

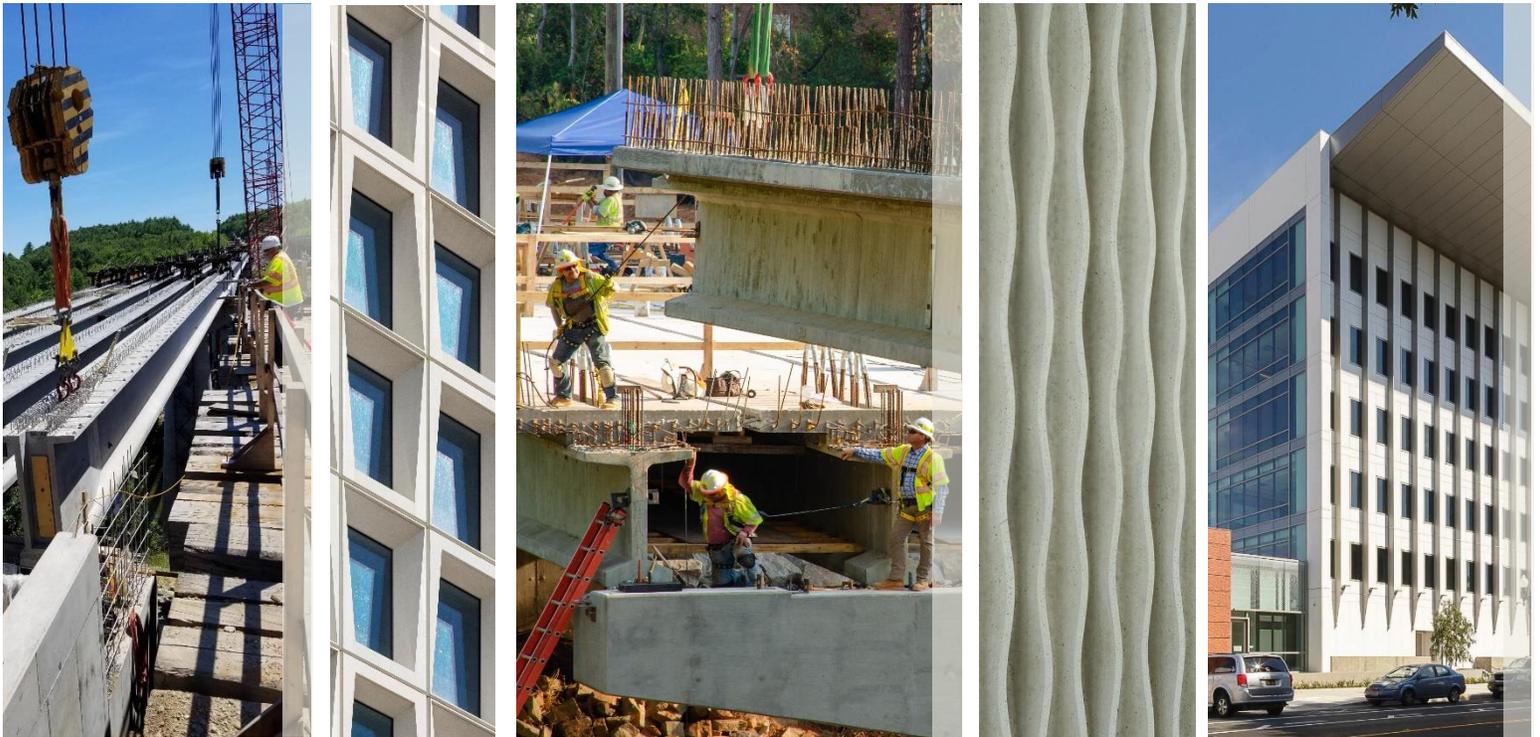


ASTM
INTERNATIONAL



Product Category Rule for Environmental Product Declarations

PCR for Precast Concrete – UNCPC: 37550



Program Operator

NSF International

National Center for Sustainability Standards

Valid through April 30, 2026

ncss@nsf.org

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PCR REVISION HISTORY

Version	Date Issued
Version 1.0 (published by ASTM)	03/03/2015
Version 2.0	03/02/2021
Version 3.0	05/30/2021

Published by
NSF International
PO Box 130140, Ann Arbor, Michigan 48113-0140, USA

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Printed in the United States of America.



PCR for
Precast Concrete –
UNCPC 37550

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Program Operator

NSF International

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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 were resolved prior to commencing this PCR development. 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.



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PCR DEVELOPMENT AND STAKEHOLDER CONSULTATION

This sub-category rule for “precast concrete” is Version 3.0 of the Product Category Rules (PCR) for ISO 14025:2006 Type III Environmental Product Declarations (EPDs) of precast concrete, updating Version 2.0 dated March 2021. The following change has been included in this document:

- compliance with ISO 21930:2017.

A committee outlined in Appendix A provided review and input to the revisions. After consideration of existing North American PCR for precast concrete (published by ASTM and currently hosted at NSF), the USGBC PCR Guidance Document, North American PCR for ready-mix concrete (published by NSF), North American PCR for cement (published by NSF), and ISO 21930:2017 (see references) the technical committee decided to use ISO 21930:2017 as the ‘core PCR’ and adapt the ASTM precast concrete PCR to be a ‘sub-category PCR.’

ISO 21930:2017 provides the core rules for construction products and services and must be read in tandem with this document.

For information about PCR development and stakeholder consultations, see Appendix A.

The development of this PCR was supported by the precast concrete industry, including the Canadian Precast / Prestressed Concrete Institute <www.cpci.ca>, the Precast / Prestressed Concrete Institute <www.pci.org>, and their members.



1 SCOPE

Per ISO 21930:2017 Section 1 with the following additions:

This sub-product category rule (PCR) addresses UN CPC Group 37550 – Prefabricated structural components for building or civil engineering, of cement, concrete or artificial stone. It enables the development of EPDs associated with the production of the product from cradle-to-gate for life-cycle-stage modules A1-A3. This PCR was developed specifically for use with precast concrete products produced from materials that conform to the standards in Table 1 and that are typically manufactured in accordance with the standards in Table 2.

Table 1
Specifications for Materials* in Precast Concrete

PRODUCT	DESCRIPTION / SPECIFICATION
portland cement	AASHTO M85, ASTM C150, ASTM C1157, or CSA A3000
blended hydraulic cement	AASHTO M240, ASTM C595, ASTM C1157, or CSA A3000
portland-limestone cement (PLC)	AASHTO M240, ASTM C595, ASTM C1157, or CSA A3000
performance-based hydraulic cements	ASTM C1157
geopolymer cements	ACI ITG 10.1R-18 or ACI ITG 10R-18
fine aggregate – natural sand or manufactured	AASHTO M6, ASTM C33/33M, or CSA A23.1
coarse aggregate – natural gravel or crushed	AASHTO M80, ASTM C33/33M, or CSA A23.1



Table 1
Specifications for Materials* in Precast Concrete

PRODUCT	DESCRIPTION / SPECIFICATION
lightweight aggregate	AASHTO M195 or ASTM C330/330M
mineral fillers – silica flour, quartz powder, ground limestone (all less than 80 micron)	ACI 211.7R or ASTM C1797/C1797M
supplementary cementitious materials (SCMs) – fly ash	AASHTO M295, ASTM C618, or CSA A3000
SCMs – ground glass pozzolans	ASTM C1866/C1866M or CSA A3000
SCMs – blended supplementary cementitious materials	CSA A3000
SCMs – silica fume	AASHTO M307, ASTM C1240, or CSA A3000
SCMs – slag cement	AASHTO M302, ASTM C989/989M, or CSA A3000
chemical admixture – accelerator	ASTM C494/C494M Type C/E
chemical admixture – air-entraining agent	ASTM C260/C260M or ASTM C494/C494M
chemical admixture – hardening accelerator	ASTM C494/C494M Type C
chemical admixture – plasticizer and superplasticizers	ASTM C494/C494M Type F/G or ASTM C1017/C1017M
chemical admixture – retarder	ASTM C494/C494M Type B/D
chemical admixture – water reducing and water resisting	ASTM C494/C494M Type A/B/D/E



Table 1
Specifications for Materials* in Precast Concrete

PRODUCT	DESCRIPTION / SPECIFICATION
chemical admixture – coloring	ASTM C979/C979M or ASTM C1582/C1582M
chemical admixture – corrosion inhibitor	ASTM C494 Type C/E or ASTM C1582/C1582M
form release agent	Not applicable (N/A)
reinforcing bars, welded wire fabric (WWF), bolts, studs, coatings, prestressing strand, etc.	ASTM A36/A36M, ASTM A108, ASTM A123/A123M, ASTM A153/A153M, ASTM A184, ASTM A307, ASTM A416/A416M, ASTM A555/A555M, ASTM A615/A615M, ASTM A666, ASTM A706/A706M, ASTM A767/A767M, ASTM A775/A775M, ASTM A820/A820M, ASTM A884/A884M, ASTM A934/A934M, ASTM A955/A955M, ASTM A1035/A1035M, ASTM A1064/A1064M, CAN/CSA-G30.18, CAN/CSA-G40.20/G40.21, CAN/CGSB-1.40, CAN/CGSB-1.181
fiber and glass reinforcement	ASTM C1116/C1116M, ASTM C1666, ASTM C144, ASTM C618, ASTM A47, ASTM A27, ASTM A653, ASTM A1011, ASTM A1008, ASTM A1003, ASTM A500, ASTM A513, ASTM D7508/D7508M, ASTM F3125, CSA S806, CSA S807, EN 14889-1
fiber-reinforced polymer (FRP)	CSA S806
insulation	ASTM C534, ASTM C552, ASTM C591, ASTM C578, ASTM C1029, ASTM C1126, ASTM C1289, ASTM C1427, ASTM C1482, ASTM C1594
thin brick	N/A
granite	N/A
pigments	ASTM C979/C979M
net consumables	N/A



Table 1
Specifications for Materials* in Precast Concrete

PRODUCT	DESCRIPTION / SPECIFICATION
batch water	ASTM C1602 or CSA 23.1
wash water	N/A
*Precast concrete may include additional materials that are not included in this table.	

Table 2
Manufacturing Specifications for Precast Concrete

SPECIFICATION	DESCRIPTION
ASTM C478/C478M	<i>Standard Specification for Circular Precast Reinforced Concrete Manhole Sections</i>
ASTM C858	<i>Standard Specification for Underground Precast Concrete Utility Structures</i>
ASTM C913	<i>Standard Specification for Precast Concrete Water and Wastewater Structures</i>
ASTM C915	<i>Standard Specification for Precast Reinforced Concrete Crib Wall Members</i>
ASTM C1227	<i>Standard Specification for Precast Concrete Septic Tanks</i>



Table 2
Manufacturing Specifications for Precast Concrete

SPECIFICATION	DESCRIPTION
ASTM C1417/C1417M	<i>Standard Specification for Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design</i>
ASTM C1433/C1433M	<i>Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers</i>
ASTM C1540/C1540M	<i>Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts and Storm Drains</i>
ASTM C1577	<i>Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD</i>
ASTM C1613	<i>Standard Specification for Precast Concrete Grease Interceptor Tanks</i>
ASTM C1786	<i>Standard Specification for Segmental Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD</i>
CSA 23.4	<i>Precast Concrete – Materials and Construction</i>
CSA A257	<i>Standards For Concrete Pipe And Manhole Sections</i>
NPCA	<i>NPCA Quality Control Manual for Precast Concrete Plants</i>
PCI MNL-116	<i>Manual for Quality Control for Plants and Production of Structural Precast Concrete Products</i>



Table 2
Manufacturing Specifications for Precast Concrete

SPECIFICATION	DESCRIPTION
PCI MNL-117	<i>Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products</i>
PCI-128	<i>Specification for Glass-Fiber-Reinforced Concrete Panels</i>

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.

ISO 14021, *Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling)*¹

ISO 14025:2006, *Environmental labels and declarations – Type III environmental declarations – Principles and procedures*¹

ISO 21930:2017, *Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services*¹

3 TERMS AND DEFINITIONS

While this PCR will likely be used primarily in North America, it may be used in other regions where program operators deem it appropriate. Per ISO 21930:2017 Section 3 with the following additions:

¹ International Organization for Standardization. Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland. <www.iso.org>



admixture: a material other than water, aggregates, cementitious materials, and fiber reinforcement, used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing. (ACI 212)

cement, blended hydraulic: a hydraulic cement consisting of two or more inorganic constituents (at least one of which is not portland cement or portland cement clinker) which separately or in combination contribute to the strength gaining properties of the cement, (made with or without other constituents, processing additions and functional additions, by intergrinding or other blending methods). (ASTM C219)

cement, portland: a hydraulic cement produced by pulverizing clinker, consisting essentially of crystalline hydraulic calcium silicates, and usually containing one or more of the following: water, calcium sulfate, up to 5% limestone, and processing additions. (ASTM C219)

cement, portland-limestone: a hydraulic cement consisting of an intimate and uniform blend of portland cement and limestone produced by intergrinding portland cement clinker and limestone; by blending portland cement and finely divided limestone; or by a combination of intergrinding and blending, in which the amount of the limestone constituent is within specified limits. (ASTM C219)

hazardous waste: Waste identified as hazardous according to regulations applicable in the market for which the EPD is valid. For the US market, wastes are hazardous if they are regulated under the Resource Conservation and Recovery Act <www.epa.gov/rcra>, see also 40 CFR 261.33 <www.govinfo.gov/content/pkg/CFR-2011-title40-vol26/pdf/CFR-2011-title40-vol26-sec261-33.pdf>. For the Canadian market, wastes are hazardous if they are regulated under the Canadian Environmental Protection Act, 1999 Regulations <www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/permit-hazardous-wastes-recyclables/management.html>.

NOTE — hazardous waste does not include radioactive waste. See ISO 21930:2017 Section 7.2.14.

industry-wide average EPD: EPD results for a specific product or group of precast concrete products categorized by performance for a specified region and/or group of manufacturers.

metric tonne: 1,000 kilograms

net consumables: Items used during manufacturing, such as lubricants, grease and oils.



non-hazardous waste: Commercial / industrial waste that is not hazardous: dust, spoil, or other waste from raw material extraction; waste in municipal disposal scheme, and leftover or waste concrete.

product specific EPD: EPD results for a specific product or group of precast concrete products, categorized by performance and developed by a manufacturer for a specific manufacturing facility location(s).

recovered material: material that would have otherwise been disposed of as waste or used for energy recovery but has instead been collected and recovered as a material input, in lieu of new primary material, for a recycling or a manufacturing process. (ISO 14021)

short ton: 2,000 lb

4 ACRONYMS AND ABBREVIATED TERMS

Per ISO 21930:2017 Section 4 with the following additions:

FRP	fiber-reinforced polymer
PLC	portland-limestone cement
SCM	supplementary cementitious material
WWF	welded wire fabric

5 GENERAL ASPECTS

5.1 Objectives of this PCR

Per ISO 21930:2017 Section 5.1 with the following additions:

- the primary objective of this sub-category PCR is to provide common rules specific to precast concrete for the application of ISO 21930:2017 for building and civil engineering works; and
- additional objectives include to:



- describe which stages of a product’s life cycle are considered in the EPD and which processes are to be included in the life cycle stages;
- encourage precast concrete producers to quantify, report, better understand and reduce the environmental impacts of precast concrete, including materials such as reinforcement and hardware and manufacturing processes such as finishing, curing, stripping, and handling;
- promote transparency and incentivize manufacturer-specific upstream data;
- represent precast concrete products appropriately following international standards for building materials and products;
- specify the data quality to be attained in precast concrete product EPDs;
- support the use and guidance of EPDs in sustainable design construction programs, calculators, and rating systems;
- address requirements for creating an industry-wide average EPD; and
- enable consistent reporting of LCA results related to precast concrete product production.

5.2 Life cycle stages

Per ISO 21930:2017 Section 5.2 with the following clarifications:

- this PCR enables reporting of a cradle-to-gate EPD as outlined in ISO 21930 Section 5.2.2.

5.3 Average EPDs for groups of similar products

Per ISO 21930:2017 Section 5.3 with the following clarifications and additions:

- examples of average EPD groupings for precast concrete products include, for example, structural, architectural, architectural with insulation, underground, or others;



- for all environmental indicators for products included in the average, the average, minimum, and maximum values of the environmental indicator shall be reported. Therefore, the EPD would report the average, minimum, and maximum value for each environmental indicator among all of the products or plants included in the development of the average EPD; and
- for greater transparency, product-specific EPDs are encouraged.

5.4 Use of EPDs for construction products

Per ISO 21930:2017 Section 5.4 with the following clarifications and additions:

- this PCR is intended to be used to create EPDs for use in business-to-business (B2B) communication.

5.5 Comparability of EPDs for construction products

Per ISO 21930:2017 Section 5.5 with the following clarifications:

- EPDs may enable comparison between products but do not themselves compare products, as stated in ISO 14025 Sections 4 and 6.7.2. It shall be stated in EPDs created using this PCR that:

“Environmental declarations from different programs (ISO 14025) may not be comparable. EPDs are comparable only if they use the same PCR (or sub-category PCR where applicable), include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works. This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. However, variations and deviations are possible. Example of variations: different LCA software and background LCI datasets may lead to different results for the life cycle stages declared.”

5.6 Documentation

Per ISO 21930:2017 Section 5.6.



6 PCR DEVELOPMENT AND USE

Per ISO 21930:2017 Section 6 with the following additions:

- this PCR document is effective for five (5) years from the latest date of publication. If after five years, relevant changes in the product category or other relevant factors have occurred (for example, evolution of LCA methodology in ISO 21930:2017), the document will be revised. See Section 5.5 for comparability.

7 PCR FOR LCA

7.1 Methodological framework

7.1.1 LCA modeling and calculation

Per ISO 21930:2017 Sections 7.1.1, and 7.2.3 to 7.2.6.

7.1.2 Functional unit

Per ISO 21930:2017 Section 7.1.2 with the following clarifications and additions:

- no functional unit is defined in this PCR.

7.1.3 Declared unit

Per ISO 21930:2017 Section 7.1.3 with the following clarifications:

Because this PCR only includes Module A (Production), a declared unit shall be used. The declared unit shall be one metric tonne of precast concrete product. Data may additionally be presented per short ton (US imperial units).

7.1.4 Reference service life

Per ISO 21930:2017 Section 7.1.3 with the following clarifications:



— because this PCR does not address module B (Use), the reference service life (RSL) of precast concrete is not addressed.

7.1.5 System boundary with nature

Per ISO 21930:2017 Section 7.1.5.

7.1.6 System boundary between products systems

Per ISO 21930:2017 Section 7.1.6.

7.1.7 System boundaries and technical information for scenarios

Per ISO 21930:2017 Section 7.1.7 with the following additions:

— as shown in Figures 1 and 2, precast concrete components are made by placing concrete and reinforcement into formwork at the plant and curing. Production procedures vary between the different categories of precast concrete products. Architectural and structural precast concrete are made with conventional reinforcement in custom-made individual forms or standardized forms. These forms can be made of wood, fiberglass, concrete, steel and other materials and can be used multiple times. Form-release agents are applied to forms prior to placing the concrete to prevent the concrete from adhering to the forms when they are removed. The steps in the precast production process include:

- formwork preparation and losses;
- placement of reinforcement, strand, and hardware as required;
- concrete mixing;
- conveying of the concrete to the form in ready-mix trucks, specially designed transporters with a dumping mechanism that places the concrete in the form, or concrete buckets carried by overhead cranes;
- placing the concrete in the form;



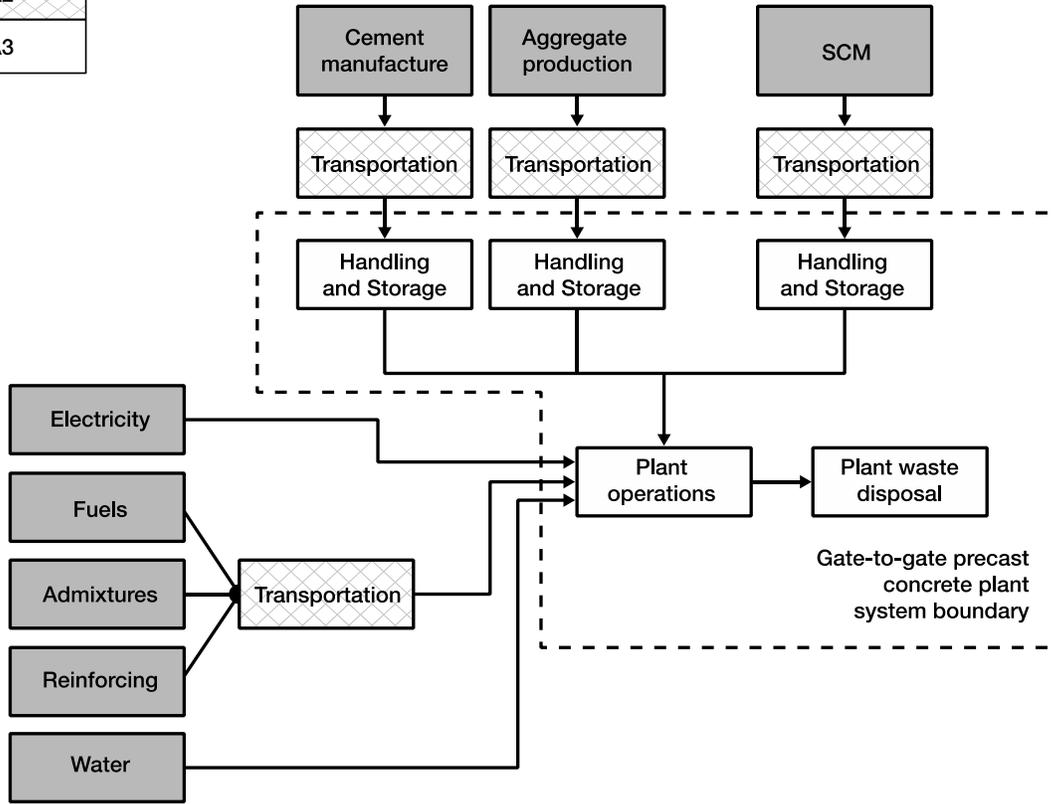
- consolidation by vibration, leveling, and/or surface finishing;

- curing; and

- form stripping and storage of the product in the yard prior to shipment.



A1
A2
A3



Cradle-to-gate precast concrete plant system boundary

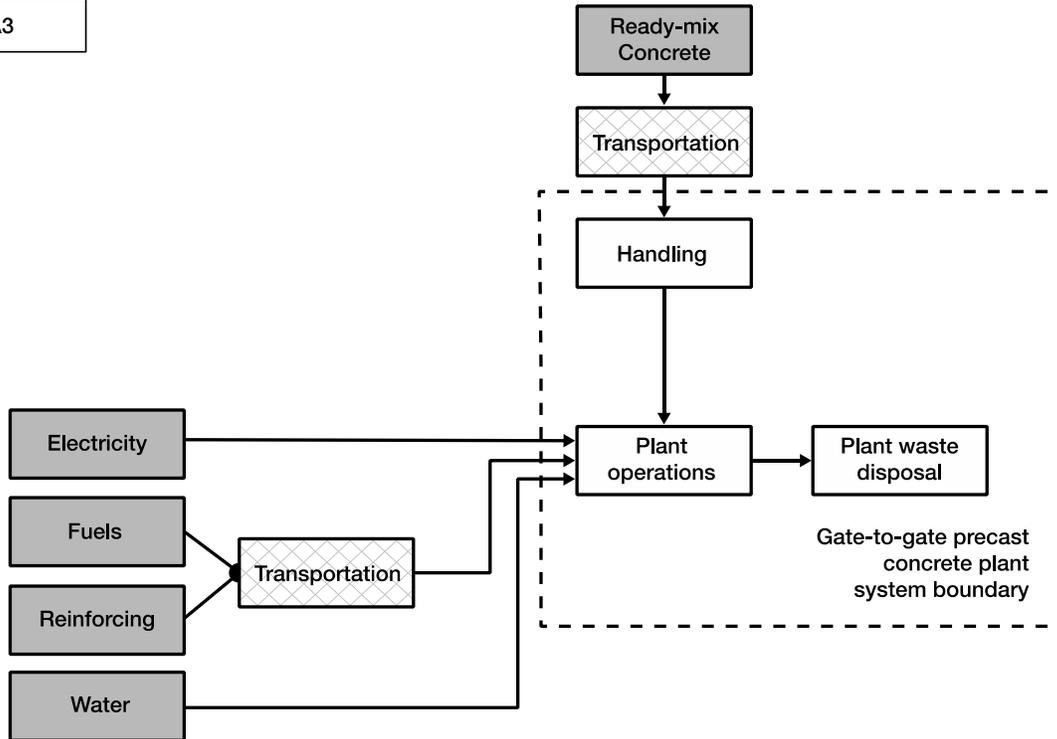
NOTE 1 — Life-cycle-stage modules are designated A1, A2, and A3 using shading in the figure.

NOTE 2 —SCM is Supplementary Cementitious Materials and consists of materials such as fly ash, slag cement (ground, granulated blast-furnace slag), and silica fume.

Figure 1
Cradle-to-gate precast plant system boundary for plants with batch facilities on site



A1
A2
A3



Cradle-to-gate precast concrete plant system boundary

NOTE 1 — There may be instances where concrete is supplied to the precast concrete plant from outside the precast concrete plant system boundary. In those cases, the manufacture and transportation of cement, aggregate, supplementary cementitious materials, and admixtures may be combined into one flow named ‘ready-mix concrete,’ which will include all upstream energy and material flows related to the manufacturing of the product ‘concrete.’

NOTE 2 — Life-cycle-stage modules are designated A1, A2, and A3 using shading in the figure.

NOTE 3 — SCM is Supplementary Cementitious Materials and consists of materials such as fly ash, slag cement (ground, granulated blast-furnace slag), and silica fume.

Figure 2

Cradle-to-gate precast plant system boundary for plants without batch facilities on site



Figure 3 shows the life-cycle stages. This PCR covers production of precast concrete from cradle-to-gate for life-cycle-stage modules A1-A3. The following are factors to be taken into account for the relevant modules.

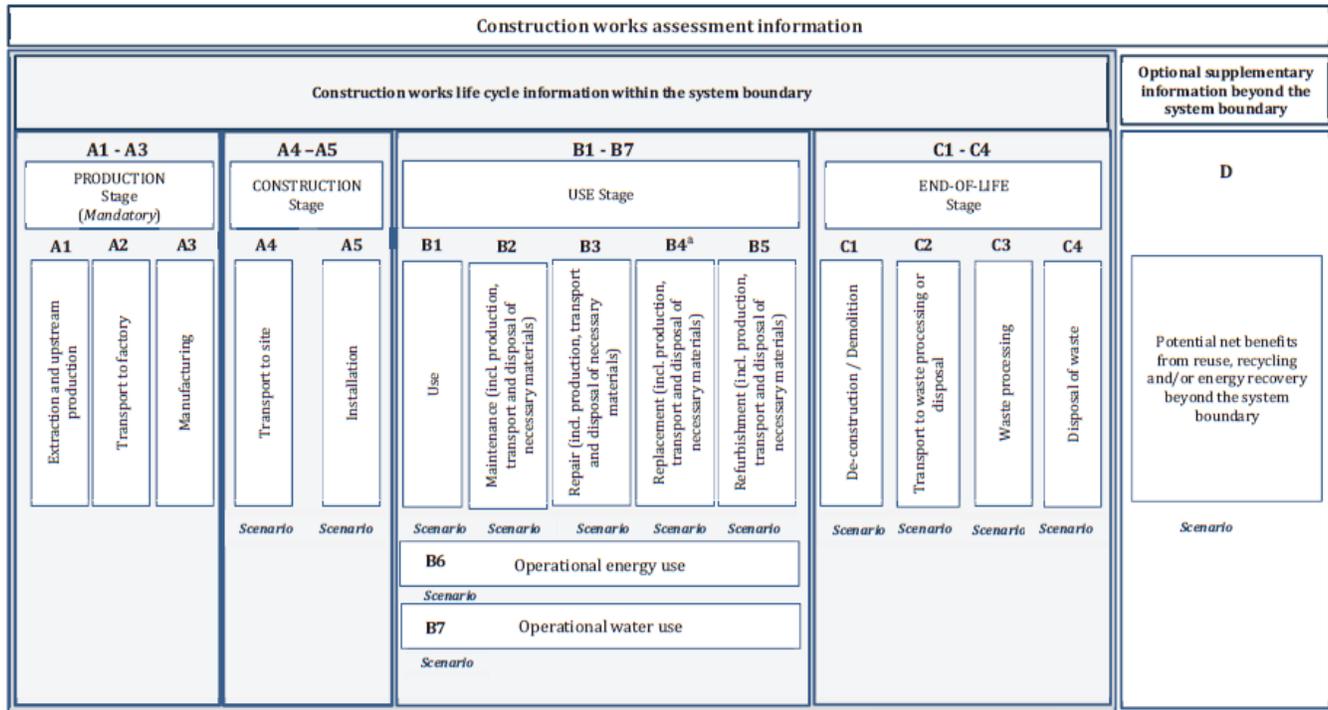
Modules A1-A3, the Product Stage:

- A1: Extraction and processing of raw materials, including fuels used in raw material production and transport within the manufacturing process (A3). Constituent materials in precast concrete may include, but are not limited to:
 - all types of cement, including normal portland cement, white cement, alternative low carbon cements, portland limestone cement, blended cements, and fine and coarse supplementary cementitious materials (fly ash, ground granulated blast furnace slag, silica fume, limestone fillers, and the like);
 - all types of aggregate (manufactured and natural, lightweight, and normal weight);
 - all types of reinforcement, including mild-steel reinforcement, stainless-steel reinforcement, fibers (synthetic and steel), prestressing strand, FRP composite reinforcement, and the like;
 - all types of insulation, including expanded polystyrene, extruded polystyrene, polyisocyanurate, and the like;
 - all admixtures; and
 - all types of hardware and embedded items, including cast-in hardware, lifting loops, blockouts, and the like.
- A2: Average or specific transportation of raw materials (including recovered materials):
 - from extraction site, manufacturing source or distribution terminal (as appropriate for each material);
 - to manufacturing site (including any recovered materials from source to be recycled in the process); and



- including empty backhauls and transportation to interim distribution centers or terminals.

- A3: Manufacturing of the product including all energy and materials required and all emissions and wastes produced. This includes, but is not limited to:
 - energy use throughout the production process, including energy used to cure the products, for heating / cooling and lighting of the manufacturing facility, for on-site transportation, and operation of equipment;
 - average or specific transportation shall be included for all inputs;
 - fresh water: batch and process water (process water would include washout water as well as curing water);
 - packaging, including transportation and waste disposal, to make product ready for shipment;
 - if packaging is purchased from multiple suppliers, then a weighted average of the transportation distances by mode from all suppliers shall be included in the LCA modeling;
 - average or specific transportation from manufacturing site to recycling / reuse / landfill for preconsumer wastes and unutilized by-products from manufacturing, including empty backhauls; and
 - recycling / reuse / energy recovery of pre-consumer wastes and by-products from production.



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

Figure 3
Life-cycle stages

Items that may be excluded from the system boundary include:

- production, manufacture, and construction of manufacturing capital goods and infrastructure;
- production and manufacture of production equipment, delivery vehicles, and laboratory equipment;
- formwork;
- personnel-related activities (travel, furniture, and office supplies); and
- energy and water use related to company management and sales activities that may be located either within the factory site or at another location.



7.1.7.1 General

Per ISO 21930:2017 Section 7.1.7.1.

7.1.7.2 A1 to A3, production stage

Per ISO 21930:2017 Section 7.1.7.2 with the following additions:

- modules A1, A2, and A3 shall not be declared as one aggregated module and shall be reported separately;
and
- transport shall include empty backhauls (bulk carriers that return empty).

7.1.7.3 A4 to A5, construction stage

Per ISO 21930:2017 Section 7.1.7.3 with the following additions:

- as this PCR does not address modules A4 to A5, this section of ISO 21930:2017 does not apply.

7.1.7.4 Use stage

Per ISO 21930:2017 Section 7.1.7.4 with the following additions:

- as this PCR does not address module B, this section of ISO 21930:2017 does not apply.

7.1.7.5 End-of-life-stage

Per ISO 21930:2017 Section 7.1.7.5 with the following additions:

- as this PCR does not address Module C, this section of ISO 21930:2017 does not apply.



7.1.7.6 Benefits and loads beyond the system boundary

Per ISO 21930:2017 Section 7.1.7.6 with the following additions:

- as this PCR does not address Module D, this section of ISO 21930:2017 does not apply.

7.1.8 Criteria for the inclusion and exclusion of inputs and outputs

Per ISO 21930:2017 Section 7.1.8.

7.1.9 Selection of data and data quality requirements

Per ISO 21930:2017 Section 7.1.9. with the following additions:

- purchased electrical energy data shall use NERC regions or similar data to represent electrical energy production for the US and Canada. Preference shall be given to datasets that include transmission and distribution losses. For regions other than the US and Canada, country- or region-specific processes shall be used for the manufacturing stage provided they are representative. The sources for electricity and the calculation procedure shall be documented; and
- credit may not be applied to LCA baseline when “green” power certificates are used, but certificates may be reported in the Additional Environmental Information section. Green power certificates must be available and provided to the program operator for the entire period of EPD validity.

7.1.10 Units

Per ISO 21930:2017 Section 7.1.10 with the following additions:

- as noted in ISO 21930:2017 SI units shall be used. Optionally, EPDs may provide both US imperial and SI units using the following conversion factors (Table 3).



Table 3
Conversion factors

Convert from:	Convert to:	Multiply by:
cubic yard (yd ³)	cubic meter (m ³)	7.654 549 E-01
square foot (ft ²)	square meter (m ²)	9.290 304 E-02
foot (ft)	meter (m)	3.048 E-01
British thermal unit (BTU)	megajoule (MJ)	1.055 056 E-03
pound (lb)	kilogram (kg)	4.535 924 E-01
short ton (T)	metric tonne (t)	9.071 848 E-01
Source: NIST: < http://physics.nist.gov/Pubs/SP811/appenB9.html >		

7.2 Inventory analysis

Per ISO 21930:2017 Section 7.2 with additional guidance as follows:

- the following materials shall be considered recovered materials and not co-products as is consistent with version 3.1 of the NSF Cement PCR and version 1 of the NSF Concrete PCR:
 - fly ash;
 - granulated blast furnace slag, and
 - silica fume.



- only the materials, water, energy, emissions, and other elementary flows associated with reprocessing, handling, sorting, and transportation from the point of the generating industrial process to their use in the precast concrete plant need to be considered for recycled or recovered materials;
- precast concrete recycling processes may be treated as closed loop recycling when the recycled precast concrete is used as a substitute for material in the precast concrete, such as crushed concrete used as aggregate. In this case, only the flows and impacts associated with recovery of the recycled precast concrete shall be taken into account and the need for allocation is avoided since the use of secondary material displaces the use of virgin (primary) materials;
- for transparency, the indicators on the emissions and uptake of CO₂ due to carbonation shall be separately reported, where available, in the relevant module in the quantification of the GWP (ISO 21930 Sections 7.2.8, 7.2.12 and 9.5.2);
- if different allocation options are relevant and a deviation of greater than 20% for any impact category is a foreseen outcome, a sensitivity analysis shall be initiated. These different allocation approaches and data sets shall be documented and declared in the EPD;
- the impacts of water desalination, if applicable, shall be included; and
- to promote uniform guidance on the data collection, calculation and reporting of results, the ACLCA methodology (ACLCA 2019) shall be used.

7.3 Impact assessment indicators describing main environmental impacts derived from LCA

Per ISO 21930:2017 Section 7.3.

Of note, ISO 21930:2017 greatly expands the indicators required to be reported. Often the best currently available data such as industry average EPDs for upstream processes do not yet align with ISO 21930:2017.



8 ADDITIONAL ENVIRONMENTAL INFORMATION

Per ISO 21930:2017 Section 8.



9 CONTENT OF AN EPD

9.1 General

Per ISO 21930:2017 Section 9.1.

9.2 Declaration of general information

Per ISO 21930:2017 Section 9.2 with the following clarifications:

- a simple visual representation of the precast concrete is required;
- the percentage of material components shall be reported. However, if the percentage of material components is considered proprietary information, alternatively, the list of materials can be reported in order of greatest mass and/or aggregated by type to protect confidential information; and
- include the following table in lieu of Figure 3 from ISO 21930:2017.

<p>ISO 21930:2017 Sustainability in Building Construction — Environmental Declaration of Building Products: serves as the core PCR NSF PCR for PRECAST CONCRETE V2 serves as the sub-category PCR Sub-category PCR review was conducted by: Thomas P. Gloria, PhD, Industrial Ecology Consultants, t.gloria@industrial-ecology.com</p>
<p>Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025: 2006 <input type="checkbox"/> internal <input type="checkbox"/> external</p>
<p>Third-party verifier: <name and contact information of third party verifier></p>
<p>For additional explanatory material: <name and email of manufacturer’s representative></p>
<p><name and version of EPD software tool (if applicable)></p>



9.3 Declaration of the methodological framework

Per ISO 21930:2017 Section 9.3 with the following additions and clarifications:

- for cradle-to-gate EPDs, scenarios are not required to be reported;
- list all secondary data sets used;
- declare software used for the underlying LCA, including version and date; and
- state whether hardware (lifting or connection) is included or not.

The EPD shall include the following:

- The following statement:

“This sub-category PCR recognizes fly ash, silica fume, and granulated blast furnace slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a precast concrete material input.”

This statement shall include any other materials that were considered recovered in the preparation of the EPD;
and

- a table summarizing the life cycle stages included in the EPD:



PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE			
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport	Waste processing	Disposal of waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X													
NOTE — X = module included															

9.4 Declaration of technical information and scenarios

ISO 21930:2017 Section 9.4 does not apply for cradle-to-gate EPDs.

9.5 Declaration of environmental indicators derived from LCA

Per ISO 21930:2017 Section 9.5 with the following additions:

— the following clarifications shall be applied and notes added:

— some of the impacts and inventory items included in ISO 21930:2017 are emerging and have high levels of uncertainty. This shall be recognized within the EPD with the following note:

“Some LCA impact categories and inventory items are still under development and can have high levels of uncertainty. To promote uniform guidance on the data collection, calculation, and reporting of results, the ACLCA methodology (ACLCA 2019) was used.”



- when upstream data (either specified in the PCR or from other sources are missing values for select impact categories or inventory items that are required to be reported in the EPD, the impact categories or inventory items shall be reported as an ‘x’ or ‘-’ and not zero and be qualified with the footnote:

“Not all LCA datasets for upstream materials include these impact categories and thus results may be incomplete. Use caution when interpreting data in these categories.”

9.6 Declaration of additional environmental information

Per ISO 21930:2017 Section 9.6 with the following additions:

- the following references shall be provided at a minimum in the EPD:
 - ISO 21930:2017 Sustainability in Building Construction — Environmental Declaration of Building Products



10 PROJECT REPORT

Per ISO 21930:2017 Section 10.



11 VERIFICATION AND VALIDITY OF AN EPD

Per ISO 21930:2017 Section 11 with the following additions:

- EPD calculations completed by software systems are permitted provided the software has been verified per similar procedures as verifying an EPD. The process used to verify the software calculations shall be publicly accessible and referenced from the EPD.



12 REFERENCES

AASHTO Standards²

AASHTO M6, *Standard Specification for Fine Aggregate for Hydraulic Cement Concrete*

AASHTO M80, *Standard Specification for Coarse Aggregate for Hydraulic Cement Concrete*

AASHTO M85, *Standard Specification for Portland Cement*

AASHTO M195, *Standard Specification For Lightweight Aggregates for Structural Concrete*

AASHTO M240, *Standard Specification for Blended Hydraulic Cement*

AASHTO M295, *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*

AASHTO M302, *Standard Specification for Slag Cement for Use in Concrete and Mortars*

AASHTO M307, *Standard Specification for Silica Fume Used in Cementitious Mixtures*

ACI Standards³

ACI 211.7R, *Guide for Proportioning Concrete Mixtures with Ground Limestone and Other Mineral Fillers*

ACI PRC-212.3, *Report on Chemical Admixtures for Concrete*

ACI ITG 10R, *Practitioner's Guide for Alternative Cements*

ACI ITG 10.1R, *Report on Alternative Cements*

ASTM Standards⁴

ASTM A27/A27M, *Standard Specification for Steel Castings, Carbon, for General Application*

ASTM A36/A36M, *Standard Specification for Carbon Structural Steel*

ASTM A47/A47M, *Standard Specification for Ferritic Malleable Iron Castings*

ASTM A108, *Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished*

ASTM A123/A123M, *Standard Specification for Corrugated Aluminum Box Culverts*

ASTM A153/A153M, *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*

ASTM A184, *Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement*

² American Association of State and Highway Transportation Officials. 555 12th Street NW, Washington, DC 20004. <www.transportation.org>

³ American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331. <www.concrete.org>

⁴ ASTM International. 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. <www.astm.org>



ASTM A307, Standard Specification for Carbon Structural Steel

ASTM A416/A416M, Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete

ASTM A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A513/A513M, Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

ASTM A555/A555M, Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods

ASTM A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

ASTM A706/A706M, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

ASTM A767/A767M, Standard Specification for Zinc-Coated (Galvanized) Steel Bars For Concrete Reinforcement

ASTM A775/A775M, Standard Specification for Epoxy-Coated Steel Reinforcing Bars

ASTM A820/A820M, Standard Specification for Steel Fibers for Fiber-Reinforced Concrete

ASTM A884/A884M, Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement

ASTM A934/A934M, Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

ASTM A955/A955M, Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement

ASTM A1003/A1003M, Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members

ASTM A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable

ASTM A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

ASTM A1035/A1035M, Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement

ASTM A1064/ A1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete



- ASTM C33/C33M, *Standard Specification for Concrete Aggregates*
- ASTM C144/C144M, *Standard Specification for Aggregate for Masonry Mortar*
- ASTM C150/C150M, *Standard Specification for Portland Cement*
- ASTM C219, *Standard Terminology Relating to Hydraulic Cement*
- ASTM C260/C260M, *Standard Specification for Air-Entraining Admixtures for Concrete*
- ASTM C330/C330M, *Standard Specification for Lightweight Aggregates for Structural Concrete*
- ASTM C478/C478M, *Standard Specification for Circular Precast Reinforced Concrete Manhole Sections*
- ASTM C494/C494M, *Standard Specification for Chemical Admixtures in Concrete*
- ASTM C534/C534M, *Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form*
- ASTM C552/C552M, *Standard Specification for Cellular Glass Thermal Insulation*
- ASTM C578/C578M, *Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation*
- ASTM C591/C591M, *Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation*
- ASTM C595/C595M, *Standard Specification for Blended Hydraulic Cements*
- ASTM C618, *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*
- ASTM C858/C858M, *Standard Specification for Underground Precast Concrete Utility Structures*
- ASTM C913/C913M, *Standard Specification for Precast Concrete Water and Wastewater Structures*
- ASTM C915/C915M, *Standard Specification for Precast Reinforced Concrete Crib Wall Members*
- ASTM C979/C979M, *Standard Specification for Pigments for Integrally Colored Concrete*
- ASTM C989/C989M, *Standard Specification for Slag Cement for Use in Concrete and Mortars*
- ASTM C1017/C1017M, *Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete*
- ASTM C1029/C1029M, *Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation*
- ASTM C1116/C1116M, *Standard Specification for Fiber-Reinforced Concrete*
- ASTM C1126/C1126M, *Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation*
- ASTM C1157/C1157M, *Performance Specification for Hydraulic Cement*
- ASTM C1227/C1227M, *Standard Specification for Precast Concrete Septic Tanks*
- ASTM C1240, *Standard Specification for Silica Fume Used in Cementitious Mixtures*
- ASTM C1289/C1289M, *Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board*
- ASTM C1417/C1417M, *Standard Specification for Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design*
- ASTM C1427/C1427M, *Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form*



ASTM C1433/C1433M, *Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers*

ASTM C1482/C1482M, *Standard Specification for Polyimide Flexible Cellular Thermal and Sound Absorbing Insulation*

ASTM C1540/C1540M, *Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts and Storm Drains*

ASTM C1577/C1577M, *Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD*

ASTM C1582/C1582M, *Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete*

ASTM C1594/C1594M, *Standard Specification for Polyimide Rigid Cellular Thermal Insulation*

ASTM C1602, *Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete*

ASTM C1613/C1613M, *Standard Specification for Precast Concrete Grease Interceptor Tanks*

ASTM C1666/C1666M, *Standard Specification for Alkali Resistant (AR) Glass Fiber for GFRC and Fiber-Reinforced Concrete and Cement*

ASTM C1786/C1786M, *Standard Specification for Segmental Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD*

ASTM C1797/C1797M, *Standard Specification for Ground Calcium Carbonate and Aggregate Mineral Fillers for use in Hydraulic Cement Concrete*

ASTM D7508/D7508M, *Standard Specification for Polyolefin Chopped Strands for Use in Concrete*

ASTM F3125/F3125M, *Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength*

CAN Standards⁵

CAN/CSA-A257.19, *Standards for Concrete Pipe and Manhole Sections*

CAN/CSA-G30.18, *Carbon Steel Bars for Concrete Reinforcement*

CAN/CSA-G40.20/G40.21, *General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel*

CAN/CGSB-1.40, *Anticorrosive Structural Steel Alkyd Primer*

CAN/CGSB-1.181, *Ready-Mixed Organic Zinc-Rich Coating*

⁵ Standards Council of Canada. 55 Metcalfe Street, Suite 600, Ottawa, ON K1P 6L5, Canada. <www.scc.ca>



CSA Standards⁶

CSA A23.1/CSA A23.2, *Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete*

CSA A23.4, *Precast Concrete - Materials and Construction*

CSA A3000, *Cementitious Materials Compendium*

CSA S806, *Design and Construction of Building Structures With Fibre-Reinforced Polymers*

CSA S807, *Specification for Fibre-Reinforced Polymers*

EN Standards⁷

EN 14889-1, *Fibres for Concrete. Steel Fibres. Definitions, Specifications and Conformity*

ISO Standards¹

ISO 14021 *Environmental Labels and Declarations - Self Declared Environmental Claims (Type II Environmental Labelling)*

ISO 14025:2006, *Environmental Labels and Declarations — Type III Environmental Declarations — Principles and Procedures*

ISO 14040:2006, *Environmental Management — Life Cycle Assessment — Principles and Framework*

ISO 14044:2006, *Environmental Management — Life Cycle Assessment — Requirements and Guidelines*

ISO 21930:2017, *Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.*

NPCA publications⁸

NPCA Quality Control Manual for Precast Concrete Plants

⁶ CSA Group. 178 Rexdale Boulevard, Toronto, ON M9W 1R3, Canada. <www.csa.ca>

⁷ European Committee for Standardization. Rue de la Science 23, B-1040 Brussels, Belgium. <www.cen.eu.com>

⁸ National Precast Concrete Association. 1320 City Center Drive #200, Carmel, IN 46032. <www.precast.org>



PCI publications⁹

PCI MNL-116, *Manual for Quality Control for Plants and Production of Structural Precast Concrete Products*

PCI MNL-117, *Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products*

ANS/PCI-128-19, *Specification for Glass-Fiber-Reinforced Concrete Panels*

Other references

American Center for Life-Cycle Assessment (ACLCA) 2019, *ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930-2017*. <<https://aclca.org/aclca-iso-21930-guidance/>>

ASTM, *Product Category Rules for Preparing an Environmental Product Declaration for Precast Concrete*, Version 1. March 2015. Extended per PCRExt 2020-102 valid through February 28, 2021 by Program Operator – NSF International⁴

North American Electric Reliability Corporation (NERC) Reporting Tools¹⁰

NSF International, *Product Category Rule for Environmental Product Declarations, PCR for Cement*. Version 2, 2020. <www.nsf.org>

US EPA, *Waste Reduction Model (WARM) – Fly Ash Chapter*¹¹

⁹ Precast / Prestressed Concrete Institute. 8770 W Bryn Mawr Avenue, Suite 1150, Chicago, IL 60631. <www.pci.org>

¹⁰ North American Electric Reliability Corporation. 3353 Peachtree Road NE, Suite 600 North Tower, Atlanta, GA 30326. <www.nerc.com>

¹¹ US Environmental Protection Agency. 1200 Pennsylvania Avenue NW, Washington, DC 20004. <www.epa.gov>



APPENDIX A: TECHNICAL REVIEW COMMITTEE

The following individuals participated in the review committee from June 2020 through April 2020.

Industry

- Robert Burak, Canadian Precast / Prestressed Concrete Institute
- Emily Clark, Clark Pacific
- Juan Gonzalez, Central Concrete Supply
- Malcolm Hachborn, M.E. Hachborn Engineering
- Shawn Kalyn, Votorantim / St. Marys Cement LLC
- David Wen, Oldcastle Infrastructure Inc.

Users

- James Bogdan, National Ready Mixed Concrete Association
- Dirk Kestner, Walter P. Moore
- Emily Lorenz, Consultant

LCA Expertise

- Stephanie Carlisle, Carbon Leadership Forum
- David Green, Master Builders Solution US, LLC
- Jamie Meil, ATHENA Sustainable Materials Institute

NSF International

- Andrea Burr



APPENDIX B: ADDITIONAL CHARACTERIZATION FACTORS FOR ADP

Table B1
Additional characterization factors for ADP

Substance	Unit	Group	Initial emission or extraction	Characterization factor kg antimony eq.	Comment
clay	kg	element	resources	1.4E-11	assimilated to silicon
bentonite	kg	element	resources	1.4E-11	assimilated to clay
limestone	kg	element	resources	0	assimilated to calcium
gravel (unspecified)	kg	element	resources	1.4E-11	assimilated to silicon
silica (SiO ₂)	kg	element	resources	1.4E-11	assimilated to silicon
sand (unspecified)	kg	element	resources	1.4E-11	assimilated to silicon

NOTE — For more information on methodology, please see Section 7.3 of ISO 21930.