



# Statement of Verification

BREG EN EPD No: 000772

Issue: 01

This is to verify that the Environmental Product Declaration provided by:

## Gradus Limited

are in accordance with the requirements of:

**EN 15804:2012+A2:2019**

and

BRE Global Scheme Document SD207

This declaration is for:

1 meter of Gradus Handrails, Dual Rails & Combination Rail with an average weight of 1.5 kg/m.

### Company Address

Park Green,  
Macclesfield,  
Cheshire  
SK11 7LZS



# GRADUS

*Hayley Thomson*  
Signed for BRE Global Limited

Hayley Thomson  
Operator

10 April 2026  
Date of this Issue

10 April 2026  
Date of First Issue

09 April 2031  
Expiry Date



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# Environmental Product Declaration

EPD Number: 000772

## General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE Environmental Profiles 2025 Product Category Rules for Type III environmental product declaration of construction products to EN 15804+A2 PN 514 Rev 3.2
Commissioner of LCA study	LCA consultant/Tool
Gradus Limited	Regina Poveda BRE LINA V2.0
Declared/Functional Unit	Applicability/Coverage
1 meter of Gradus Handrails, Dual Rails & Combination Rail with an average weight of 1.5 kg/m.	Product Average.
EPD Type	Background database
Cradle to Grave	Ecoinvent 3.8
Demonstration of Verification	
CEN standard EN 15804 serves as the core PCR <sup>a</sup>	
Independent verification of the declaration and data according to EN ISO 14025:2010 <input checked="" type="checkbox"/> Internal <input type="checkbox"/> External	
(Where appropriate <sup>b</sup> )Third party verifier: Kim Allbury	
a: Product category rules b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)	
Comparability	
Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A2:2019. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A2:2019 for further guidance	

## Information modules covered

Product			Construction		Use stage							End-of-life				Benefits and loads beyond the system boundary
					Related to the building fabric					Related to the building						
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw materials supply	Transport	Manufacturing	Transport to site	Construction – Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, Recovery and/or Recycling potential
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Note: Ticks indicate the Information Modules declared.

## Manufacturing site(s)

Springbank  
Lyme Green Business Park,  
Brunel Rd,  
Cheshire,  
Macclesfield  
SK11 0TA

Winsford  
Gerflor Flooring UK Building,  
16 Road One,  
Winsford  
CW7 3QA

## Construction Product:

### Product Description

Gradus Handrails, Dual Rails & Combination Rail products provide pedestrian guidance and support, in addition to offering a level of surface protection. Suitable for use in a wide range of environments, including healthcare, education and transport.

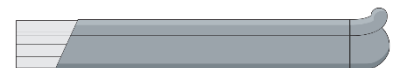
This is an average EPD and includes the following Gradus Handrails, Dual Rails & Combination Rail products.



Handrails (SHR40W, SHR40P, SHR40S)



Dual Rail (D200P – PVC, D200W – Wood, D200S – Silver anodized options)



Combination rail (CHR160, CHR110)

All products have the same composition and are available in the standard length of 4.0 meters. Gradus provides the option to adjust the length on site.

## Technical Information

Property	Value, Unit
Length	4.0 m
Standards (Handrails and Dual rails)	HBN 00-10, HBN 00-04, BS 8300-2:2018 and Approved Documents K and M of The Building Regulations 2010

Note: Technical information is available in the brochure, "Wall Protection Systems."  
<https://www.gradus.com/download/brochure-wall-protection-systems>



## Main Product Contents

Material/Chemical Input	%
Polyvinyl chloride extruded forms (PVC)	35
Aluminium	65

## Manufacturing Process

The PVC and aluminium are bought from a supplier in the UK and stored at the manufacturing sites. The PVC is stored at Springbank, and its processing is done in this facility.

The PVC is extruded into rigid lengths, cut as it is extruded and sleeved before it is transferred to the Winsford warehouse. The aluminium used during the process could be either from the Springbank storage or the Winsford warehouse; the storage will depend on the space availability. Also, the Winsford site manages inbound deliveries of subcomponents, such as endcaps, returns and reveals.

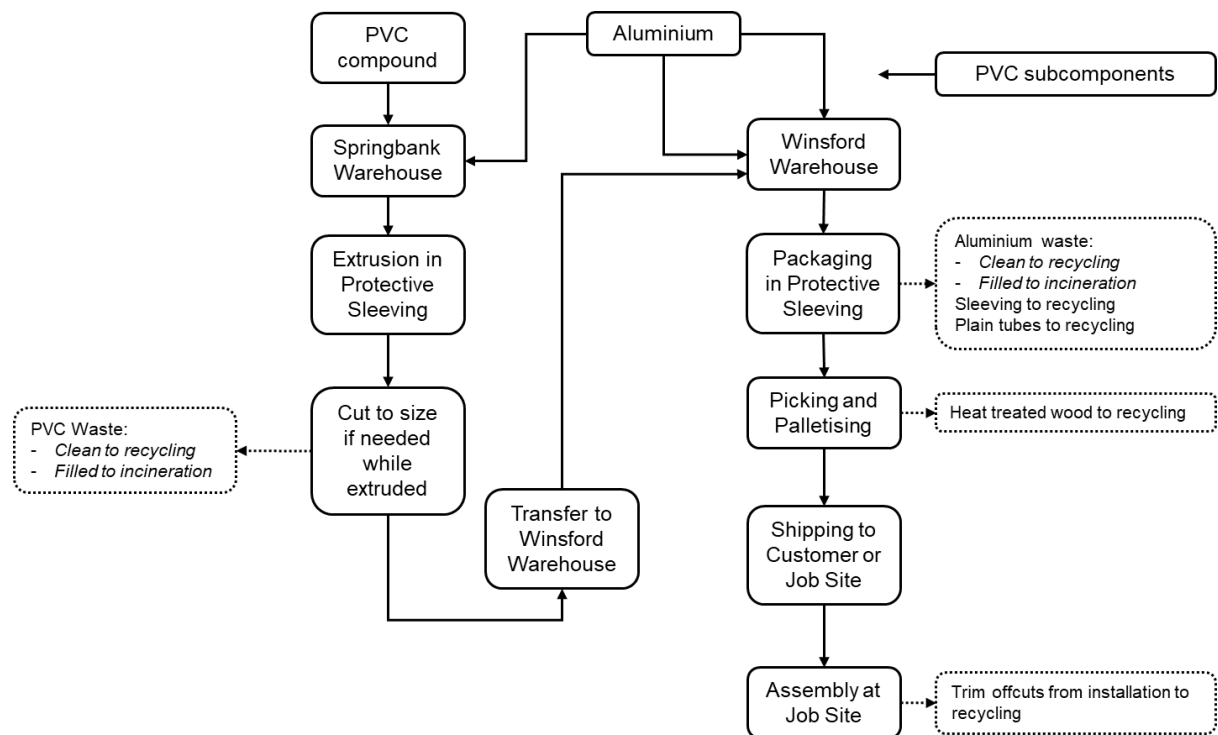
Once the PVC compound is transferred to the Winsford warehouse, both raw materials are consolidated, palletised and dispatched either directly to the customer or to designated job sites for installation.

At the installation site, the profiles are assembled with the corresponding subcomponents to form the finished product.

The electricity used at the Springback and Winsford sites is from the grid, and natural gas has been considered for the Springbank facility, which is used for heating.

Water is used as a closed-loop system on extruder lines.

### Process flow diagram



### Construction Installation

The transport distance to the construction site is set at 688 km by road, considering that the construction sites are based in the UK. All Gradus Handrails, Dual Rails & Combination Rail products are sent via Gradus' own transport. Vehicles leave loaded and make multiple drop-offs on their route. These trucks are then utilised depending on the route to bring raw material back from suppliers, like raw PVC from PVC supplier.

Gradus Handrails, Dual Rails & Combination Rail products installation happens at the final part of the construction project. Well before the job commences, the project team will price the job and work out total meterage needed for the job. This includes a small % to allow for errors in estimation. Once the materials have been delivered to site, our contracts team will move the material to the specific part of the job for installation. All Gradus Handrails, Dual Rails & Combination Rail products come in standard lengths of 4 meters; occasionally small cuts would have to be made on site. For this LCA analysis, the small cuts percentage is considered to be 3.5%.

### Use Information

Gradus Handrails, Dual Rails & Combination Rail products are installed in public buildings as wall protection barriers and aim to help people with reduced mobility. Some of the Gradus Handrails, Dual Rails & Combination Rail products have an aluminium retainer fixed, and then the PVC handrail is attached to the retainer via mounting brackets. After installation, the maintenance of the Gradus Handrails, Dual Rails & Combination Rail products includes only regular cleaning, which can be done as needed by customer requirements.



If a section of the products is damaged, it is replaced with another one. For this LCA analysis, it is assumed that the products will be replaced once every 20 years. This assumption is based on the Wall protection warranty. Please contact Gradus Ltd for more information.

During its use, Gradus Handrails, Dual Rails & Combination Rail products do not require energy and/or water for normal operation.

### **End of Life**

The building demolition can be done using different methods, which are linked to construction methodology and local geography. When the product reaches its End-of-Life, and the building is demolished; the Gradus Handrails, Dual Rails & Combination Rail products will be removed manually.

The End-of-Life scenario for the Gradus Handrails, Dual Rails & Combination Rail products is based on industrial average for Window frame, PVC (i.e. 100% to incineration) and General sheet, aluminium (i.e. 95% recycling, 5% landfill) according to BRE EN15804 A2 PCR 3.2.

The energy used for removing the components from the final waste is considered to be negligible.



## Life Cycle Assessment Calculation Rules

### Declared / Functional unit description

1 meter of Gradus Handrails, Dual Rails & Combination Rail with an average weight of 1.5 kg/m.

### System boundary

This is a Cradle to Grave LCA, reporting all modules of production stage A1 to A3, Construction process stage A4 – A5, Use stage B1-B7, end of life stage C1-C4 and Module D in accordance with EN15804:2012+A2:2019 and BRE 2025 Product Category Rules (PN 514 Rev. 3.2).

### Data sources, quality and allocation

The LCA analysis is conducted for 1 meter of Gradus Handrails, Dual Rails & Combination Rail with an average weight of 1.5 kg/m., and it includes the manufacturer-specific data from Gradus covering a period of one year from 01 January 2024 to 31 December 2024.

Specific primary data derived from the 1 meter of Gradus Handrails, Dual Rails & Combination Rail with an average weight of 1.5 kg/m. production process in Gradus Limited sites, Springbank, Lyme Green Business Park, Brunel Rd, Cheshire, Macclesfield SK11 0TA and Winsford, Gerflor Flooring UK Building, 16 Road One, Winsford, CW7 3QA, has been modelled using BRE LINA A2 and the ecoinvent 3.8 database. In accordance with the requirements of EN 15804:2012+A2:2019, the most current available data has been used. In addition to Handrail products, other products are manufactured in the Gradus manufacturing sites. Handrail products account for 2.3% of Springbank and 1.5% Winford's total production.

All raw material, ancillary, packaging and production waste have been taken from actual usages of site production provided by Gradus Ltd. As per energy and fuels, water and wastewater values have been allocated by mass production considering both sites. The inputs have been uplifted by adding the existing PVC and aluminium waste to the raw materials.

Secondary data has been obtained for all other upstream and downstream processes that are beyond the control of the manufacturer (i.e. raw material production) from the ecoinvent 3.8 database. All ecoinvent datasets are complete within the context used and conform to the system boundary and the criteria for the exclusion of inputs and outputs, according to the requirements specified in EN 15804:2012+A2:2019.

For the Reference Service Life, a 20-year product warranty is provided by Gradus Limited for Gradus Handrails, Dual Rails & Combination Rail products assessed in this EPD. However, it should be noted that the service life may vary depending on the amount and nature of Handrails, Dual Rails & Combination use as well as the type and frequency of maintenance.

ISO14044 guidance. Quality Level	Geographical representativeness	Technical representativeness	Time representativeness
Very Good	Data from area under study.	Data from processes and products under study. Same state of technology applied as defined in goal and scope (i.e., identical technology).	Less than 3 years difference between the reference year according to the documentation, and the time period for which data are representative

Specific UK datasets have been selected from the ecoinvent LCI for this LCA. The quality level of geographical and technical representativeness is therefore very good. The quality level of time representativeness is very good as the background LCI datasets are based on ecoinvent v3.8 which was compiled in 2021. The quality level of time representativeness is also Very Good, as the background LCI datasets are based on ecoinvent v3.8 which was compiled in 2021. Therefore, there is less than 3 years between the ecoinvent LCI reference year and the time period for which the LCA was undertaken.



Power mix uses a location-based approach. Therefore, the UK Consumption mix was used for electricity with an emission factor of 0.239kgCO<sub>2</sub>e/kWh. UK Natural gas data (at industrial furnace) was used with an emissions factor of 0.232 kgCO<sub>2</sub>eq/kWh.

### **Cut-off criteria**

All processes associated with the manufacturing process have been included. All inputs or outputs have been included and all raw materials, ancillary, packaging, energy and fuels, water use, and wastes are included, except for direct emissions to air, water and soil which are not measure. Upstream extraction and/or processing of inputs are included within the use of background datasets within LINA.



## LCA Results.

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CFC11 eq	mol H <sup>+</sup> eq	kg (PO <sub>4</sub> ) <sup>3-</sup> eq
Product stage	Raw material supply	A1	9.27E+00	9.22E+00	2.06E-02	1.99E-02	9.95E-07	5.36E-02	3.59E-03
	Transport	A2	2.41E-01	2.40E-01	2.05E-04	9.44E-05	5.56E-08	9.76E-04	1.55E-05
	Manufacturing	A3	5.09E-01	5.20E-01	-1.19E-02	5.44E-04	6.93E-08	1.29E-03	8.13E-05
	Total (Consumption grid)	A1-3	1.00E+01	9.98E+00	8.91E-03	2.05E-02	1.12E-06	5.59E-02	3.69E-03
Construction process stage	Transport	A4	1.72E-01	1.72E-01	1.46E-04	6.73E-05	3.97E-08	6.96E-04	1.10E-05
	Construction	A5	4.98E+00	4.98E+00	-3.30E-03	4.75E-03	1.66E-06	2.23E-02	1.42E-03
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	3.04E+01	3.03E+01	1.15E-02	5.07E-02	5.64E-06	1.58E-01	1.02E-02
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.25E-02	1.25E-02	1.06E-05	4.89E-06	2.88E-09	5.06E-05	8.03E-07
	Waste processing	C3	1.39E+00	1.39E+00	4.06E-03	5.01E-04	5.27E-08	1.99E-03	1.21E-04
Potential benefits and loads beyond the system boundaries	Disposal	C4	1.97E-03	1.95E-03	1.76E-05	2.18E-06	2.13E-10	1.30E-05	5.75E-07
	Reuse, recovery, recycling potential	D	1.56E+01	1.56E+01	4.10E-02	-2.07E-02	-4.73E-07	-9.98E-02	-4.73E-03

GWP-total = Global warming potential, total;  
 GWP-fossil = Global warming potential, fossil;  
 GWP-biogenic = Global warming potential, biogenic;  
 GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;  
 AP = Acidification potential, accumulated exceedance; and  
 EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment



## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			EP-marine	EP-terrestrial	POCP	ADP-mineral & metal	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m <sup>3</sup> world eq deprived	disease incidence
Product stage	Raw material supply	A1	9.39E-03	9.65E-02	3.04E-02	1.16E-04	1.20E+02	3.72E+00	1.18E-06
	Transport	A2	2.94E-04	3.21E-03	9.83E-04	8.36E-07	3.63E+00	1.64E-02	2.07E-08
	Manufacturing	A3	3.88E-04	3.71E-03	9.99E-04	3.05E-06	1.15E+01	1.94E-01	1.21E-08
	Total (Consumption grid)	A1-3	1.01E-02	1.03E-01	3.24E-02	1.20E-04	1.35E+02	3.93E+00	1.21E-06
Construction process stage	Transport	A4	2.10E-04	2.29E-03	7.02E-04	5.96E-07	2.59E+00	1.17E-02	1.48E-08
	Construction	A5	4.35E-03	4.41E-02	1.44E-02	5.57E-05	9.93E+01	3.24E+00	2.42E-07
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	2.93E-02	3.00E-01	9.51E-02	3.52E-04	4.74E+02	1.44E+01	2.93E-06
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.52E-05	1.67E-04	5.10E-05	4.33E-08	1.88E-01	8.48E-04	1.08E-09
	Waste processing	C3	4.45E-04	4.45E-03	1.25E-03	1.25E-05	3.77E+00	2.16E+00	2.47E-08
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.66E-02	-1.74E-01	-4.98E-02	-1.34E-05	-1.42E+02	-1.94E+00	-1.28E-06
Disposal	C4	3.21E-06	3.45E-05	1.02E-05	4.32E-09	2.78E-02	8.79E-04	1.94E-10	

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;  
 EP-terrestrial = Eutrophication potential, accumulated exceedance;  
 POCP = Formation potential of tropospheric ozone;  
 ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;

ADP-fossil = Depletion potential of the stratospheric ozone layer;  
 WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and  
 PM = Particulate matter.



## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

			Parameters describing environmental impacts				
			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U <sup>235</sup> eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	8.50E-01	2.32E+02	1.57E-08	2.01E-07	2.49E+01
	Transport	A2	1.87E-02	2.84E+00	9.18E-11	2.97E-09	2.50E+00
	Manufacturing	A3	2.74E-01	6.69E+00	2.29E-10	4.40E-09	5.74E+00
	Total (Consumption grid)	A1-3	1.14E+00	2.41E+02	1.61E-08	2.09E-07	3.32E+01
Construction process stage	Transport	A4	1.33E-02	2.02E+00	6.55E-11	2.12E-09	1.78E+00
	Construction	A5	4.46E-01	9.23E+01	3.34E-09	7.25E-08	1.83E+01
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	3.21E+00	6.71E+02	3.89E-08	5.67E-07	1.07E+02
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	9.69E-04	1.47E-01	4.76E-12	1.54E-10	1.29E-01
	Waste processing	C3	3.11E-02	6.81E+01	4.07E-10	2.49E-08	2.87E+00
	Disposal	C4	1.62E-04	3.10E+01	1.81E-12	4.78E-11	3.55E-02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-2.58E-01	-3.98E+02	-1.59E-08	-3.39E-07	-3.00E+01

IRP = Potential human exposure efficiency relative to U235;  
ETP-fw = Potential comparative toxic unit for ecosystems;  
HTP-c = Potential comparative toxic unit for humans;

HTP-nc = Potential comparative toxic unit for humans; and  
SQP = Potential soil quality index.



## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, primary energy			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.18E+01	0.00E+00	1.18E+01	1.06E+02	1.23E+01	1.19E+02
	Transport	A2	5.12E-02	0.00E+00	5.12E-02	3.57E+00	0.00E+00	3.57E+00
	Manufacturing	A3	1.92E+00	5.44E-01	2.46E+00	1.16E+01	2.21E+00	1.38E+01
	Total (Consumption grid)	A1-3	1.38E+01	5.44E-01	1.43E+01	1.21E+02	1.45E+01	1.36E+02
Construction process stage	Transport	A4	3.65E-02	0.00E+00	3.65E-02	2.55E+00	0.00E+00	2.55E+00
	Construction	A5	4.93E+00	3.43E-01	5.27E+00	6.33E+01	3.52E+01	9.85E+01
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	3.74E+01	1.77E+00	3.92E+01	3.75E+02	9.95E+01	4.74E+02
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use Operational water use	B6 B7	0.00E+00 0.00E+00	0.00E+00 0.00E+00	0.00E+00 0.00E+00	0.00E+00 0.00E+00	0.00E+00 0.00E+00	0.00E+00 0.00E+00
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.65E-03	0.00E+00	2.65E-03	1.85E-01	0.00E+00	1.85E-01
	Waste processing	C3	3.31E-01	0.00E+00	3.31E-01	-8.50E+00	1.14E+01	2.90E+00
	Disposal	C4	1.79E-03	0.00E+00	1.79E-03	2.75E-02	0.00E+00	2.75E-02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-9.11E+00	0.00E+00	-9.11E+00	-1.41E+02	0.00E+00	-1.41E+02

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;  
 PERM = Use of renewable primary energy resources used as raw materials;  
 PERT = Total use of renewable primary energy resources;

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;  
 PENRM = Use of non-renewable primary energy resources used as raw materials;  
 PENRT = Total use of non-renewable primary energy resource



## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

			Parameters describing resource use, secondary materials and fuels, use of water			
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m <sup>3</sup>
Product stage	Raw material supply	A1	2.62E-01	0.00E+00	0.00E+00	9.27E-02
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	4.05E-04
	Manufacturing	A3	2.33E-02	6.84E-06	0.00E+00	5.86E-03
	Total (Consumption grid)	A1-3	2.85E-01	6.84E-06	0.00E+00	9.89E-02
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	2.89E-04
	Construction	A5	2.51E-02	2.39E-07	0.00E+00	7.74E-02
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	6.21E-01	1.41E-05	0.00E+00	3.53E-01
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	2.10E-05
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	5.03E-02
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	2.13E-05
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-5.21E-02

SM = Use of secondary material;  
RSF = Use of renewable secondary fuels;

NRSF = Use of non-renewable secondary fuels;  
FW = Net use of fresh water



## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing waste categories			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	1.75E-01	3.79E+00	5.84E-05
	Transport	A2	4.01E-03	7.11E-02	2.46E-05
	Manufacturing	A3	2.21E-02	3.59E-01	7.45E-05
	Total (Consumption grid)	A1-3	2.01E-01	4.22E+00	1.57E-04
Construction process stage	Transport	A4	2.86E-03	5.08E-02	1.75E-05
	Construction	A5	3.36E-01	6.01E+00	1.60E-04
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	1.08E+00	2.06E+01	6.72E-04
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00
End of life	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00
	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.08E-04	3.69E-03	1.27E-06
	Waste processing	C3	3.11E-01	1.14E+00	1.33E-05
Potential benefits and loads beyond the system boundaries	Disposal	C4	7.60E-04	5.45E-02	1.10E-07
	Reuse, recovery, recycling potential	D	-3.05E+00	-2.00E+01	-1.80E-04

HWD = Hazardous waste disposed;  
 NHWD = Non-hazardous waste disposed;  
 RWD = Radioactive waste disposed



## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing output flows – at end of life						
			CRU	MFR	MER	EE
			kg	kg	kg	MJ per energy carrier
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	4.89E-02	6.27E-03	5.53E-03
	Total (Consumption grid)	A1-3	0.00E+00	4.89E-02	6.27E-03	5.53E-03
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Construction	A5	0.00E+00	8.80E-02	2.87E-02	1.94E-04
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	2.74E-01	7.00E-02	1.14E-02
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	4.02E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;  
MFR = Materials for recycling

MER = Materials for energy recovery;  
EE = Exported Energy

Biogenic carbon (product)	Biogenic carbon (packaging)
kg C	kg C
0.00E+00	8.67E-02

## Scenarios and additional technical information

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
A4 – Transport to the building site	All Gradus Handrails, Dual Rails & Combination Rail products are transported using Gradus transport. Lorries are loaded and make multiple drop-offs on their route. When needed, the same lorries are used to carry raw material from suppliers, depending on the route. To conduct the LCA analysis, it is assumed that the Gradus Handrails, Dual Rails & Combination Rail are sold only in the UK, and an average transport distance has been considered.		
	Vehicle type	Litre of fuel type per distance or vehicle type	Lorry, 16 -32 metric ton
	Distance:	km	688
	Capacity utilisation (incl. empty returns)	%	50
A5 – Installation in the building	The installation is carried out as part of the finishing materials. The Gradus Handrails, Dual Rails & Combination Rail products are assembled on site. Most of them are assembled in their standard length of 4 meters; occasionally, small cuts are made on site to fit customer requirements. Considering this, an installation wastage of 3.5% is assumed for this LCA analysis.		
	Installation wastage rate	%	3.5
	Trim offcuts from installation - PVC to recycling	kg	0.05
B1 - Use	Gradus Handrails, Dual Rails & Combination Rail products are installed to provide wall protection and to support people with reduced mobility.		
B2 – Maintenance	Gradus Handrails, Dual Rails & Combination Rail products only require general cleaning. No ancillary materials, energy and/or water are needed during this process.		
B3 – Repair	No repairs are carried out for Gradus Handrails, Dual Rails & Combination Rail products.		
B4 – Replacement	If a section of Gradus Handrails, Dual Rails & Combination Rail products is damaged, the section is removed and a new section fitted in its place. The replacement of the Gradus Handrails, Dual Rails & Combination Rail products is more likely to occur once the product reaches the end of its service life, which typically occurs after 20 years. The waste produced at the End of Life because of the replacement and the transport to deliver the waste from the site to the waste facility have been included.		
	Number of replacements per study period	Qty	2
B5 – Refurbishment	No refurbishment is carried out for Gradus Handrails, Dual Rails & Combination Rail products.		
Reference service life	Gradus Handrails, Dual Rails & Combination Rail products' service life is 20 years. This service life is based on the Wall protection product warranty period for Handrails (SHR40W, SHR40P, SHR40S), Dual Rail (D200T, D200P, D200W) and Combination rail (CHR160, CHR110), and it includes manufacturing defects and excludes failure of the double-sided tape bond.		
	Wall protection warranty. Gradus. 2023.	years	20
B6 – Use of energy	No operational energy needed.		
B7 – Use of water	No operational water needed.		
C1 – Deconstruction	When Gradus Handrails, Dual Rails & Combination Rail products reach the End-of-Life, they will be manually removed and sent to a waste processing facility. It is assumed that 100% of the product is recovered for final disposal.		



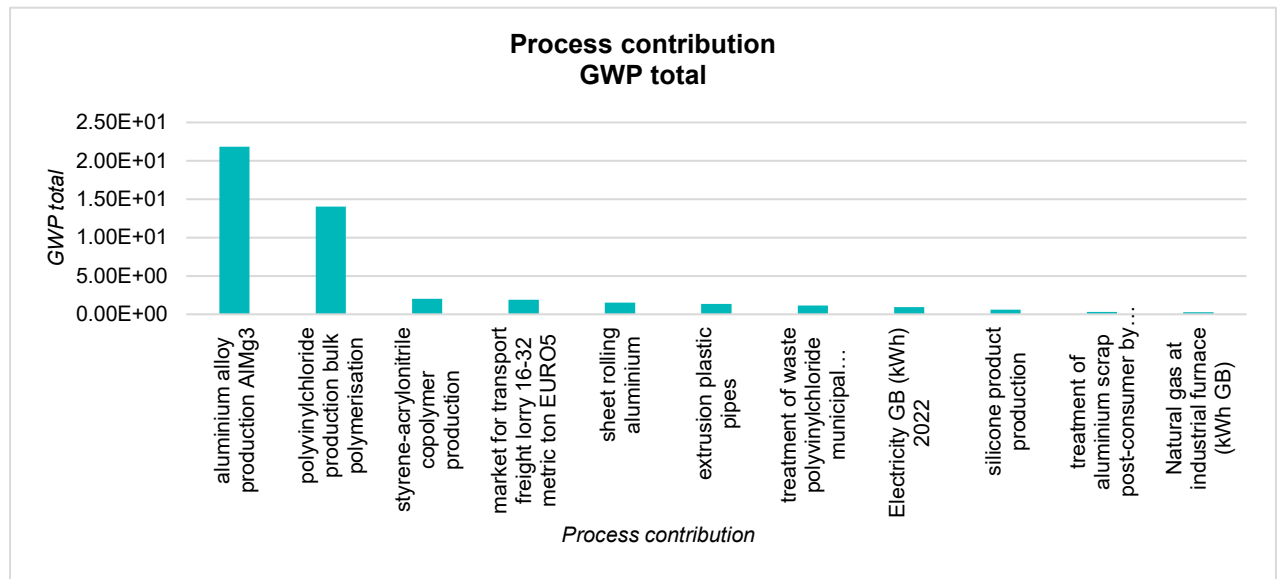
### Scenarios and additional technical information

Scenario	Parameter	Units	Results
C2 - Transport	50km by road has been modelled for module C2 as a typical distance from the demolition site to the recycling/ landfill unit. However, end-users of the EPD can use this information to calculate the impacts of a bespoke transport distance for module C2 if required.		
	Road transport	km	50
C3 - Preprocessing	Once Gradus Handrails, Dual Rails & Combination Rail products reach the End-of-Life, they will be sent to the waste processing facility. The industrial End-of-Life scenario has been selected for Polypropylene, Window frame, PVC. I.e. 100% Incineration with energy recovery; and General sheet, aluminium. i.e 95% recycling, 5% landfill. The End-of-Life scenario is based on BRE 2025 Product Category rules (PN 514 Rev 3.2)		
	PVC to incineration with energy recovery	kg	0.53
	Aluminium to recycling facility	kg	0.92
C4 - Disposal	Aluminium to landfill	kg	0.05
Module D	<p>“Benefits and loads beyond the system boundary” (module D) accounts for the environmental benefits and loads resulting from PVC and Aluminium that are used as raw material in Gradus Handrails, Dual Rails &amp; Combination Rail products, and that are collected for incineration and recycling at the end-of-life. These benefits and loads are calculated by excluding the pre-existing recycled aluminium that is used in the primary process, and it is considered that 100% of the PVC will be incinerated.</p> <p>For the benefits arising from incineration, the calorific value of Polyvinyl Chloride (PVC) has been considered, based on the Combustion and Gasification Properties of Plastics Particles (<a href="https://doi.org/10.1080/10473289.1997.10464461">https://doi.org/10.1080/10473289.1997.10464461</a>). The efficiency rate of 37.4% has been calculated by taking the weighted average of the number of waste incineration plants available in the UK. According to the Environmental Agency's 2013 article on "CHP Ready Guidance for Combustion and Energy from Waste Power Plants" in the UK, EFW plants have an efficiency of 33%, and CHP plants have an efficiency of 55%. Additionally, according to Azapagic, A., &amp; Jeswani, H. K. (2016), there are currently 25 MSW incinerators with energy recovery in the UK. It is assumed that 20 plants generate heat and power at 33%, while 5 plants generate electricity at 55%. Therefore, the weighted average calculation is used to determine the efficiency, which is calculated at 37.5%.)</p> <p>The calculation includes a bespoke dataset for heat and electricity. The dataset used to calculate the avoided impacts of heat and electricity consumption in a future system was 'Heat, district or industrial, other than natural gas {Europe without Switzerland}  market for heat, district or industrial, other than natural gas   EN15804, U', 'Heat, district or industrial, natural gas {Europe without Switzerland}  market for heat, district or industrial, natural gas   EN15804, U. ', 'Electricity, high voltage {Europe without Switzerland}  market group for electricity, high voltage   EN15804, U' all of them are from 2021.</p> <p>Calorific value of PVC: 21.2MJ/kg</p>		
	Benefits due to the incineration of waste PVC	Kg	0.53
	Benefits due to recycling of Aluminium	Kg	0.68

## Interpretation of results

The bulk of environmental impacts are attributed to the Product Module covered by information modules A1-A3 of EN 15804:2012+A2:2019. i.e Raw material supply. The GWP total for A1 is 9.01E+00 kg CO<sub>2</sub> eq.

The GWP Total process contribution can be found in the table below and it show that the major contributor is aluminium alloy production by 71.53%.





## References

BSI. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. BS EN 15804:2012+A1:2013. London, BSI, 2013.

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