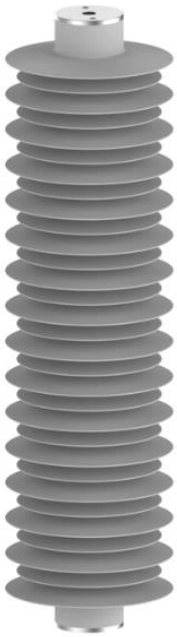
ENVIRONMENTAL PRODUCT DECLARATION

PCA3E-132-EL HIGH VOLTAGE POLYMERIC SURGE ARRESTER



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CPC CODE 4621	**DATE OF VALIDITY** 2028.12.12		In accordance with **ISO 14025** and **EN 50693**

1 GENERAL INFORMATION

PROGRAMME OPERATOR

EPDItaly, Via Gaetano De Castillia n° 10, 20124 – Milano, Italy; E-mail: www.epditaly.it

INDEPENDENT VERIFICATION OF THE DECLARATION AND DATA, ACCORDING TO ISO 14025:

☐ Internal ☑ External

THIRD PARTY VERIFIER

ICMQ S.p.A., Via Gaetano De Castillia n° 10, 20124, Milano, Italy

ACCREDITED OR APPROVED BY

Accredia

EPD OWNER

Tyco Electronics UK Ltd. Freebournes Road, Witham, Essex, CM8 3AH

YEAR OF REPORTED PRIMARY DATA

2022

MARKET APPLICABILITY

Global

APPLICATION FIELD

Secondary substations and distribution networks and transformer stations

REFERENCE STANDARDS

- EPDItaly Programme Rules - REV. 5.2 – 02/16/2022
- EN 50693:2019 – 08/30/2019: Product category rules for life cycle assessments of electronic and electrical products and systems

REFERENCE PCRs

- PCR EPDItaly 007 - REV. 3 – 13/01/2023: Electronic and electrical products and systems
- PCR EPDItaly 010 - REV. 0 – 03/16/2020: Insulators

COMPANY REFERENCE CONTACT

EH&S - Sam Denney – sam.denney@te.com

Engineering - Mike Zielinski – mike.zielinski@te.com

Quality – Chris Brown – chris.brown@te.com

DISCLAIMERS

EPDs within the same product category but from different programmes may not be comparable. The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for life cycle assessment." EN 15804 (or any other relevant European standard) establishes the framework reference for PCR.

2 SCOPE AND TYPE OF THE EPD

TYPE OF EPD

Specific EPD

PLANT LOCATION

Environmental impacts have been calculated for the plant located in Freebournes Road, Witham, Essex, CM8 3AH

SOFTWARE USED

SimaPro ver.9.5.0.0 (www.pre.nl)

DATABASE

Ecoinvent 3.8 and Industry data

REFERENCE YEAR

The reference year used for primary data collection and processing is 2022

FUNCTIONAL UNIT

The functional unit used is a single piece of equipment, complete with kit materials, operating for 25 years

SYSTEM BOUNDARIES

From cradle to grave, considering the following stages and indicated in EN 50693:

Manufacturing stage		Distribution stage	Installation stage	Use & maintenance stage	End-of-life stage
Upstream	**Core**	**Downstream**			

OBJECT OF THE EPD

This environmental Product declaration displays the eco-profile of surge arrester PCA3E-132-EL

3 DESCRIPTION OF THE COMPANY

TE is an international group which has its core business in producing highly engineered connectivity, insulating and sensing products covering a large variety of purposes, from global communication infrastructures, utility networks, factories, smart homes and transport sector. For more than 75 years, TE has partnered with customers to produce highly engineered connectivity and sensing products. With approximately 80,000 employees in 107 manufacturing site around the world, including more than 7,500 engineers, working alongside customers in approximately 140 countries, TE ensures that every connection counts. TE Connectivity consists of the following segments:

- TRANSPORTATION segment consists of: Automotive, Industrial & Commercial Transportation, Sensors, Application Tooling BU's.
- INDUSTRIAL segment consists of: Industrial, Aerospace, Defense & Marine, Medical, Energy BU's.
- COMMUNICATIONS segment consists of: Appliances, Data & Devices BU's.

3.1 ENVIRONMENTAL POLICY AND ACTIONS

TE is committed in a sustainable management of its operations. This includes our ambitions to reduce our GHG emissions by more than 35 percent by 2030 (Scope 1 and Scope 2 emissions on a normalized basis), decreasing our waste disposed and helping 100 percent of our facilities in water-stressed regions meet water reduction targets.

In addition, TE Witham plant owns the following certifications:

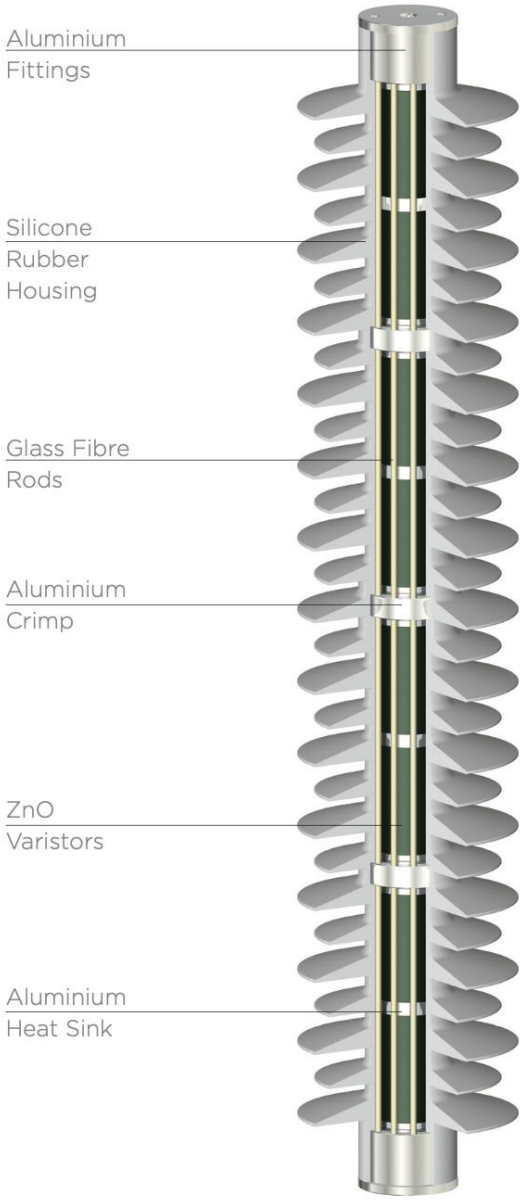
- BSI 14001
- BSI 9001
- BSI 18001/45001

TE Connectivity Witham plant:

4 THE PRODUCT

PCA3E-132-EL is a polymeric surge arrester whose function is to protect high-voltage equipment in substations, such as transformers, circuit breakers and bushings, against the effects of lightning and switching surges. The construction

comprises of a number of ZnO elements, assembled within a open cage construction, which has a silicone rubber moulded shed profile chemically bonded to the surface of the core. The arrester is then packed together with other components needed for its installation, resulting in the complete product kit delivered to customers.



Technical specifications of the product are reported in the following table:

Rated voltage U_r	132	kV
Continuous operating voltage U_c	160	kV

TOV capability T_r	152 144	kV for 1s kV for 10s
Rated short circuit current	65	kA
Cantilever load Safe long-term load (SLL) Safe short-term load (SSL)	 2.0 2.5	 kNm kNm
Dry impulse voltage – 1.2/50 µs	672	kV
Wet power frequency voltage	358	kV
Flashover Distance	1113	mm
Creepage lenght	4500	mm
Minimum distance between phase centers	990	mm
Minimum distance between phase to earth	900	mm
Height	1085	mm
Approx. arrester weight	27.5	kg
Approx. complete kit weight	37	kg

Material composition[1] of the arrester, along with material code, is provided in the following table:

M-120	Aluminium	17%
M-321	Silicone	41%
M-258	Glass fibre	2%
M-124	ZnO	36%
M-119	Steel	3%

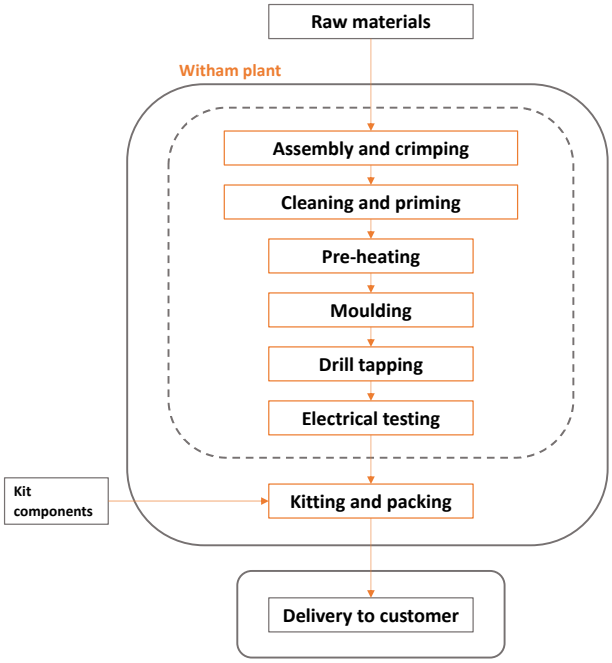
Kit materials composition, along with material code, is provided in the following table:

M-119	Steel	15%
M-120	Aluminium	85%
M-341	Paper	< 1%

[1] Sum may differ from 100% due to rounding.

5 MANUFACTURING PROCESS

The manufacturing process of PCA3E-132-EL arrester involves TE plant located in the UK (Witham). Production starts with a crimping process: varistor blocks are picked to get the correct voltage and several aluminium blocks to build to correct arrestor size, subsequently crimped and assembled together. After crimping the assembly is moved to priming station, where it is left to drain excess off. A subsequent heating in oven is needed to dry and to reach the temperature required for moulding. Once the correct temperature is reached, the assembly is moved to the moulding machine and placed into the pre-heated mould tool. During moulding cycle, the material is pushed into the mould tool under pressure and warmed up, creating the required shape. After such operation, and after the product is properly cooled down, it is dual tapped at each end to ensure thread is within specifications. Subsequently, electrical tests are performed to ensure products are properly manufactured. After successful pass, the product is packed together with kit materials, then moved on the pallet to dispatch ready to ship to customer.



6 RESULTS

Results are reported with the same number of significant figures for each impact indicator. Sums may not coincide with totals due to rounding.

ENVIRONMENTAL IMPACTS

Impact category	Unit	Manufacturing	Distribution	Installation	Use	End of life	Total
GWP, t	kg CO_2 eq	4.60E+02	8.70E+00	3.10E-01	2.80E+02	5.07E+01	8.00E+02
GWP, f	kg CO_2 eq	4.57E+02	8.70E+00	3.10E-01	2.80E+02	5.07E+01	7.97E+02

GWP, b	kg CO_2 eq	2.29E+00	5.14E-04	1.18E-05	3.28E-02	1.12E-03	2.33E+00
GWP, luluc	kg CO_2 eq	8.29E-01	1.71E-04	6.72E-06	1.55E-02	2.20E-04	8.45E-01
GWP, GHG	kg CO_2 eq	4.60E+02	8.70E+00	3.10E-01	2.80E+02	5.07E+01	8.00E+02
AP	kg H+ eq	2.76E+00	2.31E-02	4.11E-04	1.01E+00	1.30E-02	3.80E+00
EPf	kg P eq	1.32E-02	6.83E-06	2.17E-07	5.35E-03	9.10E-06	1.86E-02
EPm	kg N eq	5.00E-01	8.98E-03	1.87E-04	1.62E-01	6.82E-03	6.78E-01
EPt	mol N eq	5.38E+00	9.51E-02	1.91E-03	1.83E+00	6.83E-02	7.38E+00
POCP	kg NMVOC eq	1.71E+00	3.69E-02	5.94E-04	8.07E-01	1.72E-02	2.57E+00
ODP	kg CFC-11 eq	1.60E-02	1.88E-07	3.62E-09	5.56E-06	3.10E-08	1.60E-02
ADPe	kg Sb eq	1.45E-04	2.98E-07	4.59E-09	3.71E-06	5.53E-07	1.49E-04
ADPf	MJ	5.41E+03	1.16E+02	1.27E+00	4.30E+03	1.16E+01	9.84E+03
WDP	m3 depriv.	6.91E+01	1.06E-01	4.27E-03	3.37E+01	7.85E-01	1.04E+02

GWP, t: Global Warming Potential total; GWP, f: Global Warming Potential fossil; GWP, b: Global Warming Potential biogenic; GWP, luluc: Global Warming Potential land use and land use change; GWP, GHG: Global Warming Potential irreversible; ODP: Depletion potential of the stratospheric ozone layer; AP: Acidification potential; EP, f: Eutrophication potential-freshwater; EP, m: Eutrophication potential-marine; EP, t: Eutrophication potential-terrestrial; POCP: Formation potential of tropospheric ozone; ADP, e: Abiotic Depletion for non-fossil resources potential; ADP, f: Abiotic Depletion for non-fossil resources potential, WDP: Water deprivation potential

ADDITIONAL ENVIRONMENTAL IMPACTS

Impact category	Unit	Manufacturing	Distribution	Installation	Use	End of life	Total
PM	disease inc.	3.54E-05	5.80E-07	5.86E-09	3.56E-06	7.21E-08	3.96E-05
IRP	kBq U-235 eq	1.04E+01	1.84E-02	3.30E-04	5.67E+00	3.44E-03	1.61E+01
ETP, fw	CTUe	3.19E+02	1.28E+01	1.37E-01	6.16E+01	1.28E+00	3.95E+02
HTP, c	CTUh	4.39E-07	6.03E-10	4.56E-11	1.93E-08	6.35E-09	4.65E-07
HTP, nc	CTUh	6.41E-06	6.13E-08	8.51E-10	9.11E-07	1.22E-06	8.61E-06
SQP	Pt	1.70E+03	2.19E-01	7.12E-03	5.91E+02	1.21E+00	2.30E+03

PM: Particulate Matter Emissions; IRP: Ionising Radiation Potential; ETP, fw: Ecotoxicity - freshwater; HTP, c: Human Toxicity Potential - cancer effects; HTP, nc: Human Toxicity Potential – non-cancer effects; SQP: Soil Quality Potential.

USE OF RESOURCES

Impact category	Unit	Manufacturing	Distribution	Installation	Use	End of life	Total
PERE	MJ	5.50E+02	3.04E-01	7.39E-03	3.14E+02	1.55E-01	8.65E+02
PERM	MJ	1.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.60E+02
PERT	MJ	7.10E+02	3.04E-01	7.39E-03	3.14E+02	1.55E-01	1.02E+03
PENRE	MJ	6.57E+03	1.17E+02	1.30E+00	5.05E+03	1.29E+01	1.18E+04
PENRM	MJ	2.76E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.76E+02
PENRT	MJ	6.85E+03	1.17E+02	1.30E+00	5.05E+03	1.29E+01	1.20E+04
SM	kg	0.00E+00	0.00E+00	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
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.99E+00	4.83E-03	1.72E-04	9.08E-01	2.65E-02	3.93E+00

PERE: Renewable Primary Energy excluding Primary Energy used as raw material; PERM: Renewable Primary Energy used as raw material; PERT: Total use of Renewable Primary Energy; PENRE: Non-renewable Primary Energy excluding Primary Energy used as raw material; PENRM: Non-renewable Primary Energy used as raw material; PENRT: Total use of Non-renewable Primary Energy; SM: Use of secondary raw materials; RSF: Use of renewable secondary fuels; NRSF: Use of non-renewable secondary fuels; FW: Net use of fresh water.

OUTPUT FLOWS AND WASTE PRODUCTION

Impact category	Unit	Manufacturing	Distribution	Installation	Use	End of life	Total
HWD	kg	3.38E-01	8.28E-04	1.69E-03	4.67E-02	3.51E+00	3.89E+00
NHWD	kg	1.85E+02	5.64E-03	9.45E+00	1.71E+00	3.80E+01	2.34E+02
RWD	kg	7.47E-03	9.90E-06	2.00E-07	7.24E-03	2.17E-06	1.47E-02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	2.04E-01	0.00E+00	9.36E+00	0.00E+00	1.58E+01	2.54E+01
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	5,84E-02	0,00E+00	3,09E-01	0,00E+00	7,17E+01	7,21E+01
EET	MJ	1,20E-01	0,00E+00	6,23E-01	0,00E+00	1,42E+02	1,43E+02

HWV: Hazardous waste disposed; NHWD: Non-hazardous waste disposed; RWD: Radioactive waste disposed; CRU: Components for re-use; MFR: Materials for recycling; MER: Materials for energy recovery; EEE: Exported energy – electricity; EET: Exported energy – thermal energy.

7 CALCULATION RULES

According to reference PCR the main activities are listed and divided in the following stages:

This declaration is a cradle to grave EPD type, based on the application of Life Cycle Assessment (LCA) methodology to the whole life-cycle system. In the whole LCA model, infrastructures and production equipment are not taken into account.

Customized LCA questionnaires were used to gather primary data about all aspects of the production system (for example manufacturing processes consumptions and efficiencies, waste management), in order to provide a complete picture of the environmental burden of the system from raw materials supply to final products delivery.

Allocation occurs anytime a system is producing more than a single output. In this case it is necessary to choose a technique to proper split the environmental burdens among the output flows; international standards ISO 14040 and 14044 provide guidelines about how to deal with this issue, that have been implemented in this project as well. Physical allocation - based on total production amount - was adopted to consistently assign plant data (electricity for services, gas and fuel consumption, water supply, waste treatment) and electricity production process data to the product under study.

Below the sub-phases considered in the analysis are reported, per each life cycle stage:

MANUFACTURING STAGE

- Arrester raw materials production
- Kit parts production
- Raw materials and kit components transportation to Witham
- Manufacturing processes from raw materials to finished product
- Product kitting
- Production of packaging materials for product delivery to customer
- Process waste transportation to treatment site
- Treatment of process waste

DISTRIBUTION STAGE

- Product delivery to final customer, considering a specific scenario of transportation to Milan (Italy) by truck

INSTALLATION STAGE [2]

- Transportation of waste packaging to treatment site (50 km assumption)
- Treatment of waste packaging, according to indications provided by TE

USE STAGE

- Energy dissipation due to electricity flowing through the product [3]

END-OF-LIFE STAGE

- Transportation decommissioned product to treatment site (50 km assumption)
- Treatment of decommissioned product [4]

CUT-OFF RULES

The following processes and phases are not considered for the study:

- Packaging for incoming kit components to Witham plant
- Primer consumption over arrester body

[2] As indicated in PCR EPDItaly010, the product on-site installation procedures were not considered in the LCA model, requiring no relevant inputs in terms of materials and energy. This was also confirmed by TE (only manual operations required).

[3] 2021 Italian high voltage residual electricity mix was used as dataset in the LCA model, representative of the delivery scenario chosen.

[4] According to the Global e-waste monitor 2020 (https://ewastemonitor.info/gem-2020/), the average European rate of recycling for electric/electronic waste is around 42%. As a precautionary approach, the remaining share (ca. 58%) was assumed sent to incineration.

- Manual assembly processes at Witham plant
- Manual installation procedures at customer's site
- Material and energy flows related to dismantling phase, assuming the stage is performed adopting manual tools and specialised labour

These items have been excluded due to the complexity of collecting primary data. However, on the basis of literature and sectorial analyses, their contribution to overall environmental figures can be considered as negligible.

No cut-off was carried out regarding the BOM of the product under study.

8 REFERENCES

8.1 TECHNICAL LITERATURE

- G.L. Baldo, M. Marino, S. Rossi; "Analisi del ciclo di vita LCA – Nuova edizione aggiornata"; Edizioni Ambiente; 2008
- United Nations Institute for Training and Research, The Global E-waste Monitor 2020

8.2 INTERNATIONAL STANDARDS AND RULES

- ISO 14040:2006
- ISO 14044:2006
- ISO 14046: 2014
- ISO 14067:2018
- ISO 14025:2006
- EVS-EN 50693:2019 "Product category rules for life cycle assessment of electronic and electrical products and systems"
- EN 15804:2012+A2:2019 "Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products"
- Life cycle assessment applied to PCA3E-132-EL Surge arrester for Carbon Footprinting and/EPD purposes, Ver. 3, 2023.12.11

8.3 PROGRAMME OPERATOR RULES AND PCRS

- EPDItaly Programme Rules - REV. 5.2 – 02/16/2022
- PCR EPDItaly 007 - REV. 3.0 – 13/01/2023: Electronic and electrical products and systems
- PCR EPDItaly 010 - REV. 0 – 03/16/2020: Insulators

8.4 TOOLS FOR DISTANCE CALCULATION

- www.maps.google.it/maps
- www.sea-distances.org
- www.ecotransit.org/en/

8.5 OTHER REFERENCES

- www.aib-net.org
- www.aci.it

- www.ecoinvent.org
- www.ipcc.ch