USG Ceilings Solutions

ENVIRONMENTAL PRODUCT DECLARATION

USG Danoline™ Lay-In Panels
Acoustical Perforated Gypsum

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USG Danoline™ Lay-In Panels are glass fiber reinforced gypsum board with square or bevelled edges and a perforated surface. The perforation can vary with different types of patterns and can be perforated by area up to 23% to achieve varying levels of sound absorption. The back side is covered by an acoustic backer and the front side has a factory-applied paint finish. The products can be mounted in a grid system as lay-in panels.

CML Environmental Impacts	1 m^2 of USG Danoline™ Lay-In Panels
Global Warming Potential (kg CO_2 eq.)	**3.24**
Ozone Depletion Potential (kg CFC-11 eq.)	**4.36E-07**
Formation Potential of Tropospheric Photochemical Oxidants (kg C_2H_4 -eq.)	**9.17E-04**
Acidification Potential of Land and Water (kg N eq.)	**1.39E-02**
Eutrophication Potential (kg PO_4^{3-} eq.)	**2.39E-03**
Abiotic Depletion Potential For Non-Fossil Resources (kg Sb eq.)	**7.27E-06**
Abiotic Depletion Potential for Fossil Resources (MJ)	**55.2**

For over a century, sustainable practices have naturally been an inherent part of our business at USG. Today, they help shape the innovative products that become the homes where we live, the buildings where we work and the arenas where we play. From the product formulations we choose, to the processes we employ, USG is committed to designing, manufacturing, and distributing products that minimize overall environmental impacts and contribute toward a healthier living space. We believe that transparency of product information is essential for our stakeholders and EPDs are the next step toward an even more transparent USG. For additional information, visit usg.com, cgcinc.com and usgdesignstudio.com

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This declaration is amended for the North American market from an EPD published by Knauf A/S on 2/25/16 for the European market using CEN Standard EN 15804 as the core PCR and PCR 010 rev 1 Building Boards (12 2013). The Knauf Danoline™ Belgravia and Plaza products have been relabeled as USG Danoline™ Lay-in Panels for the North American market. It was originally published as a cradle-to-grave EPD but has been revised to a cradle-to-gate EPD to serve the North American market.

This environmental product declaration (EPD) is in accordance with ISO 14025 and ISO 21930; 2007. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

DECLARATION NUMBER	EPD 150
PROGRAM OPERATOR	Original EPD: The Norwegian EPD Foundation Current EPD: ASTM International – 100 Barr Harbor Drive, West Conshohocken, PA USA www.astm.org
DECLARATION HOLDER	USG Corporation - 550 W. Adams St., Chicago, IL USA
DECLARED PRODUCT	USG Danoline™ Lay-In Panels
REFERENCE PCR	The Norwegian EPD Foundation PCR 010 rev1 Building Boards, December 2013
DATE OF ISSUE DATE OF EXPIRATION	5/15/20 2/25/21
CONTENTS OF THE DECLARATION	This EPD is complete and contains the following: • Product Description and Product Identification • Life Cycle Calculation Rules • LCA Results • References
This declaration was independently verified in accordance with ISO 14025 and ISO 21930:2007 ☐ INTERNAL ☒ EXTERNAL	Tim Brooke, ASTM International
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Lars G. F. Tellnes, Norwegian Institute of Wood Technology (Independent verifier approved by EPD Norway)

1. Product System Documentation

1.1 Product Description and Product Identification

USG Danoline™ Lay-In Panels are glass fiber reinforced gypsum board with square or bevelled edges and a perforated surface.The perforation can vary with different types of patterns and can be perforated by area up to 40% to achieve varying levels of sound absorption. The back side is covered by an acoustic tissue and the front side has a paint finish. The products can be mounted in a gridsystem as layin panels.

Acoustical Perforated Gypsum and Benefits

- New lay-in panels offer excellent acoustics with highly refined aesthetics
- Six different perforation patterns to choose from
- Decorative perforated gypsum panel offers a smooth face with high light reflectance, 69 to 72%
- Factory applied acoustical backer provides high performance acoustics up to NRC 0.80
- Higher acoustics achieved with added mineral fiber backer
- Panels installed with standard acoustical grid system. No special tools or installation required
- Available in 2'x2', 2'x4' panels
- Ideal for renovations as well as new construction
- Panels have a Class A fire rating
- High recycled content
- Field modifiable

APPLICATIONS

- Wall to wall ceilings
- Islands and clouds
- Sloped ceilings
- New Construction and renovation
- Interior installations

SUBSTRATE

- Perforated gypsum panel
- Factory applied acoustical backer

This EPD includes USG Danoline™ Lay-In Panels in the following edge configurations: FW, FN. SL and FL. This EPD covers the following USG Danoline™ Lay-In Panels item nos.: 22701, 22702, 22703, 22704, 22705, 22706, 22707, 22708, 22709, 22710, 22711, 22712, 22713, 22716, 22719, 22722, 22725, 22726, 22727, 22728, 22729, 22730, 22731, 22735, 22737, 22738, 22739, 22740, 22741, 22742, 22743 and 22747..

1.2 Application

The USG Danoline™ Lay-In Panels products are designed to be installed in a suitable metal grid system typically designed to accommodate a nominal 2'x2' or 2'x4' panel.

1.3 Product Technical Data

The following technical data is relevant for the USG Danoline™ Lay-In Panels covered by this EPD.

Table 1: Technical Specifications for USG Danoline™ Lay-In Panels

Edge	Panel Size	Mounting	Perforation	Fire Rating	Item No.	NRC[1,2,4]	LR[3]	Grid Options	% Open Area	VOC Emissions	Backer Color	Recycled Content
						NRC						HRC
FW 	2'x2'x1/2"	Flush Wide	C4	Class A	**22706**	0.70	72.5	A	11.0%	Low	White	80%
			C6	Class A	**22701**	0.65	72.8	A	11.0%	Low	Gray	80%
			CV	Class A	**22704**	0.50	72.2	A	10.7%	Low	White	80%
			S3	Class A	**22702**	0.75	69.2	A	15.7%	Low	White	80%
			S9	Class A	**22703**	0.75	72.1	A	17.1%	Low	White	80%
			O1	Class A	**22705**	0.80	70.9	A	22.2%	Low	White	80%
	2'x4'x1/2"	Flush Wide	C6	Class A	**22713**	0.65	72.8	A	11.4%	Low	Gray	80%
			CV	Class A	**22716**	0.50	72.2	A	10.8%	Low	White	80%
FN 	2'x2'x1/2"	Flush Narrow	C4	Class A	**22712**	0.70	72.5	B	11.4%	Low	White	80%
			C6	Class A	**22707**	0.65	72.8	B	11.6%	Low	Gray	80%
			CV	Class A	**22710**	0.50	72.2	B	10.8%	Low	White	80%
			S3	Class A	**22708**	0.75	69.2	B	16.2%	Low	White	80%
			S9	Class A	**22709**	0.75	72.1	B	18.3%	Low	White	80%
			O1	Class A	**22711**	0.80	70.9	B	23.8%	Low	White	80%
	2'x4'x1/2"	Flush Narrow	C6	Class A	**22719**	0.65	72.8	B	11.7%	Low	Gray	80%
			CV	Class A	**22722**	0.50	72.2	B	10.8%	Low	White	80%
SL 	2'x2'x1/2"	Recessed Wide	C4	Class A	**22742**	0.70	72.5	C	11.0%	Low	White	80%
			C6	Class A	**22737**	0.65	72.8	C	11.0%	Low	Gray	80%
			CV	Class A	**22741**	0.50	72.2	C	10.7%	Low	White	80%
			S3	Class A	**22739**	0.75	69.2	C	15.7%	Low	White	80%
			S9	Class A	**22740**	0.75	72.1	C	17.1%	Low	White	80%
			O1	Class A	**22738**	0.80	70.9	C	22.2%	Low	White	80%
	2'x4'x1/2"	Recessed Wide	C6	Class A	**22743**	0.65	72.8	C	11.4%	Low	Gray	80%
			CV	Class A	**22747**	0.50	72.2	C	10.8%	Low	White	80%
FL 	2'x2'x1/2"	Recessed Narrow	C4	Class A	**22730**	0.70	72.5	D, E, F, G	11.4%	Low	White	80%
			C6	Class A	**22725**	0.65	72.8	D, E, F, G	11.6%	Low	Gray	80%
			CV	Class A	**22729**	0.50	72.2	D, E, F, G	10.8%	Low	White	80%
			S3	Class A	**22727**	0.75	69.2	D, E, F, G	16.2%	Low	White	80%
			S9	Class A	**22728**	0.75	72.1	D, E, F, G	18.3%	Low	White	80%
			O1	Class A	**22726**	0.80	70.9	D, E, F, G	23.8%	Low	White	80%
	2'x4'x1/2"	Recessed Narrow	C6	Class A	**22731**	0.65	72.8	D, E, F, G	11.7%	Low	Gray	80%
			CV	Class A	**22735**	0.50	72.2	D, E, F, G	10.8%	Low	White	80%

1.4 Product Composition

The gypsum used for stucco in the plasterboard production originates from mined gypsum (1 % in 2013), FGD gypsum from flue-gas desulphisation in coal power plants (81.2 % in 2013) and recycled gypsum (17.8 % in 2013). The recycled gypsum originates from internal waste and from external collection of used gypsum plasterboards.

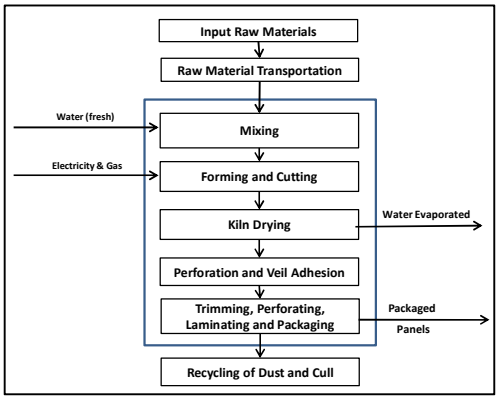
The internal recycling of gypsum boards in the factory started in 1991, and since 2004 all internal gypsum waste has been recycled and used. In 1998, they started to use recycled gypsum from gypsum plasterboards collected from building sites.

Table 3: Material Composition

Materials	kg	%
Stucco	7.5126	79.40%
Fiber glass	0.0032	0.03%
Other Additives	0.096	1.02%
Acoustic Felt	0.048	0.51%
Paint	0.2228	0.51%
Glue	0.0725	2.35%
Paper liners	0.3936	0.77%
Water*	1.1128	11.76%
Sum of Materials	9.5	96.35%
Packaging		
Polyethylene foil	0.0243	
Cardboard	0.2075	
Ceiling board	0.0598	
Sum of Additional	0.3	

1.5 Product Manufacture

The manufacture of the USG Danoline™ Lay-In Panels at the Hobro, Denmark plant, The process starts with the combining of the dry ingredients in a conveyor, feeding of this dry ingredient mixture into a mixer where these dry ingredients are mixed with water and wet additives. The resulting slurry is fed between two sheets of paper; facing paper (Manila) on the bottom and backing paper (Newsline) on the top. The wet gypsum board is allowed to hydrate after which the hard board is cut and transferred into a kiln for evaporation of excess water. After removal of the evaporative water, the board is cut to its final size, perforated, finished and end tapes are applied. Any gypsum board not meeting quality control specifications is recycled on-site.



USG Danoline™ Lay-in Panels are wrapped in corrugated sleeves and shrink wrapped in plastic.

1.6 Environment and Health During Manufacturing

All appropriate equipment required by governmental regulations are in place at all Knauf manufacturing facilities.

1.7 Packaging

USG Danoline™ Lay-In Panels are wrapped in corrugated sleeves and shrink wrapped in plastic. The production of these packaging materials was modeled in this study.

1.8 Reference Service Life

The Reference Service Life is considered not to be relevant for this cradle-to-gate study.

2. LCA Calculation Rules 2.1 Declared Unit

The declared unit for this LCA study is 1m^2 of USG Danoline™ Lay-In Panels from raw material extraction (A1) to the factory gate (A3).

2.2 System Boundary

This figure shows a flow diagram of the value chain, including the system boundaries. Biogenic carbon is also included in the system boundaries.

1.Quarry, natural gypsum

2. Power station, flue gas gypsum

3. Paper factory, face and back liner

4. Recycled paper

5. Households collecting paper for recycling

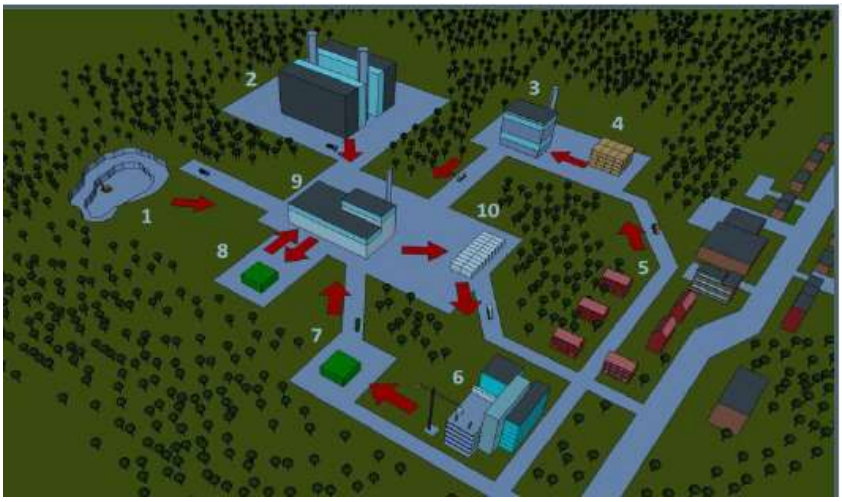
6. Building site (A5)

7. Recycled gypsum from building sites (C3)

8. Internal recycling of gypsum

9. Gypsum plasterboard factory (A3)

10. Gypsum plasterboard products at the gate



2.3 Cut-off Criteria

All major raw materials and all the essential energy is included. General cut-off criteria are given in standard EN 15804:2012 Clause 6.3.5. In compliance with these criteria, the infrastructure of the manufacturing site, small parts of the packaging and the electricity used to fasten screws are excluded from the study. No potentially hazardous materials have been excluded.

2.4 Data Quality

The data requirements are according to PCR 010 rev1 Building Boards (12 2013) Clause 7.3.6. Specific data collected from contractors is applied for the most important raw materials in A1. Specific data from the 2013 production at the manufacturing site is applied in A3. Missing data was substituted with generic data from Ecoinvent v3.1 (2014). No data is more than 5 years old.

2.5 Period under Review

All raw material and energy inputs are for the 2015 calendar year.

2.6 Allocation

The allocation is made in accordance with the provisions of EN 15804:2012. Energy and water consumption in the factory is allocated to the FU through mass allocation in module A1. Similarly, glue has been allocated with a wet weight during the production processs, and with a dry weight during end of life. Waste production in the factory is allocated on the basis of m2. The end of life waste and output flows include direct use only, upstream end of life waste and upstream output flows are not included. Effects of primary production of recycled materials is allocated to the main product in which the material was used.

2.7 Comparability

A comparison or evaluation of EPD data is only possible if all data sets to be compared are 1) created according to EN 15804 and 2) are considered in a whole building context or utilize identical defined use stage scenarios. Comparisons are only allowable when EPDs report cradle-to-grave information using a functional unit. Refer to section 5.3 of EN 15804 for further information. Comparison of the environmental performance of panels using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance allows EPD comparability only when all stages of the life cycle have been considered. However, variations and deviations are possible.

3. LCA Results

The calculations are based on the product variation with the highest environmental impact. The LCA results of the other products in the original LCA study are estimated to be between 0 and 5% lower than the reported results.

When interpreting the results, it is important to note that a 15% product loss is accounted for in A5, that A3 energy consumption is composed of Danish el-mix and natural gas, and that mass of the declared unit is 10.5 kg.

The GWP includes biogenic carbon uptake and emissions, calculated according to EN 16485: 2014 whereby 0.752 kg CO2 is taken up in A1 and emitted again in C3 and C4, so that the net value is zero within the system boundaries.

Table 4: Description of the system boundary modules

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw Material Supply	Transport	Manufacturing	Transport From Gate to Site	Assembly/Install	Use Stage	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste Processing	Disposal	Reuse, Recovery, Recycling Potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

3.1 Life Cycle Impact Assessment Results

Table 5: LCA Results for 1 Square Meter of USG Danoline™ Lay-In Panels

Environmental Impact - CML Environmental Impacts				
Parameter	Unit	A1	A2	A3
GWP	kg CO_2 eq.	1.65	0.33	1.26
ODP	kg CFC-11 eq.	3.60E-07	6.20E-08	1.40E-08
POCP	kg C_2H_4 eq.	8.00E-04	5.80E-05	5.90E-05
AP	kg N eq.	1.20E-02	1.10E-03	8.20E-04
EP	kg PO_4^{3-} eq.	2.10E-03	1.50E-04	1.40E-04
ADPM	kg Sb eq.	6.20E-06	9.20E-07	1.45E-07
ADPE	MJ	46.5	5.07	3.6

GWP Global warming potential; ODP Depletion potential of the stratospheric ozone layer; POCP Formation potential of tropospheric photochemical oxidants; AP Acidification potential of land and water; EP Eutrophication potential; ADPM Abiotic depletion potential for non-fossil resources; ADPE Abiotic depletion potential for fossil resources

Note: Life cycle impact assessment results are presented using the Leiden University Institute of Environmental Sciences (CML) methods, the default methods for the European market. The CML methods are identical to the global international market characterization methods with the exception of acidification potential (AP) and photochemical oxidant creation potential (POCP)) under Section 7.3 of ISO 21930:2017.

Table 6: Resource Use for 1 Square Meter of USG Danoline™ Lay-In Panels

Resource Use				
Parameter	Unit	A1	A2	A3
RPEE	MJ	10.7	0.07	0.79
RPEM	MJ	5.54	INA	2.73
TPE	MJ	16.2	0.07	3.53
NRPE	MJ	50.4	5.17	3.6
NRPM	MJ	INA	INA	0.73
TRPE	MJ	50.4	5.17	4.3
SM	kg	1.35	INA	3.01E-03
RSF	MJ	INA	INA	INA
NRSF	MJ	INA	INA	INA
W	m^3	6.83	0.21	0.68

RPEE Renewable primary energy resources used as energy carrier; RPEM Renewable primary energy resources used as raw materials; TPE Total use of renewable primary energy resources; NRPE Non-renewable primary energy resources used as energy carrier; NRPM Non- renewable primary energy resources used as materials; TRPE Total use of non renewable primary energy resources; SM Use of secondary materials; RSF Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; W Use of net fresh water

Table 7: Resource Use for 1 Square Meter of USG Danoline™ Lay-In Panels

Resource Use				
Parameter	**Unit**	**A1**	**A2**	**A3**
HW	kg	INA	INA	1.30E-04
NHW	kg	INA	INA	1.50E-02
RW	kg	INA	INA	INA

HW Hazardous waste disposed; NHW Non-hazardous waste disposed; RW Radioactive waste disposed

4. VOC Emissions

USG certifies that the gypum board products covered by this EPD when used in ceiling applications are Low-Emitting, defined as below the emissions of the concentrations for each individual volatile organic compound as specified in the Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions for Indoor Sources using Environmental Chambers Version 1.1 [CDPH/EHLB/Standard Method V1.1 (February 2010); chamber testing portion of CA Section 01350] and ASTM Guide D5116-06. Additional information can be obtained at USG.com, cgcinc.com and USGDesignStudio.com.

5. References

ISO 14020:2000	Environmental labels and declarations - General Principles
ISO 14025:2010	Environmental labels and declarations - Type III environmental declarations - Principles and procedures
ISO 14044:2006	Environmental management – Life cycle assessment – Requirements and guidelines
EN 15804:2012+A1:2013	Sustainability of construction works - Environmental product declaration - Core rules for the product category of construction products
ISO 21930:2007.	Environmental labels and declarations – Sustainability in building construction. Environmental declaration of building products.
ISO 21930:2017	Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
ISO 14001:2004	Environmental management systems - Requirements with guidance for use
ISO 9001: 2008	Quality management system – Requirements
OHSAS 18001: 2007	Occupational health and safety management systems. Requirements
EN 520: 2009	Gypsum Plasterboards. Definitions, requirements and test methods
EN 16485: 2014	Round and sawn timber. Environmental Product Declarations. Product Category Rules for wood and wood-based products.
Ecoinvent Centre	Ecoinvent v3.1 Database, 2014
Spielmann, M., Bauer, C., Dones, R., Tuchschmid, M.	Ecoinvent report no.14: Transport Services, 2007
Inman, Marianne Rose & Dahl	LCI/LCA Report: Six Gypsum Plasterboards, SINTEF Building and Infrastructure, Knauf
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