Product Category Rule

for Environmental Product Declarations

PCR for Powder Coatings

Program Operator

NSF International

National Center for Sustainability Standards

Valid through April 30, 2025

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PRODUCT CATEGORY RULES REVIEW PANEL

Program Operator

NSF International

Recommended for adoption by

The PCR Committee for ACA Powder Coatings

No participation fees were charged by NSF to interested parties. NSF International ensured that reasonable balance among the members of the PCR committee were achieved and potential conflicts of interest were resolved prior to commencing this PCR development.

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NSF International shall ensure that reasonable balance among the members of a PCR committee is achieved and potential conflicts of interest are identified. No participation fees will be charged by NSF International to interested parties for participation on PCR Development Committees, for attendance at PCR Development Committee meetings, or for commenting on a draft PCR document.

PCR REVISION HISTORY

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ABOUT NSF'S NATIONAL CENTER FOR SUSTAINABILITY STANDARDS (NCSS)

Through the National Center for Sustainability Standards, NSF develops life cycle based, multi-attribute sustainability standards, protocols, and PCRs for various industries including building products and materials, furniture, carpet and flooring, fabrics, wallcoverings, roofing membranes, green chemicals, and water and wastewater.

The National Center for Sustainability Standards will continue to add to its growing portfolio while providing education, outreach, and innovative support to private industry, trade associations, government and academia to foster a consensus-based approach toward conformity assessment in the sustainability field. Visit <www.nsfsustainability.org> or contact ncss@nsf.org.

To initiate your LCA, receive your EPD verification, or have questions on where to start, contact NSF Sustainability at sustainability@nsf.org or 734-476-2543.

ABOUT AMERICAN COATINGS ASSOCIATON (ACA)

The American Coatings Association (ACA) is a voluntary, nonprofit trade association working to advance the needs of the paint and coatings industry and the professionals who work in it. The organization represents paint and coatings manufacturers, raw materials suppliers, distributors, and technical professionals. ACA serves as an advocate and ally for members on legislative, regulatory and judicial issues, and provides forums for the advancement and promotion of the industry through educational and professional development services. Information about the industry's sustainability initiatives can be seen at the following link: <www.paint.org/about-our-industry/sustainability.html>.

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This PCR documents the goal and scope of life cycle assessments (LCAs) for this product category in order to produce environmental product declarations according to ISO 14025:2006 and ISO 21930:2017. This PCR includes the life cycle phases in order to obtain the raw materials and manufacture powder coating products for interior and exterior applications. The definition of a powder coating is specifically outlined in Section 1.1. The scope excludes coatings which may be used on similar substrates but are not 100% solids. Finally, this PCR does not include coatings that fall under the American Coating's Associations PCR for Architectural Coatings.

1 SCOPE

1.1 Powder coating industry classification

The powder coatings industry, as represented by the American Coatings Association (ACA), has developed a definition for powder coatings. For the purposes of this PCR, a powder coating is defined as "a 100% solids coating applied as a dry powder which, when baked at a sufficient temperature, melts out to form a continuous film". Powder coatings can be further classified by the subcategories below:

- single-layer systems; and
- multiple-layer systems.

Powder coatings shall be assessed as a product system, as opposed to individual coatings or layers, where appropriate. For example, some powder coatings may be made up of at least a basecoat and a topcoat. As such, EPDs shall consider all coatings needed to achieve the desired coating coverage and performance and not just one of these components. An example of a powder coating system as shown in Figure 1. Powder coatings are also unique from conventional coatings (i.e., paints) in that they are not site-applied, are applied primarily by downstream companies (furniture for example) versus being purchased by a customer in the store, and have a wider variety of uses / applications.

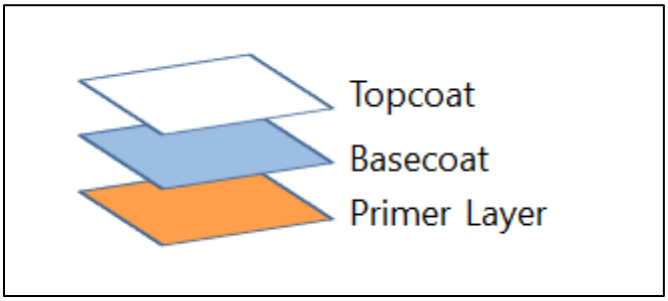


Figure 1
Example of a powder coating system with 3 layers

NOTE — It is possible for a powder coating system to require a different number of and/or types of layers than what is represented above.

Eligible products will be further classified in Section 3.3 of the PCR.

Given wide formulation ranges, optional coating layers, performance difference, and chemical precursor variability, industry average EPDs shall not be developed using this reference PCR. Given the diverse nature of powder coating products, an EPD based on industry-wide average would fail to reflect an actual product, likely making the ISO 21930:2017 requirement that impact category results range less than 10% not feasible.

1.2 Information

This document specifies the requirements for the LCA study as well as the format and content of the EPD itself. Recognizing the regional nature of LCA and the coatings industry, this PCR was designed to be applicable for the United States, but could be utilized elsewhere if desired. However, since this PCR has been written with United States assumptions in mind, any EPDs done for products manufactured or applied outside the United States should clearly state that the reference PCR was not designed for their region. If an EPD outside of the United States uses this sub-category PCR, it shall also clearly state why this PCR was chosen (in case there is a more appropriate PCR for that region) as well as disclose any areas in which this may impact the results of the LCA/EPD both in the LCA report and EPD.

The PCR Committee reviewed the various coating PCRs in the marketplace, and none were available specific to powder coatings, which are different in terms of manufacture and application relative to conventional liquid coatings. The PCR Committee decided the most appropriate course of action was to modify one of the existing ACA PCRs specifically to powder coatings. This reflects that the ACA's PCRs have been embraced by the coatings industry as a whole, and much of their framework could be readily leveraged into the Powder Coatings PCR. It is worth noting that the same approach was successfully completed by the Roof Coating Manufacturer's Association PCR, which was published in 2016, and for Resinous Floor Coatings in 2018.

The PCR Committee also referenced and utilized findings from LCAs and EPDs conducted by members of the Committee to inform its assumptions. Some PCR Committee members had experience in conducting dozens of powder coating LCAs as well as EPDs (for nonpowder coating products) with existing ACA PCRs. As such, these were a crucial resource and helped inform key assumptions and identify hotspots.

The PCR document was prepared by NSF International (the program operator) and the American Coatings Association Product Category Work Group in accordance with ISO 14025:2006. An open enrollment period was provided to seek out stakeholders interested in being part of the PCR creation. A multi-stakeholder group composed of coatings industry personnel, material manufacturers, regulators, and other experts worked to create the PCR.

The PCR at hand was formally developed by a panel of representatives of ACA members and U.S. coatings manufacturers, raw material suppliers, standards development groups, regulators, and other interested parties and conforms to ISO 21930:2017 requirements. This panel interacted with NSF International and members of the American Coatings Association. Additional requirements lie in the validation of coating service life by conforming to the requirements of various testing standards described in this PCR. Appropriate life cycle impact assessment (LCIA) methodologies were selected based on manufacturing region and will be addressed herein.

2 NORMATIVE REFERENCES

The following documents are referred to in the text. For undated reference, the latest edition of the referenced document (including any amendments) applies:

Green Guides[1]

Greenhouse Gas Protocol Product Life Cycle Accounting and Reporting Standard[2]

ISO 14025:2006, *Environmental labels and declarations – Type III environmental declarations – Principles and procedures*[3]

ISO 14040:2006, *Environmental management – Life cycle assessment – Principles and framework*[3]

ISO 14044:2006, *Environmental management – Life cycle assessment – Requirements and guidelines*[3]

ISO 21930:2017, *Sustainability in building construction – Environmental declaration of building products*[3]

Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI 2.1)[4]

US LCI Database Project Development Guidelines[5]

[1] 16 CFR Part 260 Guides for the use of environmental marketing claims. Federal Trade Commission. Available at: <www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=bce841cb851c93a436cc50e2996cc9d4&tpl=/ecfrbrowse/Title16/16cfr260_main_02.tpl>

[2] World Resources Institute (2011). 10 G Street NE, Suite 800, Washington, DC 20002. <www.wri.org/publication/greenhouse-gas-protocol-product-life cycle-accounting-and-reporting-standard>

[3] International Organization for Standardization. Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland. <https://iso.org>

[4] US EPA, Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI). Available at: <www.epa.gov/chemical-research/tool-reduction-and-assessment-chemicals-and-other-environmental-impacts-traci>

[5] US Life Cycle Inventory Database. National Renewable Energy Laboratory. Available at: <www.nrel.gov/docs/fy03osti/33807.pdf>

Waste Reduction Model (WARM)[6]

World Business Council for Sustainable Development's Global Water Tool[7]

3 TERMS AND DEFINITIONS

All LCA terms and definitions shall reference ISO 21930:2017 Section 3.

adhesion: The degree of attachment between two surfaces held together by interfacial forces.

basecoats: Coatings applied to the surface after preparation and before the application of a finish coat.

commercial project: Projects not used for residential, manufacturing, processing, or assembly purposes. Common commercial project types include education, healthcare, hospitality, entertainment, and construction.

generic data: Defined by the ILCD Handbook[8] as "a generic data set has been developed using at least partly other information than those measured for the specific process. This other information can be stoichiometric or other calculation models, patents and other plans for processes or products, expert judgment, etc. Generic processes can aim at representing a specific process or system or an average situation. Both specifically measured data and generic data can hence be used for the same purpose of representing specific or average processes or systems."

failure: The physical degradation of the surfacing material which would require substantial or complete removal in order to return the substrate to serviceable condition.

[6] US EPA Waste Reduction Model. Available at: <www.epa.gov/warm>

[7] World Business Council for Sustainable Development. Maison De La Paix, Chemin Eugène-Rogot, 2B, Case Postale 2075, CH-1211, Geneva 1. Available at: <www.wbcsd.org/Programs/Food-Land-Water/Water/Resources/Global-Water-Tool>

[8] European Commission. European Platform on Life Cycle Assessment, International Life Cycle Data system. Available at: <https://eplca.jrc.ec.europa.eu/ilcd.html>

industrial project: Any project where the primary activity includes the manufacture, production, processing, assembly, or handling of goods or materials. This could include use conditions such as heavy-wheeled traffic or the use of fixed or moving machinery. For example, in a maintenance facility or as an automotive shop.

intermediate processing: The conversion of raw materials to intermediates (e.g., titanium dioxide ore into titanium dioxide pigment, etc.).

pigment: The material(s) that give(s) a coating its color.

powder coating: A 100% solids coating applied as a dry powder which, when baked at a sufficient temperature, melts out to form a continuous film.

primers: Materials applied to a surface to promote adhesion between the substrate and subsequent coats.

primary materials: Resources made from materials initially extracted from nature. Examples include titanium dioxide ore, petroleum, etc., that are used to create basic materials used in the production of coatings (e.g., pigment, solvents).

resin / binder: Acts as the glue or adhesive to adhere the coating to the substrate.

secondary materials: Materials that contain recovered, reclaimed, or recycled content that is used to create basic materials for the production of coatings (e.g., aluminum scrap).

technical service lifetime: The estimated lifetime of a coating based solely on its hiding and performance characteristics determined by industry consensus values.

topcoat: the final layer of coating put onto a surface over another layer(s).

4 ACRONYMS AND ABBREVIATED TERMS

All LCA acronyms and abbreviations shall reference ISO 21930:2017 Section 4.

ACA: American Coatings Association

ecoinvent:[9] A life cycle database that contains international industrial life cycle inventory data on energy supply, resource extraction, material supply, chemicals, metals, agriculture, waste management services, and transport services.

EPA WARM model: United States Environmental Protection Agency Waste Reduction Model

EPD: Environmental product declaration. EPDs are forms of Type III environmental declarations under ISO 14025:2006. They are the summary document of data collected in the LCA as specified by a relevant PCR. EPDs can enable comparison between products if the underlying studies and assumptions are similar.

GaBi: Created by thinkstep, GaBi Databases[10] are LCA databases that contain ready-to-use life cycle inventory profiles.

LCA: Life cycle assessment. A technique to assess environmental impacts associated with all the stages of a product's life from cradle-to-grave (i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling), as defined in ISO 14040:2006.

NCSS: NSF International's National Center for Sustainability Standards

PCR: Product category rules. A PCR defines the rules and requirements for creating EPDs of a certain product category, as described in ISO 14025:2006.

[9] Available at: <www.ecoinvent.org/database/database.html>

[10] Available at: <www.gabi-software.com>

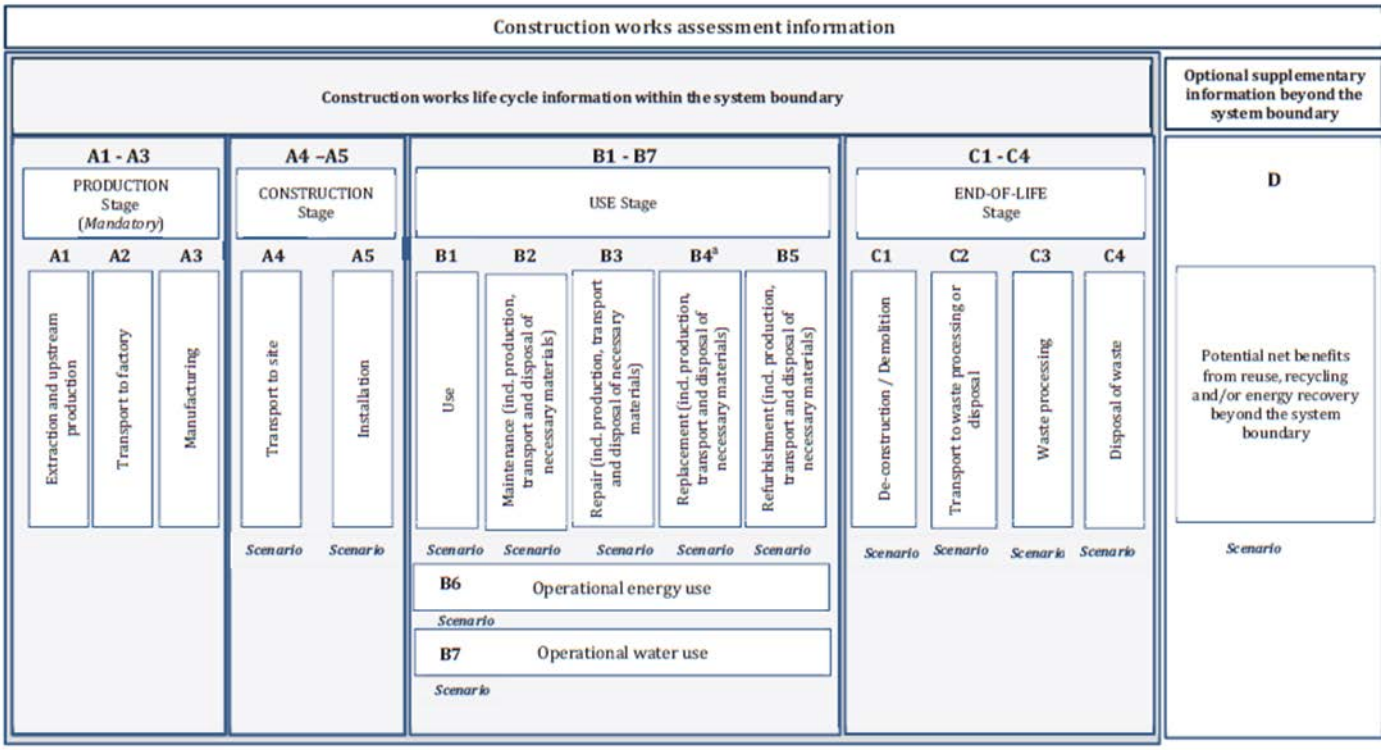
5 GENERAL ASPECTS

5.1 Objectives of this sub-category PCR

This PCR has been developed to conform with ISO 21930:2017 and to establish requirements specific to powder coatings. Its overall goals are identical to those stated in ISO 21930:2017 Section 5.1.

5.2 Life cycle stages and their information modules and Module D

This PCR and any subsequent EPDs shall only use the mandatory modules and the life cycle stages described in ISO 21930:2017 Section 5.2 and reproduced in Figure 2 below (A1-A3).



[a] Replacement information module (B4) not applicable at the product level.

Figure 2

Relevant system boundaries, information modules and life cycle stages of building products – Figure 2, pg. 26 ISO 21930:2017

The system boundary of EPDs shall at a minimum be consistent with ISO 21930:2017 Section 5.2. EPDs shall only include the life cycle phases from cradle-to-gate (A1-A3). This is because of the extreme variability of uses of powder coatings. As such, the remaining modules are not optional and shall not be reported. All relevant inputs shall be included in LCA models with the exception of:

- personnel impacts;
- research and development activities;
- business travel; and
- any secondary packaging (pallets, for example).

The rationale for excluding these areas is that they have been determined by LCAs conducted by ACA member companies to represent a negligible environmental impact in the overall life cycle performance of a coating. These studies are not publicly available as they are company-specific and contain confidential data, but the general findings and assumptions were discussed and accepted by the PCR Committee. These assumptions are also consistent with other LCA frameworks such as the Product Environmental Footprint (PEF)[11] program under development by the European Commission in the European Union.

It should also be noted that certain aggregated LCI data sets used to generate the EPD may not include all relevant flows. These differences should be noted in the data quality assessment discussed in Section 7.2.

Based on the discussions by the PCR development committee, it is believed that no significant data gaps are present in the PCR.

As stipulated by ISO 21930:2017, the system boundary shall follow both the modularity and polluter pays principle. These are discussed in greater detail in Section 7.1.1 and Table 1 of ISO 21930.

[11] Available at: <http://ec.europa.eu/environment/eussd/smgp/ef_pilots.htm>

5.3 Average EPDs for groups of similar products

Given the specifications of powder coating products such as color requirements, average EPDs may be necessary. Any instance of an average EPD shall follow the guidance outlined in ISO 21930:2017 Section 5.3.

Instances will likely occur where products are made at multiple manufacturing locations or travel to different distribution or retail centers. For situations such as this, a weighted average of production volume at each facility, site, or both shall be utilized for calculation purposes.

For example, if Site A manufactures 80% of the product system covered by the EPD and each kilogram of product manufactured requires 5 MJ of energy, whereas as Site B makes 20% of the product and each kilogram of product manufactured requires 10 MJ of energy, the average energy used per kilogram would be 6 MJ [(80%*5)+(20%*10)].

The same logic would apply for transportation distances.

If information is unavailable and default values are not already provided by this PCR, justification for any used values shall be documented and disclosed in both the project report and subsequent EPD.

5.4 Use of EPDs for construction products

Per the language in ISO 21930:2017 Section 5.4, the goal of EPDs derived using this sub-category PCR shall be used primarily in a B2B capacity. Any use in a B2C capacity shall follow the rules outlined in ISO 14025:2006 Section 9.

5.5 Comparability of EPDs for construction projects

All comparability requirements stated in ISO 21930:2017 Section 5.5 shall be followed. Comparative assertions (i.e., superiority claims versus a competing product) regarding the specific product system shall not be made in the EPD, and any comparison must also consider both the limitations of LCA as only potential impacts are being reported by the EPD (damage is not being assessed). Additionally, the following statement shall be included in all EPDs using this sub-category PCR:

"In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers or programs, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the construction works level per ISO 21930:2017 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis."

5.6 Documentation

All documentation requirements outlined in ISO 21930:2017 Section 5.6 shall be met, including those of the project report (also discussed in Section 10 of this sub-category PCR).

6 PCR DEVELOPMENT AND USE

6.1 Core PCR structure

Per ISO 21930:2017 Section 6.1, this sub-category PCR discloses all required elements and utilizes the same format and definitions to ensure conformance.

6.2 Relation between core PCR and sub-category PCR

Per the rules outlined in Section 6.2 of ISO 21930:2017, this subcategory PCR utilizes the same structure and references the appropriate sections / text of ISO 21930:2017. It only adds elements to specify, clarify, or both, and how they apply to powder coating products.

6.3 Development of sub-category PCR

The PCR at hand was formally developed by a panel of representatives of ACA members and U.S. coatings manufacturers, raw material suppliers, standards development groups, regulators, and other interested parties and conforms to ISO 21930:2017 requirements. This panel interacted with NSF International and members of the American Coatings Association. Appropriate life cycle impact assessment (LCIA) methodologies were selected based on manufacturing region and will be addressed herein.

7 PCR FOR LCA

7.1 Methodological framework

As stipulated by ISO 21930:2017, the LCA approach shall be attributional and system boundary shall follow both the modularity and polluter pays principles. These principles are discussed in greater detail in ISO 21930:2017 in Section 7.1.1 and Table 1.

The declared unit shall be 1 kg of powder coating product. If multiple products are needed in a powder coating system, 1 kg of each required product shall be assumed, and their results disclosed in the EPD.

7.1.1 Stages A1-A3 – Production stage

The material acquisition, preprocessing, intermediate processing, and processing stage (production stage) starts when the raw materials are extracted from nature (e.g., titanium dioxide ore), and ends when the intermediate materials (e.g., polyester resin, titanium dioxide pigment, etc.) reach the gate of the production facility and are processed into the final coating product and packaged for shipping. During production, the product undergoes the transformation from intermediate material to the final coating product; additionally, any co-products or wastes formed during production shall be accounted for in this stage. Processing differs depending on the powder coating technology. For example, powder coatings are typically made by adding measured amounts of ingredients into a mixer. Once the ingredients are mixed, the mixture is melt-mixed in an extruder, cooled and broken into chips, and then milled and sieved to make a fine powder. Other coating technologies may have different or additional steps and they shall be accounted for in the product stage.

Materials can be considered either “primary” or “secondary”.

- primary raw materials are made from materials initially extracted from nature. Examples include titanium dioxide ore, petroleum, etc. that are used to create basic materials used in the production of powder coatings (e.g., pigment, solvents);

- secondary raw materials are recovered, reclaimed, or recycled content that is used to create basic materials for the production of powder coatings (e.g., aluminum scrap);

- intermediate processing is the conversion of raw materials to intermediates (e.g., titanium dioxide ore into titanium dioxide pigment, etc.); and

- the following shall include the materials and energy use along with the transportation to the point of use:

    - production of the final coating by mixing of the ingredients or intermediates;
    - catalysts or other ancillary materials used during production; and
    - primary packaging of the final product.

Inbound transportation shall be included in the life cycle inventory for the production stage. All transportation, including interfacility transport, prior to the material being shipped to the application site, shall also be included.

If more than one primary data point is available for inbound transportation distances of a raw material, an average distance weighted by the transported mass may be calculated and the methodology disclosed in the EPD. If primary data is not feasibly obtainable, transport distances listed in Table 7 shall be used for inbound raw material transports to facilities located in the United States. For processes outside of the United States, appropriate regional or national transportation distance and mode(s) shall be used where primary data is unavailable. If different vehicle classes or more than one transportation mode is required, then the LCA model shall use multiple transportation datasets to represent these, provided that separate LCI datasets are available for these vehicles, modes, or both.

Waste and scrap created during raw material manufacturing and emissions associated with transporting them to point of disposal shall be accounted for in this stage. Primary data for the construction stage shall be used, if available, otherwise secondary data shall be used. Secondary data may come from any credible and relevant national or regional databases, or from commercially available life cycle inventory data such as GaBi or ecoinvent. See Section 7.2 for information relating to data quality guidelines. In the United States, the 2012 EPA Waste Reduction Model (WARM model) gives an average transport end of life distance as 32 km (19.9 mi). This value shall be used for manufacturing facilities located in the United States when primary data or other representative data are not available, and waste transports are not included in the secondary dataset.

Waste and scrap created during production ("post-production") shall be included in the LCA model. Primary data on process yields and scrap rates shall be used if available. If waste materials are recycled, landfilled, combusted, or composted, the transportation distances shall use the 32 km (19.9 mi) value mentioned above WARM model for the United States, and the appropriate regionally or nationally representative value outside of the United States unless primary data has been obtained, in which case the primary data shall be used. Any emissions from landfill shall be assumed to be accumulated over 100 years after the material was deposited in or on the landfill site.

Material recycling percentages for the United States shall be based on the most current version of the US EPA Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures.[12] Outside of the United States, regionally or nationally appropriate recycling rates shall be used.

[12] Available at: <www.epa.gov/facts-and-figures-about-materials-waste-and-recycling>

Table 1
Default transportation distances

Raw material / Classification grouping		Distance (kilometers)		
		Rail	Truck*	Water
Raw coating materials	Any material used in a coating where no primary source data is available	0 kilometers	1207 kilometers	0 kilometers
Plastics (including polymer-based materials; excluding textiles)	—	0 kilometers	1218 kilometers**	1545 kilometers**
Steel (for packaging)	32 base metal in primary or semifinal forms and in finished basic shapes	904 kilometers**	1500 kilometers	1340 kilometers**

NOTE: The average transport distances could also be used for complete components or units.

NOTE: Oceanic distances were approximated. For materials where a particular mode of transport was not typical or common, it was assumed to be zero (e.g., rail transport for plastics in North America).

Distances taken from the US Department of Transportation's Research and Innovative Technology Administration (RITA) website's "TranStats".

* Truck distances represent round trip distances, as the assumption is made that the delivery truck returns empty after making the delivery.

** 2007 US DOT Shipment Characteristics by Standard Classification of Transported Goods (SCTG) Commodity Code, Table 7.

[Table 7: North American Default Material Transport Distances from 2007 US DOT Shipment Characteristics by Standard Classification of Transported Goods (SCTG) Commodity Code][13]

[13] Available at: <www.bts.gov/archive/publications/commodity_flow_survey/classification>

7.1.2 Criteria for the inclusion and exclusion of inputs and outputs

Cut-off rules shall be as described in ISO 21930:2017 Section 7.1.8. The cut-off criteria shall be 1% of renewable primary resource (energy), 1% nonrenewable primary resource (energy) usage, 1% of the total mass input of that unit process and 1% of environmental impacts. The total of neglected input flows per module shall be a maximum of 5% of energy usage, mass and environmental impacts.

For materials characterized as hazardous by the Globally Harmonized System (GHS),[14] cut-off rules do not apply, and such substances shall be included in the inventory.

7.1.3 Selection of data and data quality requirements

Primary data (site-specific or representative averages) shall be used for facilities and processes under operational control of the reporting company. However, generic data may be used for facility operations that contribute less than 10% of the total production output of the product being reported by the EPD. If unable to meet this threshold, justification for the inability to obtain primary data shall be disclosed in the EPD. For facilities and processes outside of the operational control of the reporting company, secondary data may be used. For products that are manufactured wholly or largely outside of the reporting company control (e.g., contracted products or significant assemblies), primary data are highly encouraged; however, representative secondary data may be used in lieu of primary data.

7.1.4 Data quality

A data quality assessment shall be made for the system under study and included in the EPD. All data shall be accurate, complete, and representative of the manufacturing process, current technology and current measurement capability. The data shall be consistent with the following requirements:

1. The information obtained from the manufacturing process(es) shall be average annual values per declared unit, and it shall not be more than five years old. Any secondary data that is used shall be less than five years old. If data older than five years is used from a secondary source, justification shall be included to address why newer data are not available.

[14] See <www.osha.gov/dsg/hazcom/global.html> for additional information.

2. Data should represent the technology(ies) and process(es) in current use.

3. Data quality assessment shall conform to ISO 14044:2006 Section 4.2.3.6.

4. Data quality assessment shall, at a minimum, address the following:

    - time-related coverage: age of data and the minimum length of time over which data was collected;
    - geographical coverage: geographical area from which data for unit processes was collected to satisfy the goal of the study;
    - technology coverage: specific technology or technology mix; and
    - uncertainty of the information (e.g., data, models and assumptions):
        - may include quantitative estimation of uncertainty (optional).

5. Suitable data quality assessment frameworks include (but are not limited to):

    - USLCI Data Guidelines;[8]
    - ILCD Handbook;[11] and
    - WRI product standard,[2] Table 8.2: Criteria to Evaluate the Data Quality Indicators.

7.1.5 Data sources

All data sources used to create the EPD shall be documented and disclosed. In addition, given their prominence in the environmental impact of a coating, sources of LCI data sets used to represent the manufacturing of raw materials, intermediates, or both, in the pigment and binder(s) manufacturing processes must be disclosed separately.

Primary source data should be used whenever feasible and available for any and all processes.

If the most recent version of an LCA database is not used to create the EPD, written justification for its exclusion must be provided and properly reflected in the data quality assessment following Section 7.2. Any use of generic data shall be justified, consistent with ISO 21930:2017 Section 7.1.9.

All inputs and outputs shall account for a 100-year time period from the year stated by the data set. This time period may be extended if relevant, but justification must be included in the project report.

The EPD shall assess and disclose any significant data gaps that occur.

7.1.6 Units

International System of Units (SI units) shall be used for both the LCA and the EPD as described in ISO 21930:2017 Section 7.1.10. Quantities shall be represented with three valid digits expressed in scientific notation.

7.2 Inventory analysis

All data collection and calculation procedures outlined in ISO 14044:2006 and ISO 21930:2017 shall apply to EPDs created using this sub-category PCR.

7.2.1 Sensitivity analysis

Given the relevance of the coating's assumed durability, most assumptions in this PCR will have a minimal impact on the overall results of the EPD. Since the industry has gone to great lengths to define the crucial assumptions using industry best practices, no additional sensitivity analyses are required for the creation of the EPD. However, they can be conducted and included in the EPD if desired.

7.2.2 Allocation rules

Where possible, allocation should be avoided by dividing unit processes into two or more sub-processes (as specified in ISO 14044-2006 Section 4.3.4, Allocation). Additionally, the coproduct allocation guidance provided in ISO 21930:2017 Section 7.2.5, shall be followed. Since there will be cases were allocation cannot be avoided, the following hierarchy of allocation methods is preferred:

— mass, or other biophysical relationship; and
— economic value.

Deviation from these allocation rules shall be documented and justified.

7.2.3 Biogenic carbon

Although uncommon for powder coatings, there may be cases where biobased materials are used in a powder coating system. Any mass flows of biogenic carbon shall be reported specifically as biogenic carbon (reported in terms of CO_2 in the LCI) and shall be accounted in the module during which any sequestration or emission action occurs.

Any delayed emissions from a temporary carbon sequestration (through a biopolymer that eventually degrades, for example) shall follow the rules in ISO 21930:2017 Section 7.2.9. and this information only reported under "Additional Environmental Information".

As stated in ISO 21930:2017 Section 7.2.8., carbonation shall be considered throughout the life cycle. However, this will rarely be relevant in powder coatings products and should be assessed only when relevant. Similarly, greenhouse gas emissions from land-use changes shall be considered only when significant per ISO 21930:2017 Section 7.2.11.

If relevant to the product system (and information is available), the indicators below regarding the uptake and emissions of CO_2 shall be separately reported if they are considered in the quantification of the global warming potential to conform with ISO 21930:2017 7.2.12. This serves to enhance transparency regarding possible contributions to global warming potential throughout the product system:

— biogenic CO_2, reporting the removals and emissions associated with biogenic carbon content contained within biobased products, occurring in each module;

— biogenic CO_2, reporting the removals and emissions associated with biogenic carbon content contained within the biobased packaging, occurring in each module;

— CO_2 from calcination and carbonation, reporting the emissions and uptake of CO_2 from calcination and carbonation occurring in the relevant modules;

— biogenic CO_2, reporting the emissions from combustion of waste from renewable sources used in product processes; and

— CO_2 emissions from combustion of waste from nonrenewable sources used in product processes.

The following life cycle inventory analysis results shall be reported by life cycle module (Figure 2) and as totals:

— nonrenewable primary resources used as an energy carrier (MJ);

— nonrenewable primary resources with energy content used as a material (kg);

— renewable primary resources used as an energy carrier (MJ);

— renewable primary resources with energy content used as a material (kg);

— recovered energy from disposal of waste in previous systems – for example, combustion of landfill gases (MJ);

— abiotic depletion potential for fossil resources used as energy (MJ);

— abiotic depletion potential for fossil resources used as materials (kg); and

— consumption of freshwater[15] (m^3).

The resource metrics listed above shall be determined by assessing their totals across the LCIs used in the LCA models. State of the art LCA tools make such metrics available in the balance of the LCA.

[15] This metric represents the net value between uptake and rerelease, hence accounting only for evaporation and other forms of water displacement.

Renewable energy sources are defined as renewable nonfossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogases.

Renewable material resources are defined as ones that can be readily replaced by natural means on a level equal to their consumption.

ISO 21930:2017 also requires the reporting of:

- secondary materials (kg);
- renewable secondary fuels (MJ); and
- nonrenewable secondary fuels (MJ).

The waste allocated to the building product across all modules shall be classified in the EPD as

- hazardous waste[16] (kg); or
- nonhazardous waste (kg).

These shall be disclosed by life cycle module and as totals in the EPD.

Given concerns about inconsistent or nonexistent waste flows in commercially available LCIs, the following statement shall accompany the waste metrics in the results section or as a footnote following the waste metric reporting of the EPD:

> *"Significant data limitations currently exist within the LCI data used to generate waste metrics for Life Cycle Assessments and Environmental Product Declarations. The waste metrics were calculated in a way conformant with the requirements of ISO 21930:2017, but these values represent rough estimates and are for informational purposes only. As such, no decisions regarding actual cradle-gate waste performance between products should be derived from these reported values."*

[16] As defined by Resource Conservation and Recovery Act (RCRA) under 40 CFR 261.33. Available at: <www.govinfo.gov/app/details/CFR-2012-title40-vol27/CFR-2012-title40-vol27-sec261-33>

If relevant to the product system assessed by the EPD, carbon uptake and emission shall be reported as described in Section 3.6 of this reference PCR and conformant with ISO 21930:2017.

Finally, quantities of high-level or intermediate/low-level radioactive waste shall be reported by life cycle module and as totals per ISO 21930:2017.

7.3 Impact assessment indicators describing main environmental impacts derived from LCA

The following environmental impact categories shall be disclosed in the EPD per declared unit:

1. Climate change (GWP 100 years) [kg CO_2-eq.]
   IPCC (AR5)[17]; Biomass carbon uptake and its re-release of CO_2 and CH_4 shall be reported separately based on the biogenic carbon content of the product to be declared.

2. Acidification of land and water sources (AP) [kg SO_2-eq]
   TRACI 2.1; outside North America, regionally applicable methodologies.

3. Photochemical ozone creation (SFP, or "Smog Formation") [kg O_3 eq. / kg of emission]
   TRACI 2.1; or outside North America, regionally applicable methodologies.

4. Eutrophication (EP) [kg N eq. / kg of emission]
   TRACI 2.1; or outside North America, regionally applicable methodologies.

5. Depletion of stratospheric ozone (ODP) [kg CFC-11 eq. / kg of emission]
   TRACI 2.1; or outside North America, regionally applicable methodologies.

These impact categories are consistent with those stated in ISO 21930:2017 Section 7.3.

[17] Intergovernmental Panel on Climate Change, Fifth Assessment Report. Available at: <www.ipcc.ch/assessment-report/ar5>

Life cycle impact assessment category indicator results shall be reported separately for the product stage, construction stage, use stage, and end-of-life stage, as well as the total life cycle results. Users may also report impact category indicatory results by individual coating layer if desired, although impacts for product system total and for each life cycle stage shall still be reported as well.

Impact categories shall use the characterization models specified in Section 7.5 of this PCR. The impact category indicator results shall be reported separately for the product stage as well as total life cycle results as described by Sections 4.1 through 4.4 of this document.

1. Climate change [kg CO_2-eq.]
2. Depletion of the stratospheric ozone layer [kg CFC-11 eq. / kg of emission]
3. Acidification of land and water sources [kg SO_2-eq.]
4. Eutrophication [kg N eq. / kg of emission]
5. Formation of tropospheric ozone (photochemical oxidants) [kg O_3 eq. / kg of emission]

8 ADDITIONAL ENVIRONMENTAL INFORMATION

EPDs developed using this PCR shall include, where relevant, additional information related to environmental issues, other than the environmental information derived from LCA, LCI or information modules. This information shall be separated from the information described in ISO 21930:2017 Sections 8.2, 8.3, and 8.4. Identification of the significant environmental aspects should conform to ISO 21930:2017 Section 8.4 and ISO 14025:2006 Section 7.2.4. EPDs may also include the potential effects of emissions on human health and toxicity as described below.

EPDs may report impacts related to human health, the environment, or both using the USEtox method. If reported in the EPD, it shall be reported in the LCIA section and reported by life cycle module and as a total with an accompanying paragraph describing its results in detail.

The decision to make human and/or ecotoxicity reporting optional reflects that the PCR committee believes that such metrics are important; however, it also recognizes that there is a large degree of uncertainty surrounding toxicity and hazard assessment methods.[18] The industry will continue to monitor all available toxicity reporting methods and may make such reporting mandatory in future revisions of this PCR.

An EPD shall also include, where relevant:

- any data on building product performance (where environmentally significant);
- instructions and limits for efficient use;
- organization's adherence to any environmental management system, including a statement showing where an interested party can find additional information on the system;
- other environmental certification programs applied to the building product and a statement indicating where an interested party can find details of the certification program;
- other environmental activities of the organization, such as participation in recycling or recovery programs, provided details of these programs are readily available to the purchaser or user and contact information is provided; and
- preferred waste management option for unused coating.

8.1 Mandatory environmental information

Specifications as required by safety data sheets (SDS), such as reporting certain aspects of material composition of the assessed coating product(s), shall be disclosed in percentage of total weight.

[18] Uncertainty of the USETox method is discussed in following publication: Ralph K. Rosenbaum, Till M. Bachmann, Lois Swirsky Gold et al. USEtox—the UNEP-SETAC toxicity model: recommended characterisation factors for human toxicity and freshwater ecotoxicity in life cycle impact assessment. International Journal of LCA; November 2008, Volume 13, Issue 7, pp 532-546; Date: 22 Oct 2008.

Per ISO 21930:2017 Section 10.3, ingredients or compounds that are proprietary and covered by intellectual property rights or similar legal restrictions do not have to be disclosed in the EPD.

8.1.1 Emissions to water, soil, and to indoor air

Per ISO 21930:2017 Section 8.4.2, any releases to ground and surface water and indoor air shall meet all relevant national standards.

9 CONTENT OF AN EPD

The format of the EPD shall be as follows:

9.1 Front page

1. To avoid misinterpretation of results, a company shall include a disclaimer to the audience (reader) identifying the difficulties in comparing results and referring the reader to additional information if needed.

   "In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers or programs, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the construction works level per ISO 21930:2017 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis."

2. PCR identification.

3. Picture of product or family and brief description of product.

4. Product category and subcategory.

5. Manufacturer's / EPD holder's name and contact information.

6. Content of the product consistent with Section 8.1.

7. Information on the EPD program operator.

8. Date of certification and period of validity.

9. Declared unit.

10. Allocation rules utilized.

11. Cut-off procedure employed.

12. Overall data quality assessment score (poor, fair, good, or very good).

13. Site(s), manufacturer or group of manufacturers, or those representing them, for whom the results of the LCA are representative.

14. Information on where explanatory material can be obtained.

9.2 Product definition and characteristics

1. CAS numbers, quantities, and description of any hazardous substances contained within the product system.

2. Description of product's intended use and any product codes if relevant.

3. Additional product attributes:

   — components for reuse;

   — materials for recycling;

   — materials for energy recovery; and

   — recovered energy from the product system – shall be based on existing technology and current practices.

9.3 Key environmental parameters

As specified in Impact Assessment Categories, Section 7.5:

1. Climate change [kg CO_2-eq.]
2. Depletion of the stratospheric ozone layer [kg CFC-11 eq. / kg of emission]
3. Acidification of land and water sources [kg SO_2-eq.]
4. Eutrophication [kg N eq. / kg of emission]
5. Formation of smog [kg O_3 eq. / kg of emission]

9.4 Product specifications

As described in product description, Section 2.

9.5 Material and energy resources

As specified in parameters to be declared in the EPD, Section 8.2, sorted by:

- depletion of nonrenewable energy resources (MJ);
- depletion nonrenewable material resources (kg);
- use of renewable material resources (kg);
- use of renewable primary energy (MJ);
- consumption of freshwater (m^3);
- hazardous waste (kg);
- nonhazardous waste (kg);
- high-level radioactive waste (kg); and
- intermediate and low-level radioactive waste (kg).

9.6 Biogenic carbon updates and emissions (if relevant)

- biogenic CO_2, reporting the removals and emissions associated with biogenic carbon content contained within biobased products, occurring in each module;

- biogenic CO_2, reporting the removals and emissions associated with biogenic carbon content contained within the biobased packaging, occurring in each module;

- CO_2 from calcination and carbonation, reporting the emissions and uptake of CO_2 from calcination and carbonation occurring in the relevant modules;

- biogenic CO_2, reporting the emissions from combustion of waste from renewable sources used in product processes; and

- CO_2 emissions from combustion of waste from non-renewable sources used in product processes.

9.7 Table of differentiation of use of material and energy resources (ISO 21930:2017, Section 8.2.6)

- hydro / wind power (MJ);
- fossil energy (MJ);
- bio-energy (MJ);
- nuclear energy (MJ);
- other energy (MJ);
- renewable secondary fuels (MJ);
- nonrenewable secondary fuels (MJ);
- nonrenewable resources (kg);
- renewable resources (kg);
- recycled materials (kg);
- secondary materials (kg); and
- freshwater consumption (m^3).

9.8 Declarations of technical information and scenarios (ISO 21930:2017 Section 9.4)

9.9 Emissions and wastes

9.10 Additional environmental information per Other Environmental Information, Section 9.6

9.11 Data quality assessment and disclosure and explanation of any data gaps

9.12 Relevant references

All results must be reported and formatted in a way consistent with ISO 21930:2017 guidelines.

In addition to the above, a statement as given in Figure 3 of ISO 21930:2017 (reproduced below) shall be completed and included in the type III environmental declaration.

ISO 21930:<insert year of publication>— serves as the core PCR <Sub-category PCR, if relevant> <PCR review[a,b,c] was conducted by:> <Sub-category PCR review[ade] was conducted by:> <name and organization of the panel chair, and their contact information[f] >
Independent verification of the declaration and data, according to ISO 21930: <insert year of publication> and ISO 14025: <insert year of publication> ☐ internal ☐ external
Third party verifier[g]: <Name of the third party verifier>

a If relevant.
b Any overarching PCR shall be in accordance with this document, particularly 6.1 and 6.2.
c Any overarching PCR review shall be in accordance with 6.1.
d Sub-category PCR shall be in accordance with 6.1, 6.2 and 6.3.
e Sub-category PCR review shall be in accordance with 6.3.
f The specific details of the review, including those to be named in the EPD, are the responsibility of the Programme Operator.
g Where appropriate — optional for B2B communication; mandatory for B2C communication (see ISO 14025:2006, 9.4).

Figure 3

ISO 21930:2017 Example of demonstration of verification

9.13 Period of validity for the EPD

The validity of the EPD shall be reported in the EPD and shall not exceed a five (5) year period from the date of issuance. Any changes in formulations that result in shifts in any of the environmental impact categories by more than ± 10% shall require an update to the EPD. The EPD shall be reviewed and reissued every five years from the date of issuance or earlier, as appropriate.

9.14 References

The EPD shall, if relevant, refer to:

- the underlying LCA report;
- the relevant PCR document;
- other documents that complement, verify and support the EPD;
- instructions for coating recycling; and
- program operator instructions.[19]

10 PROJECT REPORT

A project report shall be created and externally verified per the requirements of ISO 21930:2017 Sections 10 and 11. Specifically, a project report shall contain the following:

10.1 General aspects

- author(s) of LCA Study;
- date of report; and
- statement that the report is conformant to ISO 21930:2017 and the reference PCR.

10.2 Goal of the study

- reason for completing the study; and
- intended application and audience (B2B).

[19] NSF Program Operator Instructions available at <www.nsf.org/newsroom_pdf/NSF_Program_Operator_Instructions-news.pdf>

10.3 Scope of the study

- declared unit;
- relevant technical specifications including intended/expected use of the powder coating by downstream manufacturer;
- system boundary per ISO 21930:2017 guidelines;
- any omissions (data or processes); and
- cut-off criteria.

10.4 LCI

- description of data sources (primary, secondary, generic, literature, etc.);
- description of unit processes used to model the life cycle stages;
- data quality assessment;
- treatment of missing data; and
- allocation rules – justification for use, descriptions, and statement that they were uniformly applied.

10.5 LCIA

- LCIA procedures;
- calculations;
- results and relationship to LCI results;
- characterization method (i.e., TRACI for North America); and
- statement on limitations of LCA and midpoint impact categories (i.e., potential impacts).

10.6 Interpretation

- results;
- assumptions;
- limitations of the study;
- data quality assessment; and
- transparency into any value choices and expert judgements.

This report shall be submitted for external validation before the EPD is created and published. The project report is not publicly disclosed and may contain confidential information. ISO 21930:2017 Section 13 details what information must be publicly reported through the EPD.

11 VERIFICATION AND VALIDITY

All verification of EPD, LCA, LCI and additional environmental information shall conform to the following ISO 14025:2006 Section 8 provisions:

- PCR review including a review of the LCA, LCI, information modules and additional environmental;
- information on which the PCR are based; see ISO 14025:2006 Section 8.1.2;
- independent verification of data from LCA, LCI and information modules, and of additional environmental information; see ISO 14025:2006 Section 8.1.3;
- independent verification of the EPD the independent verifier shall generate a verification report stipulating the conclusion of the verification, see ISO 14025:2006 Section 8.1.4;
- process, while adhering to the obligations of ISO 14025:2006 Section 8.3, covering rules for data confidentiality;

— this report shall be available to any person upon request; and

— competence of third-party PCR review panel, according to provisions given in ISO 14025:2006 Section 8.2.3, and independent verifier of the EPD, according to provisions given in ISO 14025:2006 Section 8.2.2.

12 REFERENCES

The development of this PCR included consideration and reference to the following PCRs:

American Coating Association – *ACA PCR for Architectural Coatings*[20]

Hauschild, M.Z., Huijbregts, M.A.J., Jolliet, O. et al. 2008. "Building a Model Based on Scientific Consensus for Life Cycle Impact Assessment of Chemicals: The Search for Harmony and Parsimony." *Environmental Science and Technology* 42, 19, 7032-7037.[21]

Rosenbaum, R.K., Bachmann, T.M., Gold, L.S. et al. 2008. USEtox – The UNEP-SETAC toxicity model: "Recommended characterisation factors for human toxicity and freshwater ecotoxicity in life cycle impact assessment". *The International Journal of Life Cycle Assessment* 13, 532-546.[22]

[20] Available at: <www.nsf.org/services/by-type/standards-publications/ncss/product-category-rule-pcr-development>

[21] Available at: <https://pubs.acs.org/toc/esthag/42/19>

[22] Available at: <https://doi.org/10.1007/s11367-008-0038-4>

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***THE HOPE OF MANKIND** rests in the ability of man to define and seek out the environment which will permit him to live with fellow creatures of the earth, in health, in peace, and in mutual respect.*