



Environmental Product Declaration – IRON GUARD®¹

Iron Guard® is a high gloss, 100% acrylic, waterborne, corrosion resistant coating designed for new construction or maintenance use. This product can be used directly over prepared substrates.

The product image to the right is an example of one of the formulas covered by the EPD. A list of all relevant IRON GUARD formulas is shown in Table 1 on page 2 of the EPD.



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Program Operator	NSF International
Declaration Holder	The Sherwin-Williams Company
Declaration Prepared by	Doug Mazeffa (douglas.p.mazeffa@sherwin.com)
Declaration Number	EPD10132
Declared Product	Iron Guard
Product Category and Subcategory	Architectural Coatings – Interior & Exterior Coatings
Program Operator	NSF International ncss@nsf.org
Reference PCR	PCR for Architectural Coatings – 7-18-2015

Date of Issue	4/5/18
Period of Validity	5 Years

Contents of the Declaration	<ul style="list-style-type: none"> – Product definition and material characteristics – Overview of manufacturing process – Information about in-use conditions – Life cycle assessment results – Testing verifications
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The PCR review was conducted by	Thomas P. Gloria, Ph. D. t.gloria@industrial-ecology.com
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This EPD was independently verified by NSF International in accordance with ISO 21930 and ISO 14025. <input type="checkbox"/> Internal <input checked="" type="checkbox"/> External	Jenny Oorbeck joorbeck@nsf.org 
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by	Jack Geibig - EcoForm jgeibig@ecoform.com 

Functional Unit:	1m ² of covered and protected substrate for a period of 60 years (the assumed average lifetime of a building)
Market-Based Lifetime Used in Assessment	5 years or 10 years depending on use
Design Lifetime Used in Assessment	Varies by base type.
Test Methods Used to Calculate Design Life	All tests listed on page 7
Estimated Amount of Colorant	Varies (see Table 2)
Data Quality Assessment Score	Very Good
Manufacturing Location(s)	Various Plants Throughout the United States
Software Program Used	GaBi (most recent version available at time of report)

¹ 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, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 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.



Product Definition:

IRON GUARD is a family of interior/exterior architectural coatings manufactured by The Sherwin-Williams Company, headquartered in Cleveland, Ohio. IRON GUARD is manufactured in a number of Sherwin-Williams facilities across the United States and the data used by the LCA were representative of all Sherwin-Williams facilities in which IRON GUARD was produced. These coatings are designed to cover and protect architectural surfaces such as walls and ceilings. For information about specific products, please visit www.sherwin-williams.com/.

Product Classification and Description:

The IRON GUARD products listed below are included within this assessment. The primary differences between these products are gloss levels (sheen) and base types. For information on other attributes of each of the specific formulations, please visit www.krylonindustrial.com/.

Table 1. List of IRON GUARD Formulas Assessed by LCA Model and Report.

<u>Product Number</u>	<u>Sheen</u>	<u>Base Type as Defined by PCR</u>
K11001011	Safety Red	Mid Base
K11001131	Gloss Black	Other
K11001201	Flat Black	Other
K11003271	Light Machinery Gray (ANSI-61)	Light Base
K11004041	Gloss White	Tintable White
K11004711	New Cat Yellow	Light Base
K11004991	Safety Orange	Light Base
K11006631	Dark Machinery Gray (ANSI-49)	Mid Base
K11006951	Red Primer	Primer
K11007751	Semi-Gloss Black	Other
K11008251	Gray Primer	Primer



K11018001	Safety Blue	Light Base
K11029101	Safety Yellow	Light Base
K11044001	Safety Green	Light Base
K11072501	White Base	Tintable White
K11072521	Deep Base	Deep Base
K11072531	Clear Base	Neutral Base
K000Z6631-16	White Primer	Primer
K11001801	Red Primer (New)	Primer
K11001802	Gray Primer (New)	Primer
K11001803	White Primer (New)	Primer

Under the Product Category Rule (PCR) for Architectural Coatings, IRON GUARD falls under the following heading:

- “a decorative or protective paint or coating that is formulated for interior or exterior architectural substrates including, but not limited to: drywall, stucco, wood, metal, concrete, and masonry.”

Architectural coatings are manufactured in a way similar to other paint and coating products. Raw materials are manually added in appropriate quantities into a high-speed disperser which are mixed. The product is then moved via compressed air or gravity and filled into containers and transported to the distribution center and finally to the point of sale. A customer travels to the store to purchase the product and transports the coating to the site where it is applied. The applied coating adheres to the substrate where it remains until the substrate is disposed. Any unused coating will be disposed by the user as well. Because the functional unit mandates a 60 year product life, multiple repaints were necessary and were accounted for by the LCA models.

The typical composition of an IRON GUARD coating is shown by % weight below.

- Water (40%-60%)
- Resin (10%-30%)
- Extender Pigments (0%-20%)
- Titanium Dioxide [CAS # 13463-97-7] (0%-20%)
- Calcium Carbonate [CAS # 1317-65-3] (0%-15%)



- Talc [CAS # 14807-96-6] (0%-10%)
- Carbon Black [CAS # 1333-86-4] (0%-5%)
- Iron Oxide [CAS # 1309-37-1] (0%-5%)
- Phenoxypropanol [CAS # 770-35-4] (0%-2%)

Other than the materials with CAS numbers listed above, there are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting. For additional information about product hazards, please refer to the Safety Data Sheet for the specific IRON GUARD formula available on www.krylonindustrial.com/.

About Sherwin-Williams:

For 150 years, Sherwin-Williams has provided contractors, builders, property managers, architects and designers with the trusted products they need to build their business and satisfy customers. IRON GUARD is just one more way we bring you industry-leading paint technology — innovation you can pass on to your customers. Plus, with more than 4,000 stores and 2,400 sales representatives across North America, personal service and expert advice is always available near jobsites. Find out more about IRON GUARD at your nearest Sherwin-Williams store or to have a sales representative contact you, call 800-524-5979.



Definitions:

Acronyms & Abbreviated Terms:

- **ACA:** American Coating Association
- **ASTM:** A standards development organization that serves as an open forum for the development of international standards. ASTM methods are industry-recognized and approved test methodologies for demonstrating the durability of an architectural coating in the United States.
- **ecoinvent:** 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 form of as Type III environmental declarations under ISO 14025. 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 PE INTERNATIONAL GaBi Databases are LCA databases that contain ready-to-use Life Cycle Inventory profiles.
- **LCA:** Life Cycle Assessment or Analysis. 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).
- **NCSS:** NSF International's National Center for Sustainability Standards
- **PCR:** Product Category Rule. A PCR defines the rules and requirements for creating EPDs of a certain product category.
- **TRACI:** Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts.

Terminology:

- **Architectural coating:** a coating recommended for field application to stationary structures or their appurtenances at the site of installation, to portable buildings, to pavements, or to curbs. For purposes of this PCR an 'architectural coating' does not include adhesives and coatings for shop applications or original equipment manufacturing, nor does it include coatings solely for application to non-stationary structures, such as airplanes, ships, boats, and railcars. *Please see the product category requirements in Section 1.1 of the PCR.*
- **Biologic growth or bio deterioration:** any undesirable change in material properties brought about by the activities of microorganisms.
- **Blistering:** the formation of dome shaped hollow projections in paints or varnish films resulting from the local loss of adhesion and lifting of the film from the surface or coating.
- **Burnish resistance:** the resistance of a coating to an increase in gloss or sheen due to polishing or rubbing.
- **Design life:** The estimated lifetime of a coating based solely on its hiding and performance characteristics determined by results in certain ASTM durability tests.



- **Durability:** the degree to which coatings can withstand the destructive effect of the conditions to which they are subjected and how long they retain an acceptable appearance and continue to protect the substrate.
- **Erosion:** the wearing away of the top coating of a painted surface e.g., by chalking, or by the abrasive action of windborne particles of grit, which may result in exposure of the underlying surface. The degree of resistance is dependent on the amount of coating retained.
- **Flaking/Peeling:** the phenomenon manifested in paint films by the actual detachment of pieces of the film itself either from its substrate or from paint previously applied. Peeling can be considered as an aggravated form of flaking. It is frequently due to the collection of moisture beneath the film.
- **Gloss:** a value of specular reflection which is often used to categorize certain types of paints.
- **Intermediate processing:** the conversion of raw materials to intermediates (e.g. titanium dioxide ore into titanium dioxide pigment, etc.).
- **Market-based life:** The estimated lifetime of a coating based off the actual use pattern of the product type. In this instance, a repaint may occur before the coating fails.
- **Pigment:** the material(s) that give a coating its color.
- **Primary materials:** resources extracted from nature. Examples include titanium dioxide ore, crude oil, etc. that are used to create basic materials used in the production of architectural coatings (e.g., titanium dioxide).
- **Resin/Binder:** acts as the glue or adhesive to adhere the coating to the substrate.
- **Scrubbability or scrub resistance:** the ability of a coating to resist being worn away or to maintain its original appearance when rubbed repetitively with an abrasive material.
- **Secondary materials:** recovered, reclaimed, or recycled content that is used to create basic materials to be used in the production of architectural coatings.
- **Washability:** the ease with which the dirt can be removed from a paint surface by washing; also refers to the ability of the coating to withstand washing without removal or substantial damage.



Underlying Life Cycle Assessment Methodology:

Functional Unit:

Per the reference PCR, the functional unit for the study was covering and protecting 1m² of substrate for a period of 60 years (the assumed lifetime of a building). The product has no additional functionalities beyond what is stated by the functional unit. Since Iron Guard is designed to be applied to both interior and exterior substrates, it was assessed using both performance schemes and results are included for both application types.

In the reference PCR, product life for interior architectural coatings was calculated both in terms of a typical market life (5 years) and a technical life (either 3,7, or 15 years depending on performance in certain durability tests/methodologies prescribed in the reference PCR). In order to determine the design life of the IRON GUARD formulas, the following durability test methodologies (which were stated in the reference PCR) were utilized:

- ASTM D2805-11 – Opacity
- ASTM D2486-06(2012)e1 – Scrub Resistance
- ASTM D6736-08(2013) – Burnish
- ASTM D4828-94(2012)e1 – Washability

In the reference PCR, product life for exterior architectural coatings was calculated both in terms of a typical market life (10 years) and a technical life (either 5,10, or 20 years depending on performance in certain durability tests/methodologies prescribed in the reference PCR). In order to determine the design life of the IRON GUARD formulas, the following durability test methodologies (which were stated in the reference PCR) were utilized:

- ASTM D2805-11 – Opacity
- ASTM D714-02(2007) - Blistering
- ASTM D662-93(2011) – Erosion
- ASTM D772-86(2011) - Flaking/Peeling
- ASTM D3274-95 or 09(2013) – Biologic Growth

Based on the durability test results, the appropriate quality levels and coating quantities were derived for each IRON GUARD formula. If testing results were unavailable for a formula, then it was assumed to be of 'low' quality. This is consistent with the reference PCR.



Table 2. Interior Formula Lifetimes and Quantity of Coating Needed to Satisfy Functional Unit

Product Formula	Quality Level ²	Market-Based Lifetime (years)	Corresponding Design Life (years)	Total Quantity Needed using Market-Based Life (kg) ³	Total Quantity Needed using Design Life (kg) ⁴	Tint Needed - Market (grams)	Tint Needed - Design (grams)
K11001011	High	5	15	1.01	0.33	23	7
K11001131	High	5	15	1.01	0.33	31	10
K11001201	High	5	15	1.09	0.36	67	22
K11003271	High	5	15	1.05	0.35	24	8
K11004041	High	5	15	1.15	0.38	35	11
K11004711	High	5	15	1.07	0.35	66	22
K11004991	High	5	15	1.02	0.34	23	7
K11006631	High	5	15	1.08	0.36	33	11
K11006951	Primer	5	3	1.16	1.93	0	0
K11007751	High	5	15	1.06	0.35	32	10
K11008251	Primer	5	3	1.20	2.00	0	0
K11018001	High	5	15	1.04	0.34	37	62
K11029101	High	5	15	1.05	0.35	32	10
K11044001	High	5	15	1.03	0.34	31	10
K11072501	High	5	15	1.12	0.37	34	11
K11072521	High	5	15	1.07	0.35	33	11
K11072531	High	5	15	0.99	0.33	30	10
K000Z6631-16	Primer	5	3	1.19	1.99	0	0
K11001801	Primer	5	3	1.43	2.38	0	0
K11001802	Primer	5	3	1.48	2.47	0	0
K11001803	Primer	5	3	1.48	2.47	0	0

Table 3. Exterior Formula Lifetimes and Quantity of Coating Needed to Satisfy Functional Unit

Product Formula	Quality Level ⁵	Market-Based Lifetime (years)	Corresponding Design Life (years)	Total Quantity Needed using Market-Based Life (kg) ⁶	Total Quantity Needed using Design Life (kg) ⁷	Tint Needed - Market (grams)	Tint Needed - Design (grams)
K11001011	High	10	20	0.50	0.25	6	11
K11001131	High	10	20	0.50	0.25	8	15
K11001201	High	10	20	0.55	0.27	17	34
K11003271	High	10	20	0.53	0.26	6	12
K11004041	High	10	20	1.15	0.57	36	18
K11004711	High	10	20	0.53	0.27	16	33
K11004991	High	10	20	0.51	0.26	6	12

² See reference PCR for background on quality levels for technical performance.

³ Value includes 10% over-purchase stipulated by reference PCR.

⁴ Value includes 10% over-purchase stipulated by reference PCR.

⁵ See reference PCR for background on quality levels for technical performance.

⁶ Value includes 10% over-purchase stipulated by reference PCR.

⁷ Value includes 10% over-purchase stipulated by reference PCR.



K11006631	High	10	20	0.54	0.27	8	17
K11006951	Primer	10	5	0.58	1.18	0	0
K11007751	High	10	20	0.53	0.26	8	16
K11008251	Primer	10	5	0.60	1.20	0	0
K11018001	High	10	20	0.52	0.26	37	18
K11029101	High	10	20	0.53	0.26	8	16
K11044001	High	10	20	0.52	0.26	8	16
K11072501	High	10	20	0.56	0.28	8	17
K11072521	High	10	20	0.54	0.27	8	16
K11072531	High	10	20	0.50	0.25	8	15
K000Z6631-16	Primer	10	5	0.60	1.20	0	0
K11001801	Primer	10	5	0.71	1.43	0	0
K11001802	Primer	10	5	0.74	1.48	0	0
K11001803	Primer	10	5	0.74	1.47	0	0

Tinting:

As stated in the reference PCR, the tint/colorant inventory was taken from thinkstep carbon black pigment data in the appropriate quantity specified by the type of coating base for that IRON GUARD formula. The amount of colorant needed for each formula is shown in Table 2 above.

The impact of the tint is included in the overall LCIA results, but is not reported individually since it is not a differentiator between formulas or the eventual EPDs.

Allocation Rules:

In accordance with the reference PCR, allocation was avoided whenever possible, however if allocation could not be avoided, the following hierarchy of allocation methods was utilized:

- Mass, or other biophysical relationship; and
- Economic value.

In the LCA models, mass allocation was ONLY used during packaging and end of life-stages.

Treatment of Biogenic Carbon:

In accordance with the reference PCR, global warming values were calculated and presented both including and excluding biogenic carbon.



System Boundary:

This LCA included all relevant steps in the coating manufacturing process as described by the reference PCR. The system boundary began with the extraction of raw materials to be used in the IRON GUARD coating and its formulas are manufactured in a way similar to other architectural paint and coating products. The raw materials are manually added in appropriate quantities into a high-speed disperser which are mixed. The product is then moved via compressed air or gravity and filled into containers and shipped to a distribution center and then to the point of sale. A customer travels to the store to purchase the product and transports the coating to the site where it is applied. The applied coating adheres to the substrate where it remains until the substrate is disposed. Any unused coating will be disposed by the customer as well. Because the functional unit mandates a 60 year product life, multiple repaints were necessary and were accounted for by the LCA models. The system boundary ends with the end-of-life stage. This can be seen in Figure 1, below.

As described in the reference PCR, the following items were excluded from the assessment and they were expected to not substantially affect the results.

- personnel impacts;
- research and development activities;
- business travel;
- any secondary packaging (pallets, for example);
- all point of sale infrastructure; and
- the coating applicator.

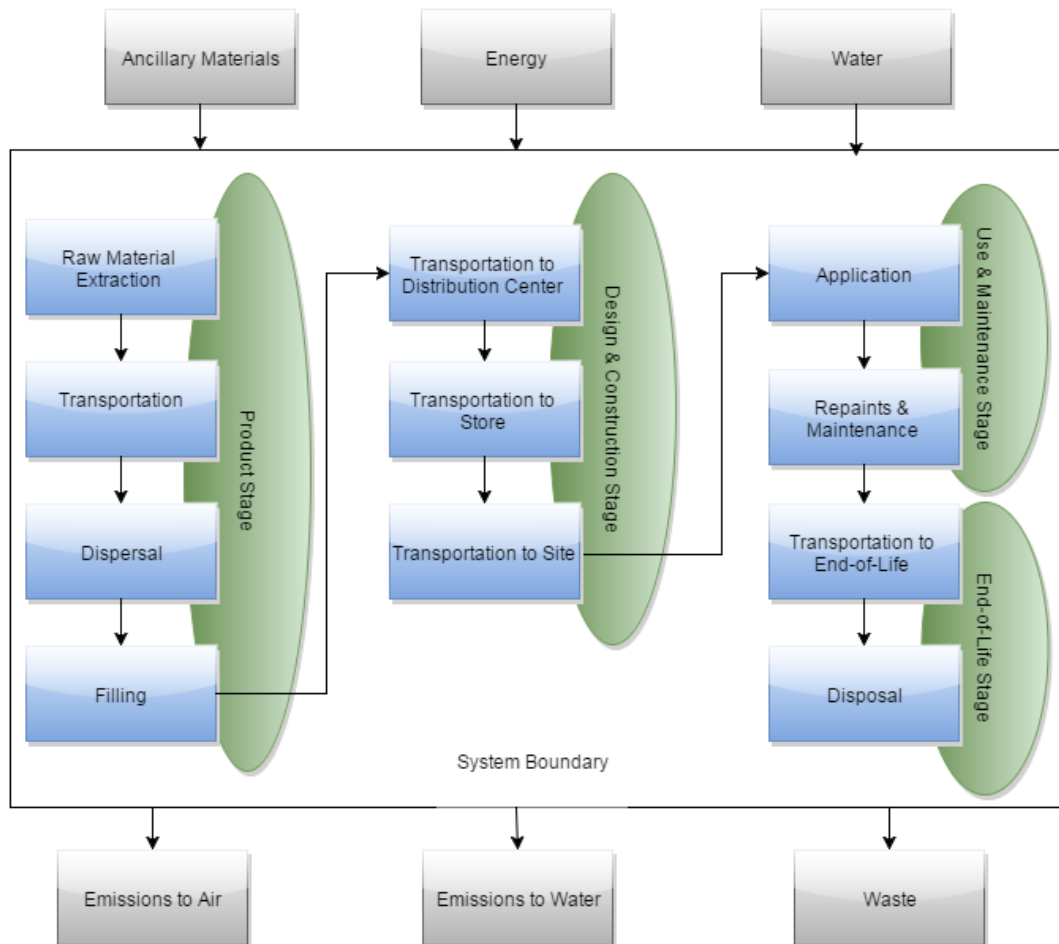


Figure 1. Diagram of System Boundary for the EPD.

Cut-Off Rules:

The cut-off rules prescribed by the reference PCR required a minimum of 95% of the total mass, energy, and environmental relevance be captured by the LCA models. All formulas were modeled to at least 99.6% of their material content by weight. No significant flows were excluded from the LCA models and the 5% threshold prescribed by the PCR was not exceeded.



Data Sources & Quality:

When primary data was unavailable, data was taken from either thinkstep, ecoinvent, or CEPE's coating industry life cycle inventory. The data from thinkstep and ecoinvent are widely accepted by the LCA community and the CEPE database has been built using those databases as a foundation. A brief description of these databases is below:

Table 3. Overview of Databases used in LCA Models.

Database	Comments
Sherwin-Williams	Primary source data taken as an average monthly value over a 12-month average of 2016 relevant facilities operation metrics.
thinkstep/GaBi	DB Version 6.110
ecoinvent	Version 3.1 – Most recent version available in GaBi.
CEPE LCI	Most recent version of industry LCI. Last revised August 14, 2014. Made up of refined data from thinkstep and ecoinvent so that it is more representative of coating manufacturing. Primarily limited to EU data, although some processes are global.

Precision and Completeness:

Annual averages from the 2016 calendar year of primary data was used for all gate-gate processes and the most representative inventories were selected for all processes outside of Sherwin-Williams' direct operational control. Secondary data was primarily drawn from the most recent GaBi and ecoinvent databases and CEPE's 2014 coating life cycle inventory. All of these databases were assessed in terms of overall completeness.

Assumptions relating to application and disposal were conformant with the reference PCR. All data used in the LCA models was less than five years old. Pigment and resin data were taken from both ecoinvent v3.1 and GaBi databases.

Consistency and Reproducibility:

In order to ensure consistency, primary source data was used for all gate-to-gate processes in coating manufacturing. All other secondary data were applied consistently and any modifications to the databases were documented in the LCA Report.

This assessment was completed using an EPD calculator tool that has been externally verified by NSF International. This tool was not altered in any way from its original and verified form to generate the LCA results described in this EPD, and the results from the calculator were translated into the EPD by hand. Reproducibility is possible using the verified EPD Calculator tool or by reproducing the LCIs documented in the LCA Report.



Temporal Coverage:

Primary data was collected from the manufacturing facilities from the 2016 calendar year. Secondary data reflected the most up-to-date versions of the LCA databases mentioned above.

Geographic Coverage:






IRON GUARD is manufactured by the Sherwin-Williams Company entirely within the United States. Given that the facilities making IRON GUARD are spread across the United States, the average US grid mix was used in the LCA models. IRON GUARD products are purchased, used, and the unused portions are disposed by the customer throughout the US as well.



Life Cycle Impact Assessment:

The purpose of the Life Cycle Impact Assessment (LCIA) is to show the link between the life cycle inventory results and potential environmental impacts. As such, these results are classified and characterized into several impact categories which are listed and described below. The TRACI 2.1 method was used and the LCIA results are formatted to be conformant with the PCR, which was based on ISO 21930. The TRACI method is widely accepted for use in the US and was developed by the US EPA.

Table 4. Overview of Impact Categories⁸

Overview of LCA Impact Categories	
Impact Category Name	Description of Impact Category
<p>Global Warming Potential</p> 	<p><i>“Global warming is an average increase in the temperature of the atmosphere near the Earth’s surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes, both natural and human induced. In common usage, “global warming” often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities” (US Environmental Protection Agency 2008b).</i></p> <p><i>Biogenic carbon was both included and excluded in the analysis as stipulated by the PCR.</i></p>
<p>Ozone Depletion Potential</p> 	<p><i>Ozone within the stratosphere provides protection from radiation, which can lead to increased frequency of skin cancers and cataracts in the human populations. Additionally, ozone has been documented to have effects on crops, other plants, marine life, and human-built materials. Substances which have been reported and linked to decreasing S-10637-OP-1-0 REVISION: 0 DATE: 6/22/2012 Page 13 24 Document ID: S-10637-OP-1-0 Date: 7/24/2012 the stratospheric ozone level are chlorofluorocarbons (CFCs) which are used as refrigerants, foam blowing agents, solvents, and halons which are used as fire extinguishing agents (US Environmental Protection Agency 2008j).</i></p>
<p>Acidification Potential</p> 	<p><i>Acidification is the increasing concentration of hydrogen ion (H+) within a local environment. This can be the result of the addition of acids (e.g., nitric acid and sulfuric acid) into the environment, or by the addition of other substances (e.g., ammonia) which increase the acidity of the environment due to various chemical reactions and/or biological activity, or by natural circumstances such as the change in soil concentrations because of the growth of local plant species n (US Environmental Protection Agency 2008a).</i></p>
<p>Smog Formation Potential</p> 	<p><i>Ground level ozone is created by various chemical reactions, which occur between nitrogen oxides (NOx) and volatile organic compounds (VOCs) in sunlight. Human health effects can result in a variety of respiratory issues including increasing symptoms of bronchitis, asthma, and emphysema. Permanent lung damage may result from prolonged exposure to ozone. Ecological impacts include damage to various ecosystems and crop damage. The primary sources of ozone precursors are motor vehicles, electric power utilities and industrial facilities (US Environmental Protection Agency 2008e).</i></p>
<p>Eutrophication Potential</p> 	<p><i>Eutrophication is the “enrichment of an aquatic ecosystem with nutrients (nitrates, phosphates) that accelerate biological productivity (growth of algae and weeds) and an undesirable accumulation of algal biomass” (US Environmental Protection Agency 2008d).</i></p>

⁸ See EPA TRACI References for Additional Detail



Life Cycle Impact Assessment Results:

The LCA results are documented and grouped separately below into the following stages as defined by ISO 21930.

- Total Impact (across the entire cradle-grave lifecycle including tinting)
- Product Stage (Stage 1)
- Construction & Design Stage (Stage 2)
- Use & Maintenance Stage (Stage 3)
- End-Of-Life Stage (Stage 4)

No weighting or normalization was done to the results. At this time it is not recommended to weight the results of the LCA or the subsequent EPD. It is important to remember that LCA results show potential and expected impacts and these should not be used as firm thresholds/indicators of safety and/or risk. As with all scientific processes, there is uncertainty within the calculation and measurement of all impact categories and care should be taken when interpreting the results.

Results:

The results of the LCA are shown in the tables below. LCIA results for each life cycle stage as defined by ISO 21930 are shown graphically in Figure 2.

Table 5. LCA Results for Technical Life Scenario (INTERIOR).

Product Number	GWP Inc Bio Carb (kg CO2e)	GWP Exc Bio Carb (kg CO2e)	Acidification (kg SO2e)	Eutrophication (kg N e)	Ozone Depletion (kg CFC-11e)	Smog Formation (kg o3e)
K11001011	0.53	0.53	0.08	5.85E-04	2.46E-08	0.11
K11001131	0.59	0.59	0.09	6.05E-04	2.60E-08	0.11
K11001201	0.72	0.72	0.10	5.65E-04	2.72E-08	0.12
K11003271	0.66	0.66	0.10	6.50E-04	2.80E-08	0.12
K11004041	0.90	0.89	0.14	6.59E-04	2.60E-08	0.14
K11004711	0.72	0.72	0.09	5.92E-04	2.79E-08	0.12
K11004991	0.61	0.61	0.10	7.14E-04	3.02E-08	0.12
K11006631	0.99	0.98	0.16	7.13E-04	2.72E-08	0.14
K11006951	2.85	2.85	0.57	2.94E-03	1.16E-07	0.66
K11007751	0.59	0.59	0.09	5.60E-04	2.59E-08	0.12
K11008251	4.07	4.05	0.66	2.98E-03	1.23E-07	0.72
K11018001	0.57	0.57	0.10	6.64E-04	2.69E-08	0.12
K11029101	0.71	0.70	0.11	6.89E-04	2.73E-08	0.12
K11044001	0.58	0.58	0.08	6.43E-04	2.70E-08	0.12
K11072501	0.83	0.83	0.13	6.50E-04	2.73E-08	0.14
K11072521	0.74	0.73	0.11	6.62E-04	2.42E-08	0.13
K11072531	0.56	0.56	0.08	6.38E-04	2.39E-08	0.11
K00026631-16	3.56	3.54	0.65	2.96E-03	1.16E-07	0.72



K11001801	3.38	3.38	0.59	3.59E-03	1.25E-07	0.81
K11001802	4.22	4.22	0.75	3.60E-03	1.20E-07	0.88
K11001803	4.22	4.22	0.75	3.60E-03	1.20E-07	0.88

Table 6. LCA Results for Market Life Scenario (INTERIOR).

Product Number	GWP Inc Bio Carb (kg CO2e)	GWP Exc Bio Carb (kg CO2e)	Acidification (kg SO2e)	Eutrophication (kg N e)	Ozone Depletion (kg CFC-11e)	Smog Formation (kg o3e)
K11001011	1.59	1.59	0.24	1.76E-03	7.39E-08	0.34
K11001131	1.77	1.76	0.26	1.81E-03	7.81E-08	0.34
K11001201	2.17	2.17	0.31	1.69E-03	8.15E-08	0.37
K11003271	1.98	1.97	0.31	1.95E-03	8.41E-08	0.37
K11004041	2.69	2.67	0.43	1.98E-03	7.81E-08	0.43
K11004711	2.15	2.15	0.27	1.78E-03	8.38E-08	0.37
K11004991	1.83	1.83	0.29	2.14E-03	9.07E-08	0.35
K11006631	2.97	2.93	0.48	2.14E-03	8.15E-08	0.43
K11006951	1.71	1.71	0.34	1.77E-03	6.95E-08	0.40
K11007751	1.77	1.77	0.27	1.68E-03	7.78E-08	0.36
K11008251	2.44	2.43	0.40	1.79E-03	7.38E-08	0.43
K11018001	1.72	1.71	0.30	1.99E-03	8.06E-08	0.36
K11029101	2.12	2.11	0.32	2.07E-03	8.18E-08	0.37
K11044001	1.75	1.75	0.25	1.93E-03	8.11E-08	0.35
K11072501	2.50	2.48	0.40	1.95E-03	8.20E-08	0.41
K11072521	2.22	2.20	0.34	1.99E-03	7.25E-08	0.39
K11072531	1.67	1.67	0.24	1.91E-03	7.16E-08	0.34
K00026631-16	2.13	2.12	0.39	1.77E-03	6.98E-08	0.43
K11001801	2.03	2.03	0.35	2.15E-03	7.52E-08	0.49
K11001802	2.53	2.53	0.45	2.16E-03	7.19E-08	0.53
K11001803	2.53	2.53	0.45	2.16E-03	7.22E-08	0.53

Table 7. LCA Results for Technical Life Scenario (EXTERIOR).

Product Number	GWP Inc Bio Carb (kg CO2e)	GWP Exc Bio Carb (kg CO2e)	Acidification (kg SO2e)	Eutrophication (kg N e)	Ozone Depletion (kg CFC-11e)	Smog Formation (kg o3e)
K11001011	0.40	0.40	0.06	4.39E-04	1.85E-08	0.08
K11001131	0.44	0.44	0.06	4.54E-04	1.95E-08	0.09
K11001201	0.54	0.54	0.08	4.24E-04	2.04E-08	0.09
K11003271	0.49	0.49	0.08	4.87E-04	2.10E-08	0.09
K11004041	2.69	2.67	0.43	1.98E-03	7.81E-08	0.43
K11004711	0.54	0.54	0.07	4.44E-04	2.09E-08	0.09
K11004991	0.46	0.46	0.07	5.35E-04	2.27E-08	0.09



K11006631	0.74	0.73	0.12	5.35E-04	2.04E-08	0.11
K11006951	1.77	1.77	0.39	1.87E-03	6.86E-08	0.48
K11007751	0.44	0.44	0.07	4.20E-04	1.95E-08	0.09
K11008251	2.44	2.43	0.40	1.79E-03	7.38E-08	0.43
K11018001	0.43	0.43	0.08	4.98E-04	2.02E-08	0.09
K11029101	0.53	0.53	0.08	5.17E-04	2.04E-08	0.09
K11044001	0.44	0.44	0.06	4.82E-04	2.03E-08	0.09
K11072501	0.63	0.62	0.10	4.88E-04	2.05E-08	0.10
K11072521	0.55	0.55	0.09	4.96E-04	1.81E-08	0.10
K11072531	0.42	0.42	0.06	4.79E-04	1.79E-08	0.08
K00026631-16	2.13	2.12	0.39	1.77E-03	6.98E-08	0.43
K11001801	2.03	2.03	0.35	2.15E-03	7.52E-08	0.49
K11001802	2.53	2.53	0.45	2.16E-03	7.19E-08	0.53
K11001803	2.53	2.53	0.45	2.16E-03	7.22E-08	0.53

Table 8. LCA Results for Market Life Scenario (EXTERIOR).

Product Number	GWP Inc Bio Carb (kg CO2e)	GWP Exc Bio Carb (kg CO2e)	Acidification (kg SO2e)	Eutrophication (kg N e)	Ozone Depletion (kg CFC-11e)	Smog Formation (kg o3e)
K11001011	0.79	0.79	0.12	8.78E-04	3.70E-08	0.17
K11001131	0.88	0.88	0.13	9.07E-04	3.91E-08	0.17
K11001201	1.09	1.09	0.16	8.47E-04	4.08E-08	0.19
K11003271	0.99	0.98	0.16	9.75E-04	4.20E-08	0.18
K11004041	1.35	1.34	0.22	9.89E-04	3.90E-08	0.21
K11004711	1.07	1.07	0.14	8.89E-04	4.19E-08	0.18
K11004991	0.91	0.91	0.14	1.07E-03	4.53E-08	0.18
K11006631	1.48	1.47	0.24	1.07E-03	4.07E-08	0.21
K11006951	0.85	0.85	0.17	8.83E-04	3.47E-08	0.20
K11007751	0.88	0.88	0.13	8.41E-04	3.89E-08	0.18
K11008251	1.22	1.21	0.20	8.94E-04	3.69E-08	0.22
K11018001	0.86	0.86	0.15	9.96E-04	4.03E-08	0.18
K11029101	1.06	1.06	0.16	1.03E-03	4.09E-08	0.19
K11044001	0.87	0.87	0.13	9.65E-04	4.05E-08	0.17
K11072501	1.25	1.24	0.20	9.76E-04	4.10E-08	0.21
K11072521	1.11	1.10	0.17	9.93E-04	3.62E-08	0.19
K11072531	0.83	0.83	0.12	9.57E-04	3.58E-08	0.17
K00026631-16	1.07	1.06	0.20	8.87E-04	3.49E-08	0.22
K11001801	1.01	1.01	0.18	1.08E-03	3.76E-08	0.24
K11001802	1.27	1.27	0.23	1.08E-03	3.60E-08	0.26
K11001803	1.27	1.27	0.23	1.08E-03	3.61E-08	0.26

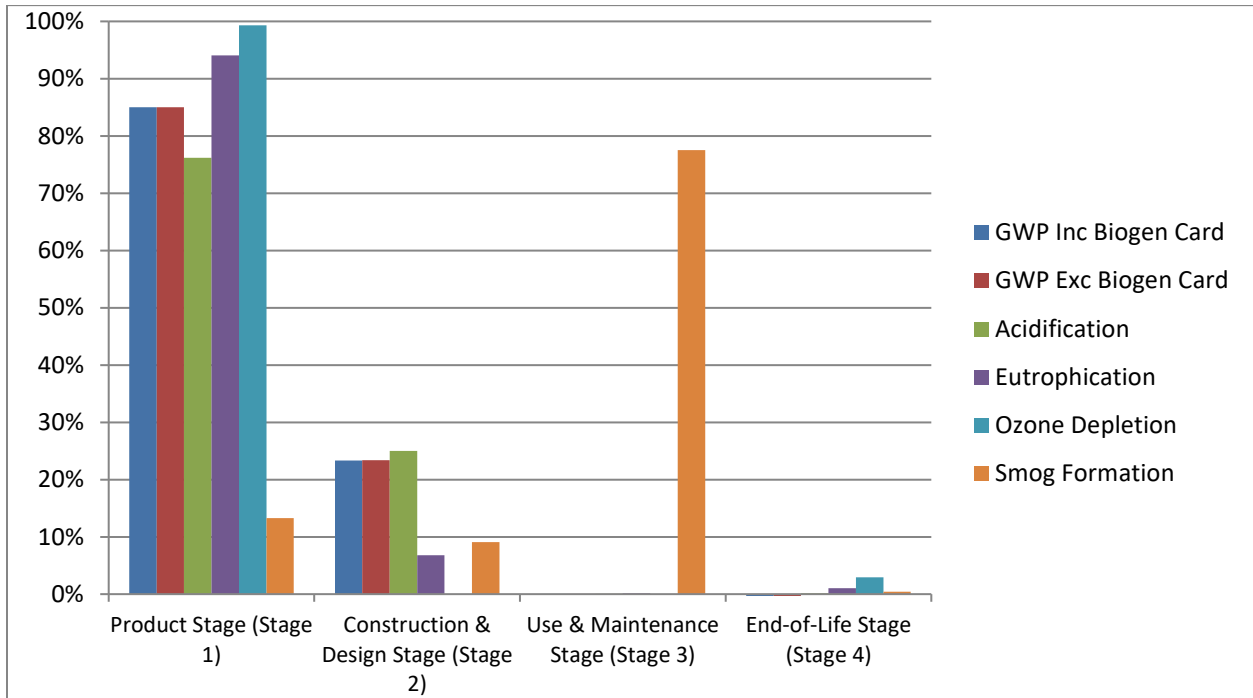


Figure 2. Impact Category Result Breakdown by ISO 21930 Stage for Average IRON GUARD Formulation/Application.

Table 9. INTERIOR Energy, Resource, and Waste Results for Technical and Market Life Scenarios (Based on Average IRON GUARD Formulation).

(TECHNICAL LIFE)	TOTAL	Stage 1	Stage 2	Stage 3	Stage 4
Non-Renew. Energy (MJ)	19.62	16.38	3.13	0.00	0.11
Use of Renewable Primary Energy (MJ)	0.82	0.68	0.13	0.00	0.00
Use of Non-Renew Mat. Resources (kg)	1.16	0.97	0.18	0.00	0.01
Use of Renewable Mat. Resources (kg)	1146.31	957.01	182.88	0.06	6.35
Consumption of Freshwater (m3)	0.94	0.78	0.15	0.00	0.01
Hydro Power (MJ)	0.00	0.00	0.00	0.00	0.00
Fossil Energy (MJ)	18.80	15.70	3.00	0.00	0.10
Nuclear Energy (MJ)	1.39	1.16	0.22	0.00	0.01
Other Energy (MJ)	0.00	0.00	0.00	0.00	0.00
Secondary Fuels (MJ)	0.00	0.00	0.00	0.00	0.00
Recycled Materials (kg)	0.00	0.00	0.00	0.00	0.00
Secondary Raw Materials (kg)	0.00	0.00	0.00	0.00	0.00
Non-Hazardous Waste	68.75%	N/A	N/A	N/A	N/A
Hazardous Waste	31.25%	N/A	N/A	N/A	N/A



(MARKET LIFE)	Total	Stage 1	Stage 2	Stage 3	Stage 4
Non-Renew. Energy (MJ)	33.97	28.36	5.42	0.00	0.19
Use of Renewable Primary Energy (MJ)	1.42	1.19	0.23	0.00	0.01
Use of Non-Renew Mat. Resources (kg)	2.00	1.67	0.32	0.00	0.01
Use of Renewable Mat. Resources (kg)	1984.91	1657.14	316.67	0.11	10.99
Consumption of Freshwater (m3)	1.62	1.35	0.26	0.00	0.01
Hydro Power (MJ)	0.00	0.00	0.00	0.00	0.00
Fossil Energy (MJ)	32.56	27.18	5.19	0.00	0.18
Nuclear Energy (MJ)	2.40	2.00	0.38	0.00	0.01
Other Energy (MJ)	0.00	0.00	0.00	0.00	0.00
Secondary Fuels (MJ)	0.00	0.00	0.00	0.00	0.00
Recycled Materials (kg)	0.00	0.00	0.00	0.00	0.00
Secondary Raw Materials (kg)	0.00	0.00	0.00	0.00	0.00
Non-Hazardous Waste	68.75%	N/A	N/A	N/A	N/A
Hazardous Waste	31.25%	N/A	N/A	N/A	N/A

Table 10. EXTERIOR Energy, Resource, and Waste Results for Technical and Market Life Scenarios (Based on Average IRON GUARD Formulation).

(TECHNICAL LIFE)	TOTAL	Stage 1	Stage 2	Stage 3	Stage 4
Non-Renew. Energy (MJ)	13.14	10.97	2.10	0.00	0.07
Use of Renewable Primary Energy (MJ)	0.55	0.46	0.09	0.00	0.00
Use of Non-Renew Mat. Resources (kg)	0.77	0.65	0.12	0.00	0.00
Use of Renewable Mat. Resources (kg)	767.96	641.14	122.52	0.04	4.25
Consumption of Freshwater (m3)	0.63	0.52	0.10	0.00	0.00
Hydro Power (MJ)	0.00	0.00	0.00	0.00	0.00
Fossil Energy (MJ)	12.60	10.52	2.01	0.00	0.07
Nuclear Energy (MJ)	0.93	0.77	0.15	0.00	0.01
Other Energy (MJ)	0.00	0.00	0.00	0.00	0.00
Secondary Fuels (MJ)	0.00	0.00	0.00	0.00	0.00
Recycled Materials (kg)	0.00	0.00	0.00	0.00	0.00
Secondary Raw Materials (kg)	0.00	0.00	0.00	0.00	0.00
Non-Hazardous Waste	68.75%	N/A	N/A	N/A	N/A
Hazardous Waste	31.25%	N/A	N/A	N/A	N/A



(MARKET LIFE)	Total	Stage 1	Stage 2	Stage 3	Stage 4
Non-Renew. Energy (MJ)	16.99	14.18	2.71	0.00	0.09
Use of Renewable Primary Energy (MJ)	0.71	0.59	0.11	0.00	0.00
Use of Non-Renew Mat. Resources (kg)	1.00	0.84	0.16	0.00	0.01
Use of Renewable Mat. Resources (kg)	992.46	828.57	158.34	0.05	5.50
Consumption of Freshwater (m3)	0.81	0.68	0.13	0.00	0.00
Hydro Power (MJ)	0.00	0.00	0.00	0.00	0.00
Fossil Energy (MJ)	16.28	13.59	2.60	0.00	0.09
Nuclear Energy (MJ)	1.20	1.00	0.19	0.00	0.01
Other Energy (MJ)	0.00	0.00	0.00	0.00	0.00
Secondary Fuels (MJ)	0.00	0.00	0.00	0.00	0.00
Recycled Materials (kg)	0.00	0.00	0.00	0.00	0.00
Secondary Raw Materials (kg)	0.00	0.00	0.00	0.00	0.00
Non-Hazardous Waste	68.75%	N/A	N/A	N/A	N/A
Hazardous Waste	31.25%	N/A	N/A	N/A	N/A

Specific resource metrics for an IRON GUARD formula are available upon request. These results were not reported in the EPD to maintain simplicity. Please contact douglas.p.mazeffa@sherwin.com for the specific resource results for an individual IRON GUARD formula.

Interpretation:

For IRON GUARD formulations, the raw materials were responsible for the largest environmental impact across all impact categories except smog formation. Specifically, the pigments and resins were the most impactful raw materials. Manufacturing, packaging, use, and disposal were only responsible for a small percent of overall impact with the exception of smog formation during the use phase (due to emissions of VOC content). Transportation impacts were significant for several impact categories, but still much smaller than those of the raw materials.

Since the raw materials were responsible for the largest chunk of the impact, product performance and durability were especially important. Within the IRON GUARD formulas, there was a range of as little as 0.33 kg of coating being needed to satisfy the functional unit to as much as 2 kg of coating. This means that approximately 6 times as much material was needed depending on whether the technical or market based lifetime was used.

Generally speaking, the longer a coating lasts, the better its environmental performance will be. Ultimately, the end-user should decide which lifetime is more appropriate for their decision-making.

Study Completeness:

Completeness estimates are somewhat subjective as it is impossible for any LCA or inventory to be 100% complete. However, based on expert judgment, it is believed that given the overall data quality that the study is at least 95% complete. As such, at least 95% of system mass, energy, and environmental relevance were covered.



Uncertainty:

Because a large number of data sets are linked together in the LCA models, it is unknown how many of the data sets have goals that are dissimilar to this LCA. As such, it is difficult to estimate overall uncertainty of the LCA models. However, primary source data was used whenever possible and the most appropriate secondary data sources were used throughout the models. The thinkstep and ecoinvent databases are widely accepted by the LCA community and CEPE's LCI Database is based off thinkstep and ecoinvent data, just optimized/corrected for coating manufacturing processes.

Since the reference PCR stipulated the majority of the crucial LCA assumptions, Sherwin-Williams is comfortable with the methodology of the LCA and feel they reflect best-practices.

Limitations:

LCA is not a perfect tool for comparisons and impact values are constantly changing due to shifts in the grid mix, transportation, fuels, etc. Because of this, care should be taken when applying or interpreting these results. This being said, the relative impacts between products should be more reliable and less sensitive versus the specific impact category and metric values.

As stated in the LCA report, there were cases where analogue chemicals had to be used in the LCA models. This occurred when no LCI data was available for an intermediate chemical/material. This was typically limited to additives representing a very small amount of the overall formula (less than a percent), but still may impact the results. Likewise, there were cases where data had to be used from a different region or technology. These instances were uncommon and noted in the Data Quality section of the LCA Report and were not expected to have a serious effect on the results, but still may limit the study.

Emissions to Water, Soil, and to Indoor Air:

VOC determination was done using the federally-accepted methods outlined by the EPA in the Federal Register. Additional information on VOCs certification can be found on the environmental data sheets for the specific IRON GUARD formula on www.krylonindustrial.com/.

Critical Review:

Since the goal of the LCA was to generate an EPD, it was submitted for review by NSF International. NSF commissioned Mr. Jack Geibig of EcoForm to conduct the formal review of the LCA report.



Additional Environmental Information:

Environmental Certifications	
N/A	N/A

VOC Content	
<100 g/L	Determined by EPA VOC Regulatory Calculation

Preferred End-of Life Options for IRON GUARD :

Please visit www.paintcare.org/ for information about disposing leftover latex paint. If possible, unused paint should be taken to an appropriate recycling/take-back center. Additional information can also be found on the Sherwin-Williams website at: www.sherwin-williams.com/homeowners/ask-sherwin-williams/painting/interior-painting-how-tos/interior-cleaning-up/.



References:

ASTM International, West Conshohocken, PA, 2014, www.astm.org.

American Coating Association Product Category Rule for Architectural Coatings. Available at http://standards.nsf.org/apps/group_public/download.php/28098/ACA%20PCR%20%2006-17-15%20-%20Final.pdf. Revised June, 2017.

EPA VOC Calculation Rules. <http://www3.epa.gov/ttn/atw/183e/aim/fr1191.pdf>

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 21930:2007 *Sustainability in building construction – Environmental declaration of building products.*

Krylon Industrial Website . www.krylonindustrial.com/.

PaintCare - <http://www.paintcare.org/>

Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) TRACI version 2.1. The Environmental Protection Agency. August 2012.

Sherwin-Williams Website. <http://www.sherwin.com/>.