

Environmental Product Declaration

in compliance with ISO 14025 and EN 50693

Product name:

Liquid immersed distribution transformers with 1000 kVA operating power

Site plant:

Siemens Energy Ltd.
H-1214 Budapest
II. Rákóczi Ferenc út 189.



Program operator:	EPDIItaly
Publisher:	EPDIItaly
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GENERAL INFORMATION

EPD OWNER	Siemens Energy Ltd H-1158 Budapest, Késmárk utca 24-28.
PLANT INVOLVED IN THE DECLARATION	H-1214 Budapest, II. Rákóczi Ferenc út 189.
SCOPE OF APPLICATION	This EPD is valid for Liquid immersed distribution transformers with operating power: 1000 kVA. The LCA results are specific for the transformer products included in the EPD: ID 9141277487, ID 9141277473
PROGRAM OPERATOR	EPDIItaly via Gaetano De Castillia 10, 20124 Milano, Italy https://www.epditaly.it/ info@epditaly.it
INDEPENDENT VERIFICATION	Independent verification of the declaration and data, according to ISO 14025. <input type="checkbox"/> Internal <input checked="" type="checkbox"/> External Third party verifier: ICMQ SpA, via De Castillia, 10 20124 Milano (www.icmq.it) Accredited by: Accredia registration n. 007/E
CPC CODE	CPC 46121 "Electrical transformers"
PRODUCT CATEGORY RULES (PCR)	Core-PCR EPDIItaly007 - Electronic and electrical products and systems, Rev. 2, 21/10/2020. Sub-PCR EPDIItaly018 - Power transformers, rev 3.5, 13/12/2021
OTHER REFERENCES	Regulations of the EPDIItaly programme, rev 5, 01/07/2020 EN 50693:2019: Product category rules for life cycle assessments of electronic and electrical products and systems
CORPORATE CONTACT	Ildikó DARABANT email: ildiko.darabant@siemens-energy.com
TECHNICAL SUPPORT	Balazs SARA www.lifecycleexpert.com
ACCOUNTABILITY	Siemens Energy Ltd relieves EPDIItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence; EPDIItaly declines all responsibility for the manufacturer's information, data and results of the life cycle assessment.
COMPARABILITY	Environmental declarations published within the same product category, but from different programs, may not be comparable. In particular, EPDs of similar products may not be comparable if they do not comply with the reference PCRs.

COMPANY

Let's energize society – At Siemens Energy, our mission is to empower our customers to meet the growing global demand for energy while transitioning to a more sustainable world. Our transmission portfolio includes digital products, solutions, and services for the growing demand of sustainable electrification.

At our Hungarian subsidiary, Siemens Energy Ltd. we manufacture fluid-immersed and dry-type (Geafol, cast-resin) distribution transformers for domestic and international customers at our Csepel Plant in Budapest, Hungary. Csepel Transformer Factory was founded in 1960, and its main activity ever since is transformer production. The production of fluid-immersed distribution transformers started more than 60 years ago at the foundation of the factory, from 1963 it has been specialized for individual orders only, and in 1978 the production was supplemented with cast-resin distribution transformers. In 1995, it became a subsidiary of Siemens and from 2020 as part of Siemens Energy it's involved in the transformer manufacturing operations in many countries.

SCOPE AND TYPE OF EPD

The reason for publishing this EPD is the requirements of business partners and customers of Siemens Energy Ltd. The intended audience is the head of Siemens Energy Ltd. and the business partners, the communication is focused on the above-mentioned audience.

According to the PCR the declared unit related to the functional unit is a single piece of transformer operating for 35 years. The type of EPD is “from cradle to grave”.

The system boundaries include the following processes classified in life cycle phases according to EN 50693:2019 (Manufacturing, Distribution, Installation, Use and maintenance, End of life) and the Regulations of the EPDItaly programme (Upstream, Core, Downstream):

Manufacturing		Distribution	Installation	Use and maintenance	End of life
Upstream	Core	Downstream			
<ul style="list-style-type: none"> production of materials and components, production of packaging materials, production of electricity for manufacturing, production of natural gas, for manufacturing, transport of materials, components and packaging 	<ul style="list-style-type: none"> direct emissions of manufacturing, internal transportation, waste handling processes 	<ul style="list-style-type: none"> transportation of the packed product to installation site 	<ul style="list-style-type: none"> unpacking and packaging waste processing 	<ul style="list-style-type: none"> operation of the product including energy losses in 35 years, painting as maintenance 	<ul style="list-style-type: none"> treatment product parts at end-of-life

Geographical validity:

The manufacturing site of the products is in Hungary, while installation and use are in Romania.

Database and software:

LCA-Tool, implemented through openLCA 1.10.3 software and MS Excel

The identification code of the LCA-Tool used is: SE-DB-LIDT-LCA-Tool v.1, issued on the 10/02/2022.

The database is ecoinvent v 3.7.1.

EPD realized by means of a validated algorithm:

In 2022 Siemens Energy Ltd implemented and certified a LCA-Tool by using an algorithm that has been validated and certified by ICMQ S.p.A., in agreement with the requirements of the EPDIItaly programme. The process is based on a data collection from the manufacturing plant that have been integrated, verified and validated in compliance with internal procedures. The validated algorithm allows the automatic calculation of the indicators reported into the current EPD coming from an LCA model implemented into the LCA-Tool.

DESCRIPTION OF THE PRODUCTS AND MANUFACTURING PROCESS

Distribution transformers can be both the last step in the conversion chain that brings electrical energy to the consumer as well as the first transformation step to feed decentrally-generated power into the power grid. The products have the following main parts:

Core: The iron core forms the central element of every transformer. High-grade, cold-rolled, silicon alloyed metal sheets are precision-cut using computer-controlled machines to ensure compliance with even the smallest tolerances. The individual sheets are then assembled into cores using the step-lap technique or, in the case of transformers with a lower power rating, using precise winding technology. In this way, Siemens oil-filled distribution transformers achieve an especially good flux distribution at the joints, resulting in exceptionally low losses and minimal no-load noise.

Windings: Transformer windings are subject to extremely high electrical and mechanical stresses and must therefore be protected. The transformer windings of distribution transformers are made of copper or aluminium. Low-voltage windings are made from strip or flat wire, and high-voltage windings are manufactured from round or profile wire. The use of insulating paper partially coated with epoxy resin (diamond-dotted paper) bonds the winding into a compact block during the drying process and additionally increases the short-circuit capacity.

Insulating liquids: The selected transformers are filled with mineral or natural ester oil to ensure sufficient cooling of the windings and to avoid hot spots.

Tank and cooling: Whether during transport or operation, the tank must remain sealed tight under mechanical stress regardless of wind or other weather conditions. Corrosion protection is especially important. The surface is sandblasted and then multicoated. The tank of the distribution transformer has to dissipate the entire heat loss. The selected transformers are hermetically sealed type, the corrugated walls absorb the changes in the insulation liquid's volume.

The production has the following steps: Core production; Production of windings; Final assembly and oil filling; Testing. The tank is manufactured at Siemens Energy Ltd or by a supplier.

The EPD is specific for transformer products with individual Identification Codes **9141277487** and **9141277473**. These products have similar technical characteristics but their weight, Bill of Materials and potentially their power losses in the use phase are different. The following tables describe the technical characteristics and material content of the products included in this EPD.

The material content is defined according to the classification of the IEC 62474 standard and quantified according to the Bill of Materials (considering < 1% cut-off).

Product Identification Code		9141277487		
Operating power (kVA)		1000		
Operating primary voltage (kV)		20		
Operating secondary voltage (kV)		0,42		
Country of installation		Romania		
Total product mass, without packaging (kg)		3342,7		
Material content	ID	kg	%	
Stainless steel	M-100	3.00	0.1%	
Other ferrous alloys, non-stainless steels	M-119	2100.12	62.8%	
Aluminium and its alloys	M-120	503.02	15.0%	
Copper and its alloys	M-121	5.64	0.2%	
Zinc and its alloys	M-124	0.00	0.0%	
Ceramics	M-160	0.00	0.0%	
Polyamide (unfilled)	M-208	0.00	0.0%	
Other unfilled thermoplastics	M-249	0.00	0.0%	
Polyamide (filled)	M-258	0.00	0.0%	
Epoxy resin	M-302	6.00	0.2%	
Other duromers	M-319	8.70	0.3%	
NBR	M-320	0.00	0.0%	
Paper	M-341	54.74	1.6%	
Oils and greases	M-410	628.50	18.8%	

Product Identification Code		9141277473		
Operating power (kVA)		1000		
Operating primary voltage (kV)		20-10		
Operating secondary voltage (kV)		0,42		
Country of installation		Romania		
Total product mass, without packaging (kg)		3003		
Material content	ID	kg	%	
Stainless steel	M-100	3.00	0.1%	
Other ferrous alloys, non-stainless steels	M-119	1755.74	58.5%	
Aluminium and its alloys	M-120	539.51	18.0%	
Copper and its alloys	M-121	12.67	0.4%	
Zinc and its alloys	M-124	0.00	0.0%	
Ceramics	M-160	0.00	0.0%	
Polyamide (unfilled)	M-208	0.00	0.0%	
Other unfilled thermoplastics	M-249	0.00	0.0%	
Polyamide (filled)	M-258	0.00	0.0%	
Epoxy resin	M-302	11.22	0.4%	
Other duromers	M-319	8.80	0.3%	
NBR	M-320	0.00	0.0%	
Paper	M-341	68.82	2.3%	
Oils and greases	M-410	577.00	19.2%	

Siemens Energy Ltd. fully complies with all substance restrictions concerning Regulation (EC) No 1907/2006 (hereinafter called "REACH") in Annex XVII and restrictions defined in other regulations and provisions that apply to our articles. This declaration is based on currently available information. Our portfolio of Distribution Transformers does not contain substances that are intended to be released under normal or reasonably foreseeable conditions of use.

One or several articles included in our Distribution Transformers contain following substances of the Candidate List [REACH Article 59 (1)] based on the current available information in a concentration of more than 0.1% weight by weight (w/w): Lead (CAS Nr. 7439-92-1).

LCA RESULTS

The following results have been calculated:

Environmental impact indicators:

- Global Warming Potential - total (GWP tot)
- Global Warming Potential - fossil (GWP foss)
- Global Warming Potential - biogenic (GWP bio)
- Global Warming Potential - land use and change in land use (GWP luluc)
- Depletion potential of the stratospheric ozone layer (ODP)
- Acidification potential, Accumulated Exceedance (AP)
- Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshw)
- Formation potential of tropospheric ozone (POCP)
- Abiotic Depletion for non-fossil resources potential (ADP-min)
- Abiotic Depletion for non-fossil resources potential (ADP-foss)
- Water deprivation potential, deprivation weighted water consumption (WDP)

Resource use:

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

Waste and output flows:

- Hazardous landfill waste (HWD)
- Non-hazardous waste disposed (NHWD)
- Radioactive waste disposed (RWD)
- Materials for energy recovery (MER)
- Material for recycling (MFR)
- Components for reuse (CRU)
- Exported thermal energy (ETE)
- Exported electricity energy (EEE)

Abbreviations of life cycle phases:

Distr: Distribution, **Instal:** Installation, **Use&M:** Use and maintenance, **EoL:** End of life

Environmental impact indicators of ID 9141277487 product

		Manufacturing		Distr.	Instal.	Use&M	EoL	TOTAL
	Unit	Upstream	Core	Downstream				
GWP tot	kg CO2 e	1.26E+04	2.58E+02	3.03E+02	1.87E-01	6.28E+05	3.56E+02	6.42E+05
GWP foss	kg CO2 eq	1.24E+04	2.58E+02	3.03E+02	1.87E-01	6.28E+05	3.54E+02	6.41E+05
GWP bio	kg CO2 eq	3.73E+01	1.18E-02	1.06E-01	6.59E-05	1.87E+02	2.26E+00	2.26E+02
GWPluluc	kg CO2 eq	9.37E+01	9.70E-03	1.00E-01	6.30E-05	9.16E+01	9.97E-02	1.86E+02
ODP	kgCFC11eq	1.57E-03	6.63E-06	6.94E-05	4.30E-08	1.62E-02	6.56E-05	1.79E-02
AP	mol H+ eq	7.85E+01	1.98E-01	1.22E+00	1.05E-03	4.24E+03	1.41E+00	4.32E+03
EPfreshw	kg P eq	5.42E+00	4.82E-03	2.10E-02	1.31E-05	1.22E+03	5.49E-02	1.22E+03
POCP	kgNMVOCeq	5.03E+01	4.15E-01	1.28E+00	1.20E-03	1.29E+03	1.49E+00	1.34E+03
ADP min	kg Sb eq	1.21E-01	1.03E-04	1.01E-03	6.46E-07	1.69E+00	1.03E-03	1.81E+00
ADPfoss	MJ	1.86E+05	4.41E+02	4.63E+03	2.87E+00	1.19E+07	3.95E+03	1.21E+07
WDP	m3 eq	8.34E+03	5.43E+00	2.18E+01	1.35E-02	4.87E+05	3.60E+01	4.96E+05

Resource use of ID 9141277487 product

		Manufacturing		Distr.	Instal.	Use&M	EoL	TOTAL
	Unit	Upstream	Core	Downstream				
PENRE	MJ	1.56E+05	4.41E+02	4.63E+03	2.08E+02	1.19E+07	3.95E+03	1.21E+07
PERE	MJ	2.87E+04	6.47E+00	6.31E+01	3.95E-02	2.19E+06	7.25E+01	2.22E+06
PENRM	MJ	2.96E+04	0.00E+00	0.00E+00	0.00E+00	1.01E+02	0.00E+00	2.97E+04
PERM	MJ	1.67E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.67E+03
PENRT	MJ	1.86E+05	4.41E+02	4.63E+03	2.08E+02	1.19E+07	3.95E+03	1.21E+07
PERT	MJ	3.03E+04	6.47E+00	6.31E+01	3.95E-02	2.19E+06	7.25E+01	2.22E+06
FW	m3	2.08E+02	1.29E-01	5.37E-01	3.33E-04	1.33E+04	8.74E-01	1.35E+04
MS	kg	0.00E+00	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	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

Waste and output flows of ID 9141277487 product

		Manufacturing		Distr.	Instal.	Use&M	EoL	TOTAL
	Unit	Upstream	Core	Downstream				
HWD	kg	2.75E+00	1.16E-03	1.17E-02	7.31E-06	4.66E+00	1.07E-02	7.44E+00
NHWD	kg	3.58E+03	4.06E+01	2.98E+02	1.79E-01	4.39E+04	2.33E+02	4.81E+04
RW	kg	7.73E-01	2.94E-03	3.17E-02	1.96E-05	1.36E+02	2.64E-02	1.37E+02
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	1.53E+02	2.81E+02	0.00E+00	2.85E+01	0.00E+00	3.25E+03	3.71E+03
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Environmental impact indicators of ID 9141277473 product

		Manufacturing		Distr.	Instal.	Use&M	EoL	TOTAL
	Unit	Upstream	Core	Downstream				
GWP tot	kg CO2 e	1.22E+04	2.31E+02	2.72E+02	1.77E-01	6.96E+05	3.73E+02	7.09E+05
GWP foss	kg CO2 eq	1.20E+04	2.31E+02	2.72E+02	1.77E-01	6.96E+05	3.68E+02	7.09E+05
GWP bio	kg CO2 eq	3.91E+01	1.06E-02	9.51E-02	6.24E-05	2.07E+02	5.15E+00	2.51E+02
GWPluluc	kg CO2 eq	9.95E+01	8.71E-03	8.99E-02	5.97E-05	1.01E+02	9.93E-02	2.01E+02
ODP	kgCFC11eq	1.49E-03	5.95E-06	6.24E-05	4.07E-08	1.79E-02	6.47E-05	1.96E-02
AP	mol H+ eq	7.77E+01	1.78E-01	1.10E+00	9.95E-04	4.70E+03	1.33E+00	4.78E+03
EPfreshw	kg P eq	5.64E+00	4.33E-03	1.89E-02	1.25E-05	1.35E+03	6.39E-02	1.35E+03
POCP	kgNMVOCeq	4.82E+01	3.73E-01	1.15E+00	1.13E-03	1.43E+03	1.38E+00	1.48E+03
ADP min	kg Sb eq	2.43E-01	9.26E-05	9.11E-04	6.12E-07	1.87E+00	1.02E-03	2.11E+00
ADPfoss	MJ	1.79E+05	3.96E+02	4.17E+03	2.72E+00	1.32E+07	3.77E+03	1.34E+07
WDP	m3 eq	8.30E+03	4.88E+00	1.96E+01	1.28E-02	5.40E+05	3.98E+01	5.48E+05

Resource use of ID 9141277473 product

		Manufacturing		Distr.	Instal.	Use&M	EoL	TOTAL
	Unit	Upstream	Core	Downstream				
PENRE	MJ	1.51E+05	3.96E+02	4.17E+03	2.08E+02	1.32E+07	3.77E+03	1.33E+07
PERE	MJ	3.00E+04	5.81E+00	5.67E+01	3.74E-02	2.42E+06	7.49E+01	2.45E+06
PENRM	MJ	2.73E+04	0.00E+00	0.00E+00	0.00E+00	1.01E+02	0.00E+00	2.74E+04
PERM	MJ	1.87E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.87E+03
PENRT	MJ	1.79E+05	3.96E+02	4.17E+03	2.08E+02	1.32E+07	3.77E+03	1.34E+07
PERT	MJ	3.19E+04	5.81E+00	5.67E+01	3.74E-02	2.42E+06	7.49E+01	2.46E+06
FW	m3	2.08E+02	1.16E-01	4.83E-01	3.16E-04	1.47E+04	9.64E-01	1.49E+04
MS	kg	0.00E+00	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	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

Waste and output flows of ID 9141277473 product

		Manufacturing		Distr.	Instal.	Use&M	EoL	TOTAL
	Unit	Upstream	Core	Downstream				
HWD	kg	2.89E+00	1.04E-03	1.05E-02	6.92E-06	5.17E+00	1.05E-02	8.08E+00
NHWD	kg	3.39E+03	3.65E+01	2.68E+02	1.69E-01	4.87E+04	2.22E+02	5.26E+04
RW	kg	7.42E-01	2.64E-03	2.85E-02	1.86E-05	1.51E+02	2.50E-02	1.51E+02
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	1.49E+02	2.52E+02	0.00E+00	2.70E+01	0.00E+00	2.90E+03	3.33E+03
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CALCULATION RULES

Functional unit: According to the sub-PCR the declared unit related to the functional unit is a single piece of transformer operating for 35 years.

Data quality: The following specific data have been collected and used for the LCA:

- Bill of materials of the products,
- weighted average transport distances of suppliers,
- electricity and natural gas consumptions of manufacturing,
- internal transport distance,
- quantity of waste produced and their destination,
- air emissions of manufacturing,
- power dissipated in load and in no load during operation.

Generic data have been selected from the most updated version of the ecoinvent database (v 3.7.1):

- production of materials: global or European average data,
- production of energy (electricity, natural gas): country specific,
- transport processes: global or European average data,
- waste management processes: country specific or European data.

Technological, geographical and temporal representativeness is appropriate. The data quality can be considered as good.

Reference time period: Specific data collected for the LCA study refer to 2020.

Cut-off criteria: According to the sub-PCR, the following flows and operations have been cut-off:

- Production, use and disposal of the packaging of components and semi-finished intermediates.
- Materials making up the transformer itself whose total mass does not exceed 1% of the total weight of the device.
- Material and energy flows related to dismantling phase as it is reasonable to assume that dismantling is performed by adopting manual tools.
- Devices external to the product itself required for installation.

Auxiliary materials of the transformer manufacturing have also been cut-off, as their weight is negligible compared to the mass of input materials for the construction of the product. Only the sand materials for wet-cutting machine and for blast cleaning have been considered.

Allocation: Input and output flows of the Siemens Energy manufacturing site had to be divided among:

- oil-filled transformer production line,
- Geafol (dry-type) production line,
- tank production process, if the tank is manufactured by a supplier,
- tank painting process, if the tank is painted by a supplier.

Division has been carried out by using measured data, calculations or internal expert judgments. However, there have been flows that cannot be measured or estimated to a single product. In such cases it was not possible to avoid allocation, the applied rule was based on mass.

SCENARIOS

The following scenarios have been defined for the Downstream life cycle phases:

Distribution: The specific installation sites are not known, so an average distance has been defined concerning the destination country: Romania 708 km.

Installation: There is no measurable energy consumption and there is no scrap production. The only waste is related to the packaging material. After unpacking, the packaging waste is transported to recycling. An average 50 km distance was considered.

Use: Total energy consumed during 35 years has been calculated according to the formula defined by the Sub-PCR. The average load factor is 70%, based on the Sub-PCR. Power loss values are according to specific customer requirements (ENEL).

Maintenance: The products do not require particular maintenance. Replacement of parts or oil is not foreseen in 35 years. The only potential maintenance activity is related to preventive painting of the tank. An average 3 kg of painting has been estimated for each product.

End of life: The following scenario has been considered according to the expertise of Siemens Energy Ltd:

- recovery of transformer oil: hazardous waste to recycling,
- recovery of core (steel), aluminium and copper parts: non hazardous waste for recycling,
- recovery of steel structural parts (tank): non hazardous waste for recycling,
- materials contaminated with transformer oil (presspapers): hazardous waste to incineration,
- non metallic parts of bushings and other components: non hazardous waste to landfill.

As the specific installation sites are not known, the transport distances to recycling, incineration or landfill disposal are estimated. The following worst-case scenario has been applied: 100 km for transport to landfill or incineration, 500 km for transport to recycling.

REFERENCES

- ISO 14040:2006, Environmental management — Life cycle assessment — Principles and framework
- ISO 14044:2006, Environmental management — Life cycle assessment — Requirements and guidelines
- ISO 14025:2006 - Environmental labels and declarations — Type III environmental declarations — Principles and procedures
- EN 50693:2019: Product category rules for life cycle assessments of electronic and electrical products and systems
- Regulations of the EPDIItaly programme, rev 5, 01/07/2020
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