Benjamin Moore & Co.
101 Paragon Drive,
Montvale, NJ 07645

Environmental Product Declaration – Ultra Spec® EXT

Certified Environmental Product Declaration
www.nsf.org

Ultra Spec® EXT is a professional-quality coating ideal for exterior surfaces where durability is critical. Available in thousands of colors, contractors will appreciate its superior coverage, adhesion, ease of application and easy soap and water clean-up. Tinted with Benjamin Moore's proprietary zero VOC* waterborne Gennex® colorants, all of the finishes in the Ultra Spec® EXT line are low VOC. Visit www.benjaminmoore.com for more information.

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

**Zero VOC according to EPA Method 24.*

Declaration Holder	Benjamin Moore & Co. (email: info@benjaminmoore.com); website: benjaminmoore.com for additional information)
Declaration Number	EPD10101
Declared Product	Ultra Spec® EXT
Product Category and Subcategory	Architectural Coatings – Exterior Architectural Coatings
Program Operator	NSF International (ncss@nsf.org)
PCR	PCR for Architectural Coatings – 7-18-2015
Date of Issue	August 31, 2017
Period of Validity	5 years from date of issue
Product Contents	See Table 2.

The PCR review was conducted by	Thomas P. Gloria, PhD – Industrial Ecology Consultants (t.gloria@industrial-ecology.com)	
This EPD was independently verified by NSF International in accordance with ISO 21930 and ISO 14025. ☐ Internal ☒ External	Jenny Oorbeck joorbeck@nsf.org	
This life cycle assessment was independently verified in accordance with ISO 14044 and the PCR by ☐ Internal ☒ External	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	10 years
Design Lifetime Used in Assessment	20 years (see Table 3)
Test Methods Used to Calculate Design Life	ASTM D2805-11, ASTM D2486-06, ASTM D6736-08, ASTM D4828-94
Estimated Amount of Colorant	Varies (see Table 3)
Data Quality Assessment Score	Very good
Manufacturing Location(s)	All Benjamin Moore manufacturing locations in the United States producing the products listed in this EPD.

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.

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Product Definition and Characteristics

Ultra Spec® EXT has been specifically designed for professional contractors to deliver superior hide and coverage when rolled or sprayed. It delivers a smooth application for a wide variety of exterior applications, including wood, hardboard, vinyl and aluminum siding, shakes, unglazed brick, concrete, stucco, cinder block and primed metal. Ultra Spec® EXT is formulated to withstand harsh weather conditions. It's highly resistant to peeling, cracking, blistering, mildew formation, and color fading, so it will look great longer.

The Benjamin Moore® Advantage

Over 5,000 independent retailers and 200+ field and architectural representatives ready to help you. Benjamin Moore provides a full selection of premium and commercial products for every job as well as an architectural support program to help you specify the right products for any job. To find a Benjamin Moore representative in your area, visit www.benjaminmoore.com or call 866-708-9180.

Product Classification and Description

The products listed below in Table 1 are included within this assessment. The primary differences between these products are gloss levels (sheen) and base types. For additional information on each of the specific products, please visit www.benjaminmoore.com.

Table 1: List of Ultra Spec® EXT Waterborne formulas assessed by LCA model and report

EPD Product Name	Product Number	Sheen	PCR Base Type
Ultra Spec® EXT- Flat Finish and White Base	N44701	Flat	None
Ultra Spec® EXT- Flat Finish and 1X Base	N4471X	Flat	Light Base
Ultra Spec® EXT- Flat Finish and 2X Base	N4472X	Flat	Pastel Base
Ultra Spec® EXT- Flat Finish and 3X Base	N4473X	Flat	Deep Base
Ultra Spec® EXT- Flat Finish and 4X Base	N4474X	Flat	Accent Base
Ultra Spec® EXT- Satin Finish and White Base)	N44801	Satin	None
Ultra Spec® EXT- Satin Finish and 1X Base	N4481X	Satin	Light Base
Ultra Spec® EXT- Satin Finish and 2X Base	N4482X	Satin	Pastel Base
Ultra Spec® EXT- Satin Finish and 3X Base	N4483X	Satin	Deep Base
Ultra Spec® EXT- Satin Finish and 4X Base	N4484X	Satin	Accent Base
Ultra Spec® EXT- Gloss Finish and White Base	N44901	Gloss	None
Ultra Spec® EXT- Gloss Finish and 1X Base	N4491X	Gloss	Light Base
Ultra Spec® EXT- Gloss Finish and 2X Base	N4492X	Gloss	Pastel Base
Ultra Spec® EXT- Gloss Finish and 3X Base	N4493X	Gloss	Deep Base

Ultra Spec® EXT- Gloss Finish and 4X Base	N4494X	Gloss	Accent Base

Under the Product Category Rule (PCR) for Architectural Coatings, all of the Ultra Spec® EXT products fall under the General exterior and interior coatings category. All Ultra Spec® EXT products described in this EPD are considered to be Exterior Architectural Coatings.

In the paint manufacturing process, pigments, resin, solvents, and additives are mixed together to form a paste. This pigment-based paste is then processed to disperse the pigment into additional solvent. Finally, this paste is thinned with the proper amount of solvent to form the final product. In addition to the materials associated with paint production, other inputs to the production process include electrical energy, process water, and metal, plastic, and paper packaging materials. The outputs of this manufacturing stage include packaged paint products, waste for disposal, waste water for treatment, and manufacturing emissions.

Material composition

The typical composition of an Ultra Spec® EXT coating is shown by % mass in Table 2.

Table 2: Typical composition of Ultra Spec® EXT by % mass

Ingredient category	% of product by mass
Additive	0.85 – 13%
Antifoamer	0 – 0.27%
Biocide	0 – 0.37%
Nepheline	0 – 23%
Resin	20 – 63%
Silica	0 – 30%
Surfactant	0 – 1.2%
Thickener	0– 3.4%
Titanium dioxide	0 – 46%
Water	13 – 24%

Life Cycle Assessment Methodology

Functional unit

Per PCR requirements, this EPD is based on a cradle-to-grave LCA, and the functional unit for the study is defined as 1 m^2 of covered and protected substrate for a period of 60 years. The PCR requires results to be calculated for a market-based lifetime and a design lifetime for the coating product.

Table 3: Lifetime, reference flow, and quantity of colorant required

Product Number	Quality level	Design lifetime (years)	Market lifetime (years)	Design lifetime quantity (kg)	Market lifetime quantity (kg)	Colorant - Design lifetime (g)	Colorant - Market lifetime (g)
N44701	High	20	10	0.348	0.696	-	-
N4471X	High	20	10	0.333	0.666	15.1	30.2
N4472X	High	20	10	0.325	0.649	22.0	43.9
N4473X	High	20	10	0.302	0.604	35.6	71.2
N4474X	High	20	10	0.390	0.780	55.4	111
N44801	High	20	10	0.223	0.446	-	-
N4481X	High	20	10	0.213	0.426	10.1	20.1
N4482X	High	20	10	0.193	0.386	14.6	29.1
N4483X	High	20	10	0.177	0.354	23.5	47.0
N4484X	High	20	10	0.336	0.671	54.6	109
N44901	High	20	10	0.209	0.418	-	-
N4491X	High	20	10	0.199	0.398	10.0	20.1
N4492X	High	20	10	0.185	0.370	14.5	29.1
N4493X	High	20	10	0.169	0.337	23.4	46.7
N4494X	High	20	10	0.320	0.641	54.3	109

Market-based life used in assessment

The market-based lifetime for exterior coatings is 10 years.

Design-based life used in assessment

The design-based lifetime is determined by the warranty, which is 20 years for the Ultra Spec® EXT product line. Corresponding coating quantities were calculated for each product and can be found in Table 3.

Amount of colorant needed

Following the PCR, for any coating that can accept colorant, it was assumed that the full allowable amount of colorant is added to the paint either at the point of sale or application site. The tint/colorant inventory was taken from the GaBi carbon black pigment data in the appropriate quantity specified for the type of coating base for the respective Ultra Spec® Interior Waterborne product. The amount of colorant needed for each formula is shown in Table 3 and its impact is included in the overall LCA results.

Data Quality Assessment

Precision and Completeness

The majority of the relevant foreground data are measured or calculated based on primary data from the owner of the technology, so precision is considered high. Completeness of each foreground process is considered high as each process was checked for mass balance and completeness of the emission

inventory. All background data are sourced from the GaBi 2016 databases with the documented precision and completeness.

Consistency and Reproducibility

To ensure data consistency, all primary data were collected with the same level of detail, while all background data were sourced from the GaBi 2016 databases. Reproducibility is supported as much as possible through the disclosure of input-output data, dataset choices, and modeling approaches.

Temporal Coverage

All primary data were collected for the fiscal year 2015. All secondary data come from the GaBi 2016 databases and are representative of the years 2010-2015. As the study intended to compare the product systems for the reference year 2015, temporal representativeness is considered to be high.

Geographic Coverage

All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data were used. Geographical representativeness is considered to be high.

Allocation

As stated in the reference PCR, allocation was avoided whenever possible. The only allocation used in the LCA model was volume-based allocation during the manufacturing process, to assign Benjamin Moore manufacturing plant inputs and outputs across multiple paint products produced at the same plant.

System Boundary

As shown in Figure 1 , the system boundary includes all life cycle stages as defined by ISO 21930, from raw material extraction and processing, coating manufacture, application and end-of-life treatment, with transportation included in all stages.

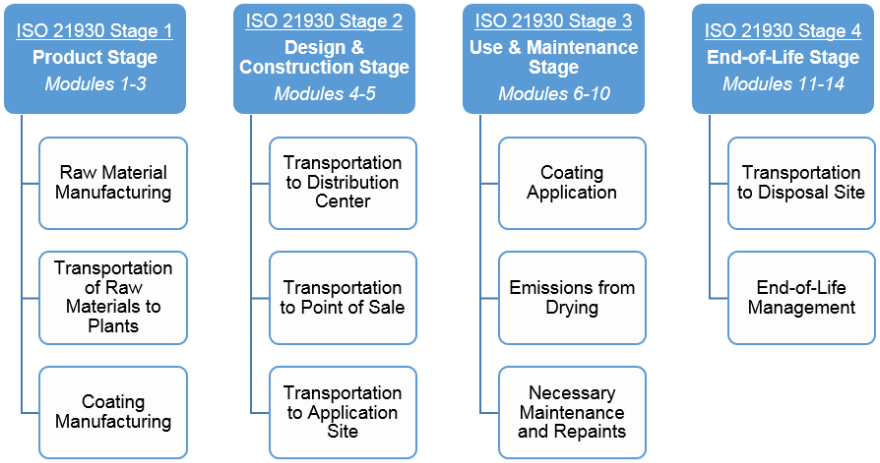

Figure 1: Life cycle stages included in system boundary

Cut-off criteria

No cut-off criteria were defined for this study. All relevant inputs were included in LCA models with the exception of:

- Personnel impacts;
- Research and development activities;
- Business travel;
- Any secondary or tertiary packaging (e.g., pallets);
- All point of sale infrastructure; and,

- The coating applicator.

Life Cycle Impact Assessment

Impact Assessment Categories

The Life Cycle Impact Assessment (LCIA) relates the life cycle inventory to the potential environmental impacts. The PCR requires that the following key parameters of environmental impact assessment be declared based on the EPA's TRACI methodology (v2.1), except in the case of global warming potential which must be declared based on the IPPC (AR5) methodology:

- Global warming potential (GWP) – 100 year (used in place of climate change)
- Acidification potential (AP)
- Ozone depletion potential (ODP)
- Smog formation potential (SFP) (used in place of photochemical ozone creation potential)
- Eutrophication (EP)

The PCR also requires that the following material and energy emissions and waste shall be calculated and declared:

- Depletion of non-renewable energy resources
- Depletion of non-renewable material resources
- Use of renewable primary energy
- Use of renewable material resources
- Consumption of freshwater
- Hazardous waste disposed
- Non-hazardous waste disposed
- Secondary fuels
- Non-renewable resources
- Renewable resources
- Recycled materials
- Secondary raw materials
- Water

Key Environmental Parameters

The LCIA results for the design lifetime and the market lifetime are shown in Table 4 and

Table 5. A representative product was chosen based on the median of the five impact categories. Results for global warming potential for the entire product line and the representative product are shown in Figure 2. Results for the representative product grouped by life cycle stages prescribed by the PCR are presented in Figure 3. Results in **Error! Reference source not found.** are shown for market life, but the percent contribution for each stage for design life are essentially identical.

Table 4: LCIA results for design lifetime

Impact category	Global warming potential 100, excl biogenic carbon [kg CO_2-equiv.]	Acidification [kg SO_2-equiv.]	Eutrophication [kg N-equiv.]	Ozone depletion air [kg CFC 11-equiv.]	Smog air [kg O_3-equiv.]
N44701	9.76E-01	2.33E-02	2.31E-04	1.32E-09	6.60E-02
N4471X	9.77E-01	2.24E-02	2.25E-04	1.26E-09	6.50E-02
N4472X	8.47E-01	1.68E-02	1.91E-04	1.23E-09	5.75E-02
N4473X	6.50E-01	6.36E-03	1.34E-04	1.15E-09	4.59E-02
N4474X	8.68E-01	8.31E-03	1.77E-04	1.50E-09	6.02E-02
N44801	6.92E-01	1.81E-02	1.62E-04	1.23E-09	4.46E-02
N4481X	7.03E-01	1.74E-02	1.62E-04	9.73E-10	4.53E-02
N4482X	5.52E-01	9.65E-03	1.18E-04	1.13E-09	3.56E-02
N4483X	4.54E-01	4.27E-03	8.89E-05	1.06E-09	2.97E-02
N4484X	6.44E-01	1.59E-03	1.19E-04	2.05E-09	4.71E-02
N44901	6.76E-01	1.68E-02	1.64E-04	8.02E-10	4.58E-02
N4491X	6.73E-01	1.61E-02	1.60E-04	7.65E-10	4.49E-02
N4492X	5.62E-01	1.12E-02	1.29E-04	7.35E-10	3.92E-02
N4493X	4.52E-01	4.74E-03	9.57E-05	6.83E-10	3.15E-02
N4494X	7.68E-01	1.90E-03	1.51E-04	1.31E-09	5.46E-02

Table 5: LCIA results for market lifetime

Impact category	Global warming potential 100, excl biogenic carbon [kg CO_2-equiv.]	Acidification [kg SO_2-equiv.]	Eutrophication [kg N-equiv.]	Ozone depletion air [kg CFC 11-equiv.]	Smog air [kg O_3-equiv.]
N44701	1.95E+00	4.66E-02	4.62E-04	2.64E-09	1.32E-01
N4471X	1.95E+00	4.49E-02	4.51E-04	2.53E-09	1.30E-01
N4472X	1.69E+00	3.36E-02	3.82E-04	2.45E-09	1.15E-01
N4473X	1.30E+00	1.27E-02	2.69E-04	2.30E-09	9.17E-02
N4474X	1.74E+00	1.66E-02	3.54E-04	3.01E-09	1.20E-01
N44801	1.38E+00	3.62E-02	3.24E-04	2.46E-09	8.92E-02
N4481X	1.41E+00	3.49E-02	3.24E-04	1.95E-09	9.07E-02
N4482X	1.10E+00	1.93E-02	2.36E-04	2.26E-09	7.11E-02
N4483X	9.08E-01	8.54E-03	1.78E-04	2.13E-09	5.93E-02
N4484X	1.29E+00	3.18E-03	2.38E-04	4.10E-09	9.42E-02
N44901	1.35E+00	3.35E-02	3.29E-04	1.60E-09	9.16E-02
N4491X	1.35E+00	3.21E-02	3.19E-04	1.53E-09	8.97E-02
N4492X	1.12E+00	2.23E-02	2.59E-04	1.47E-09	7.85E-02
N4493X	9.04E-01	9.47E-03	1.91E-04	1.37E-09	6.30E-02
N4494X	1.54E+00	4.25E-03	5.03E-04	3.59E-09	1.13E-01

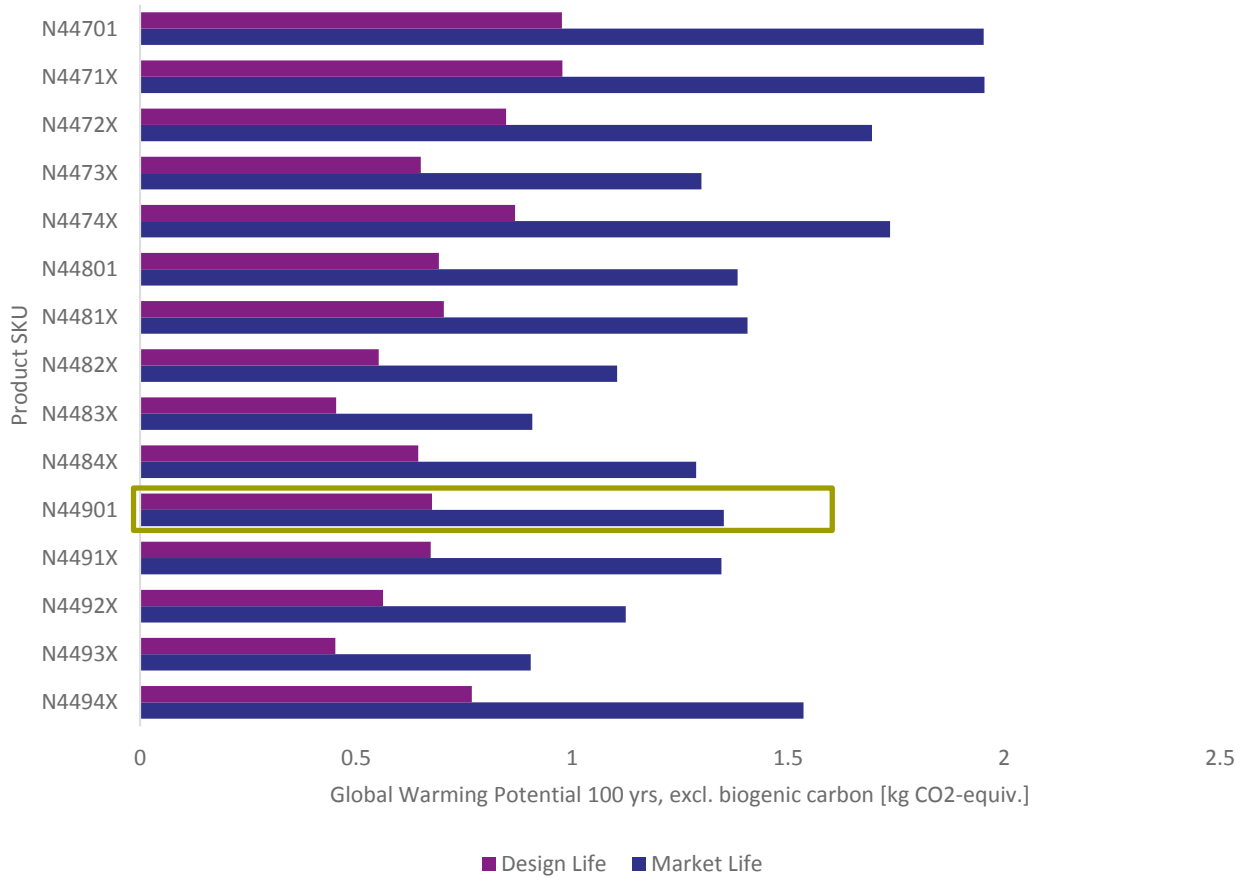

Figure 2: Global Warming Potential 100 yrs., excl. biogenic carbon for product line, design and market life

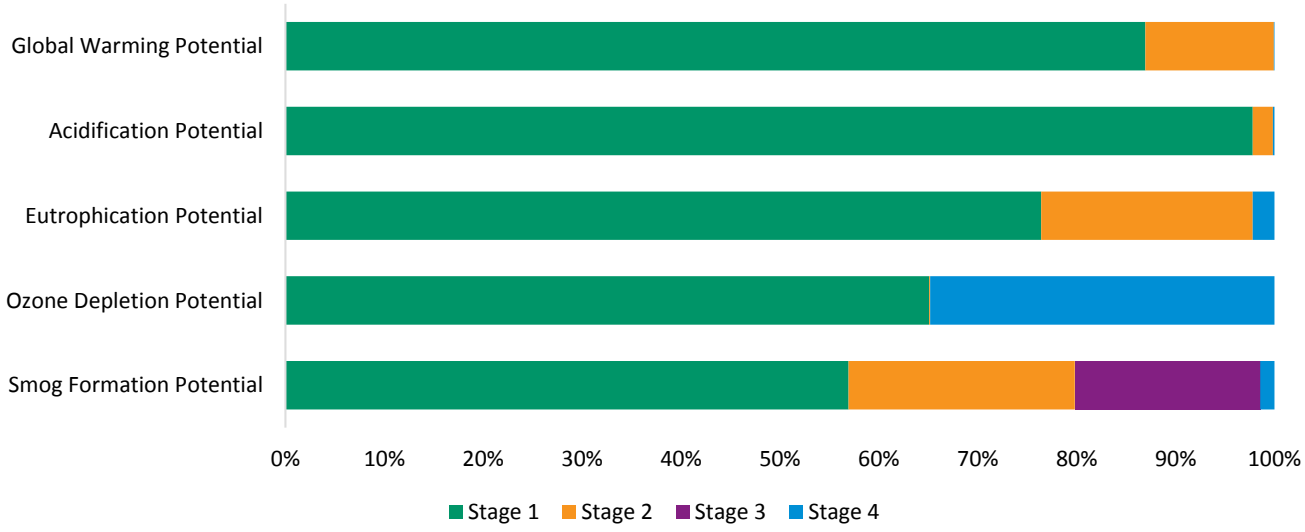

Figure 3: LCIA results by product stage for representative product, N44901 (market life)

Material and Energy Resources, Emissions, and Wastes:

Additional Life Cycle Inventory Results

The additional inventory results required by the PCR for the representative product are shown in Table 6 and Table 7 for the design and market life, respectively.

Table 6: Additional LCI categories for the design life of N44901

Additional LCI category	Total	Stage 1	Stage 2	Stage 3	Stage 4
Primary energy, non-renewable [MJ]	***1.12E+01***	***1.00E+01***	***1.19E+00***	***0.00E+00***	***5.18E-02***
Crude oil [MJ]	**3.53E+00**	2.40E+00	1.06E+00	0.00E+00	6.65E-02
Hard coal [MJ]	**2.34E+00**	2.42E+00	1.41E-02	0.00E+00	-4.73E-02
Natural gas [MJ]	**6.23E-01**	6.15E-01	1.30E-03	0.00E+00	7.22E-03
Lignite [MJ]	**4.05E+00**	3.93E+00	1.07E-01	0.00E+00	1.20E-02
Uranium [MJ]	**6.73E-01**	6.53E-01	6.92E-03	0.00E+00	1.34E-02
Primary energy, renewable [MJ]	***6.82E-01***	***6.26E-01***	***4.21E-02***	***0.00E+00***	***1.39E-02***
Geothermal [MJ]	**1.49E-02**	1.46E-02	2.39E-04	0.00E+00	6.52E-05
Hydro [MJ]	**1.49E-02**	1.46E-02	2.39E-04	0.00E+00	6.52E-05
Solar [MJ]	**1.38E-01**	1.31E-01	2.05E-03	0.00E+00	5.21E-03
Wind [MJ]	**3.49E-01**	3.03E-01	3.87E-02	0.00E+00	6.73E-03
Depletion of non-renewable material resources [kg]	***1.60E+00***	***1.57E+00***	***5.60E-03***	***0.00E+00***	***2.84E-02***
Use of renewable resources [kg]	***5.21E+00***	***5.15E+00***	***2.87E-02***	***0.00E+00***	***2.57E-02***
Air [kg]	**5.17E+00**	5.13E+00	2.08E-02	0.00E+00	2.31E-02
Carbon dioxide [kg]	**2.31E-02**	2.02E-02	2.39E-03	0.00E+00	5.36E-04
Nitrogen [kg]	**0.00E+00**	0.00E+00	5.70E-15	0.00E+00	-2.38E-09
Oxygen [kg]	**1.10E-02**	3.48E-03	5.53E-03	0.00E+00	1.99E-03
Primary forest [kg]	**5.25E-08**	5.05E-08	1.88E-15	0.00E+00	1.99E-09
Renewable fuels [kg]	**2.37E-08**	2.75E-07	0.00E+00	0.00E+00	0.00E+00
Recycled materials (kg)	**5.29E-03**	0.00E+00	0.00E+00	0.00E+00	5.29E-03
Secondary raw materials (kg)	**2.43E-04**	2.43E-04	0.00E+00	0.00E+00	0.00E+00
Hazardous waste [kg]	**1.94E-07**	9.17E-09	1.85E-07	0.00E+00	2.58E-10
Non-hazardous waste [kg]	**2.22E-01**	8.53E-03	8.68E-05	0.00E+00	2.13E-01
Blue water consumption [m^3]	**4.28E-03**	3.99E-03	2.92E-04	0.00E+00	-1.90E-06

Table 7: Additional LCI categories for the market life of N44901

Additional LCI category	Total	Stage 1	Stage 2	Stage 3	Stage 4
Primary energy, non-renewable [MJ]	***2.24E+01***	***2.00E+01***	***2.37E+00***	***0.00E+00***	***1.04E-01***
Crude oil [MJ]	**7.05E+00**	4.80E+00	2.12E+00	0.00E+00	1.33E-01
Hard coal [MJ]	**4.68E+00**	4.83E+00	2.82E-02	0.00E+00	-9.46E-02
Natural gas [MJ]	**1.25E+00**	1.23E+00	2.59E-03	0.00E+00	1.44E-02
Lignite [MJ]	**8.09E+00**	7.85E+00	2.15E-01	0.00E+00	2.40E-02
Uranium [MJ]	**1.35E+00**	1.31E+00	1.38E-02	0.00E+00	2.68E-02
Primary energy, renewable [MJ]	***1.36E+00***	***1.25E+00***	***8.43E-02***	***0.00E+00***	***2.79E-02***
Geothermal [MJ]	**2.98E-02**	2.92E-02	4.77E-04	0.00E+00	1.30E-04

Hydro [MJ]	**2.98E-02**	2.92E-02	4.77E-04	0.00E+00	1.30E-04
Solar [MJ]	**2.76E-01**	2.61E-01	4.09E-03	0.00E+00	1.04E-02
Wind [MJ]	**6.98E-01**	6.07E-01	7.75E-02	0.00E+00	1.35E-02
Depletion of non-renewable material resources [kg]	***3.19E+00***	***3.14E+00***	***1.12E-02***	***0.00E+00***	***5.67E-02***
Use of renewable resources [kg]	***1.04E+01***	***1.03E+01***	***5.74E-02***	***0.00E+00***	***5.13E-02***
Air [kg]	**1.03E+01**	1.03E+01	4.15E-02	0.00E+00	4.63E-02
Carbon dioxide [kg]	**4.62E-02**	4.03E-02	4.78E-03	0.00E+00	1.07E-03
Nitrogen [kg]	**0.00E+00**	0.00E+00	1.14E-14	0.00E+00	-4.76E-09
Oxygen [kg]	**2.20E-02**	6.96E-03	1.11E-02	0.00E+00	3.97E-03
Primary forest [kg]	**1.05E-07**	1.01E-07	3.76E-15	0.00E+00	3.98E-09
Renewable fuels [kg]	**4.74E-08**	5.49E-07	0.00E+00	0.00E+00	0.00E+00
Recycled materials (kg)	**1.06E-02**	0.00E+00	0.00E+00	0.00E+00	1.06E-02
Secondary raw materials (kg)	**4.86E-04**	4.86E-04	0.00E+00	0.00E+00	0.00E+00
Hazardous waste [kg]	**3.88E-07**	1.83E-08	3.69E-07	0.00E+00	5.16E-10
Non-hazardous waste [kg]	**4.44E-01**	1.71E-02	1.74E-04	0.00E+00	4.27E-01
Blue water consumption [m^3]	**8.57E-03**	7.99E-03	5.84E-04	0.00E+00	-3.80E-06

Emissions to Water, Soil, and to Indoor Air

Because coatings are a passive product during use, the only impacts occurring during this stage are generally due to the off-gassing of material components in the paint. The quantity of VOC emissions during the use stage for Ultra Spec® EXT products are assumed to equal the EPA Method 24 listed VOC contents on the label.

LCA Interpretation

For all Ultra Spec® EXT, raw materials and manufacturing are the highest contributors to most impact categories. The only exception to this is smog formation potential, which is dominated by both paint production (Stage 1) and by VOC emissions during use (Stage 3). The raw materials burden is dominated by the pigments and acrylic resin, which follows as they are often the highest percent by weight in the paint composition. Additionally, the energy demand for producing titanium dioxide (a pigment) is relatively high. Acidification potential in particular is dominated by the titanium dioxide production. Packaging and use are low for all impact categories with the exception of the use stage's contribution to smog formation potential. The relatively high ozone depletion in the end of life are due to the energy required to recycle packaging materials at end of life. Transportation is small but significant for global warming potential and ozone depletion potential.

Additional Environmental Information

Environmental Certifications

Ultra Spec® EXT paints meet stringent VOC standards, and are Master Painters Institute approved. Additional information is available at benjaminmoore.com or call 866-708-9180.

Preferred End-of Life Options

Please visit www.paintcare.org for information about disposing unused acrylic enamel paint. If possible, unused paint should be taken to an appropriate recycling/take-back center or disposed of in accordance with local environmental regulatory agency guidance.

References

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

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