GF Piping Systems

# Environmental Product Declaration

## Polyethylene system

According to EN 15804+A1

## Sea water cooling intake in a power plant

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## 1. Declaration of general information

### 1.1 Introduction

GF Piping Systems is one of the three divisions within Georg Fischer Corporation and a leading provider of plastic and metal piping systems with global market presence. The product portfolio includes pipes, fittings, valves and the corresponding automation and jointing technology for industry, building technology as well as water and gas utilities. Georg Fischer Piping Systems proactively incorporates its environmental responsibility into its everyday business activities. Because we understand environmental awareness as one of the corporation's core values, internal structures and processes are geared towards sustainability. In this context, life cycle assessments are the correct tool to gain insight in the different life cycle phases of our systems.

This EPD is based on a detailed background report written by the Flemish Institute for technological research (Vito). The report is in line with EN 15804+A1 "Sustainability of construction works – environmental product declarations – Core rules for the product category of construction products". The data of the study complies with the quality requirements set out in EN 15804+A1
(EN 15804+A1:2013, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products). Data regarding the production of the pipe system components is company specific and was provided by GF Piping Systems.

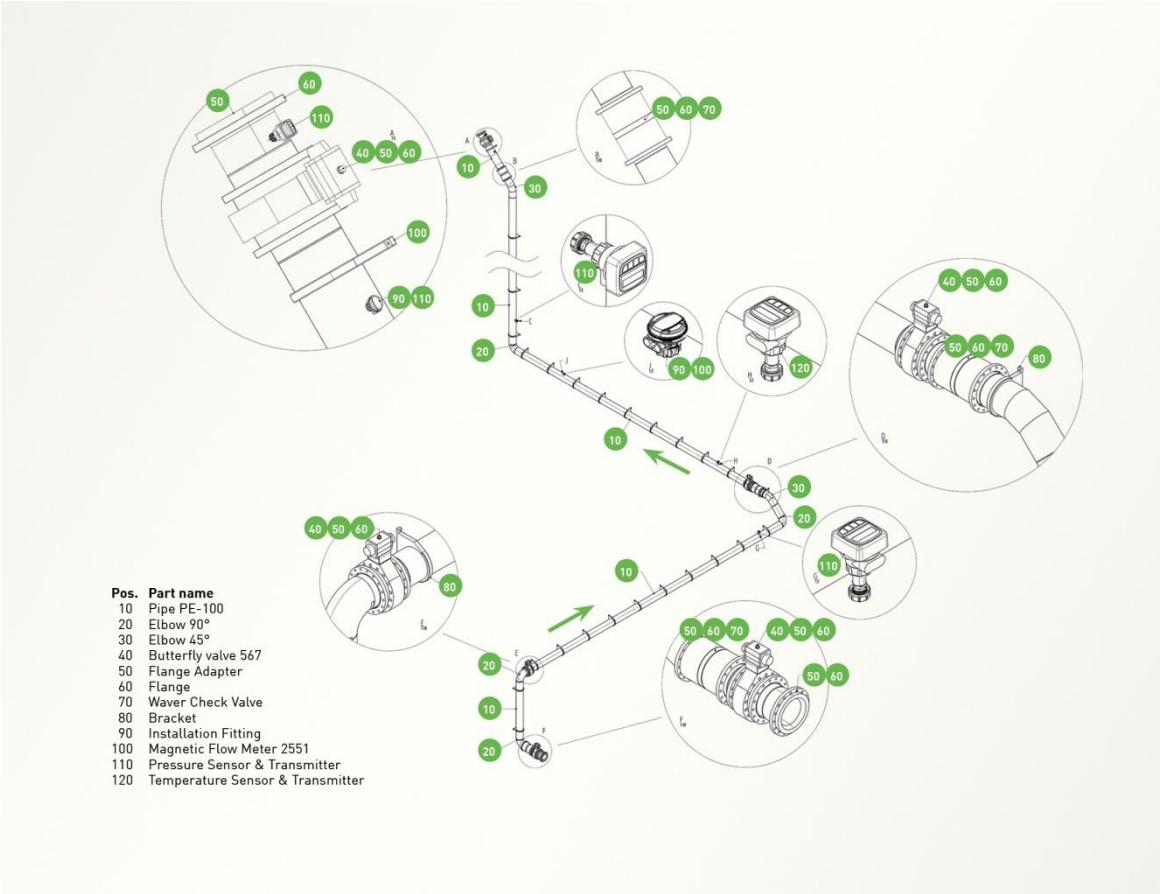
| Declaration | |
|---|---|
| Declaration owner & Program operator's name | Georg Fischer Piping Systems Ltd. |
| Validity | 26.03.2020 – 25.03.2025 |
| Declaration Number | GFPS-EPD_2005-1_5 |

| | |
|---|---|
| EPD-Type | Cradle to grave |
| Data calculated by | Vito NV (Flemish Institute for technological research) www.vito.be |
| Life Cycle Inventory (LCI) source for generic background processes | Ecoinvent 3.5 Industry data 2.0 database |
| Software | SimaPro 9.0.0 |

Certified Management System SQS ISO 9001 / 14001 / OHSAS 18001

## 1.2 System

The analyzed case represents an exemplary system for the transport of sea water to a power plant where it is used for process cooling. The system is designed in the dimension d400 and installed in Jiaxing (China). The used jointing technology is butt fusion.




### Materials

The material of the main pipe system components (pipes and fittings) is PE-100. The whole system consists of the materials as listed below.

| Material | | Weight (kg) |
|---|---|---|
| PE-100 | | 3 802 |
| Plastics (other than PE-100) | | 316 |
| Steel | | 154 |
| Other metals | | 29 |
| Rubber | | 3 |
| Cable (metal + plastics) | | 2 + 4 |
| Pump | Iron | 499 |
| | Steel | 234 |
| Motor | Steel | 931 |
| | Iron | 455 |
| | Other metals | 115 |
| | Paint | 8 |
| | Resin | 7 |
| | Insulation material | 6 |

### Reference service life

25 years

Please refer to chapter 2.3 for further information on the reference service life of the system.

### Functional unit (FU)

The above ground transportation of sea water to the cooling facility in a power plant, over a length of 80.2 m and a height difference of 10 m over the whole service lifetime of 25 years. The transport starts at the water surface and ends at the cooling facility.

### Components of the system (number of pieces or meter)

The system mainly consists of Georg Fischer Piping Systems components. However, to complete the system also external components (Ext.) are necessary which are not produced by Georg Fischer Piping Systems. The calculation of the environmental impact of these products is based on publicly available data and assumptions.

| | Product Code | Pieces or meter | Material |
|---|---|---|---|
| **System components** | | | |
| PE pipe, d400 | 193017175 | 80.2 m | PE-100 |
| Bend 90°, d400 | 753021025 | 4 | PE-100 |
| Bend 45°, d400 | 753051025 | 2 | PE-100 |
| Flange adapters, d400 | 753800025 | 16 | PE-100 |
| Installation fittings, d400 – d630 | 753314002 | 3 | PE-100 |
| Backing flanges, d400 | 727700525 | 16 | PPGF30 |
| Butterfly valve type 567 (with pneumatic actuator), d400 | 167567052 | 4 | PP-H (body) and others |
| Wafer check valve type 369, d400 | Custom made item | 3 | PP-H (body) and others |
| 2551 Magmeter flow sensor | 159001112 | 2 | PP (sensor body) and others |
| Level/pressure integral system | 159001041 | 2 | PVDF (sensor housing) and others |
| 2350 Temperature sensor | 159000920 | 1 | PVDF (sensor housing) and others |
| 9900 Transmitter | 159001696 | 1 | PBT (housing) and others |
| Cable | Ext. | 120 m | Copper and others |
| Pump | Ext. | 1 | Various metals and others |
| Motor | Ext. | 1 | Various metals and others |
| **Components for installation** | | | |
| Bolts | Ext. | 64 | Stainless steel |
| Nuts | Ext. | 128 | Stainless steel |
| Washers | Ext. | 128 | Stainless steel |
| Brackets | Ext. | 32 | PP |

## 1.3 Comparability

EPDs of construction products may not be comparable if they do not comply with the EN 15804+A1.

## 1.4 Demonstration of verification

**CEN standard EN 15804 serves as the core PCR**

Independent verification of the declaration and data, according to EN ISO 14025:2010

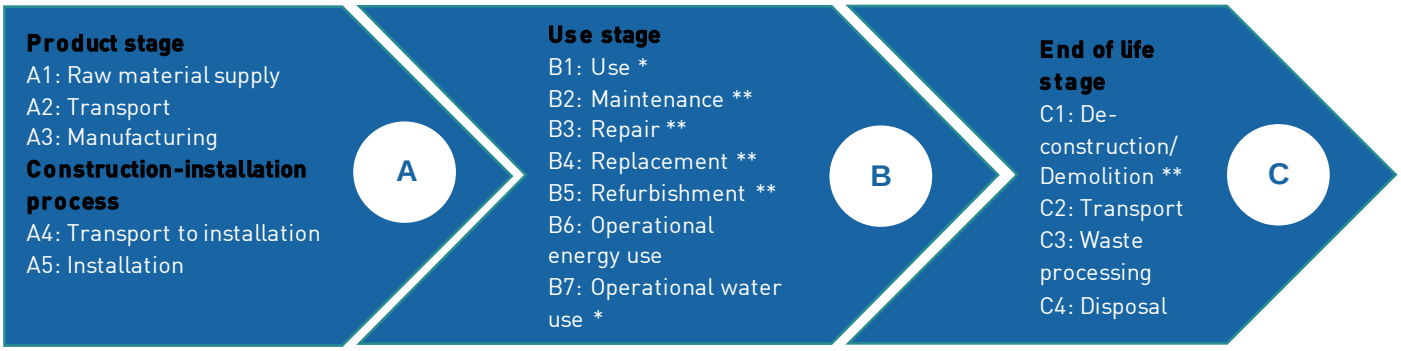
☐ internal ☒ external

Dr. Frank Werner

Company: Dr. Frank Werner Umwelt & Entwicklung, Zürich (Switzerland)

# 2. Declaration of environmental parameters derived from LCA

## 2.1 Flow diagram of the processes included in the LCA




* Stage not relevant, ** Environmental impact below cut-off criteria. Please refer to chapter 2.3 for details.

## 2.2 Parameters describing environmental impacts

| | Impact category | Global warming | Ozone depletion | Acidification of soil and water | Eutro-phication | Photo-chemical ozone creation | Abiotic depletion - non fossil | Abiotic depletion - fossil |
|---|---|---|---|---|---|---|---|---|
| | | kg $CO_2$ eq | kg CFC-11 eq | kg $SO_2$ eq | kg $PO_4^{3-}$ eq | kg $C_2H_4$ eq | kg Sb eq | MJ |
| A1-3 | Product stage | 1.84E+04 | 3.03E-03 | 1.26E+02 | 2.41E+01 | 8.33E+00 | 3.96E-01 | 4.09E+05 |
| A4 | Transport to installation | 6.52E+03 | 1.20E-03 | 2.42E+01 | 4.13E+00 | 1.04E+00 | 2.23E-03 | 9.43E+04 |
| A5 | Installation | 2.45E+02 | 4.10E-06 | 4.50E-01 | 1.25E-01 | 5.07E-02 | 1.16E-04 | 1.31E+03 |
| B1-5 | Use, Maintenance, Repair, Replace-ment, Refurbish-ment | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| B6 | Operational energy use | 1.03E+07 | 7.47E-02 | 4.55E+04 | 4.70E+03 | 1.70E+03 | 2.00E+00 | 9.13E+07 |
| B7 | Operational water use | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C1 | De-construction/ Demolition | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C2 | Transport to end-of-life treatment | 3.37E+02 | 5.49E-05 | 1.07E+00 | 1.72E-01 | 5.74E-02 | 1.62E-03 | 4.98E+03 |
| C3 | Waste processing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C4 | Disposal | 5.08E+02 | 1.08E-05 | 2.35E-01 | 1.05E-01 | 8.67E-02 | 4.93E-05 | 9.17E+02 |

## 2.3 Scenarios and additional technical information

The analyzed case represents an exemplary system for the transport of sea water to a power plant where it is used for process cooling.

| Product stage | |
|---|---|
| A1 | The production of the plastic raw material was modeled by generic European data (source: ecoinvent) and complemented by specific data from GF Piping Systems to consider the company specific formulation of the raw material. |
| A2 | Wherever possible, the specific transport distances were taken into account. Data from ecoinvent with the respective parameters was used to model the transportation. |
| A3 | The use of energy is the most important input for this process step. Pipes are extruded while fittings and valve parts are injection moulded. Each of GF Piping Systems' worldwide production sites is certified according to ISO 14001 (Environmental management systems) and to OHSAS 18001 (Occupational health and safety management systems) or is currently in the certification process. For the production of GF Piping Systems components, electricity mixes for the respective country/continent were used. The production of external products was modeled using generic ecoinvent data records for the process. |

| Construction process | |
|---|---|
| A4 | The system is installed in Jiaxing (near Shanghai), China.<br>Pipes, bends 90° and flange adapters, brackets as well as bolts, nuts and washers are transported over a distance of 127 km by means of a truck directly to the installation site. Measuring instruments are transported by air freight (10 885 km) and truck (127 km) to the installation site. The other components are first transported by truck to storage: Installation fittings (150 km), backing flanges (560 km), bends 45° (130 km), butterfly valves (456 km), check valves (250 km), brackets (700 km). Afterwards they are transported by air (9 262 km) and truck (127 km) to the installation site.<br>For all transportations by truck the ecoinvent data record "Transport, freight, lorry 16-32 metric ton, EURO5 {RER}| transport, freight, lorry 16-32 metric ton, EURO5 | Cut-off, U'" was used. Loading capacity is 60%. |
| A5 | For the installation of the whole system 72 kWh welding energy (Chinese electricity mix) is needed. Furthermore, specific cleaner (0.2 kg/FU) is necessary. The cleaner is transported by truck (1 027 km) and air freight (9 262 km) to the installation site.<br>Outputs of the complete installation of the system are PE pipe left over (5 kg/FU) and packaging waste (118 kg/FU) whereof 77% is cardboard. All waste is going to landfill. Transport distance to landfill is assumed to be 200 km. Transport is carried out by truck. |

| Use stage | |
|---|---|
| B1 | There are no further environmental impacts arising from the use of the system. This stage is considered as not relevant. |
| B2-B5 | The system is designed to be operated without repair, maintenance, replacement or refurbishment during the reference service life. This is subject to the condition that the system is operated according to the specifications given by GF Piping Systems.<br>The lifetime of a valve is mainly influenced by the actuation cycles. The number of actuation cycles the valves are tested for is not reached during the life time of the evaluated system. It is possible that in individual cases components of the valve (e.g. seals) must be replaced. In this case the environmental impact is negligible compared to the impact of the whole system and below the cut-off criteria defined in EN 15804+A1. |
| B6 | The operational energy use of the system is an important stage because of the long reference service life of 25 years. 10 082 200 kWh of energy (ecoinvent dataset: Electricity, medium voltage {CN}| market group for | Cut-off, U) for the pump during the use stage is necessary per functional unit. |
| B7 | No operational water use is necessary for the system. This stage is considered as not relevant. |

| End of life stage | |
|---|---|
| C1 | A small energy input is needed to cut the pipe into smaller pieces. The environmental impact is negligible compared to the impact of the whole system and below the cut-off criteria defined in EN 15804+A1. |
| C2 | Transportation to the end of life treatment facilities is carried out by truck. Distances to recycling and landfill are 200 km. |
| C3 | All metal parts of the system – in total 2 419 kg - are recycled. |
| C4 | All other parts – in total 4 146 kg - are going to landfill. |

## Reference service life data

| Parameter | Data |
|---|---|
| Reference service life | 25 years |
| Declared product properties | System components are compliant with relevant international standards, e.g.<br>• EN (European Standards)<br>• ISO (International Organization for Standardization)<br>• BS (British Standard)<br>• ASTM (American Society for Testing and Materials)<br>• JIS (Japan Industrial Standard)<br><br>Most relevant standards are:<br>ISO 15494 Plastics piping systems for industrial applications - Polybutene (PB), Polyethylene (PE) and Polypropylene (PP) - Specifications for components and the system<br>ISO 16136 Industrial valves - Butterfly valves of thermoplastics materials<br>ISO 16137 Industrial valves - Check valves of thermoplastics materials<br>EN 12201 Plastics piping systems for water supply, and for drainage and sewerage under pressure - Polyethylene (PE) |
| Design application parameters | PE-100 characteristics / Value / Test standard<br>Operating temperature range / -50 °C to + 60 °C /<br>UV resistant / yes /<br>Density / 0.95 g/cm$^3$ / EN ISO 1183 - 1<br>Yield stress at 23 °C / 25 N/mm$^2$ / EN ISO 527 - 1<br>Tensile e-modulus at 23 °C / 900 N/mm$^2$ / EN ISO 527 - 1<br>Charpy notched impact strength at 23 °C / 83 kJ/m$^2$ / EN ISO 179 – 1/1eA<br>Charpy notched impact strength at -40 °C / 13 kJ/m$^2$ / EN ISO 179 – 1/1eA<br>Ball indentation hardness (132 N) / 37 MPa / EN ISO 2039 - 1<br>Crystallite melting point / 130 °C / DIN 51007<br>Heat conductivity at 23 °C / 0.38 W/m K / EN 12664<br>Water absorption at 23 °C / 0.01-0.04% / EN ISO 62<br><br>For more information, please refer to the planning fundamentals which are available at: gfps.com › support & services › Planning Assistance › Planning Fundamentals › Industrial Piping Systems |
| Assumed quality of work | • Constant water supply without interrupting operations<br>• Leakproof system reduces water losses<br>• Flexibility of plastics pipes minimizes the risk of water hammer<br>• No corrosion and no incrustation reduces maintenance to a minimum |
| Outdoor environment | The system is installed in Jiaxing (near Shanghai) where the following outdoor parameters apply:<br>Average air temperature: 17°C<br>Average water temperature: 17°C<br>Average hours of sunshine/day: 5h |
| Usage conditions | • SDR 11<br>• PN 16<br>• Flow rate 2.5 m/s |
| Maintenance | The system is designed to be operated without repair, maintenance, replacement or refurbishment. This is subject to the condition that the system is installed and operated according to the specifications given by GF Piping Systems. Please refer also to chapter 2.3. |

## 2.4 Parameters describing resource use

| Parameters describing resource use, primary energy | | Product stage | Construction process stage | | Use stage | | | End of life | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (of product stage) | Transport | Construction installation process | Use, Maintenance, Repair, Replacement, Refurbishment | Operational energy use | Operational water use | De-construction / Demolition | Transport | Waste processing | Disposal |
| | | A1-3 | A4 | A5 | B1-B5 | B6 | B7 | C1 | C2 | C3 | C4 |
| Use of renewable primary energy excluding renewable primary energy resources used as raw materials | MJ, net calorific value | 2.77E+04 | 5.12E+02 | 8.29E+01 | 0 | 9.13E+06 | 0 | 0 | 6.35E+01 | 0 | 3.04E+01 |
| Use of renewable primary energy resources used as raw materials | | 3.55E+02 | 0 | 5.84E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) | | 2.81E+04 | 5.12E+02 | 8.35E+01 | 0 | 9.13E+06 | 0 | 0 | 6.35E+01 | 0 | 3.04E+01 |
| Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials | | 2.64E+05 | 9.56E+04 | 1.11E+03 | 0 | 9.44E+07 | 0 | 0 | 5.09E+03 | 0 | 9.87E+02 |
| Use of non-renewable primary energy resources used as raw materials | | 1.72E+05 | 0 | 2.59E+02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) | | 4.36E+05 | 9.56E+04 | 1.36E+03 | 0 | 9.44E+07 | 0 | 0 | 5.09E+03 | 0 | 9.87E+02 |

| Parameters describing resource use, secondary materials and fuels, and use of water | | Product stage | Construction process stage | | Use stage | | | End of life | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (of product stage) | Transport | Construction installation process | Use , Maintenance, Repair, Replacement, Refurbishment | Operational energy use | Operational water use | De-construction / Demolition | Transport | Waste processing | Disposal |
| | | A1-3 | A4 | A5 | B1-B5 | B6 | B7 | C1 | C2 | C3 | C4 |
| Use of secondary material* | kg | 1.37E+03 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Use of renewable secondary fuels* | MJ, net calorific value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Use of non-renewable secondary fuels* | MJ, net calorific value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net use of fresh water | $m^3$ | 2.74E+02 | 1.11E+01 | 4.14E-01 | 0 | 1.44E+04 | 0 | 0 | 8.08E-01 | 0 | 1.14E+00 |

*Only for foreground process from which LCI data are made available by GF Piping Systems - the number does not include processes and materials modelled by means of background data, e.g. transportation, electricity, ancillary materials, etc.

## 2.5 Environmental information describing output flows

| Other environmental information describing output flows | | Product stage | Construction process stage | | Use stage | | | End of life | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (of product stage) | Transport | Construction installation process | Use, Maintenance, Repair, Replacement, Refurbishment | Operational energy use | Operational water use | De-construction / Demolition | Transport | Waste processing | Disposal |
| | | A1-3 | A4 | A5 | B1-B5 | B6 | B7 | C1 | C2 | C3 | C4 |
| Components for re-use* | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Materials for recycling* | kg | 4.15E+01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.42E+03 |
| Materials for energy recovery* | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Exported energy - electricity* | MJ per energy carrier | 3.67E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Exported energy - thermal energy* | MJ per energy carrier | 7.75E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Only for foreground process from which LCI data are made available by GF Piping Systems - the number does not include processes and materials modelled by means of background data, e.g. transportation, electricity, ancillary materials, etc.

| Other environmental information describing waste categories | | Product stage | Construction process stage | | Use stage | | | End of life | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (of product stage) | Transport | Construction installation process | Use , Maintenance, Repair, Replacement, Refurbishment | Operational energy use | Operational water use | De-construction/ Demolition | Transport | Waste processing | Disposal |
| | | A1-3 | A4 | A5 | B1-B5 | B6 | B7 | C1 | C2 | C3 | C4 |
| Hazardous waste disposed | kg | 4.84E-01 | 3.22E-02 | 1.55E-03 | 0 | 1.58E+02 | 0 | 0 | 4.01E-03 | 0 | 4.17E-04 |
| Non-hazardous waste disposed | | 7.61E+03 | 4.30E+02 | 1.36E+02 | 0 | 8.87E+05 | 0 | 0 | 1.77E+02 | 0 | 4.15E+03 |
| Radioactive waste disposed | | 4.66E-01 | 6.81E-01 | 2.35E-03 | 0 | 5.49E+01 | 0 | 0 | 3.34E-02 | 0 | 6.57E-03 |

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