INDUSTRIAL SENSORS

PRODUCT GROUP CLASSIFICATION: UN CPC 4823, 4825, 4826

C-PCR-XXX (TO PCR 2024:06)
VERSION: X.Y.Z *(TO BE ADDED BY THE SECRETARIAT)*

INTRODUCTION TO OPEN CONSULTATION

This draft PCR document is available for open consultation from 2025-06-10 until 2025-08-10. Feel free to forward the draft to any other stakeholder you might think is relevant, including colleagues and other organisations.

We are interested in comments from stakeholders on:

- General
  - Alignment with PCRs available in other programmes for type III environmental declarations, industry-specific LCA guidelines or similar.
- Scope of PCR
  - Product category definition and description
  - Classification of product category using CPC codes
- Goal and scope, life cycle inventory and life cycle impact assessment
  - Functional unit/declared unit
  - System boundary
  - Allocation rules
  - Data quality requirements
  - Recommended databases for generic data
  - Impact categories and impact assessment methodology
- Additional information

Comments shall be sent directly to the PCR Moderator (contact details available in Section 1). There is a template for comments on www.environdec.com that may be used.

For questions about the PCR, please contact the PCR moderator. For general questions about the International EPD System, EPD or PCR development, please contact the Secretariat via https://www.environdec.com/support.

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1 INTRODUCTION

1.1 GENERAL

This document constitutes complementary Product Category Rules (c-PCR) developed in the framework of the International EPD System: a programme for type III environmental declarations[1] according to ISO 14025:2006, ISO 14040:2006, ISO 14044:2006, and product-specific standards. Environmental Product Declarations (EPD) are voluntary documents for a company or organisation to present transparent, consistent and verifiable information about environmental performance of their product (goods or services).

The rules for the overall administration and operation of the programme are the General Programme Instructions (GPI), publicly available on www.environdec.com. PCRs and c-PCRs complement the GPI and the normative standards by providing specific rules and guidelines for developing an EPD for one or more specific product categories (see Figure 1). A PCR/c-PCR should enable different practitioners using the PCR/c-PCR to generate consistent results when assessing products of the same product category.

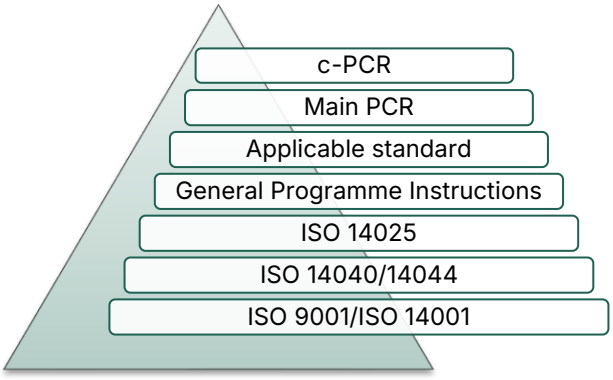

Figure 1 This c-PCR in relation to the hierarchy of standards and other documents.

The present c-PCR uses the following terminology:

- The term "shall" is used to indicate what is obligatory, i.e. a requirement.
- The term "should" is used to indicate a recommendation. Any deviation from a recommendation shall be justified in the EPD development process.
- The terms "may" or "can" are used to indicate an option that is permissible.

For definitions of further terms used in the document, see the GPI, the main PCR, and the normative standards.

A main PCR and its c-PCRs are valid for a pre-determined period of time to ensure that it is updated at regular intervals. The latest version of the PCR and its c-PCRs are available on www.environdec.com. Stakeholder feedback on PCRs and c-PCRs is very much encouraged. Any comments on this c-PCR may be sent directly to the PCR Moderator and/or the Secretariat during its development or during its period of validity.

Any references to this document shall include the PCR registration number, name and version.

The programme operator maintains the copyright of the PCR to ensure that it is possible to publish, update, and make it available to all organisations to develop and register EPDs. Stakeholders participating in PCR development should be acknowledged in the final document and on the website.

[1] Type III environmental declarations in the International EPD System are referred to as EPDs, Environmental Product Declarations.

1.2 ROLE OF THIS DOCUMENT

This c-PCR complements the main PCR 2024:06 Electronic and electric equipment, and electronic components (non-construction), available on www.environdec.com. The c-PCR cannot be used by itself but shall be used together with PCR 2024:06, for products within the scope of the PCR (see Section 2.2.1). It is required to use an applicable c-PCR after it has been published 90 days. It is optional to the use the c-PCR if it has been published for less than 90 days.

If more than one c-PCR is applicable, the EPD owner may choose to use any of them, but it is recommended to use the one that is more specific in scope in terms of product function. An alternative is to use, and verify the EPD towards, several applicable c-PCRs, as long as there are no conflicting requirements in the c-PCRs.

If requirements in the main PCR and the c-PCR are in conflict, the requirements in the c-PCR take precedence over those in the main PCR.

See Figure 2 for an illustration on how PCR 2024:06 and this c-PCR relate to each other and the EPDs that may be based on them.

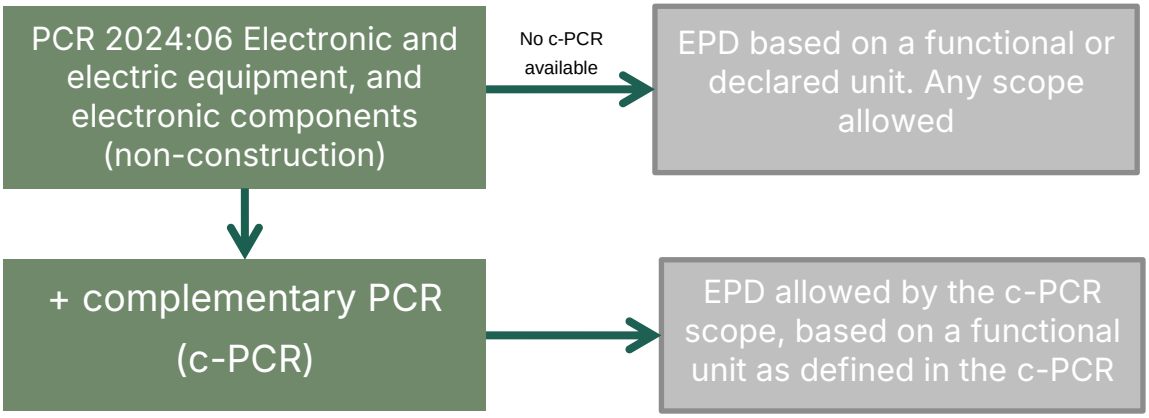

Figure 2 Overview of how PCR 2024:06 can be used directly, or together with a c-PCR, to develop an EPD. An EPD that uses a functional unit shall be based on a c-PCR. An EPD based on a declared unit can be developed without a c-PCR.

2 GENERAL INFORMATION

2.1 ADMINISTRATIVE INFORMATION

Name:	Industrial sensors
Registration number and version:	*To be added by the Secretariat*
Programme:	EPD INTERNATIONAL EPD SYSTEM
Programme operator:	EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden. Website: www.environdec.com E-mail: support@environdec.coms
PCR Moderator:	Leo Breedveld, 2B Srl, breedveld@to-be.it
PCR Committee:	ABB PAMA Division and 2B Srl
Publication date	*To be added by the Secretariat* See Section 8 for a version history of the c-PCR.
Valid until:	*To be added by the Secretariat* The validity may change. See www.environdec.com for the latest version of the PCR and the latest information on its validity and transition periods between versions.
Development and updates:	The c-PCR has been developed following ISO 14027, including public consultation and review. The rules for the development and updating processes are described in Section 9 of the GPI. The c-PCR is valid for a pre-determined time period to ensure that it is updated at regular intervals. When the c-PCR is about to expire, the PCR Moderator shall initiate a discussion with the Secretariat on if and how to proceed with updating the c-PCR and renewing its validity. A c-PCR may be updated before it expires, based on changes in normative standards or provided significant and well-justified proposals for changes or amendments are presented. When there has been an update of the c-PCR, the new version should be used to develop EPDs. For small updates (change of third-digit version number), the previous version is normally immediately removed from the PCR library on www.environdec.com and there is no transition period. For medium updates (change of second-digit version number), the previous version of the c-PCR is valid in parallel during a transition period of at least 90 days, but not exceeding its previously set validity period. For large updates (change of first-digit version number), the previous version is valid in parallel during a transition period of at least 180 days, but not exceeding its previously set validity period. In case a c-PCR is developed by a CEN Product TC, the standard will replace this c-PCR, with a transition period of at least 90 days under which both are valid.

	Stakeholder feedback on PCRs is very much encouraged. Any comments on this PCR may be sent directly to the PCR Moderator and/or the Secretariat during its development or during its period of validity.
Standards documents and conformance:	General Programme Instructions (GPI) of the International EPD System, version referred to in the main PCR[2] ISO 14025 ISO 14040/14044 EN 50693 ISO 15686 series (these standards are referenced regarding service life general principles and estimation)
	At the time of publication, this c-PCR was available in English. If the c-PCR is available in several languages, these are available on www.environdec.com. In case of translated versions, the English version takes precedence in case of any discrepancies.

2.2 SCOPE

2.2.1 PRODUCT CATEGORY DEFINITION AND DESCRIPTION

This document provides complementary product category rules (c-PCR) for the assessment of the environmental performance of Industrial sensors and the declaration of this performance by an EPD. A definition of sensor is provided by Control Engineering (www.controleng.com):

"A sensor in process instrumentation is a device that detects and measures a physical parameter, such as temperature, pressure, flow, level or chemical composition, and converts it into an electrical signal that can be read by an instrument or control system."

Industrial sensors include a broad range of devices used in process instrumentation, analytical applications, and force measurement. The product category corresponds to UN CPC 4823, 4825 (or HS code 9027.10-.80) and 4826 which cover all instrumentation, analytics and force measurement sensors (including laser level measurement, dimension and flatness control sensors).

Optical instruments (intended as equipment that rely on optical elements like lenses and mirrors primarily used in scientific, medical and consumer applicationts such as optical telescopes, optical microscopes and spectacles) and navigational, hydrological and meteorological instruments and appliances are excluded from the scope of this c-PCR as well as flow computers, RTUs (Remote Terminal Units) and maintenance tools.

The UN CPC classification hierarchy is:

Section: 4 - Metal products, machinery and equipment

- Division: 48 - Medical appliances, precision and optical instruments, watches and clocks
    - Group: 482 - Instruments and appliances for measuring, checking, testing, navigating and other purposes, except optical instruments; industrial process control equipment; parts and accessories thereof
        - Class: 4823 - Precision balances; instruments for drawing, calculating, measuring length, etc.
        - Class: 4825 - Hydrometers and similar floating instruments, thermometers, pyrometers, barometers, hygrometers and psychrometers, instruments and apparatus for measuring or

[2] Some rules influencing EPD development are independent of the GPI version referred to in the main PCR. For example, the latest rules on EPD verification procedures in the GPI shall be followed within 90 days of its publication. See Section 5.1 in the GPI for a description of the four categories of rules and when they shall be followed.

checking the flow, level, pressure or other variables of liquids or gases except navigational, hydrological or meteorological instruments and appliances, gas or liquid supply meters, and automatic regulating or controlling instruments and apparatus for physical or chemical analysis, for measuring or checking viscosity, porosity, expansion, surface tension or the like, or for measuring or checking quantities of heat, sound or light

- Class: 4826 - Other measuring, checking and testing instruments and appliances

See *https://unstats.un.org/unsd/classifications/Family/Detail/1074* for additional information on the UN CPC classification scheme.

2.2.2 GEOGRAPHICAL SCOPE

This c-PCR may be used globally.

2.2.3 EPD VALIDITY

See PCR 2024:06.

3 PCR REVIEW AND BACKGROUND INFORMATION

This c-PCR was developed in accordance with the PCR development process described in the GPI of the International EPD® System, including open consultation and review.

3.1 OPEN CONSULTATION

3.1.1 VERSION 1.0.0

This c-PCR was available for open consultation from 2025-06-10 until 2025-08-10, during which any stakeholder was able to provide comments by contacting the PCR Moderator and/or the Secretariat.

Above dates shall be given in the following format: 20YY-MM-DD.

Add information about any physical or web-based meetings held during the open consultation phase, if applicable.

Stakeholders were invited via e-mail or other means to take part in the open consultation and were encouraged to forward the invitation to other relevant stakeholders. The following stakeholders provided comments during the open consultation and agreed to be listed as contributors in the c-PCR and at www.environdec.com.

- *List of stakeholder names and affiliation (to be added after the open consultation).*

In case no stakeholders provided comments and agreed to be listed as contributors, the above sentence shall be adjusted accordingly ("No stakeholders provided comments during the open consultation and agreed to be listed as contributors in the PCR and on www.environdec.com.") and the bullet list shall be removed.

In case of multiple large updates of the c-PCR (version 1.0.0, 2.0.0, etc.), information about each open consultation shall be added as sub-sections (3.1.1, 3.1.2, etc.).

3.2 PCR REVIEW

3.2.1 VERSION 1.0.0, 20YY-MM-DD

PCR review panel:	The Technical Committee of the International EPD System. A full list of members is available on www.environdec.com. The review panel may be contacted via support@environdec.com. Members of the Technical Committee were requested to state any potential conflict of interest with the PCR Committee, and if there were conflicts of interest they were excused from the review.
Chair of the PCR review:	*To be added by the Secretariat*
Review dates:	*To be added by the Secretariat*

In case of multiple large updates of the c-PCR (version 1.0.0, 2.0.0, etc.), information about each open consultation shall be added as sub-sections (3.2.1, 3.2.2, etc.).

3.3 EXISTING PCRS FOR THE PRODUCT CATEGORY

As part of the development of this c-PCR, existing PCRs/c-PCRs and other internationally standardised methods that could potentially act as c-PCRs were considered to avoid unnecessary overlaps in scope and to ensure harmonisation with established methods of relevance for the product category. The existence of such documents was checked among the following EPD programmes and international standardisation bodies:

- International EPD System. www.environdec.com.

- PEP ecopassport®. www.pep-ecopassport.org
- Institut Bauen und Umwelt. www.ibu-epd.com
- EPD Italy. www.epditaly.it
- EPD Norway. www.epd-norge.no
- All other programmes listed at https://environdec.com/global-network/intl-cooperation

No existing PCRs or other relevant internationally standardized methods with overlapping scope were identified.

3.4 REASONING FOR DEVELOPMENT OF C-PCR

This c-PCR was developed to provide rules and guidance additional to those in PCR 2024:06, for developing EPDs for the product category in absence of existing PCRs/c-PCRs or other relevant internationally standardized methods for industrial sensors. The c-PCR thereby enables different practitioners to generate consistent results when assessing the environmental impact of products of the same product category, and thereby it supports comparability of products within a product category.

3.5 UNDERLYING STUDIES USED FOR C-PCR DEVELOPMENT

The methodological choices made during the development of this c-PCR (declared/functional unit, system boundary, allocation methods, impact categories, data quality rules, etc.) were primarily based on the following underlying studies:

- 2B Srl (2024) LCA of ABB PGS300 pressure transmitter (confidential).
- ABB PAMA Division (2024) LCA of ABB AWT420 analytical transmitter (confidential).
- ABB PAMA Division (2024) LCA of ABB PDS300 pressure transmitter (confidential).
- ABB PAMA Division (2025) LCA of ABB TZIDC positioner (confidential).

4 LCA METHOD

This section provides specific rules, requirements and guidelines for developing an EPD for the product category as defined in Section 2.2.1.

4.1 FUNCTIONAL UNIT

Industrial sensors can be distinguished in three main types: measuring instruments, positioners and actuators.

Measuring instruments are devices designed to detect, measure, and monitor specific physical or chemical parameters within a system. These instruments provide critical input data (such as pressure, temperature, flow, or chemical compositions like pH and gas concentrations) to controllers and other components, ensuring efficient process control and adherence to predefined tolerances.

Positioners are used to control the position of actuator valve shaft, thereby controlling the valve operation. Positioner gets the valve setpoint digitally or electrically from the controller. It is connected mechanically to the valve shaft and can thereby reads the actual position as a feedback. Using the setpoint and feedback, the positioner pneumatically controls the actuator valve shaft position to reach the setpoint.

Actuators control the valve operation by moving the valve stem based on the pneumatic input. Positioners can control the movement of the valve stem in the actuator.

The functional unit shall be defined depending on the type of industrial sensor (indications written in square brackets in the below definitions shall be decided upon during the EPD development and be replaced by relevant product information) and are elaborated as follows:

1. For measuring instruments (such as flowmeters, pressure transmitters and thermometers):

   Measurement of [specify the physical or chemical variable(s)] over 15 years under defined reference use conditions and performance level, including regular maintenance.

   The reference use conditions include: [list relevant specific conditions such as temperature range, humidity, operational environment, frequency of use, etc.].

   The performance level includes: [list relevant/key product specifications such as accuracy, resolution, response time etc.].

   Regular maintenance includes: [describe maintenance process as recommended by the manufacturer with specific indications such as required frequency, ancillary materials, and replacement parts, if applicable and if relevant or include a statement that regular maintenance is not foreseen or not relevant].

   Example 1 for a level transmitter:

   Measurement of level over 15 years under defined reference use conditions and performance level, including regular maintenance.

   The reference use conditions include:

   - *Process temperature range: –70° to 230 °C*
   - *Ambient temperature: –40 to 85 °C*
   - *Humidity: 0 to 100 % RH.*

   The performance level includes:

   - *Measuring accuracy: ±0.01 % of full scale or 1.27 mm, whichever is greater*
   - *Repeatability: ±0.005 % of full scale or 0.31 mm, whichever is greater*

   Regular maintenance includes:

   - *One inspection roundtrip of one person of 100 km per year to perform loop check (electrical check of analog output of the instrument to confirm its accuracy) and sensor inspection (inspection of sensor tube and float to ensure the structure of the tube and free movement of the float). Re-calibration and manual cleaning are performed when needed with no use of consumables.*

   Example 2 for an oxygen analyser:

Measurement of oxygen in gas over 15 years under defined reference use conditions and performance level, including regular maintenance.

The reference use conditions include:

- *Operating temperature: +5 to +50 °C*
- *Electric Power supply: 110 to 230 V AC, ±10 %*
- *Electric Power consumption: 200 VA*
- *Relative Humidity: maximum 75%, no condensation*
- *Area Classifications: general purpose*
- *Process (Sample) pressure: on-flammable sample gases, max. 1.6 bar*
- *Process (Sample) flow: 30 to 90 l/h*
- *Process (Sample) composition: Gas*
- *IP Rating: IP 20 without connection box in accordance with EN 60529*

The performance level includes:

- *Component analyzed/reported: oxygen*
- *Measurement range: 0 to 10/15/25/100 vol. % O_2*
- *Linearity: error ≤ 0.5 % of the span or 0.005 vol. % O_2, the greater value applies*
- *Repeatability: ≤ 50 ppm O_2*
- *Zero Drift: ≤ 0.05 vol. % O_2 per week*
- *Span Drift: drift per week, ≤ 0.2 % of the measured value or ≤ 0.01 vol. % O_2, the greater value applies*
- *Limit of detection: ≤ 50 ppm O_2*
- *Rise(fall) time (T10-90): 3s*

Regular maintenance includes:

- *One inspection roundtrip of one person of 100 km per year to perform 1-point calibration with air and visual inspection (to check for damage and blocked filters). The inspection trip is assumed annual as frequency may depend on required safety conditions (SIL).*

2. For positioners:

Control of the valve actuator over 15 years under defined reference use conditions and performance level, including regular maintenance.

The reference use conditions include: [list relevant specific conditions such as temperature range, humidity, operational environment, frequency of use, etc.].

The performance level includes: [list relevant/key product specifications such as accuracy, resolution, response time etc.].

Regular maintenance includes: [describe maintenance process as recommended by the manufacturer with specific indications such as required frequency, ancillary materials, and replacement parts, if applicable and if relevant or include a statement that regular maintenance is not foreseen or not relevant].

Example for a positioner:

Control of the valve actuator over 15 years under defined reference use conditions and performance level.

The reference use conditions include:

- *Ambient temperature: −40 to 85 °C*
- *Humidity: 0 to 95% RH*
- *Vibration immunity: < 1 % to 10 g and 80 Hz*

The performance level includes:

- *Deviation: <= 0.5%*
- *Resolution: > 16000 steps*
- *Sampling frequency: 20 ms*
- *Influence of vibration: ≤ 1 % to 10 g and 80 Hz*

Regular maintenance includes:

- *Two inspection roundtrips of one person of 100 km per year to perform mechanical feedback linkage inspection (inspection for worn, loose or broken mechanical system that connects the valve stem movement to the positioner as feedback). One of the two inspections also include an analog input check (annual electrical check of analog input to confirm accuracy). Re-calibration is performed when needed with no use of consumables.*

3. For actuators:

   Operate the valve stem over 15 years under defined reference use conditions and performance level, including regular maintenance.

   The reference use conditions include: [list relevant specific conditions such as temperature range, humidity, operational environment, frequency of use, etc.].

   The performance level includes: [list relevant/key product specifications such as accuracy, resolution, response time etc.].

   Regular maintenance includes: [describe maintenance process as recommended by the manufacturer with specific indications such as required frequency, ancillary materials, and replacement parts, if applicable and if relevant or include a statement that regular maintenance is not foreseen or not relevant].

   Example for an actuator:

   Operate the valve stem over 15 years under defined reference use conditions and performance level, including regular maintenance.

   The reference use conditions include:

   - *Ambient temperature: −40 to 85 °C*
   - *Maximum supply pressure: 6 bar*

   The performance level includes:

   - *Efficiency range: 2-10%*

   Regular maintenance includes:

   - *Two inspection roundtrips of one person of 100 km per year to perform 1 visual inspection (inspections for cracks, corrosion or damage) and air leak test (examination for air leaks around pneumatic connectors and seals) for each maintenance inspection.*

Relevant product specific conditions may include the following information (the list is not exhaustive): ambient temperature, operating temperature, storage temperature, humidity, relative humidity, process temperature, process pressure, process flow, process composition, chemical exposure, mechanical wear, vibrations, unexpected external forces on the equipment, electric power supply, electric power consumption, area classifications, IP rating, utility requirements, and calibration requirements.

Relevant product specifications may include the following information (the list is not exhaustive): measurement accuracy, measurement range, repeatability, response time, measurement update time, rise(fall) time (T10-90), availability/uptime, component analyzed/reported, linearity, limit of detection, minimum detectable change, trending range, cross sensitivity, zero drift, and span drift.

The reference flow in the LCA shall be defined at the point where the product arrives at the customer gate, i.e. any losses occurring before then shall be accounted for.

The functional unit and reference flow shall be stated in the EPD.

4.1.1 REFERENCE SERVICE LIFE (RSL)

See PCR 2024:06.

The reference service life (RSL) of a product is the reference time period during which the product is in use and meets or exceeds the required performance, under reference operational and ambient conditions. The RSL is a theoretical time period to which the performance of the product is related to in a functional unit.

The reference service life is set as 15 years, based on expert judgement and being a typical lifespan of industrial sensors. When an EPD is developed based on this c-PCR, the RSL for the product shall be stated in the EPD, as part of the functional unit.

4.1.2 PRODUCT LIFESPAN

See PCR 2024:06.

The product lifespan is the average time for which the product has been designed or proven to last, or the average time for which the product has been shown to be in use. Note that the product lifespan is not necessarily the same as the RSL of the product category. For example, this c- PCR specifies the RSL to be 15 years (being a typical technical lifespan for this product category), and the functional unit is to fulfil a certain function over this RSL. If a product then has a (proven) technical lifespan of 5 years, three such products are needed to fulfil the functional unit. If a product has a (proven) technical lifespan higher than 15 years, only one product shall be considered with a lifespan equal to the reference service life. This is to account for advancements in technology and evolving industry standards that can lead to sensor replacement prior to reaching their full operational lifespan.

The lifespan of industrial sensors can vary significantly based on factors such as environmental conditions (e.g. exposure to high temperatures, dust, humidity, and vibrations), frequency of use, specific application requirements, and adherence to maintenance schedules.

The lifespan of the sensor shall be declared in the product information section of the EPD and shall be expressed in years. A lifespan provided by the manufacturer can be declared only if this information is accompanied by explanations on the origin of the declared lifespan, e.g. referring to simulations, tests, an assessment of the manufacturer or statistical data, etc. Guidance on product lifespan estimation can be found in ISO 15686 series. If the product lifespan cannot be defined, this shall be stated in the EPD and the product lifespan shall be set equal to the RSL (i.e. 15 years).

4.1.3 TECHNICAL SPECIFICATION

The technical specification shall be declared as part of the functional unit in the product information section of the EPD.

4.2 SYSTEM BOUNDARIES

See PCR 2024:06.

The scope of EPDs based on this c-PCR is cradle-to-grave.

4.3 CUT-OFF RULES

See PCR 2024:06.

4.4 PROCESS FLOW DIAGRAM

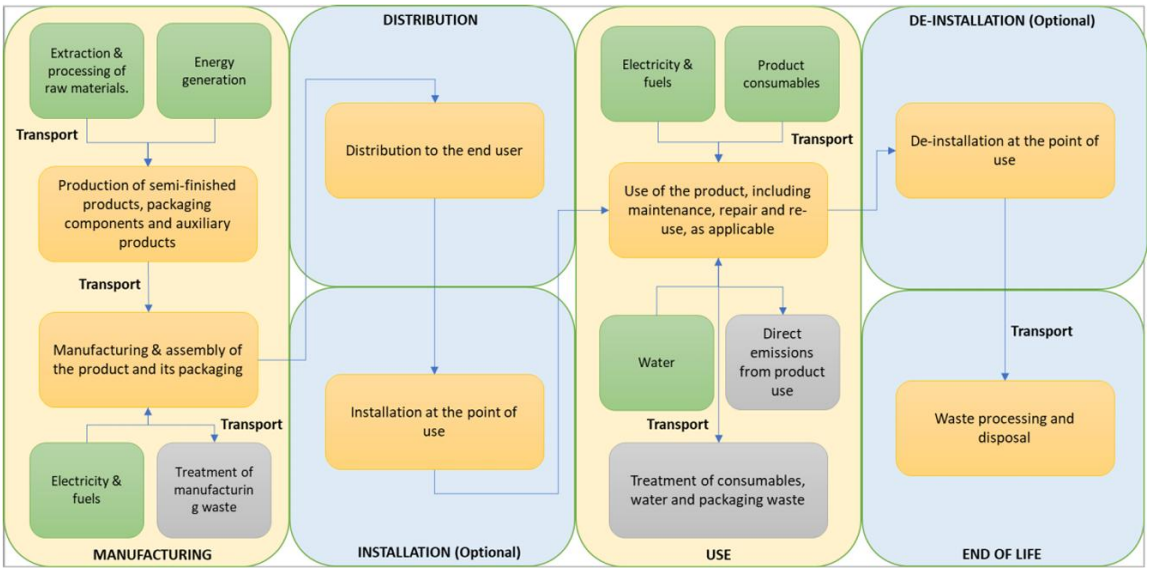

Figure 3 Process flow diagram illustrating the processes that shall be included in the product system, divided into the life-cycle stages. The illustration of processes to include may not be exhaustive.

4.5 ALLOCATION RULES

See PCR 2024:06.

If there is any material/energy recovery, the rules in Section G.2 of Annex G of EN 50693 (Formula without benefits) shall be followed. The EPD shall include a statement indicating that the rules in Section G.2 have been applied. This approach excludes system expansion and no benefits are accounted in the product life cycle for the secondary materials or energy provided as output after recovery operations, even if they can be used in a subsequent life cycle at the point of substitution. The impacts of the recovery processes are entirely allocated to the product producing the secondary material/energy. The same applies for disposal processes. The location of the point of substitution for each secondary material or energy shall be stated in the LCA report. The point of substitution corresponds to the point in the value chain where secondary materials substitute primary materials as a recovered material or as a solid recovered fuel (incineration with energy recovery). For example, for polypropylene (PP), the point of substitution can be defined at the output of the PP regenerator, where the recovered material is ready to substitute for virgin PP. Similarly, for wood, the point of substitution can be reached at the output of wood cutting processes, where the resulting wood chips are suitable to replace virgin wood chips in the manufacturing of wood-based panels.

R_1, R_2 and R_3 values as provided in Section G.5 of Annex G of EN 50693 may be used when no specific or representative data (e.g. from an LCA database, Eurostat, OECD) are available. The default values for the parameters R_1, R_2 and R_3 provided in EN 50693 are based primarily on data and assumptions relevant to the European context. However, they may still be used even if the geographical scope of the EPD is global, as these values are intended to set a common basis in absence of representative data. The EPD shall declare the source of these parameters. Data quality requirements in Section 4.7.1 for recycled materials shall be followed.

4.6 DATA CATEGORIES AND DATA QUALITY RULES

See PCR 2024:06.

4.7 OTHER LCA RULES

See PCR 2024:06.

4.8 SPECIFIC RULES PER LIFE-CYCLE STAGE

See PCR 2024:06.

4.8.1 MANUFACTURING STAGE, A1-A3

- Recycled materials: specific data shall be used for the recycled content of a product part if the environmental impact related to its production is significant. A product part is intended as a fundamental unit or building block of a product (e.g. sensor body or termination board). In the absence of specific data, the material shall be modelled as 100% virgin material. When the environmental impact related to the component production is insignificant or less significant, verifiable secondary data (e.g. LCA database) may be used. Specific data on recycled materials shall be demonstrated by appropriate certification or a similar document (e.g. an EPD) as provided by the material supplier. This ensures the reliability and traceability of the information. The aim of these additional rules is to stimulate stronger supply chain integration, thereby enhancing both transparency and data traceability related to recycled input materials, while also preventing practices that could lead to improper recycled content values through unverified estimates. The environmental impact related to the component production is significant if it exceeds 10% for one or more default environmental impact indicators.

- Specific data on the product manufacturing process (e.g. energy consumption, water consumption, emissions, waste production…) over which the manufacturer (EPD owner) has direct control shall be used for the EPD (e.g. via engineering models, direct monitoring, material/product balances, stoichiometry, energy diagnosis, power consumption or specification of the manufacturing machinery). This is to ensure the accuracy and reliability of the LCA study.
  Specific data can be collected both for each manufacturing step and at the facility level. In case specific data is not available for each manufacturing step within reasonable effort and/or only partially available, specific data from the entire facility where the manufacturing process occurs (e.g. invoices, bills of sale) shall be used. Overall facility data on mass and energy flows directly associated to product manufacturing (including those related to heating and cooling the manufacturing area) can be attributed to the product according to the proportion of production volumes (expressed as mass, amount, or sales) in the reference year. Office-related consumption (i.e. energy and other resources used in non-production areas) can be excluded from the product manufacturing process data if the production facility is equipped with dedicated counters to separately measure production-related consumption. If specific counters are not available, the total facility consumption shall be considered. Attribution based on product units (pieces) is only possible if the production is homogeneous in the facility. Homogeneous here refers to similar manufacturing steps for all products processed in the facility, with no relevant differences in terms of mass and energy flows. Note that the above definition of homogeneous production differs from the definition of homogeneous products in the main PCR and EN 50693. Any attribution choice shall be documented and justified in the LCA report and mentioned in the EPD.
  The two approaches are proposed as complementary: process-specific data generates the most accurate representation of the manufacturing impacts, while facility-level data guarantee completeness when detailed process data are only partially available. Together, they ensure that the LCA study remains comprehensive and reliable under varying data availability conditions.

- Manufacturing waste: if the distance to the end-of-life treatment facility is unknown, an assumption of 100 km transport by lorry shall be considered for transportation of manufacturing waste.

4.8.2 DISTRIBUTION AND INSTALLATION STAGE, A4-A5

The transport of the product to the customer shall be described in the EPD, where relevant, and be accounted for in this priority:

1. Actual transportation modes and distances to specific a customer or market, representing the geographical scope of the EPD. Use of specific data is of particular importance if air freight is used.

2. A weighted average of transportation modes and distances, based on transportation to several customers or markets, representing the geographical scope of the EPD.

If the product is transported to a distribution centre or retailer and the final costumer is unknown, a transport of 1000 km by lorry shall be included to account for the transport to the final customer. If the route from the customer to the installation site is not known, the location of the final customer can considered the installation place and no additional transportation is required.
The adequate distance for ship and airplane can be determined using https://sea-distances.org/ and https://www.airportdistancecalculator.com/, respectively. When no specific data are available for ship transportation, assumptions can be made based on the list of container ports available on https://www.searates.com/maritime.

4.8.3 USE STAGE, B1-B7

- When use stage includes maintenance inspections, a transportation distance of 100 km roundtrip for 1 person may be assumed. The transportation means shall be specified in the EPD.

- Depending on the product and the environment at the installation location, additional means may be needed to operate the product within its specifications. This can include fugitive emissions occurring during operations (e.g. refrigerant gas and insulating gas), utilities (e.g. electrical power, instrument air, cooling water, and carrier gas) and consumables (e.g. calibration gases, test gases/liquids to verify performance, reagents, cleaning chemicals, filters, and pump replacement parts.

- In absence of specific data, operational energy use shall be defined according to the manufacturer's recommendations.

4.8.4 END-OF-LIFE STAGE, C1-C4

- If transportation distance of the product to the waste treatment facility in the end-of-life stage is unknown, 1000 km truck transportation shall be assumed.

- In absence of specific data, given the product B2B (business to business) nature, it can be assumed that the end-of-life occurs under controlled conditions with a 100% collection rate. Here, the collection rate is defined as the ratio of the amount of product at the end of its life that is collected to the amount of product that is properly recycled and/or disposed.

- In order to support assumptions for a realistic end-of-life stage scenario, the EPD owner can:

  - investigate end-of-life management and waste treatment processes of defective products or product parts, including transport to end-of-life treatment facility, even if these processes are conducted by third parties.

  - declare whether partial or complete product disassembly is feasible. As stated by Vanegas et al. (2016), disassembly is a reversal process in which a product is separated into its components and/or sub-assemblies by non-destructive or semi-destructive operations which only damage the connectors/fasteners. If the product separation process is irreversible, this process is called dismantling or dismounting. The disassembly or the destructive removal of components (i.e. dismantling), have the potential to significantly increase the recovery rate of precious metals, critical metals and plastics.

  - declare whether the product as a whole or its individual parts are (technically) recyclable.

- Key assumptions regarding the end-of-life stage scenario shall be documented in the LCA report and in the EPD, including: collection rate, end-of-life transportation distance between the collection point and final treatment facilities and transportation mode, recovery and disposal rates and processes (e.g. depollution, dismantling, crushing, shredding, sorting processes, incineration with energy recovery), and data sources.

- Default values for material recovery rates through recycling are available for reference in standard EN 50693 (Table G.4). These values are based primarily on data and assumptions relevant to the European context. However, they may still be used even if the geographical scope of the EPD is global, as these values are intended to set a common basis in absence of representative data. It is recommended to use more recent and representative values for material

recovery rates whenever these are available. Additional guidance for the end-of-life scenario development can be found in EN 45555 and Hischier et al. (2007).

- Recommendations for source separation and recycling can be given in the EPD, as well as recommendations for other waste treatment of product parts if relevant. Such recommendation shall be given as additional environmental information (see Section 5.4.6 of PCR 2024:06).

4.9 ENVIRONMENTAL PERFORMANCE INDICATORS

See PCR 2024:06.

The EPD shall include the following statement in connection to the results of the impact indicators of the use stage and aggregated form: "Comparisons of EPDs of industrial sensors should account for differences in the product market. The product market influences the electricity mix (and its corresponding emission factor) for the electricity consumed during the use stage which may significantly affect the environmental performance results of the use stage and aggregated form".

4.10 SPECIFIC RULES PER EPD TYPE

4.10.1 INCLUDING MULTIPLE PRODUCTS IN THE SAME EPD

From an LCA perspective, it is possible to group multiple product configurations if the differences among them do not affect the product life cycle (e.g. in terms of material composition, weight, target market). In such cases, a representative subset of configurations can be identified. Results of an LCA performed for a reference product may be extrapolated to other products, provided that these products belong to the same homogeneous product family as the reference product. In case of homogeneous products the rules described in Annex A.1 on EN 50693, for extrapolation of results to a homogeneous product family, shall be followed. Note that the extrapolation of results is only possible if the results of a representative product are used to include multiple products in the same EPD (i.e. the second option described in Section 4.9.1 on PCR 2024:06).

To belong to a homogeneous product family, the group of products shall have the following characteristics:

- Same main function
- Same product standards
- Similar manufacturing technology: same type of materials and manufacturing processes.

If the environmental data, material balance or environmental impacts differ from those of the reference product, extrapolation rule(s) allowing the data to be estimated at every stage of the life cycle shall be used.

The LCA study shall be performed for a sufficient number of products to cover the whole homogeneous product family.

The LCA report and EPD shall include:

- a statement that the products to which the extrapolation rules are applied belong to the same homogeneous product family as the reference product
- a complete list of products to which the extrapolation rules are applied, including their relevant technical specifications and product parameters (physical characteristics) that vary between the different products of the homogeneous product family (e.g. dimensions, weight of parts, materials, energy consumption…).

The extrapolation of LCA results of the reference product shall be done for all environmental impact indicators listed at www.environdec.com/indicators. Extrapolation for inventory indicators may also be included in the EPD.

The format for the extrapolation rules shall be described in the EPD. Extrapolation rules can be derived in the form of conversion factors or equations:

1. Conversion factors: it is possible to report conversion factors to change the set of LCA results of the reference into the results of another product of the same homogeneous family by multiplication. Conversion factors shall be declared for each life cycle stage. In this option,
the amount of included products in the EPD shall be limited in order to not compromise the EPD readability and to keep a reasonable number of EPD pages for the intended audience and use. It is recommended to not include more than 10 products in each EPD.

2. Equations: it is possible to describe a relationship between LCA results of the reference product and the other homogeneous products by means of linear regression or multivariate analysis, supported by sensitivity analysis.
   The following steps shall be followed to define extrapolation rule(s):
   - Perform the LCA of representative products of the homogenous product family,
   - Identify and quantify the products parameters (physical characteristics) that vary between the different products of the homogeneous product family (e.g. dimensions, weight of parts, materials, energy consumption…) and run a sensitivity analysis to identify influential parameters and define an extrapolation rule,
   - The extrapolation rule(s) and the process to define it shall be documented in the LCA report, including the sensitivity analysis. The type of equation, parameters and formula for each life cycle stage and in aggregated form shall be stated in the LCA report and EPD. Parameters values and/or range shall be specified and influential parameters to each life cycle stage shall be declared separately from parameters that have limited or no influence on the environmental indicators results.

   In this option, the amount of included products in the EPD shall be limited in order to not compromise the EPD readability and to keep a reasonable number of EPD pages for the intended audience and use. It is recommended to not include more than a few hundred products in each EPD.

5 CONTENT OF THE LCA REPORT

See version 5.0 of the GPI.

6 CONTENT AND FORMAT OF EPD

See PCR 2024:06.

6.1.1 PRODUCT INFORMATION

See PCR 2024:06.

The product information section of the EPD shall include the following statement: “Total energy consumption is determined according to the manufacturer's recommended operating conditions. Actual power consumption may vary depending on the conditions under which the product is installed and operates.”

7 LIST OF ABBREVIATIONS

In addition to abbreviations listed in PCR 2024:06:

B2B	Business to Business
bar	Pressure
IP	Ingress protection
OECD	Organization for Economic Co-operation and Development
PP	Polypropylene
ppm	Parts per million
R_1	Material recycled content (EN 50693)
R_2	Material recovery rate (EN 50693)
R_3	Energy recovery rate (EN 50693)
RH	Relative humidity
RTU	Remote Terminal Unit
VA	Volt-ampere
vol. % O_2	Volume percentage of oxygen

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9 VERSION HISTORY OF C-PCR

VERSION 20XX-YY-ZZ

Original version of the c-PCR.