 4.2)

[8] Intended to allow comparison of PEPs, this default scenario is deliberately penalizing and represents the use of electrical products through which the main current passes during non-continuous operation. In fact, power outlets are not always used at rated current and, when they are, this occurs intermittently, depending on the habits of the users.

Note: Whatever the chosen calculation method:

- The energy consumption of the active elements incorporated in the cable management products must be added to the calculation of energy dissipation by the Joule effect of the energy network (e.g. indicator light, circuit breaker, surge arrester, etc.)
- The energy losses due to the Voice Data Image (VDI) elements of the cable management products, only operating in digital data transmission mode (i.e. without transmission of a power supply current to the connected devices, e.g.: PoE Power on Ethernet), were determined to be negligible in comparison with elements of the energy network (*). This consumption should not be taken into account in the Life Cycle Assessments (LCA). It will be mentioned in the LCA report.

(*) As an example, the energy dissipation of a standard RJ45 socket installed in a communication network in a typical commercial office and used only for Ethernet according to the 802.3-2002 standard, is less than 0.02 mW, which corresponds to dissipated energy lower than 0.7 Wh over 20 years at the rate of 8 hours of use per day, 220 days per year. These consumption values do not change the LCA results for the cable management solutions.

4.1.1. Taking into account dissipated power by actual measurement of product impedance

- For each independently-powered circuit, measure the impedance at each power socket outlet, and take the maximum impedance value.
- Impedance is measured using a shunt to close off the circuit at the power socket outlet in order to measure the internal impedance of the circuit at the other end (terminal block, cable, or cord). This measurement is taken with a current higher than or equal to 1 A.
- Apply the following formula:

$$P = (Z_{circuit1} \times (30\% \, I_1)^2) + (Z_{circuit2} \times (30\% \, I_2)^2) + (Z\ldots)$$

where $Z_{circuit\ n}$ is the maximum impedance of circuit n

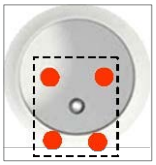
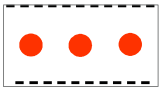
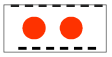
4.1.2. Taking into account dissipated power by estimating product impedance

- Draw up a schematic representation of the product in the form of connected segments in order to isolate, for each independently-powered circuit, any element that contribute to the maximum impedance (power socket outlet, switch, connection terminal block, internal wiring – See an example of a schematic representation in Appendix 4).
- Determine the number of connection points in accordance with Table 2 below.

- Assign a default resistance of 5 mΩ to each connection point

Table 2:

Methodological requirements to count the connection points

Type of function	Number of connections to be counted (*)	Note	Schematic representation
Power socket outlet	4 connections *(2 socket contacts /customer plug connections + 2 connector terminal block connections)*	To calculate energy consumption, select the most distant socket or the one with the most complex circuit (penalizing assumption)	
Switch	3 connections *(1 connection on each side + 1 for the mobile contact of the switch)*	3 connections per pole	
Connection terminal block	2 connections	Also for the external terminal blocks intended to receive a customer connection via cable or cord	
(*) Soldered connections, screwed or screwless connections, pin-contacts are taken into account. Wire end ferrules are neglected because of their low energy consumption[9].			

- Add the linear resistance of the internal wiring between all the connections in accordance with Tables No. 3 below.

Table 3: Linear resistance by class, section, and conductor material

Class 1 cable

Nominal cross-sectional area	Maximum resistance of conductor at 20 °C		
	Circular, annealed copper conductors		Aluminium and aluminium alloy conductors, circular or shaped c
	Plain	Metal-Coated	
mm²	Ω/km	Ω/km	Ω/km
0,5	36,0	36,7	-
0,75	24,5	24,8	-
1,0	18,1	18,2	-
1,5	12,1	12,2	-
2,5	7,41	7,56	-
4	4,61	4,70	-
6	3,08	3,11	-
10	1,83	1,84	3,08 a

[9] These correspond to flows identified as negligible compared to the other environmental issues of cable management solutions, and which are beyond the manufacturer's control.

Class 2 cable

Nominal cross-sectional area mm²	Minimum number of wires in the conductor						Maximum resistance of conductor at 20°C		
	Circular		Circular compacted		Shaped		Annealed copper conductor		Aluminium or aluminium alloy conductor[c]
	Cu	Al	Cu	Al	Cu	Al	Plain wires Ω/km	Metal-coated wires Ω/km	Ω/km
0,5	7	-	-	-	-	-	36,0	36,7	-
0,75	7	-	-	-	-	-	24,5	24,8	-
1,0	7	-	-	-	-	-	18,1	18,2	-
1,5	7	-	6	-	-	-	12,1	12,2	-
2,5	7	-	6	-	-	-	7,41	7,56	-
4	7	-	6	-	-	-	4,61	4,70	-
6	7	-	6	-	-	-	3,08	3,11	-
10	7	7	6	6	-	-	1,83	1,84	3,08

Class 5 cable

Nominal cross-sectional area mm²	Maximum diameter of wires in conductor mm	Maximum resistance of conductor at 20 °C	
		Plain wires Ω/km	Metal-coated wires Ω/km
0,5	0,21	39,0	40,1
0,75	0,21	26,0	26,7
1,0	0,21	19,5	20,0
1,5	0,26	13,3	13,7
2,5	0,26	7,98	8,21
4	0,31	4,95	5,09
6	0,31	3,30	3,39
10	0,41	1,91	1,95

Class 6 cable

Nominal cross-sectional area mm²	Maximum diameter of wires in conductor mm	Maximum resistance of conductor at 20 °C	
		Plain wires Ω/km	Metal-coated wires Ω/km
0,5	0,16	39,0	40,1
0,75	0,16	26,0	26,7
1,0	0,16	19,5	20,0
1,5	0,16	13,3	13,7
2,5	0,16	7,98	8,21
4	0,16	4,95	5,09
6	0,21	3,30	3,39
10	0,21	1,91	1,95

4.1.3. Taking into account energy consumption

The manufacturer shall use the following formula to calculate product energy consumption:

(P diffused by Joule effect + P of active elements) x (20 years x 30%)

5. Rules for extrapolation to a homogeneous environmental family extrapolation

This paragraph complements and explains the Product Environmental Profile (PEP) Drafting Rules defined by the PEP Ecopassport® Program (PEP-PCR ed.3-EN-2015 04 02), in Section 2.4 'Rules for allocation between co-products'.

The extrapolation coefficient applies to trunking systems and conduit systems (Family 1), as well as cable tray systems and cable ladder systems (Family 2). It enables users to use the environmental data provided in the PEP for cable management systems other than the reference system for which the PEP was calculated.

The PEP shall mention the extrapolation coefficient to be applied to the indicators at each stage or to the total life cycle.

Since a documented sensitivity study has proven that the environmental impact of these systems is proportional to their mass, an extrapolation method has been established and verified. It is shown in Table 4 below:

Table 4:
Methodological and writing requirements to extrapolate the LCA results from the reference system (Families 1 and 2)

Methodological & writing requirements	Illustration provided for information
1. Take as base 100, the mass of the reference system used for the LCA whose results are given in the PEP Ecopassport ®.	Example for a mass of the 'XL mini-trunking' reference system The system whose section is 32 x 12.5 has a mass of 3.9 kg.
2. Fill in the total system mass for a different section (mass of System A) belonging to the same range or homogeneous reference family	Mass of System A 'XXL mini-trunking' System cross-section 40 x 12.5 with partition at a mass of 4.81 kg
3. Calculate the following coefficient: Mass of System A/Mass of reference system = extrapolation coefficient to be applied to environmental indicator values	In this example, the extrapolation coefficient is: 4.81 kg / 3.9 kg = 1.23

Methodological & writing requirements	Illustration provided for information
4. Create and fill in a table to be included in the "Environmental impacts" section of the PEP Ecopassport® with Note 1 opposite. In parallel, a similar table can be placed in the "Materials and substances" section of the PEP Ecopassport®, to enable users to find out the total mass of a system other than the reference system for which the material report was established. See Note 2 opposite.	Note 1 *"The environmental impact of a system covered by the PEP Ecopassport® other than the reference system for which it was drawn up can be calculated by multiplying the values of the environmental indicators by the corresponding factor."* Note 2 *"The table below gives the total mass of a system other than the reference system for which the material report was drawn up."*
Sample conversion table provided for information:	

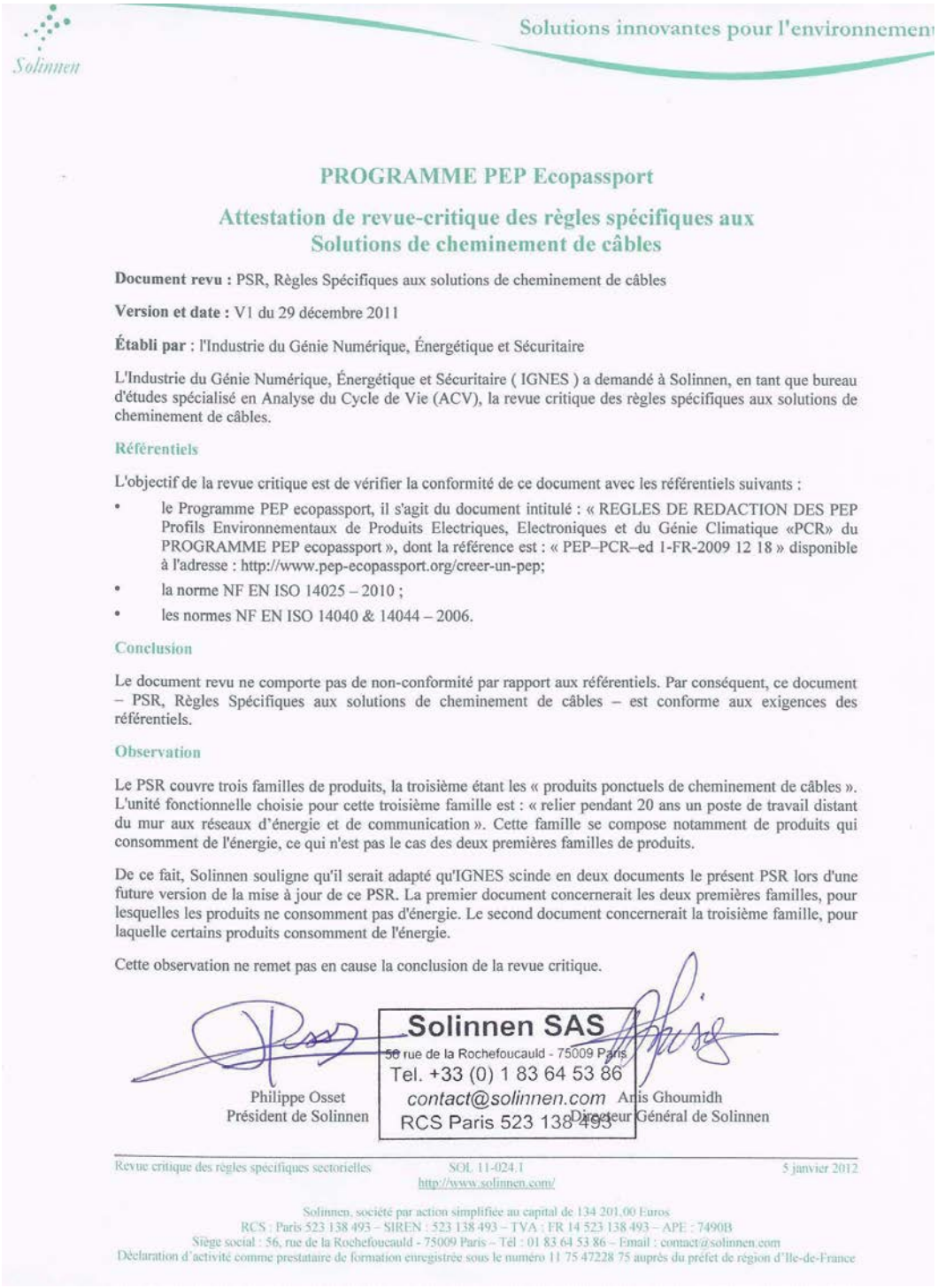
Depth (mm)	25	25	40	40	40	40	40	60	60	60
Width (mm)	25	40	25	40	60	80	100	25	40	60
Coefficient	0.4	0.5	0.5	0.7	1.0	1.2	1.8	0.6	0.9	1.2

Depth (mm)	60	60	60	60	80	80	80	80	80	100	100	100
Width (mm)	80	100	120	25	40	60	80	100	120	60	80	100
Coefficient	1.4	1.8	2.0	0.8	1.0	1.3	1.7	2.0	2.2	1.6	1.9	2.3

6. APPENDICES

6.1. Appendix 1: Certificate of compliance with the ISO 14025 and ISO 14040 standards

The Critical Review report published on 05/01/2012 is available from PEP Association on request: contact@pep-ecopassport.org



Solinnen

Solutions innovantes pour l'environnemen

PROGRAMME PEP Ecopassport

Attestation de revue-critique des règles spécifiques aux Solutions de cheminement de câbles

Document revu : PSR, Règles Spécifiques aux solutions de cheminement de câbles

Version et date : V1 du 29 décembre 2011

Établi par : l'Industrie du Génie Numérique, Énergétique et Sécuritaire

L'Industrie du Génie Numérique, Énergétique et Sécuritaire (IGNES) a demandé à Solinnen, en tant que bureau d'études spécialisé en Analyse du Cycle de Vie (ACV), la revue critique des règles spécifiques aux solutions de cheminement de câbles.

Référentiels

L'objectif de la revue critique est de vérifier la conformité de ce document avec les référentiels suivants :

- le Programme PEP ecopassport, il s'agit du document intitulé : « REGLES DE REDACTION DES PEP Profils Environnementaux de Produits Electriques, Electroniques et du Génie Climatique «PCR» du PROGRAMME PEP ecopassport », dont la référence est : « PEP–PCR–ed 1-FR-2009 12 18 » disponible à l'adresse : http://www.pep-ecopassport.org/creer-un-pep;
- la norme NF EN ISO 14025 – 2010 ;
- les normes NF EN ISO 14040 & 14044 – 2006.

Conclusion

Le document revu ne comporte pas de non-conformité par rapport aux référentiels. Par conséquent, ce document – PSR, Règles Spécifiques aux solutions de cheminement de câbles – est conforme aux exigences des référentiels.

Observation

Le PSR couvre trois familles de produits, la troisième étant les « produits ponctuels de cheminement de câbles ». L'unité fonctionnelle choisie pour cette troisième famille est : « relier pendant 20 ans un poste de travail distant du mur aux réseaux d'énergie et de communication ». Cette famille se compose notamment de produits qui consomment de l'énergie, ce qui n'est pas le cas des deux premières familles de produits.

De ce fait, Solinnen souligne qu'il serait adapté qu'IGNES scinde en deux documents le présent PSR lors d'une future version de la mise à jour de ce PSR. La premier document concernerait les deux premières familles, pour lesquelles les produits ne consomment pas d'énergie. Le second document concernerait la troisième famille, pour laquelle certains produits consomment de l'énergie.

Cette observation ne remet pas en cause la conclusion de la revue critique.

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Revue critique des règles spécifiques sectorielles SOL 11-024.1 5 janvier 2012
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Déclaration d'activité comme prestataire de formation enregistrée sous le numéro 11 75 47228 75 auprès du préfet de région d'Ile-de-France

6.2. Appendix 2: Bibliography

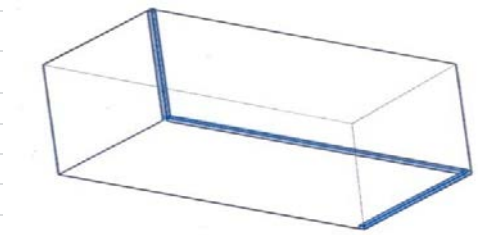
- Installation cable trunking systems (including mini-trunking and skirting): EN 50085 standard
- Distribution cable trunking systems (including trunking on consoles): EN 50085 standard
- Cable ducting systems: EN 50085 standard
- Conduit systems: EN 61386 standard
- Cable tray systems: EN 61537 standard
- Cable ladder systems: EN 61537 standard
- Home entry Technical Trunking : EN 50085 standard
- Floor boxes: EN 60670-23 + EN50085-2-2 standards
- Service poles and service posts : EN 50085-2-4 standard
- Slotted cable trunking systems for cabinets: EN 50085-2-3 standard
- Articulated systems and flexible systems for cable guiding : EN 62-549 standard

6.3. Appendix 3: Description of typical installations to determine baskets of functions

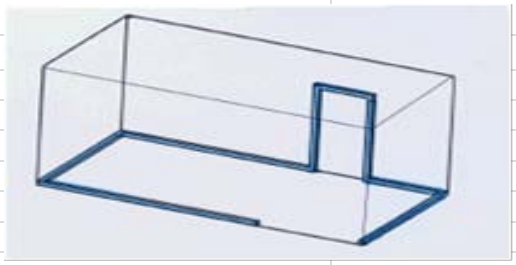
To determine the reference flow, the manufacturer must apply the basket of functions corresponding to the system being analysed. He identifies and lists the Catalogue Numbers of the components (lengths and accessories) that will satisfy the specified functions in both quantity and diversity.

In order to allow comparison of PEP, these baskets of functions have been established by agreement and documented by all manufacturers involved in the process, who represent more than 95% of the activities in their trade in terms of business volume. The functions satisfy the requirements of the typical installations representative of standard use seen in the various intended markets.

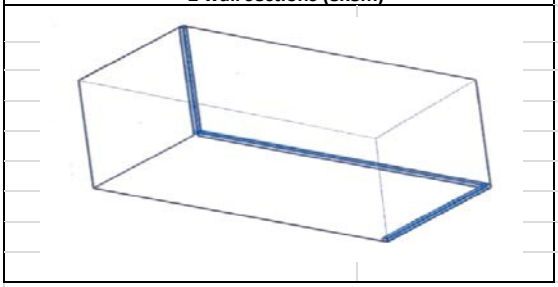
Each typical installation representative of these standard uses has a corresponding basket of functions illustrated by a simple diagram, whose details are given below:

TYPICAL INSTALLATION NO.1 **Installation trunking systems**	**Basket of functions N°1**		**Total normalized to installed m**
Room with a vertical drop (of 2.5 m) + 2 equipped wall sections (2x4m)	Functions to be fulfilled	Number of functions	
	Length (m)	**10.50**	**1.03 m ***
	Length scrap rate (3%)	**0.32**	
	90° angle with plane change	**1**	**0.10**
	90° angle in the plane	**1**	**0.10**
	90° diversion in the plane	**0**	**0.00**
	Junction	**3**	**0.29**
	Termination of trunking	**2**	**0.19**
	Single apparatus mounting	**2**	**0.19**
	Double apparatus mounting	**2**	**0.19**

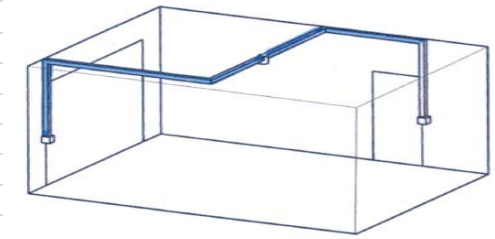
*** = 1.03 m of profiles taken into account to install 1 m of linear trunking function**

TYPICAL INSTALLATION NO.2 **Mini-trunking & skirting**	**Basket of functions No.2**		**Total normalized to installed m**
16m² room with 4 wall sections to be covered (4x4m) + 1 door frame (2x2m) with interruption of banding filled in by the profile covering the top of the door	Functions to be fulfilled	Number of functions	
	Length (m)	**20.00**	**1.03 m ***
	Length scrap rate (3%)	**0.60**	
	90° angle with plane change	**3**	**0.15**
	90° angle in the plane	**4**	**0.20**
	90° diversion in the plane	**0**	**0.00**
	Junction	**4**	**0.20**
	Termination of trunking	**2**	**0.10**
	Single apparatus mounting	**3**	**0.15**
	Double apparatus mounting	**1**	**0.05**

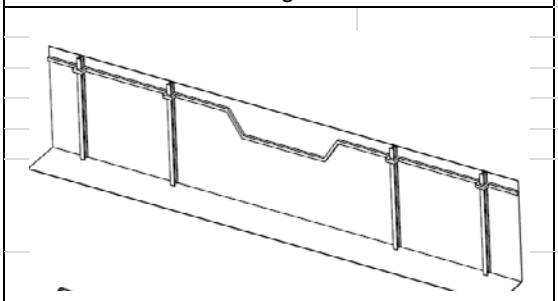
*** = 1.03 m of profiles taken into account to install 1 m of linear trunking function**

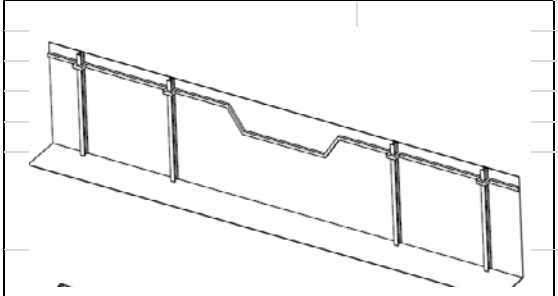
TYPICAL INSTALLATION NO.3 Distribution trunking systems	Basket of functions No.3 Distribution trunking systems		Total normalized to installed m
Room with a vertical drop (of 2.5 m) + 2 wall sections (8x8m)	Functions to be fulfilled	Number of functions	
	Length (m)	18.50	1.03 m *
	Length scrap rate (3%)	0.56	
	90° angle with plane change	1	0.05
	90° angle in the plane	1	0.05
	90° diversion in the plane	0	0.00
	Junction	7	0.38
	Termination of trunking	2	0.11
	Single apparatus mounting	0	0.00
	Double apparatus mounting	0	0.00

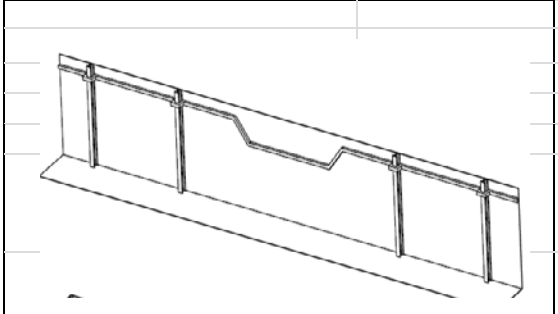
* = 1.03 m of profiles taken into account to install 1 m of linear trunking function

TYPICAL INSTALLATION N°4 Rigid conduit systems	Basket of functions No. 4 Rigid conduit systems		Total normalized to installed m
home entry parking enclosure, (5x3 m) 15 m2, with 2 vertical downfeeds to switches + 1 length & 1 width of profile to supply 1 light fitting	Functions to be fulfilled	Number of functions	
	Length (m)	11.00	1.03 m *
	Length scrap rate (3%)	0.33	
	90° angle with plane change	0	0.00
	90° angle in the plane	4	0.36
	90° diversion in the plane	0	0.00
	Junction	0	0.00
	Termination of trunking	0	0.00
	Single apparatus mounting	0	0.00
	Double apparatus mounting	0	0.00
	Wall mounting element	14.00	1.27

TYPICAL INSTALLATION N°5 Surface-mounted or embedded flexible conduits OR buried underground conduits	Basket of functions No.5 Surface-mounted or embedded flexible conduits OR buried underground conduits		Total normalized to installed m
A worksite length of 100 m (conduit only. without connection accessories or mounting accessories)	Functions to be fulfilled	Number of functions	
	Length (m)	100.00	1.03 m *
	Length scrap rate (3%)	3.00	
	90° angle with plane change	0	0.00
	90° angle in the plane	0	0.00
	90° diversion in the plane	0	0.00
	Junction	0	0.00
	Termination of trunking	0	0.00
	Single apparatus mounting	0	0.00
	Double apparatus mounting	0	0.00
	Wall mounting element	0.00	0.00

TYPICAL INSTALLATION NO.6 Distribution on cantilever brackets	Basket of functions No. 6 Distribution on cantilever brackets		Total normalized to installed m
100 m worksite with 4 obstacles (post contour) and 1 change of level	Functions to be fulfilled	Number of functions	
	Length (m)	100.00	1.03 m *
	Length scrap rate (3%)	3.00	
	90° angle with plane change	4	0.04
	90° angle in the plane	16	0.16
	Junction	33	0.33
	Earthing terminal (for a metal trunking and if imposed by national regulations)	10	0.10
	Bracket (including assembly elements to fix the length to the bracket)	66	0.66

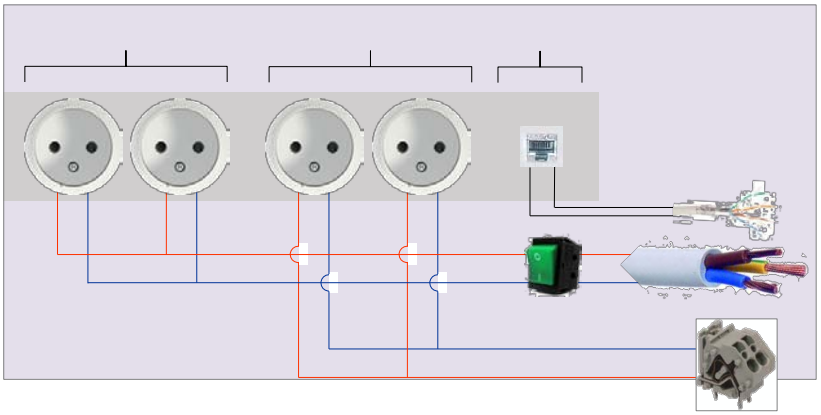
TYPICAL INSTALLATION NO.7 Cable tray systems	Basket of functions No.7 Cable tray systems		Total normalized to installed m
100 m worksite with 4 obstacles (post contour) and 1 change of level	Functions to be fulfilled	Number of functions	
	Length (m)	100.00	1.03 m *
	Length scrap rate (3%)	3.00	
	90° angle with plane change	4	0.04
	90° angle in the plane	16	0.16
	Junction	33	0.33
	Earthing terminal (for a metal trunking and if imposed by national regulations)	10	0.10
	Bracket (including assembly elements to fix the length to the bracket)	66	0.66

TYPICAL INSTALLATION NO.8 Cable ladder systems	Basket of functions No.8 Cable ladder systems		Total normalized to installed m
100 m worksite with 4 obstacles (post contour) and 1 change of level	Functions to be fulfilled	Number of functions	
	Length (m)	100.00	1.03 m *
	Length scrap rate (3%)	3.00	
	90° angle with plane change	4	0.04
	90° angle in the plane	16	0.16
	Junction	33	0.33
	Earthing terminal (for a metal trunking and if imposed by national regulations)	10	0.10
	Bracket (including assembly elements to fix the length to the bracket)	50	0.50

6.4. Appendix 4: Sample calculation of energy consumption

Hypothesis: An outlet box with three independently-powered circuits:

- Circuit 1: Independent energy network supplied via a cord, including two socket outlets
- Circuit 2: Independent energy network supplied via a terminal block, including two socket outlets
- Circuit 3: Communication network

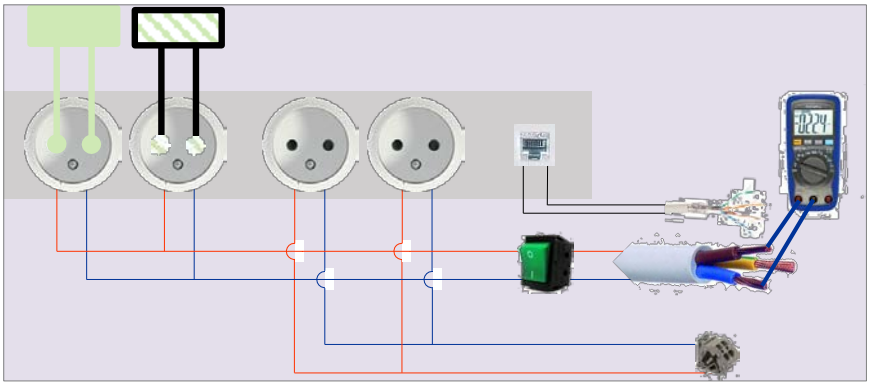


1. Calculation of energy consumption by actual measurement of product impedance

Shunt resistance: R_{shunt}= 3.2 Ω

In our chosen example, the impedance of Circuit 1 and then Circuit 2 is measured.

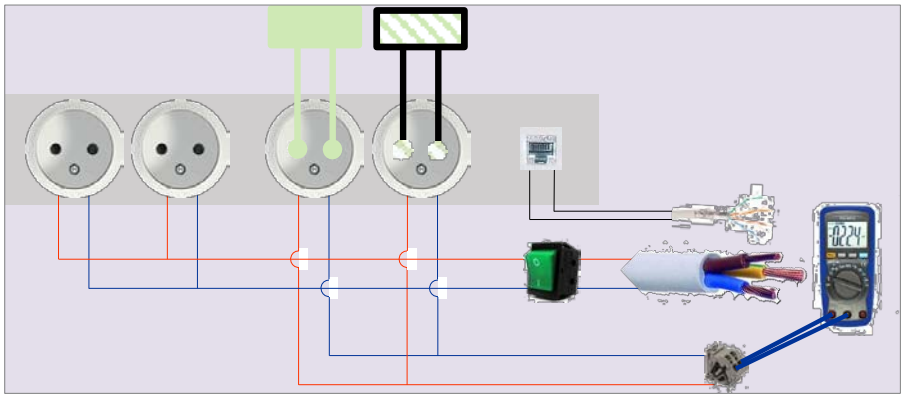
For Circuit 1, the sockets are shunted one by one. The measurement is taken at the end of the cord.



In this case:

- We obtain Z1=120 mΩ and Z2=125 mΩ
- We take Zcircuit1 = Z2 = 125 mΩ (highest measured impedance value)

For Circuit 2, the sockets are shunted one by one. The measure is done at the connection terminal block.



In this case:

- We obtain Z3=60 mΩ and Z4=67mΩ
- We take Zcircuit2 = Z4 = 67 mΩ (highest measured impedance value)

For circuit 3, we neglect its energy consumption, which is very low compared to the energy due to the other two circuits. We apply the following scenario of use:

- 30% of the rated current (In) flows through the product 30% of the time.
- For a Reference Life Time of 20 years.

For the energy network distributed via the outlet box, the total dissipated power is obtained via the following formula:

$$\mathbf{P_{outlet\ box} = (Z_{circuit1} \times (30\%\ I_{n1})^2) + (Z_{circuit2} \times (30\%\ I_{n2})^2) + P_{indicator}}$$

where I_{n1} and I_{n2} are the rated currents of Circuits 1 and 2 respectively. $P_{indicator}$ is the power of the switch indicator light.

In the example, $I_{n1} = I_{n2} = 16A$ and $P_{indicator} = 2W$.

$$P_{outlet\ box} = (0.125 \times 4.8^2) + (0.067 \times 4.8^2) + 2 = 6.42\ W$$

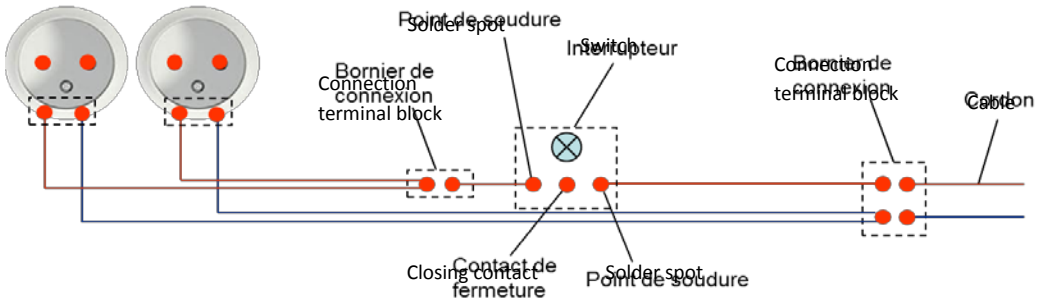
For the outlet box used in the example, the energy consumption is therefore:

$$(P_{\mathbf{outlet\ box}}) \times (30\% \times 20\ years \times 365\ days \times 24\ hours) = 337.4\ kWh$$

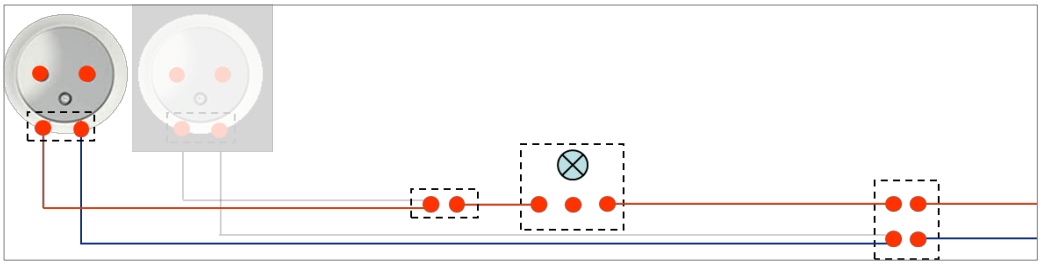
2. Calculation of energy consumption by conventional estimate of the product resistance

The independently supplied circuit are represented as indicated in the following table, with the number of contact points to be included.

CIRCUIT 1 – SCHEMATIC DIAGRAM OF THE COMPLETE CIRCUIT



CONTACT POINTS TO BE COUNTED IN THE ENERGY CONSUMPTION CALCULATION (CIRCUIT 1)

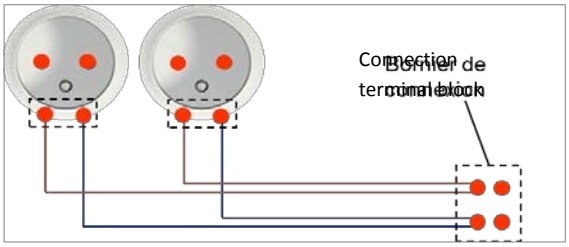


The following items are taken into account for the calculation of energy consumption of circuit 1:

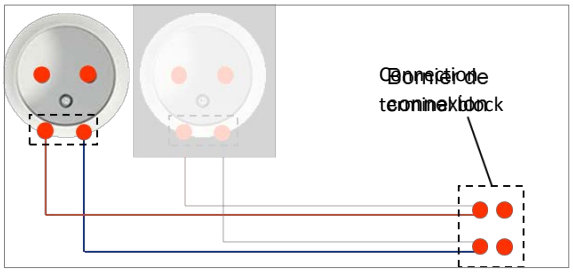
- The connection of the load to the outlet
- The contacts at the various terminal blocks
- The solder spots (in our example, the switch with indicator light is soldered to two conductors)
- The contact “on” of the switch
- The consumption of the switch indicator light
- The power cable of the product
- The theoretical resistance of the various conductor segments between the contact points

Number of contacts = 13

CIRCUIT 2 – SCHEMATIC DIAGRAM OF THE COMPLETE CIRCUIT



CONTACT POINTS TO BE INCLUDED IN THE ENERGY CONSUMPTION CALCULATION (CIRCUIT 2)



The following items are taken into account for the calculation of energy consumption of circuit 2:

- The connection between the load and the socket outlet
- The contacts at the various terminal blocks
- The theoretical resistance of the various conductor segments between the contact points

Number of contacts = 8

The impedance of the contact points in circuit 1 is: $Z_{contacts\ 1}$ = 13 x 5 mΩ = 65 mΩ
The impedance of the contact points in circuit 2 is: $Z_{contacts\ 2}$ = 8 x 5 mΩ = 40 mΩ

Assuming the product has 6 m of Class 1 cable of section 1 mm², its impedance per unit length is 18.2 Ω/km. 4 m is used for circuit 1, and 2 m for circuit 2.
The impedance of the cables in circuit 1 is: $Z_{cables\ 1}$ = 4 m x 18.2 mΩ/m = 72.8 mΩ
The impedance of the cables in circuit 2 is: $Z_{cables\ 2}$ = 2 m x 18.2 mΩ/m = 36.4 mΩ

The energy consumption of circuit 3 is neglected because it is very low compared to that of the other circuits. The chosen scenario of use is:

- 30% of the rated current (In) flows through the product for 30% of the time.
- For a typical working life of 20 years

The total dissipated power is obtained from the following formula:

$$\mathbf{P_{outlet\ box} = [(Z_{contacts\ 1} + Z_{cables\ 1}) \times (30\%\ I_{n1})^2] + [(Z_{contacts\ 1} + Z_{cables\ 1}) \times (30\%\ I_{n2})^2] + P_{indicator}}$$

where I_{n1} and I_{n2} are the rated currents of Circuits 1 and 2 respectively. $P_{indicator}$ is the power of the switch indicator light.

In the example, $I_{n1} = I_{n2}$ = 16A and $P_{indicator}$ = 2W.

$$\mathbf{P_{outlet\ box} = [0.138 \times 4.8^2] + [0.076 \times 4.8^2] + 2 = 6.93\ W}$$

For the outlet box used in the example, the energy consumption is therefore:

($P_{outlet\ box}$) x (30% x 20 years x 365 days x 24 hours) = 364.2 kWh