



Dragon Products Company Thomaston, ME Cement Plant

An Environmental Product Declaration



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An Environmental Product Declaration

In accordance with ISO 14025 and 21930

About this EPD

This is a cradle-to-gate environmental product declaration (EPD) for portland, blended, masonry and slag cements as produced by Dragon Products Company, Inc. at its Thomaston, ME plant. The results of the underlying life cycle analysis (LCA) are computed with the North American (N.A.) version of the Global Cement and Concrete Association (GCCA) Industry EPD tool for cement and concrete [1]. This tool and the underlying LCA model and database [2] have been previously verified to conform to the prevailing Sub-Product Category Rule (PCR) [3], ISO 21930:2017 (the core PCR) [4] as well as ISO 14020:2000 [5] ISO 14025:2006 [6] and ISO 14040/44:2006 LCA standards [7], [8].

This EPD is certified by ASTM to conform to the Sub-Product Category Rule (PCR) referenced above, as well as to the requirements of ISO 14020, ISO 14025, ISO 21930 and ASTM International's General Program Instructions [9]. This EPD is intended for business-to-business audiences.

General Summary

EPD Commissioner and Owner



Dragon Products Company, Inc.

A Company of Giant Cement Holding, Inc.
U.S. Route 1
Thomaston, ME 04861
<https://www.giantcement.com>

The Thomaston, ME Cement Plant provided both LCI and meta-data for limestone extraction, clinker production, and cement manufacture for reference year 2021.

The owner of the declaration is liable for the underlying information and evidence.

Product Group and Name

Cement, UN CPC 3744.

Product Definition

Portland cement is defined as 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 C150 [10], ASTM C219 [11]).
Portland Cement *Type I*—For use when the special properties specified for any other type are not required.

Portland Cement *Type II*—For general use, especially when moderate sulfate resistance is desired.

Portland Cement *Type III*—For use when high early strength is desired.

Some cements are designated with a combined type classification, such as Type I/II, indicating that the cement meets the requirements of the indicated types and is being offered as suitable for use when either type is desired.

Blended cement is 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).





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- Type IL (ASTM C595 [12]) — is a Portland-limestone cement and is a hydraulic cement in which the limestone content is more than 5% but less than or equal to 15% by mass of the blended cement.

Masonry cement is hydraulic cement manufactured for use in mortars for masonry construction or in plasters, or both, which contains a plasticizing material and, possibly, other performance-enhancing addition(s). Mortar cements are produced in Type N, Type S, and Type M classifications for use in preparation of ASTM Specification C270 [13].

Slag cement, UN CPC 3744 and UNSPSC Code 30111601, is defined as granulated blast-furnace slag that has been ground to cement fineness, with or without additions, and is a hydraulic cement [16].

Product Category Rules (PCR)	NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021 [3]. AND NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Slag Cement, v2.0, December 2020 [16].
Date of Issue & Validity Period	08/31/2022 – 5 years
Declared Unit	1 metric ton of cement

EPD and Project Report Information

Program Operator	ASTM International	
Declaration Number	EPD 361	
Declaration Type	Cradle-to-gate (modules A1 to A3). Facility and product-specific.	
Applicable Countries	United States	
Product Applicability	Portland cement is the basic ingredient of concrete. Concrete, one of the most widely used construction materials in the world, is formed when Portland cement creates a paste with water that binds with sand and rock to harden. Slag cement is a supplementary cementing material able to substitute for Portland cements on a one-to-one basis.	
Content of the Declaration	This declaration follows Section 9; Content of an EPD, NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021 [3].	
This EPD was independently verified by ASTM in accordance with ISO 14025 and the reference PCR:	Tim Brooke ASTM International 100 Barr Harbor Drive PO Box C700	Thomas P. Gloria, Ph. D. Industrial Ecology Consultants 35 Bracebridge Rd. Newton, MA 02459-1728





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Internal	External X	West Conshohocken PA 19428-2959, USA cert@astm.org
Notes		The EPD results reported herein are computed using the N.A. GCCA Industry EPD tool for Cement and Concrete (https://concrete-epd-tool.org).
EPD Prepared by:		Athena Sustainable Materials Institute 280 Albert Street, Suite 404 Ottawa, Ontario, Canada K1P 5G8 info@athenasmi.org www.athenasmi.org



PCR Information

Program Operator	NSF International
Reference PCR	Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021 [3]. AND NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Slag Cement, v2.0, December 2020 [16].
PCR review was conducted by:	Thomas P. Gloria, Ph. D. (Chair), Industrial Ecology Consultants Mr. Jack Geibig, EcoForm (cements) /Dr. Michael Overcash, Environmental Clarity (slag cement) Mr. Bill Stough, Sustainable Research Group

Dragon Products Company, Inc. and Production Facility

Dragon Products Company, Inc. has been producing high quality Portland cement since the 1920s and is the only cement manufacturer in New England. Dragon Products Company, Inc. modernized its operations in 2001 with a new finish mill, raw mill, preheater/precalciner kiln system, and cooler. The plant modernization decreased energy consumption, decreased emissions, and increased production efficiency. Its Portland cement products have been used by its customers in the northeast for many projects such as the Maine Medical Building and Portsmouth Naval Shipyard. Dragon Products Company, Inc. currently employs over 80 Maine residents and indirectly supports another 400 jobs in the area. Dragon contributes regularly to support and bolster the local communities in which the company operates, including volunteering annually at the Rockland Lobster Festival food tent. Dragon Products Company, Inc. aligns its values with those of the World Business Council for Sustainable Development and the Global Cement and Concrete Association by ensuring that its operations are sustainable for current and future generations. Dragon Products Company, Inc. minimizes the impact of its operations on its neighbors and focuses on operating in an environmentally ethical manner. Additionally, Dragon Products Company, Inc. conserves natural resources by recycling our by-products and making them into usable products. Dragon Products Company, Inc. also recovers energy from recycled, alternative fuels, which replaces a portion of the fossil fuel usage. The health and safety of our employees is vital to our success as we strive for zero harm.





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Facility Name: Dragon Products Company, Inc.
Thomaston Plant
U.S. Route 1
Thomaston, ME 04861

Product Description

This EPD reports environmental transparency information for five cement types produced by Dragon Products Company, Inc. at its Thomaston, ME plant. Cements are hydraulic binders and are manufactured by grinding cement clinker and other main or minor constituents into a finely ground, usually grey colored mineral powder. When mixed with water, cement acts as a glue to bind together the sand, gravel and/or crushed stone to form concrete, one of the most durable, resilient, and widely used construction materials in the world. Slag cement is a supplementary cementitious material (SCM). Iron blast furnace slag (BFS) is a waste material of pig iron production and as such is categorized as a “recovered material” [16]. To transform iron BFS, so it can be used as a SCM in concrete and mortars, it is first rapidly quenched with water to form granules known as Granulated Blast Furnace Slag (GBFS). It then undergoes dewatering, crushing of oversized material only (if applicable), and storage at the granulating facilities. GBFS is then shipped to the grinding facilities where it undergoes dewatering/drying (if applicable), iron removal from slag granules (if applicable), crushing (if applicable), grinding, and packaging (if applicable) [16]. The Table below identifies the constituents and applicable standards for each cement type. Cements are primarily sold packaged.

Products and Standards

Inputs	Portland Type I/II ASTM C150	Portland Type III ASTM C150	Blended Type IL ASTM C595	Masonry ASTM C270	Slag Cement ASTM C989
Clinker	92%	91%	85%	56%	
Gypsum	6%	6%	5%	6%	
Limestone	2%	3%	10%	39%	
GBFS					100%
Other	<1%	<1%	<1%	<1%	<1%
Total	100%	100%	100%	100%	

Applicable Standards:

- ASTM C150 / C150M – 20 Standard Specification for Portland Cement
- ASTM C270 – 19 Standard Specification for Mortar for Unit Masonry
- ASTM C595 / C595M – 20 Standard Specification for Blended Hydraulic Cement
- ASTM C989/C989M, Standard Specification for Slag Cement for Use in Concrete and Mortars
- AASHTO M 85-20 Standard Specification for Portland Cement (ASTM Designation: C150 / C150M - 20)

Declared Unit

The declared unit is one metric ton of cement.

System Boundary

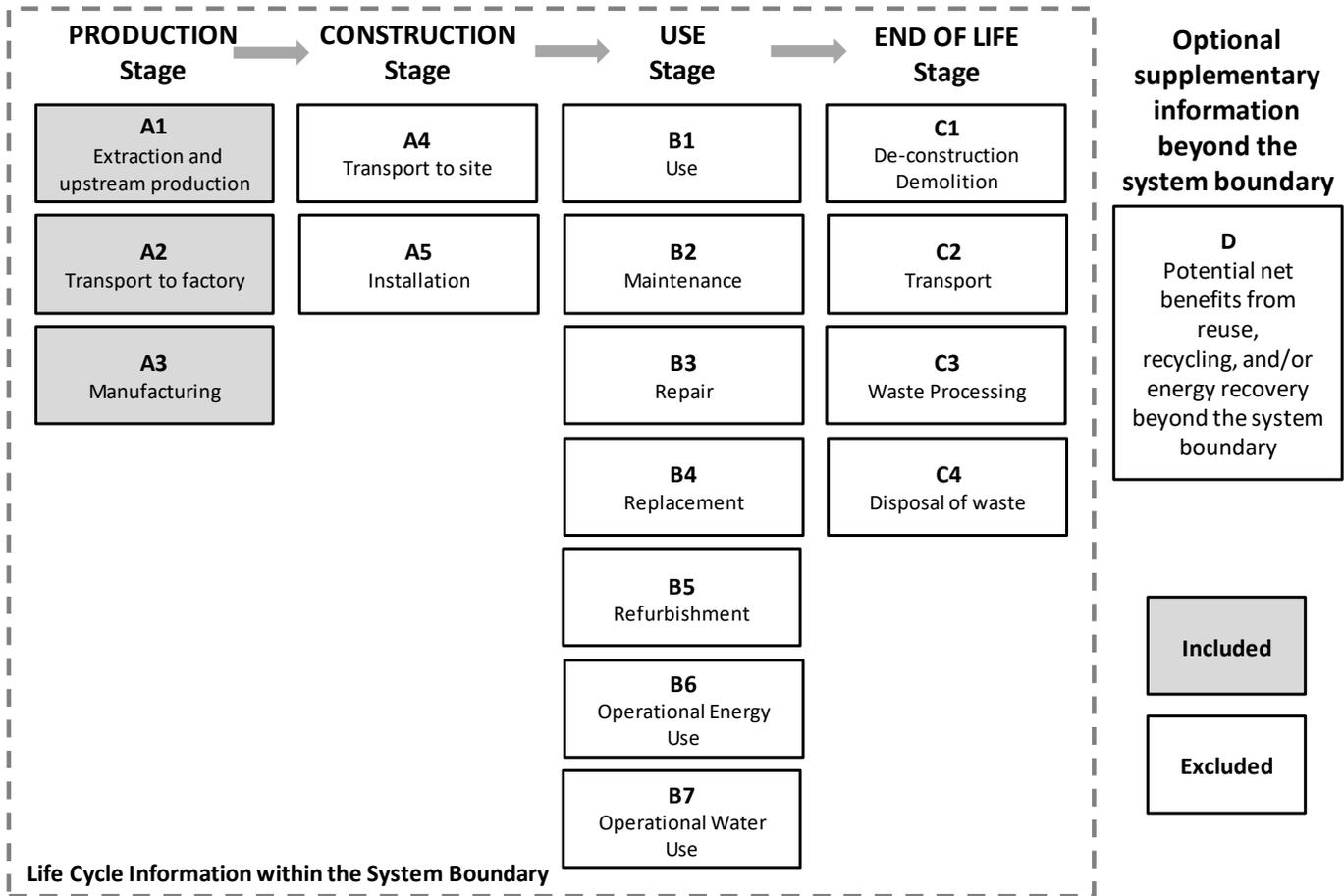
This is a cradle-to-gate EPD covering the production stage (A1-A3) as depicted in the figure below. The production stage includes extraction of raw materials (cradle) through the manufacture and packaging of cements ready for shipment (gate). The Thomaston Cement Plant sources its limestone supply from an adjacent, on-site quarry.





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Items 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
- Personnel-related activities (travel, furniture, and office supplies)
- Energy and water use related to company management and sales activities that may be located either within the factory site or at another location

Cut-off Criteria

The cut-off criteria as per NSF PCRs, Section 7.1.8 [3] and ISO 21930, 7.1.8 [4] were followed. Per ISO 21930, 7.1.8, all input/output data required were collected and included in the LCI modelling. No substances with hazardous and toxic properties that pose a concern for human health and/or the environment were identified in the framework of this EPD.

Data Collection

Gate-to-gate input/output flow data were collected for the following processes for the reference year 2021:

- Limestone quarry operations, clinker production, and cement manufacture.





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Allocation Rules

Allocation of inventory flows and subsequent environmental impact is relevant when assets are shared between product systems. The allocation method prescribed by the PCR [3] is applied in the underlying LCA model. Both sub-category PCR recognizes fly ash, furnace bottom ash, mill scale, polluted soils, spent catalyst, aluminum oxide waste, silica fume, granulated blast furnace slag, iron rich waste, cement kiln dust (CKD), flue gas desulfurization (FGD) gypsum, calcium fluoride rich waste and postconsumer gypsum as recovered materials and thus, the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a cement material input. Further, used tires, plastics, solvents, used oil and oily waste, coal/carbon waste, roofing asphalt, household refuse-derived waste, non-hazardous liquid waste, industrial sludge, and agricultural waste are considered non-renewable and/or renewable secondary fuels. Only the materials, water, energy, emissions, and other elemental flows associated with reprocessing, handling, sorting and transportation from the point of the generating industrial process to their use in the production process are considered. All emissions from combustion at the point of use are considered. For co-products, no credit is considered, and no allocation is applied. See the LCA model and LCA database reports of the N.A. version of GCCA's Industry Tool for EPDs of cement and concrete for more information [1 & 2].

Data Quality Requirements and Assessment

Data Quality Requirements	Description
Technology Coverage	<p>Data represents the prevailing technology in use at the Thomaston Cement Plant. Whenever available, for all upstream and core material and processes, North American typical or average industry LCI datasets were utilized.</p> <p>The Thomaston Cement Plant utilizes a <i>dry process with preheater and precalciner kiln technology</i>.</p> <p><i>Technological representativeness is characterized as "high".</i></p>
Geographic Coverage	<p>The geographic region considered is U.S.</p> <p><i>Geographical representativeness is characterized as "high".</i></p>
Time Coverage	<p>Activity (primary) data are representative of 2021 calendar year (12 months).</p> <ul style="list-style-type: none"> - Thomaston limestone extraction, - Thomaston clinker production, - Thomaston cement manufacturing, - In-bound/out-bound transportation data - primary data collected for quarry site and cement manufacturing plant. <p><i>Temporal representativeness is characterized as "high".</i></p>





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Completeness	All relevant, specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled in the GCCA Tool to complete production profile for Dragon Products Company, Inc. cement products. The Thomaston Cement Plant operates a continuous emissions monitoring system and reports emissions to the US EPA. These data for 2021 were drawn on in the completion of this EPD. The completeness of the foreground process chain in terms of process steps is rigorously assessed.
Consistency	To ensure consistency, cross checks of the energy demand and the calculated raw meal to clinker ratio against ranges reported in the WBCSD Cement Sustainability Initiative, Cement CO2 and Energy Protocol, v3.1 December, 2013 were conducted [14]. The LCA team conducted mass and energy balances at the facility level and selected process levels to maintain a high level of consistency
Reproducibility	External reproducibility is not possible as the source LCI data and subsequent LCA background reports are confidential.
Transparency	Activity datasets are disclosed in the project LCI compilation, and the background reports generated by the GCCA Tool.
Uncertainty	A <i>sensitivity check</i> was conducted relative to the PCA industry average [15]. The variation across significant inputs were found to be well within the expected range and hence, there is high degree of confidence in the results.

Life Cycle Impact Assessment Results: Thomaston Cement Plant

This section summarizes the production stage life cycle impact assessment (LCIA) results including resource use and waste generated metrics based on the cradle-to-gate life cycle inventory inputs and outputs analysis. The results are calculated based on 1 metric ton of each cement type as produced at the Thomaston, ME plant.

It should be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks [4], [5]. Further, many LCA impact categories and inventory items are still emerging or under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting results for these categories – identified with an “*” [3].

Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products [3]. Environmental declarations from different programs may not be comparable [8]. EPDs are comparable only if they comply with ISO 21930, use the same, sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works [3].





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Production stage EPD Results – per metric ton

Impact category and inventory indicators	Unit	Portland Type I/II ASTM C150	Portland Type III ASTM C150	Blended Type IL ASTM C595	Masonry ASTM C270	Slag Cement ASTM C989
Global warming potential, GWP 100, AR5	kg CO2 eq	979	974	910	611	234
Ozone depletion potential, ODP	kg CFC-11 eq	3.3E-05	3.3E-05	3.1E-05	2.4E-05	4.7E-05
Smog formation potential, SFP	kg O3 eq	32.7	32.6	30.7	21.9	25.5
Acidification potential, AP	kg SO2 eq	1.4	1.4	1.4	1.0	3.4
Eutrophication potential, EP	kg N eq	0.2	0.2	0.2	0.2	1.1
Abiotic depletion potential for non-fossil mineral resources, ADP elements*	kg Sb eq	1.8E-04	1.8E-04	1.7E-04	1.5E-04	1.8E-04
Abiotic depletion potential for fossil resources, ADP fossil*	MJ LHV	353	352	336	264	428
Renewable primary resources used as an energy carrier (fuel), RPRE*	MJ LHV	143	143	138	115	209
Renewable primary resources with energy content used as material, RPRM*	MJ LHV	40	40	40	40	40
Non-renewable primary resources used as an energy carrier (fuel), NRPRE*	MJ LHV	2536	2529	2399	1840	3919
Non-renewable primary resources with energy content used as material, NRPRM*	MJ LHV	0.4	0.4	0.4	0.4	0.4
Secondary materials, SM*	kg	24	23	22	14	1000
Renewable secondary fuels, RSF *	MJ LHV	45	45	42	27	0
Non-renewable secondary fuels, NRSF *	MJ LHV	177	176	164	108	0
Recovered energy, RE*	MJ LHV	0	0	0	0	0
Consumption of freshwater, FW*	m3	0.7	1.4	1.3	1.1	1.3
Hazardous waste disposed, HWD*	kg	0.6	0	0	0	0
Non-hazardous waste disposed, NHWD *	kg	39.9	39.9	39.5	37.9	34.9
High-level radioactive waste, conditioned, to final repository, HLRW*	kg	x ¹⁾	x ¹⁾	x ¹⁾	x ¹⁾	x ¹⁾





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Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW*	kg	x ¹⁾				
Components for re-use, CRU*	kg	0	0	0	0	0
Materials for recycling, MFR*	kg	0.4	0.4	0.4	0.4	0
Materials for energy recovery, MER*	kg	0	0	0	0	0
Recovered energy exported from the product system, EE*	MJ LHV	0	0	0	0	0

Additional Inventory Parameters for Transparency

Global warming potential - biogenic, GWPbio*	kg CO ₂ eq	2.0	2.0	1.9	1.5	1.6
Emissions from calcination*	kg CO ₂ eq	481	478	446	294	0
Emissions from combustion of waste from renewable sources*	kg CO ₂ eq	0.03	0.03	0.03	0.02	0
Emissions from combustion of waste from non-renewable sources*	kg CO ₂ eq	22	21	20	13	0

Table Notes:

x¹⁾ – The GCCA EPD Tool does not support these indicators.

* Use caution when interpreting results for these categories

LCA Interpretation

For portland cement based products, the Manufacturing module (A3) drives most of the potential environmental impacts. Manufacturing impacts are primarily driven by energy use (electricity and thermal fuels) during the pyroprocessing of limestone in the production of clinker. Clinker content in cement similarly defines the relative environmental profile of the final cement product. Raw material extraction (A1) is the second largest contributor to the Production stage EPD results, followed by transportation (A2). Dragon Products' slag cement profile is dominated by A2 due to the long distance transport of the recovered raw material – granulated blast furnace slag.

Additional Environmental Information

Environmental Protection and Equipment

Dragon Products Company, Inc. manufacturing facilities comply with the U.S. Environmental Protection Agency (EPA) regulations, monitor, and report the emissions to air during the manufacturing process as per the following:
 - EPCRA Section 313 Toxic Release Inventory reporting (U.S) <https://www.epa.gov/toxics-release-inventory-tri-program>, accessed 12-2020.

Dragon Products Company, Inc.'s EMS was developed based on the ISO 14001: 2004 Standards and the EPA Compliance-Focused Environmental Management System Enforcement Agreement Guidance.





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Committed to sustainability, the Thomaston Cement Plant co-processes by-product materials by recovering energy from *tires, carpets, and used oil* to replace some of the fossil fuels and mineral resources used in cement processing.

Air pollution abatement equipment used at the Thomaston Cement Plant consist of high and low temperature baghouses, cartridge filters, and a selective non-catalytic reduction system.

References

1. Global Cement and Concrete Association (GCCA) and Portland Cement Association (PCA), *GCCA Industry EPD Tool for Cement and Concrete (V3.0), Users Manual, North American version*, Prepared by Quantis, April 2021. <https://demo.gcca.quantis.solutions/us>
2. Global Cement and Concrete Association (GCCA) 2021. LCA Database, North American version, Prepared by Quantis, April 2021
3. NSF International, Product Category Rule Environmental Product Declarations, PCR for Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021.
4. ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
5. ISO 14020:2000 Environmental labels and declarations — General principles
6. ISO 14025:2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.
7. ISO 14040:2006/Amd1:2020 Environmental management - Life cycle assessment - Principles and framework.
8. ISO 14044:2006/Amd1:2017/Amd2:2020 Environmental management - Life cycle assessment - Requirements and guidelines.
9. ASTM General Program Instructions. V.8.0, April 29, 2020.
10. ASTM C150 / C150M – 20 Standard Specification for Portland Cement.
11. ASTM C219 - Standard Terminology Relating to Hydraulic and Other Inorganic Cements
12. ASTM C595 / C595M - 21 Standard Specification for Blended Hydraulic Cements
13. AASHTO M 85-21 Standard Specification for Portland Cement (ASTM Designation: C150/C150M-21)
14. WBCSD CSI 2013: CO₂ and Energy Protocol Version 3.1 of 9 December 2013. <https://www.cement-co2-protocol.org/en/>
15. Portland Cement Association Environmental Product Declaration – Portland Cement, ASTM International, March 12, 2021. https://www.astm.org/CERTIFICATION/DOCS/634.EPD_for_Portland_Athena_Final_revised_04082021.pdf
16. NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Slag Cement, v2.0, December 2020.

