Statement of Verification

BREG EN EPD No: 000747 Issue: 02

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

Corrosion Resistant Products Ltd

are in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:
1 unit of PFA injection moulded steel spools or fittings (cast and stainless steel) with an average weight of 8 kg.

Company Address

Corrosion Resistant Products Ltd
Todmorden Road
Littleborough
OL15 9EG

the corrosion expert

Signed for BRE Global Limited — Hayley Thomson, Operator

Date of this Issue	Date of First Issue	Expiry Date
20 January 2026	28 November 2025	27 November 2030

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Environmental Product Declaration

EPD Number: 000747

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE Environmental Profiles 2023 Product Category Rules for Type III environmental product declaration of construction products to EN 15804+A2 PN 514 Rev 3.1
Commissioner of LCA study	**LCA consultant/Tool**
Corrosion Resistant Products Ltd Todmorden Road Littleborough OL15 9EG	LCA Consultant: Regina Poveda Tool: BRE LINA A2
Declared/Functional Unit	**Applicability/Coverage**
1 unit of PFA injection moulded steel spools or fittings (cast and stainless steel) with an average weight of 8 kg.	Product Average.
EPD Type	**Background database**
Cradle to Grave	Ecoinvent 3.8

Demonstration of Verification
CEN standard EN 15804 serves as the core PCR [a]
Independent verification of the declaration and data according to EN ISO 14025:2010 ☒Internal ☐ External
(Where appropriate [b])Third party verifier: Roger Connick
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
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑

Note: Ticks indicate the Information Modules declared.

Manufacturing site(s)

Corrosion Resistant Products Ltd
Todmorden Road
Littleborough
OL15 9EG

Construction Product:

Product Description

This is an average EPD representing PFA injection moulded steel spools or fittings (cast and stainless steel) with an average weight of 8kg.

All PFA-lined pipes and fittings (cast and stainless steel) follow the same manufacturing process and the material recipe remains the same. For this EPD, the average weight has been selected due to the large variations in dimensions of all product types produced for PFA, which are bespoke designs for individual customer specifications and applications. More information about PFA products is available at https://www.crp.co.uk/products/introduction-to-lined-piping/.

PFA injection moulded steel spools or fittings (cast and stainless steel) are typically more complex shapes often with multiple branches and connections – Elbows, Tees, Concentrics – which are manufactured using injection moulding techniques. Dedicated tooling is designed and manufactured for the required component and fitted to the steelwork. Molten PFA is then injected into the component and cooled to produce a finished lining within the component. In this case, the flare faces are formed by the tooling design.

Technical Information

Property	Value according to Virgin PFA - ASTM D3307 Type II and Static Dissipating PFA unless specify	Unit
Mechanical minimum Tensile Strength	26.2	MPa
Mechanical minimum Elongation at Break	300	%
Mechanical hardness	55	Shore D
Specific Gravity	2,12 – 2,17	
Melt Flow Rate when tested to ASTM D3307 at 372°C	2 (Virgin PFA - ASTM D3307 Type II) 1.8 – 2.5 (Static Dissipating PFA)	g/10 min
Liner Colour	Translucent (Virgin PFA – ASTM D3307 Type II) Black (Static Dissipating PFA)	
Water absorption	<0.03	%
FDA Compliant	Yes (Virgin PFA - ASTM D3307 Type II), No (Static Dissipating PFA)	
Thermal conductivity	0.19	W/(m·k)
Coefficient of Linear Thermal Expansion 21˚C to 100˚C	$140x10^{-6}$	mm/mm.K
Coefficient of Linear Thermal Expansion 100˚C to 150˚C	$180x10^{-6}$	mm/mm.K
Coefficient of Linear Thermal Expansion 150˚C to 208˚C	$220x10^{-6}$	mm/mm.K
Electrical Volume Resistivity	10^{16} (Virgin PFA - ASTM D3307 Type II) 0.15 – 0.25 (Static Dissipating PFA)	Ω.m
Electrical Surface Resistivity	10^{17} (Virgin PFA - ASTM D3307 Type II)	Ω/£

Note: Technical properties of all products assessed within this EPD available in Lined Piping Catalogue. For more information, please visit CRP website at https://www.crp.co.uk/product-types/lined-piping/

Main Product Contents

PFA injection moulded steel spools or fittings (cast and stainless steel).

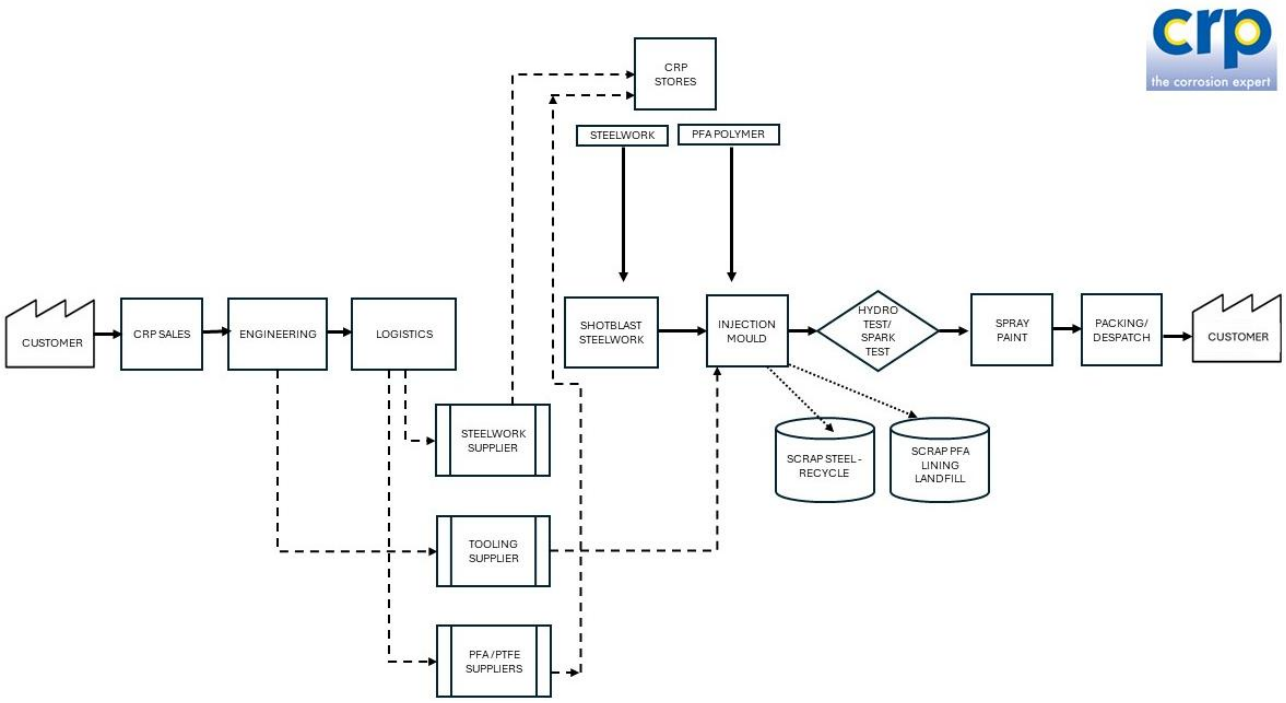
Material/Chemical Input	%
Carbon steel castings	73
PFA	23
Stainless steel fabrications	2
Paint	2

Note: This table represents an average material composition of all products assessed within this average EPD.

Manufacturing Process

Carbon steel pipes and fittings are cleaned by shotblasting. Tooling is bolted to the steel component. The steel work is then heated to 375 ˚C in ovens, then transferred to an injection moulding press. Molten PFA is then injected into the component and cooled using compressed air and water. The tooling is removed, and the PFA-lined component is then tested by filling it with water and pressurising the assembly. After this, the component is spray-painted to the customer's requirement and packed and boxed, then transported to the customer.
During the manufacturing process, scrap waste is produced by the steel, which is sent to recycling and scrap for PFA, while the remaining waste is sent to landfill.

Process flow diagram



Construction Installation

CRP transports the products by road and sea. To calculate the transport from the factory to the construction site, the average Central European distance has been used for road transport, and Sea transport for China.

The PFA injection moulded steel spools or fittings (cast and stainless steel) are installed manually, therefore there is no waste in the installation process.

Use Information

PFA injection moulded steel spools or fittings (cast and stainless steel) becomes passive elements incorporated into the finished refinery pipework. It carries chemical and/or products through. These products remain stationary in situ. The product requires maintenance, which will vary depending on the application and environment.

To prevent any external corrosion and/or weathering of steelwork it is advisable to cover the PFA injection moulded steel spools or fittings (cast and stainless steel) once every five years using epoxy primer paint. If necessary, the product should be fully replaced of original installation.

The product does no use energy to operate because it is a passive component.

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; PFA products will be removed manually by disconnecting or unbolting the pipes and fittings from each other and remove from installation.

The industrial average End-of-Life scenario for the steel components are based on the industrial scenario for Framework (cladding support), stainless steel according to BRE EN15804 A2 PCR 3.1. i.e 95% recycling and 5% landfill. On the other hand, PFA and paint are sent 100% to landfill. The PFA end-of-life scenario is based on the European Environment Agency landfill disposal route, considering that the main types of PFAs polymers can degrade and form non-polymeric PFAs in the environment.

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

Life Cycle Assessment Calculation Rules

Declared / Functional unit description

1 unit of PFA injection moulded steel spools or fittings (cast and stainless steel) with an average weight of 8 kg.

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 2023 Product Category Rules (PN 514 Rev. 3.1).

Data sources, quality and allocation

The LCA analysis is conducted for 1 unit of PFA injection moulded steel spools or fittings (cast and stainless steel) with an average weight of 8 kg, and it includes the manufacturer-specific data from CRP covering a period of one year from 01 January 2023 to 31 December 2023.

Specific primary data derived from PFA injection moulded steel spools or fittings (cast and stainless steel) production process in Corrosion Resistant Products Ltd, Todmorden Road, Littleborough, OL15 9EG factory 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 PFA injection moulded steel spools or fittings (cast and stainless steel), other products are manufactured in the CRP manufacturing site. PFA injection moulded steel spools or fittings (cast and stainless steel) account for 20.44% of the site's total production.

All raw material, ancillary materials, packaging and production waste have been taken from actual usages of the site production provided by CRP Ltd. As per energy and fuels, water and water waste values has been allocated by mass production. There is no uplift of the raw material as it is within tolerance.

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 completed 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.

Perfluoropentane is used as a proxy for PFA raw materials since both materials are classified as perfluorinated compounds, and PVC waste has been used as a proxy for PFA waste.

For the Reference Service Life, an industrial average scenario proxy was selected. Currently, CRP does not measure the PFA injection moulded steel spools or fittings (cast and stainless steel) product Service Life, this is because the performance can vary depending on the application and operation environment, which is out of CRP's control. Considering the product components, the closest industrial scenario in BRE 2023 PCR PN514 Rev 3.1 is Fencing (chain-link), steel (plastic coated).

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.

UK Consumption mix was used for electricity with an emission factor of 0.239kgCO2e/kWh. UK Natural gas data (at industrial furnace) was used with an emissions factor of 0.232 kgCO2eq/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 materials, packaging, energy & fuels, water, waste 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_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	4.17E+01	4.17E+01	5.38E-02	1.89E-02	1.47E-03	1.48E-01	8.64E-03
	Transport	A2	2.06E+00	2.05E+00	7.66E-04	1.25E-03	4.32E-07	4.30E-02	1.05E-04
	Manufacturing	A3	1.40E+01	1.44E+01	-4.74E-01	8.91E-03	1.16E-06	2.21E-02	1.25E-03
	Total (Consumption grid)	A1-3	5.78E+01	5.82E+01	-4.20E-01	2.91E-02	1.47E-03	2.13E-01	1.00E-02
Construction process stage	Transport	A4	3.34E+00	3.34E+00	1.71E-03	1.90E-03	7.17E-07	4.98E-02	1.96E-04
	Construction	A5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	1.75E+00	1.74E+00	6.93E-03	1.56E-03	2.60E-07	7.85E-03	5.10E-04
	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	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
	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
End of life	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	1.33E-01	1.33E-01	1.13E-04	5.22E-05	3.08E-08	5.40E-04	8.56E-06
	Waste processing	C3	3.28E-01	3.28E-01	1.16E-04	3.27E-05	7.00E-08	3.40E-03	1.01E-05
	Disposal	C4	1.71E-01	1.71E-01	2.14E-04	2.37E-05	7.09E-09	2.00E-04	3.24E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.81E+00	-5.83E+00	1.83E-02	-1.65E-03	-2.33E-07	-2.11E-02	-2.30E-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^3 world eq deprived	disease incidence
Product stage	Raw material supply	A1	2.43E-02	2.56E-01	1.17E-01	4.41E-04	3.13E+02	1.28E+01	2.13E-06
	Transport	A2	1.08E-02	1.20E-01	3.16E-02	6.16E-06	2.82E+01	9.94E-02	1.13E-07
	Manufacturing	A3	7.79E-03	7.52E-02	2.02E-02	5.16E-05	3.27E+02	1.05E+00	1.65E-07
	Total (Consumption grid)	A1-3	4.29E-02	4.51E-01	1.69E-01	4.99E-04	6.68E+02	1.39E+01	2.41E-06
Construction process stage	Transport	A4	1.26E-02	1.40E-01	3.74E-02	1.11E-05	4.71E+01	1.95E-01	1.93E-07
	Construction	A5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	1.43E-03	1.49E-02	6.11E-03	2.12E-05	3.38E+01	1.01E+00	7.02E-08
	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	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
	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
End of life	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	1.63E-04	1.78E-03	5.44E-04	4.62E-07	2.01E+00	9.05E-03	1.15E-08
	Waste processing	C3	1.51E-03	1.65E-02	4.54E-03	1.68E-07	4.49E+00	1.04E-02	9.12E-08
	Disposal	C4	8.00E-04	7.33E-04	2.47E-04	7.41E-08	5.46E-01	2.45E-02	3.95E-09
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.02E-03	-5.32E-02	-2.93E-02	-4.39E-06	-5.89E+01	-4.18E-01	-3.90E-07

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^{235} eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.86E+00	7.70E+02	1.95E-07	2.48E-06	6.23E+01
	Transport	A2	1.38E-01	1.99E+01	1.22E-09	1.75E-08	1.04E+01
	Manufacturing	A3	6.94E+00	1.16E+02	4.08E-09	7.24E-08	1.27E+02
	Total (Consumption grid)	A1-3	8.94E+00	9.05E+02	2.00E-07	2.57E-06	1.99E+02
Construction process stage	Transport	A4	2.37E-01	3.51E+01	1.69E-09	3.18E-08	2.03E+01
	Construction	A5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	1.41E-01	7.90E+01	2.08E-09	2.47E-08	4.28E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	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
	Operational water use	B7	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
	Transport	C2	1.03E-02	1.57E+00	5.08E-11	1.64E-09	1.38E+00
	Waste processing	C3	2.02E-02	2.63E+00	1.02E-10	1.91E-09	5.72E-01
	Disposal	C4	2.57E-03	7.78E+00	1.78E-11	1.52E-09	1.28E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.04E-01	-1.74E+02	-3.12E-08	-1.20E-07	-1.15E+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	1.99E+01	0.00E+00	1.99E+01	2.97E+02	1.37E+01	3.11E+02
	Transport	A2	3.10E-01	0.00E+00	3.10E-01	2.77E+01	0.00E+00	2.77E+01
	Manufacturing	A3	5.30E+01	5.38E+00	5.84E+01	3.89E+02	1.01E+01	3.99E+02
	Total (Consumption grid)	A1-3	7.33E+01	5.38E+00	7.86E+01	7.14E+02	2.38E+01	7.38E+02
Construction process stage	Transport	A4	1.10E-01	0.00E+00	1.10E-01	1.61E+01	0.00E+00	1.61E+01
	Construction	A5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	1.52E+00	0.00E+00	1.52E+00	2.90E+01	4.62E+00	3.36E+01
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	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
	Operational water use	B7	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	2.83E-02	0.00E+00	2.83E-02	1.97E+00	0.00E+00	1.97E+00
	Waste processing	C3	2.52E-02	0.00E+00	2.52E-02	4.41E+00	0.00E+00	4.41E+00
	Disposal	C4	9.34E-03	0.00E+00	9.34E-03	-4.27E+01	4.32E+01	5.36E-01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.21E+00	0.00E+00	-1.21E+00	-5.84E+01	0.00E+00	-5.84E+01

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^3
Product stage	Raw material supply	A1	2.70E+00	0.00E+00	0.00E+00	3.07E-01
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	2.46E-03
	Manufacturing	A3	4.84E-02	1.80E-04	0.00E+00	5.87E-02
	Total (Consumption grid)	A1-3	2.75E+00	1.80E-04	0.00E+00	3.68E-01
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	4.84E-03
	Construction	A5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	4.93E-03	0.00E+00	0.00E+00	2.43E-02
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	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	2.24E-04
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	2.56E-04
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	5.75E-04
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	3.45E+00	0.00E+00	0.00E+00	-1.01E-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	3.88E+00	3.94E+01	6.70E-04
	Transport	A2	3.68E-02	4.65E-01	1.31E+01
	Manufacturing	A3	3.07E-01	5.55E+00	2.07E-03
	Total (Consumption grid)	A1-3	4.22E+00	4.54E+01	1.31E+01
Construction process stage	Transport	A4	2.19E-02	1.78E-01	1.14E-04
	Construction	A5	0.00E+00	0.00E+00	0.00E+00
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	1.11E-01	2.31E+00	5.13E-05
	Repair	B3	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00
	Operational energy use	B6	0.00E+00	0.00E+00	0.00E+00
	Operational water use	B7	0.00E+00	0.00E+00	0.00E+00
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.22E-03	3.94E-02	1.36E-05
	Waste processing	C3	5.92E-03	4.14E-02	3.10E-05
	Disposal	C4	1.04E-03	2.03E+00	3.26E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.38E-01	-1.11E+01	-6.24E-05

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	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	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	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	3.06E-03	1.59E-06	1.49E-01	0.00E+00	-1.69E-01
	Total (Consumption grid)	A1-3	0.00E+00	3.06E-03	1.59E-06	1.49E-01	0.00E+00	-1.69E-01
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Construction	A5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	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
	Operational water use	B7	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	5.69E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	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	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

Scenarios and additional technical information

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
A4 – Transport to the building site	PFA injection moulded steel spools or fittings (cast and stainless steel) will be distributed to customers in China and Central European Construction sites.		
	Transport mode to China / Vehicle type	Sea transport	Ship, sea
	Distance:	km	17,000
	Transport mode to Central European Construction sites / Vehicle type	Road transport	Lorry, 7.5 – 16 metric ton
	Distance:	kg	1,200
A5 – Installation in the building	PFA injection moulded steel spools or fittings (cast and stainless steel) are manually assembly using hand tools; therefore, installation waste rate is minimal which have been assumed as 0.0% so the results are negligible.		
B1 - Use	Product remains static in situ. No additional energy or materials required once installed. Items become passive elements incorporated into the finished refinery pipework design which the customer uses to transport their chemicals/products through.		
B2 - Maintenance	The recommended touching up of the steelwork paint finish will depend on application and installation environment. It is recommended to retouch the steelwork painted once every 5 years.		
	Epoxy Primer Paint	kg	0.03
B3 – Repair	Not measure		
B4 - Replacement	Assumed to be full replacement of original installation – identical values should be used.		
B5 - Refurbishment	Not applicable		
B6 – Operational Energy use	No energy is used. Passive component of pipeline		
B7 – Operational water use	No water use.		
Reference service life	Service Life Scenario proxy based on BRE EN15804 A2 PCR 3.1.		
	Considering the product components the closest industrial scenario in BRE 2023 PCR PN514 Rev 3.1 is Fencing (chain-link), steel (plastic coated).	years	25
C1 - Deconstruction	At the End-of-Life the product is manually disconnected and/or unbolt pipes and fittings from each other and removed from the building. No ancillary materials, energy or water are required for the process. Therefore, there are no impacts associated with this module. The end-of-life scenarios for the steel components are based on the industrial scenario for Framework (cladding support), stainless steel according to BRE EN15804 A2 PCR 3.1. i.e 95% recycling and 5% landfill. PFA end of life scenario is based on European Environment Agency disposal route landfill. i.e 100% landfill (European Environment Agency, 2025). Since the paint cannot be detached from the product, it is assumed to be sent 100% to landfill.		
C2 - Transport	100 km 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.	Litres per Km	0.227
	Distance: Deconstruction unit to pre-processing unit	km	100

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
	Transportation	Road transport	Lorry, 16 – 32 metric ton
C3 – Waste processing	In the pre-processing stage, the separation process involves dismantling manually the PFA lined products, into the stainless steel or carbon steel casting and PFA materials. The end-of-life scenarios are according to BRE EN15804 A2 PCR 3.1 for the stainless steel and carbon steel casting which will be 95% sent to a recycling facility and 5% will be sent to landfill. As for PFA, it will be 100% sent to landfill, based on European Environment Agency. Since paint is not able to separate from the product, it will be assumed that it is sent 100% to landfill.		
	95% of Carbon Steel Casting to recycling	kg	5.54
	95% of Stainless Steel sent to recycling	kg	0.15
C4 - Disposal	5% Carbon Steel Casting to landfill	kg	0.29
	5% Stainless Steel to landfill	kg	0.01
	100% PFA + Paint to landfill	kg	2.01
Module D	“Benefits and loads beyond the system boundary” (module D) accounts for the environmental benefits and loads resulting from Carbon Steel Casting and Stainless Steel that is used as raw material in the PFA injection moulded steel spools or fittings (cast and stainless steel) and that is collected for recycling at end of life. These benefits and loads are calculated by excluding the pre-existing recycled steel that is used in the primary process. In the pre-processing stage, 5.54 kg of recovered Carbon Steel and 0.15 kg of Stainless Steel are recycled, initially which is a mix of scrap Carbon Steel (38.9%) and virgin Carbon Steel (61%), and a mix of scrap Stainless Steel (56%) and virgin Carbon Steel (44%). In order to calculate the benefits of the product at Module D, the pre-existing content of scrap steel in the recovered Carbon Steel and Stainless-Steel waste should be excluded from 5.54 kg and 0.15 kg respectively, i.e., 2.15 kg and 0.09 kg accordingly of pre-existing content should be avoided and only 3.38 kg and 0.07 kg of virgin Carbon and Stainless Steel should be considered in Module D.		
	Benefits of Carbon Steel Casting	kg	3.38
	Benefits of Stainless Steel	kg	0.07

Interpretation of results

The graph in Figure 1 shows that the total GWP value for the production stage of 1 unit of PFA injection moulded steel spools or fittings (cast and stainless steel) with an average weight of 8 kg is 4.17E+01 and it is higher in the Product Stage. i.e. Raw material supply.

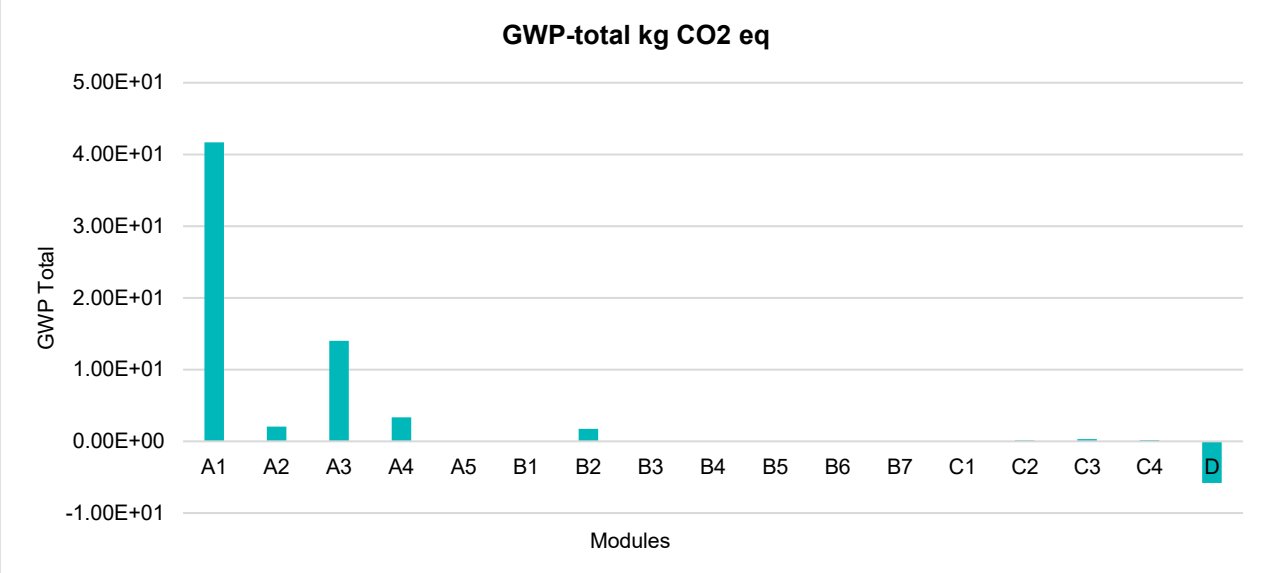


Figure 1. GWP of 1 unit of PFA injection moulded steel spools or fittings (cast and stainless steel) with weight an average weight of 8 kg by Stages.

In Figure 2, the Perfluoropentane production at Product stage accounts for 53.6%, followed by Cast iron (16.1%) and Electricity (13.3%).

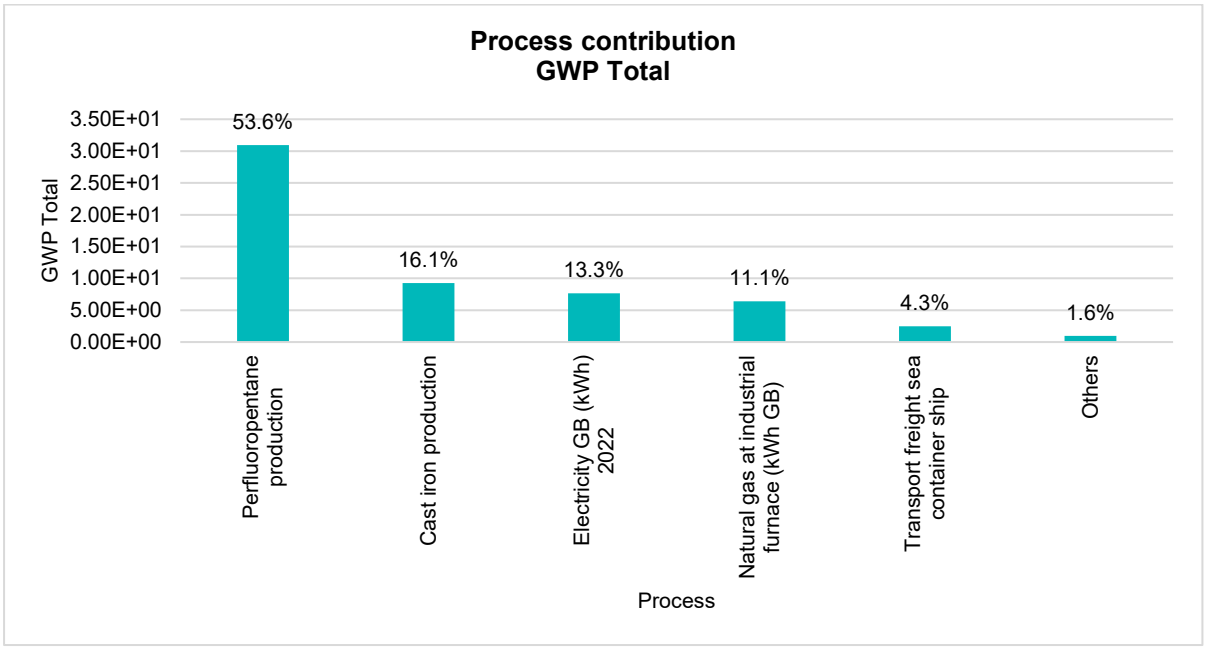


Figure 2. Process contribution of 1 unit of PFA injection moulded steel spools or fittings (cast and stainless steel) with an average weight of 8 kg.

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