EPD

Environmental Product Declaration

Indoor Voltage Transformer TJC 7.1 33000/√3//110/√3//110/3V

Production site: Brno, Czech Republic

DOCUMENT KIND Environmental Product Declaration	IN COMPLIANCE WITH ISO 14025 and EN 50693			
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EPD Owner	ABB Switzerland Ltd, Group Technology Management		
Organization No.	CHE-101.538.426		
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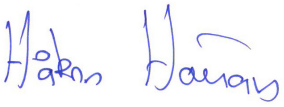
Declared product	Indoor voltage transformer TJC 7.1 33000/√3//110/√3//110/3V		
Product description	The TJC 7.1 insulated voltage transformer are cast in epoxy resin and designed mostly for insulation voltage up to 36 kV.		
Functional unit	To measure and protect an energy distribution system (the system voltage up to 36 kV.) during a service life of 20 years and with a use rate of 100%.		
Reference flow	Indoor instrument voltage transformer TJC 7.1 casted in epoxy resin and its related accessories and packaging.		
CPC code	46121 - Electrical transformers		
Independent verification	Independent verification of the declaration and data, according to ISO 14025:2010 ☐ INTERNAL ☒ EXTERNAL Independent verifier approved by EPD-Norge: Elisabet Amat Signature: 		
Approved by	Håkon Hauan, EPD-Norge Signature: 		
Reference PCR	EN 50693:2019 – Product Category Rules for Life Cycle Assessments of Electronic and Electrical Products and Systems. EPDItaly007 – Electronic and Electrical Products and Systems, Rev. 3.0, 2023/01/13.		
Program instructions	The Norwegian EPD Foundation/EPD-Norge, General Programme Instructions 2019, Version 3.0, 2019/04/24.		
LCA study	This EPD is based on the LCA study described in the LCA report 1VLG101124.		
EPD type	Specific product by a specific manufacturer		
EPD scope	Cradle-to-grave		
Product RSL	20 years, this is a theoretical period selected for calculation purposes only and it is not representative for the minimum, average, nor actual service life of the product		
Geographical representativeness	Manufacturing (suppliers): Global	Manufacturing (ABB): Czech Republic	Downstream: Europe
Reference year	2022		
LCA software	SimaPro 9.5 (2023)		
LCI database	Ecoinvent v3.9.1 (2022)		
Comparability	EPDs published within the same product category, though originating from different programs, may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible.		
Liability	The owner of the declaration shall be liable for the underlying information and evidence. EPD-Norge shall not be liable with respect to manufacturer, life cycle assessment data, and evidence.		

Contents

Sustainability at ABB

ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future. By connecting software to its electrification, robotics, automation, and motion portfolio, ABB pushes the boundaries of technology to drive performance to new levels.

At ABB, we actively contribute to a more sustainable world, leading by example in our own operations and partnering with customers and suppliers to enable a low-carbon society, preserve resources, and promote social progress.

Learn more on our website global.abb/group/en/sustainability or scan the QR code.

General Information

The product declared in this Environmental Product Declaration is the indoor voltage transformer TJC 7.1 33000/√3//110/√3//110/3V, including related accessories and packaging.

The instrument transformer TJC 7.1 is a measuring device which is standardly used in medium voltage indoor switchgears for transforming nominal voltage into low voltage which can be then safely used controlling and monitoring relay devices. Most common type of switchgear is UniGear ZS1.

General technical specifications of the product are presented below.

Technical information		
	Unit	**Value**
Outer height/width/length	mm	324/250/393
Insulation level	kV	36/70/170
Rated primary	V	33000
Rated secondary	V	110
Accuracy class	-	0.5 / 6P
Rated output	VA	15/10/50
Frequency	Hz	50
Thermal burden	VA	150

The production of the instrument transformers, from which medium indoor voltage transformer TJC 7.1 is part of, is located in the ABB Brno Videnska factory. The instrument transformers are produced and assembled directly in the ABB factory combined with components produced by ABB's suppliers.

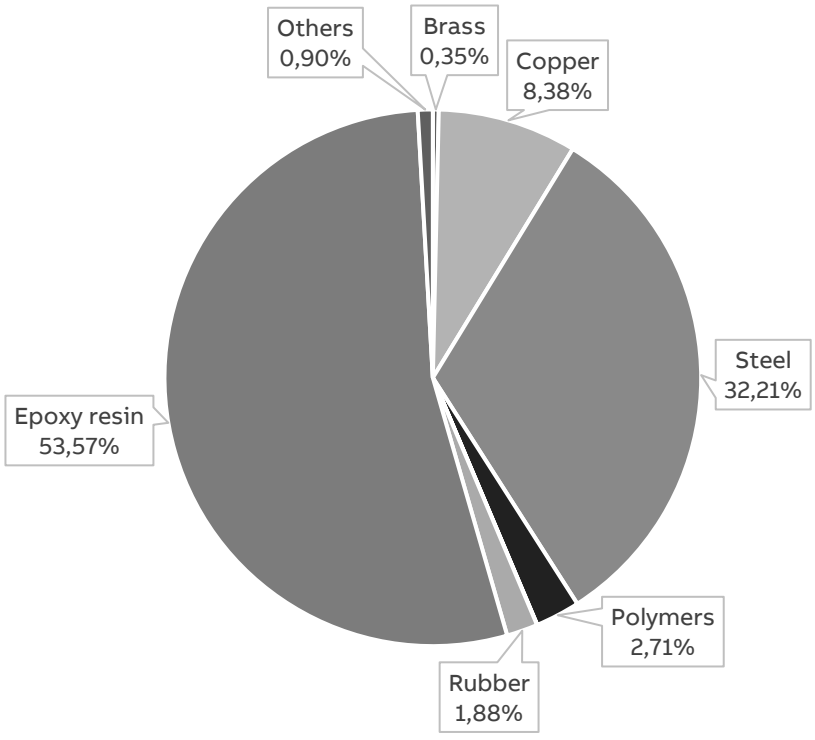
ABB Brno ELDS adopts and implements for its own activities an integrated Quality/Environmental/Health Management System in compliance with the following standards:

- UNI EN ISO 9001:2015 - Quality Management Systems- Requirements
- UNI EN ISO 14001:2015 - Environmental Management Systems
- UNI EN ISO 45001:2018 - Occupational Health and Safety Management system

Constituent Materials

The TJC 7.1 33000/√3//110/√3//110/3V weighs 59.29 kg, and the constituent materials are presented below.

Type	Material	Weight [kg]	Weight %
Metals	Copper	4.97	8.38
	Steel	19.10	32.21
	Brass	0.21	0.35
Plastics and Rubbers	Polymers	1.60	2.71
	Rubber	1.12	1.88
Others	Epoxy resin	31.76	53.57
	Others	0.53	0.90
Total		**59.29**	**100**



The packaging materials and accessories weighs 8.04 kg, and the constituent materials are presented below.

Description	Material	Weight [kg]	Weight %
Metals	Aluminum	0.006	0.08
	Steel	0.381	4.74
Plastics and Rubbers	Polymers	0.069	0.86
	Rubber	0.010	0.12
Wooden base materials	Wood (pallet + case)	7.479	93.04
Unit test report	Paper	0.005	0.06
Others	Cardboard	0.088	1.10
Total		**8.038**	**100**

LCA Background Information

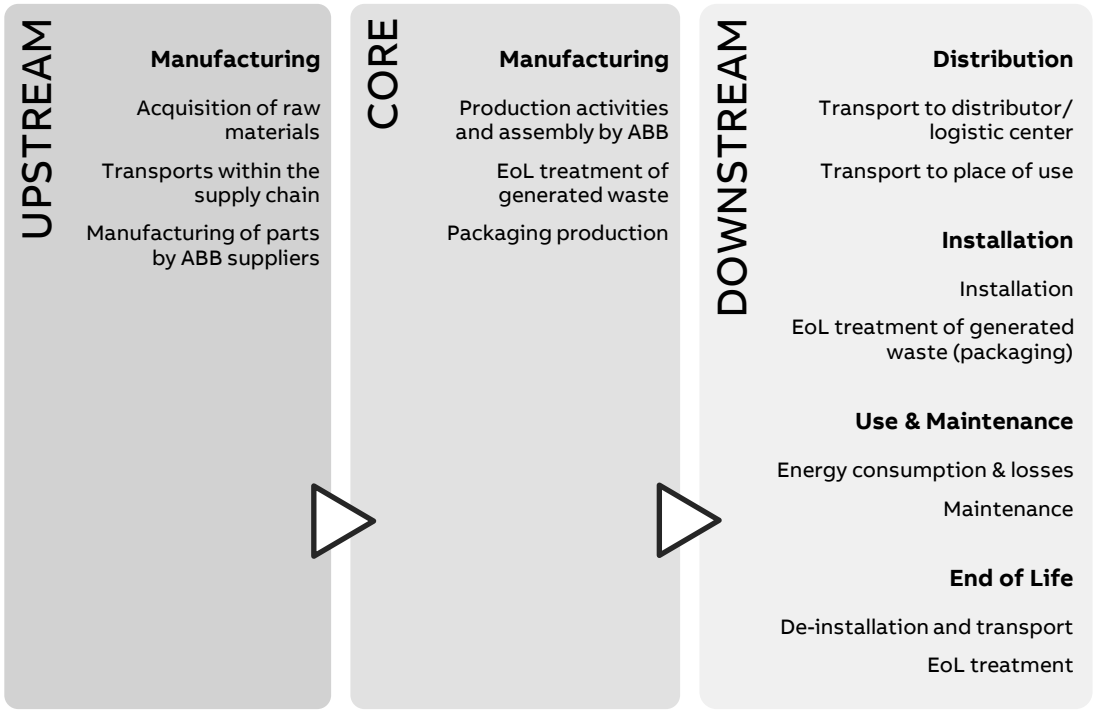
Functional Unit

The functional unit of this study is to measure and protect an energy distribution system (the system voltage up to 36 kV), during a service life of 20 years and with a use rate of 100 %. The reference flow is an indoor voltage transformer TJC 7.1 33000/√3//110/√3//110/3V casted in epoxy resin, including related accessories and packaging.

Note, the reference service life (RSL) of 20 years is a theoretical period selected for calculation purposes only – this is not representative for the minimum, average, nor actual service life of the product.

System Boundaries

The life cycle assessment of the TJC 7.1, an EEPS (Electronic and Electrical Products and Systems), is a “cradle-to-grave” analysis. The figure below shows the product life cycle stages and the information considered in the LCA.



In terms of exclusions from the system boundary, according to Standard/PCR, capital goods such as machinery, tools, buildings, infrastructure, packaging for internal transports, and administrative activities, which cannot be allocated directly to the production of the reference product, are excluded.

Infrastructures, when present, such as in processes deriving from the ecoinvent database, have not been excluded. Scraps for metal working and plastic processes are also included when already defined in ecoinvent.

Temporal and geographical boundaries

In terms of temporal boundaries, all primary data collected from ABB are from 2022, which is considered a representative production year. Secondary data are provided by ecoinvent v3.9.1 which was released in 2022.

In terms of geographical boundaries, the materials and components used in the production of the TJC 7.1 are globally sourced. The supply chains are often complex and can extend across multiple countries and continents. Therefore, materials and background processes with global representativeness are selected from ecoinvent. Thus, a conservative approach is adopted.

Data quality

Both primary and secondary data are used. The main sources for primary data are the bill of materials and technical drawings, while site specific foreground data are provided by ABB. Furthermore, information and data obtained from other LCA studies are also used.

For all processes for which primary data are not available, generic data originating from the ecoinvent v3.9.1 database, “allocation, cut-off by classification”, are used. The LCA software used for the calculations is SimaPro 9.5.

Environmental impact indicators

The information obtained from the inventory analysis is aggregated according to the effects related to the various environmental issues. In accordance with the PCR EPDItaly007 and EN 50693, the environmental impact indicators are determined by using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019.

Allocation rules

The utility consumption and waste generation at the ABB manufacturing site is allocated to the production of one TJC 7.1 by using allocation rules.

All the commodities - Natural Gas, Water, Electricity, Wastes are available for whole ABB Brno Videnska facility for 2022. Specific allocation related to instrument transformers and sensors production was done as follow:

- Natural Gas – measurement for whole facility ABB Videnska allocated by surface areas of ITS (Instrument Transformers and Sensors) production related buildings.
- Water – measurement for whole facility ABB Videnska allocated per ITS production employees.
- Electricity – sub measurements for ITS production.
- Wastes – based on the data of HSE and Facility office (no allocation key required)

The allocation coefficient to the single unit for all listed commodities was defined as ratio between product weight and ITS production in 2022 (represented by total weight of all produced units).

For the end-of-life allocation, the “Polluter Pays” principle is adopted according to what is defined in the CEN/TR 16970 standard, as required by the PCR EPDItaly007. This means, waste treatment processes are allocated to the product system that generates the waste

until the end-of-waste state is reached. The environmental burdens of recycling and energy recovery processes are therefore allocated to the product system that generates the waste, while the product system that uses the exported energy and recycled materials receives it burden-free. However, the potential benefits and avoided loads from recovery and recycling processes are not considered because it is not required by EPDItaly007.

Cut-off criteria

The materials that were excluded are glue, and adhesive, as their mass represents less than 2% of that of the whole product, as stated in the paragraph of cut-off criteria of EPDItaly015: “Materials making up the transformer itself whose total mass does not exceed 2% of the total weight of the device”.

The same applies for tape and labels used in packaging, which are even a smaller fraction of the total mass.

Sandblasting of capacitors and phosphating were also excluded due to the model complexity and unavailability of reference data.

Inventory Analysis

Manufacturing stage

As presented in chapter Constituent Materials, epoxy resin and steel are the most frequently used materials, followed by copper and polymers.

All steel components (hot rolled steel, spring steel, stainless steel) are modelled with the same kind of steel: *"Steel, low-alloyed {GLO}| market for | Cut-off, S",* as it is representative for the large majority of the steel parts. Stainless steel is only used for a small amount of screws and due to lack of data they are modelled using one type of steel.

To account for the production activities of metal and plastic parts, *Metal working, average* and *Injection molding* are the most frequently used processes. Surface treatments are also included, and the most common surface treatments are *ABB_Zinc coat, pieces (GLO)_SMP_V1* and *ABB_Tin plating, pieces (GLO)_SMP_V1*.

Supply chain transports are added as far as data is available between ABB, the suppliers, and sub-suppliers. Only primary suppliers are considered. The rest of the transports are assumed to already be included in ecoinvent's "market for"-processes. The selected ecoinvent processes are *Transport, freight, lorry 16-32 metric ton, EURO4 {RER}* for lorry and *transport, freight, sea, container ship {GLO}* for sea transport.

For the ABB manufacturing site, which is considered in the core manufacturing stage, utility consumption and waste generation are allocated to the production of one TJC 7.1 according to the defined allocation rules. The packaging materials and accessories associated with the product are also considered in the core manufacturing stage.

The energy mix used for the production is representative for ABB Videnska factory based on the guarantee of origin (GO) energy certificate. This dataset includes electricity inputs produced in this country and from imports and transformed to medium voltage, the transmission voltage, direct emissions to air and electricity losses during transmission. The emission factor of the energy mix is presented in table 8, according to the impact category "GWP – Total".

Data source	Amount	Unit
ABB_Electricity mix Brno factory {CZ}_2022 | S_SMP_V1	0.51	kg CO_2-eq/kWh

Distribution

The transport distance from ABB's plant to the site of installation is assumed to be 300 km over land, as suggested by the PCR EPDItaly015, as the actual distance is unknown. The selected ecoinvent process is *Transport, freight, lorry 16-32 metric ton, euro4 {RER}| market for transport, freight, lorry 16-32 metric ton, EURO4 | Cut-off, S*, and the scenario is representative for Europe.

Installation

The installation phase only implies manual activities, and no energy is consumed. Therefore, this phase only considers the end-of-life of the packaging materials used.

The end-of-life scenario for packaging materials is based on *Packaging waste by waste management operations* by Eurostat (2020), which is representative for Europe. A

transport by lorry is assumed as actual location of disposal is unknown. The waste is assumed to be sorted by hand when disposed, and possible losses in the separation processes are assumed to be negligible. Finally, because the actual transportation of waste is unknown, a transport distance of 100 km is assumed with the ecoinvent process *Transport, freight, lorry 16-32 metric ton, euro4 {RER}| market for transport, freight, lorry 16-32 metric ton, EURO4 | Cut-off, S*.

Use

The use stage considers the losses in the magnetic core (magnetic core) and joule losses in the resistance of the primary and secondary coils over the reference service life of 20 years as defined in the functional unit. This is calculated using the following formula, according to the PCR EPDItaly015 “Electronic and electrical products and systems - Switchboards” which defines specific rules for major product family the functional unit is used in:

$$\Delta P_{use} = \Delta P_F + \Delta P_J = 14.025 + 0.17 = 14.19\ W$$

$$E_{use} = \frac{\Delta P_{use} * 8760 * RSL}{1000} = \frac{14.19 * 8760 * 20}{1000} = 2486.40\ \ kWh$$

Where:

- E_{use} = Total energy use over the reference service life
- ΔP_{use} = Reference power consumption in watts
- ΔP_J = Joule losses in the primary and secondary coils
- ΔP_F = Losses in all magnetic cores (-C-core-)
- RSL = Reference Service Life in years
- α = Use time rate
- 8760 is the number of hours in a year
- 1000 is the conversion factor from W to kW

Because this product is sold globally and is not limited to any specific country, the latest energy mix of the European Union is adopted as suggested by the standard EN 50693. The emission factor of the energy mix is presented below.

Energy mix	Source	Amount	Unit
Electricity, medium voltage {RER}| market group for	Cut-off, S	Ecoinvent v3.9.1	0.374	kg CO_2-eq/kWh

Since no maintenance happens during the use phase, the environmental impacts linked to this procedure are omitted from the analysis.

End of life

Decommissioning of the product only implies manual activities, and no energy is consumed. Therefore, this phase only considers the end-of-life of the product.

The end-of-life scenario for the product is based on PCR EPDItaly015 and IEC/TR 62635 (Annex D.3), which is representative for Europe. In case of epoxy casted transformer, we are limited with very demanding process of disassembling which resulting into situation, that all the materials casted in the epoxy are typically landfilled. Only for components out of the epoxy body can the IEC/TR 62635 allocation be applied. This approach was applied for modeling of end-of-life waste scenario. A transport distance of 100 km by lorry is assumed as actual location of disposal is unknown.

Environmental Indicators

The following tables show the environmental impact indicators of the life cycle of TJC 7.1 3300/√3//110/√3//1100/3V as requested by PCR EPDItaly007 and EN 50693:2019.

The indicators are divided into the contribution of the processes to the different modules (upstream, core and downstream) and stages (manufacturing, distribution, installation, use and end-of-life).

TJC 7.1 33000/√3//110/√3//110/3V

			Cradle-to-gate		Cradle-to-grave			
Impact category	**Unit**	**Total**	**UPSTREAM**	**CORE**	**DOWNSTREAM**			
			Manufacturing		**Distribution**	**Installation**	**Use and maintenance**	**End-of-life**
GWP – total	kg CO_2 eq.	1.20E+03	1.83E+02	9.01E+01	3.88E+00	3.89E+00	9.15E+02	6.85E+00
GWP – fossil	kg CO_2 eq.	1.11E+03	1.79E+02	4.10E+01	3.88E+00	3.37E-01	8.80E+02	5.78E+00
GWP – biogenic	kg CO_2 eq.	2.96E+01	3.06E+00	-1.13E+01	3.82E-03	3.55E+00	3.33E+01	1.07E+00
GWP – luluc	kg CO_2 eq.	6.28E+01	2.56E-01	6.04E+01	1.86E-03	1.24E-04	2.16E+00	1.59E-03
ODP	kg CFC-11 eq.	2.62E-05	8.17E-06	2.35E-06	8.27E-08	5.65E-09	1.55E-05	4.19E-08
AP	mol H+ eq.	8.65E+00	3.73E+00	5.44E-01	1.56E-02	1.32E-03	4.34E+00	1.09E-02
EP – freshwater	kg P eq.	1.09E+00	2.94E-01	9.99E-03	2.66E-04	3.68E-05	7.89E-01	3.23E-04
EP – marine	kg N eq.	2.63E+00	2.86E-01	1.49E+00	5.97E-03	1.60E-03	7.72E-01	7.73E-02
EP – terrestrial	mol N eq.	1.59E+01	3.45E+00	5.49E+00	6.37E-02	5.66E-03	6.81E+00	3.98E-02
POCP	kg NMVOC eq.	6.35E+00	1.17E+00	2.94E+00	2.29E-02	1.88E-03	2.19E+00	1.48E-02
ADP – minerals and metals	kg Sb eq.	4.43E-02	4.22E-02	3.31E-04	1.22E-05	8.02E-07	1.72E-03	8.96E-06
ADP – fossil	MJ, net calorific value	2.30E+04	2.61E+03	4.08E+02	5.39E+01	3.40E+00	1.99E+04	3.31E+01
WDP	m^3 eq.	3.11E+02	7.10E+01	3.59E+01	2.19E-01	1.87E-02	2.03E+02	6.66E-01

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; EP-freshwater: Eutrophication potential-freshwater compartment; EP-marine: Eutrophication potential-marine compartment; EP-terrestrial: Eutrophication potential-accumulated exceedance; POCP: Formation potential of tropospheric ozone; ADP-minerals & metals: Abiotic Depletion for non-fossil resources potential; ADP-fossil: Abiotic Depletion for fossil resources potential; WDP: Water deprivation potential.

Resource use parameters	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
PENRE	MJ, low cal. value	2.27E+04	2.20E+03	4.74E+02	5.39E+01	3.40E+00	1.99E+04	3.31E+01
PERE	MJ, low cal. value	6.31E+03	2.76E+02	2.21E+03	8.36E-01	6.93E-02	2.11E+04	5.05E-01
PENRM	MJ, low cal. value	4.16E+02	4.13E+02	3.09E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ, low cal. value	1.26E+02	1.36E+01	1.12E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	2.31E+04	2.61E+03	4.77E+02	5.39E+01	3.40E+00	1.22E+05	1.86E+01
PERT	MJ, low cal. value	6.43E+03	2.90E+02	2.32E+03	8.36E-01	6.93E-02	2.11E+04	5.05E-01
FW	m^3	1.89E+01	1.98E+00	1.35E+00	7.68E-03	7.31E-04	1.02E+02	1.07E-02
MS	kg	7.66E+00	7.38E+00	2.82E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PENRE: Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material; PERE: Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM: Use of non-renewable primary energy resources used as raw material; PERM: Use of renewable primary energy resources used as raw material; PENRT: Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials); PERT: Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW: Net use of fresh water; MS: Use of secondary materials; RFS: Use of renewable secondary fuels; NRSF: Use of non-renewable secondary fuels.

Waste production indicators	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
HWD	kg	1.18E-01	9.04E-02	2.02E-03	3.43E-04	1.96E-05	4.33E-02	3.90E-05
NHWD	kg	1.82E+02	4.85E+01	1.77E+01	2.63E+00	3.12E+00	4.04E+02	3.29E+01
RWD	kg	1.49E-01	3.18E-03	7.93E-04	1.75E-05	1.66E-06	8.94E-01	1.14E-04
MER	kg	2.74E+00	2.26E-03	4.90E-01	0.00E+00	2.24E+00	0.00E+00	2.46E-03
MFR	kg	1.08E+01	8.61E-01	2.59E+00	0.00E+00	2.82E+00	0.00E+00	1.79E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	MJ	1.06E+01	1.98E-02	1.40E+00	0.00E+00	9.16E+00	0.00E+00	1.89E-02
EEE	MJ	5.78E+00	1.10E-02	6.82E-01	0.00E+00	5.09E+00	0.00E+00	9.65E-03

HWD: hazardous waste disposed; NHWD: non-hazardous waste disposed; RWD: radioactive waste disposed; MER: materials for energy recovery; MFR: material for recycling; CRU: components for reuse; ETE: exported thermal energy; EEE: exported electricity energy.

Additional Environmental Information

Recyclability potential

Due to the limited recyclability of casted epoxy, both the entire epoxy body and all its components end up in the landfill. Consequently, the actual recyclability potential of the product is 7.62 %. Technically achieved by removing steel holder plate and plastic covers from the body.

In case that every material goes through complete separation process and all steel and copper is extracted, theoretically recyclability potential will increase up to 38.03 % - this is based on IEC/TR 62635 scenario.

Greenhouse gas emissions from the use of electricity in the manufacturing phase

Production mix from import, medium voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing process.

Energy mix	Data source	Amount	Unit
ABB_Electricity mix Brno factory {CZ} 2022 / S_SMP_V1	Ecoinvent v3.9.1	0.51	kg CO_2-eq/kWh

Dangerous substances

The product contains no substances given by the REACH Candidate list.

Indoor environment

The product meets the requirements for low emissions.

Carbon footprint

Carbon footprint has not been worked out for the product.

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