Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019

LK Universal & Heating Pipe, PE-Xa/PE-RT/PE-X/RiR

LK Systems AB

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-06048
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An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

Company information

Owner of the EPD:	LK Systems AB Johannesfredsvägen 7 168 69 Bromma Sweden
Contact:	info@lksystems.se https://www.lksystems.se/
Name and location of production site:	LK Pex AB Rönnåsgatan 4A 523 21 Ulricehamn Sweden
Product-related or management system-related certifications:	EN ISO 1587 5/ EN ISO 22391 / Sintef Norge TG 20312

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025.

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website::	www.environdec.com
E-mail:	info@environdec.com
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)	
Product category rules (PCR): 2019:14, Construction products (EN 15804:A2) (1.11)	
PCR review was conducted by: Claudia A. Peña, The Technical Committee of the International EPD® System. Contact: info@environdec.com	
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification	
Third party verifier: Daniel Böckin, PhD, under guidance of Pär Lindman, Miljögiraff AB, daniel@miljogiraff.se. Approved by: The International EPD® System.	

Company information

LK Systems is the leading manufacturer of easy-to-install systems for heating and tap water distribution in the Nordics. Through our prefabrication factory, we also provide tailor-made solutions that simplify the installation process even further. From idea to final solution, you can be sure of the smartest answers for your everyday challenges, today and tomorrow.

For the simpler, smarter everyday

Simpler. Smarter. More sustainable. At LK, we believe there's a better way to do everything. That's why – from water, heating and hydronic solutions to pipe extrusion – we push for innovation over status quo and simplicity over complexity. It's a belief all of us at LK apply to every product and solution we create

Product information

LK Universal pipes and PEX pipes, can be used for radiator and floor heating as well as tap water and cooling. The pipes are suitable for LK universal system and contains a wide range of pipes. The system is tested and approved according to the market's strictest regulations and test methods; The National Board of Housing, Building and Planning's Building Rules, Safe Water Installation and the North Test Method. PEX pipes are manufactured from homogeneous PE-Xa and PE-RT in the highest quality in our Swedish production facility. The pipes are equipped with an oxygen barrier, which means that they can also be used in heating systems without the risk of oxygenation of the water. The pipes are available in dimension 8, 12, 16, 20, 25 and 32 mm, and is delivered on rolls up to 500 meters. The declared unit is based on the Pipe in pipe that has the highest GWP-GHG of all pipes that are declared. The calculations are based on the average pipe, 16 dimensions.

Further information can be found at https://www.lksystems.se/

Product name and product number

LK Underfloor heating pipe PE-Xa	241 72 48; 241 72 49; 241 72 50; 241 94 62; 241 74 98; 241 74 99; 241 75 00; 241 78 28; 241 75 01; 241 75 02; 241 75 03; 271 74 50; 241 78 48
LK Underfloor heating pipe PE-RT	241 67 13; 241 67 14; 241 67 15; 241 67 16; 241 67 27; 241 67 18;
LK Ground heating pipe PE-RT	241 67 19; 241 67 20; 241 67 26; 241 67 21; 241 67 23; 241 67 24
LK Heating pipe PE-Xa RiR	241 78 29; 243 46 34; 241 78 30; 241 90 74
LK Heating pipe PE-X	241 95 40; 241 95 41; 241 95 42; 241 95 43
LK PE-X Universal pipe	188 25 40; 187 06 98
LK PE-X Universal pipe X with corrugated pipe PiP (Pipe-in-Pipe)	188 23 35; 188 23 36; 188 23 67; 188 25 41; 188 25 42; 187 06 94
LK PE-X Universal pipe X16 replacement pipe PiP (Pipe-in-Pipe)	188 26 65

LCA information

Functional unit / declared unit	In accordance with EN 15804 + A2 the declared unit is mass 1 kg of pipe.
Time representativeness:	2021
Database:	Ecoinvent 3.7.1 - “allocation cut off by classification” is used throughout the study.
LCA software used:	SimaPro 9.3.0.2
Geographical scope	Europe
LCA Report	LK Systems AB, Report no. 1

Description of system boundaries:

The scope of the EPD is a cradle to gate with options, including A4, C and D. See Table 1 for the modules declared. The system boundary mean that all processes needed for raw material extraction, transport, manufacturing and disposal are included in the study. Figure 1. gives an overview of the included processes.

Table 1, Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geog-raphy	Euro	Euro	SE	SE									SE	SE	SE	SE	SE
Specific data used	24%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	<10%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	-					-	-	-	-	-	-	-	-	-	-	-	-

X = Modules included in the analysis ND = Module not declared O= Optional modules

Content information

Declared products contains no dangerous substances from the candidate list of SVHC for Authorization.

Table 2, shows the weight for the raw material of the declared product.

Product components	Weight, kg	Post-consumer material, weight-%	Renewable material, weight-%
Polyethylene	0,62	0	0
Polypropylene (Corrugated pipe)	0,33	0	0
Adhesive	0,02	0	0
Oxygen barrier	0,02	0	0
Pigment	0,01	0	0
TOTAL	1	0	0
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	
Cardboard box	0,09	9	
Pallet	0,33	33	
TOTAL	0,42	42	

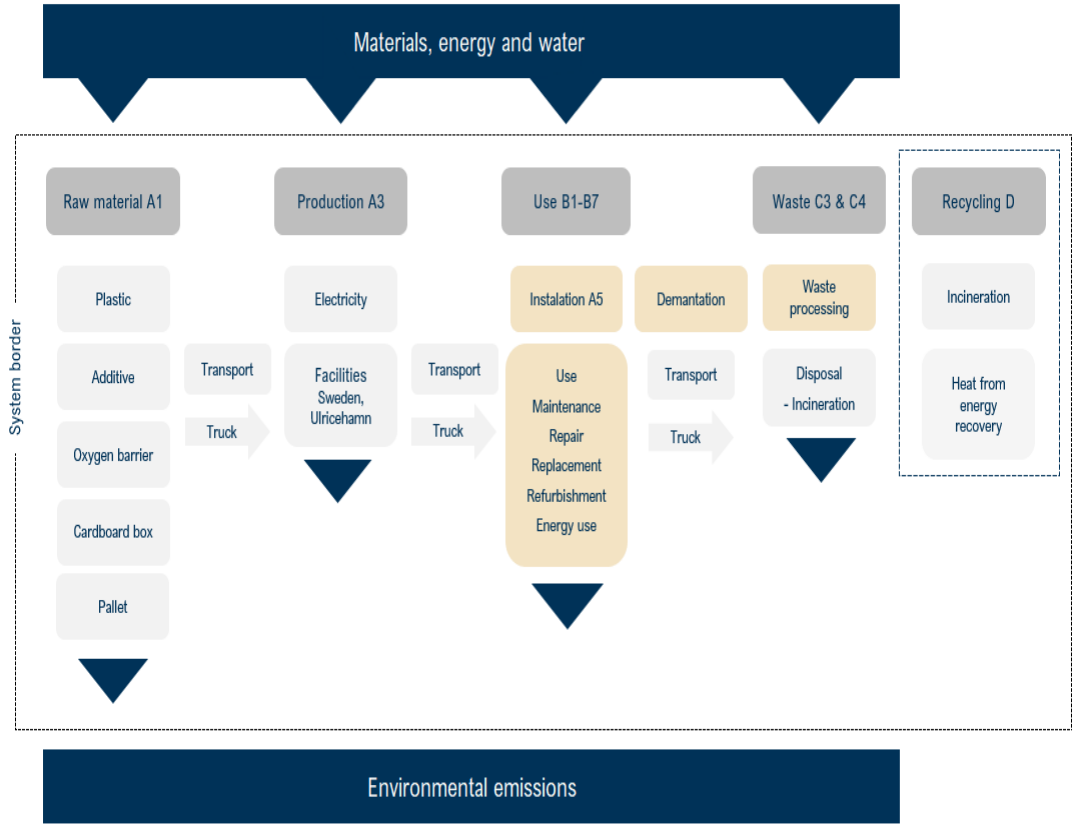


Figure 1, overview of the included processes. Light gray represents modules included, yellow represent models not declared.

Product life-cycle

Raw material supply, transport, manufacturing and packaging (A1-A3)

The products are manufactured with polyethylene, additives and oxygen barrier. The PE-Xa process flows in one line with different machines after each other, to complete the product in different steps. The materials are mixed while they are fed into a tube extruder, where the mixture melts and subsequently crosslinks in an IR-oven. Then the crosslinked pipe is calibrated to correct dimension, extruded with oxygen barrier, cooled, coiled, and packaged. The PE-RT pipe process is similar but do not contain the crosslinking step, so both polyethylene and oxygen barrier is co-extruded in the first part of the production line. Pipe in pipe has one additional step in the process. After production of the inner pipe, an outer corrugated pipe, made of polypropylene (PP) is extruded on the outside of the inner pipe to form a protective layer. The pipe in pipe product is then coiled. The pipes are supplied in coils that are packed in cardboard box and then on pallets

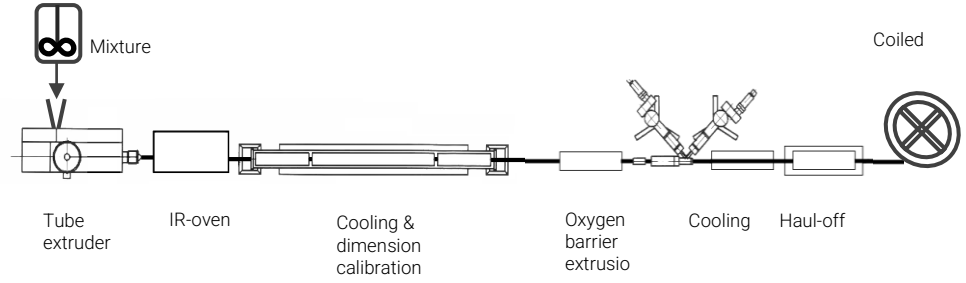


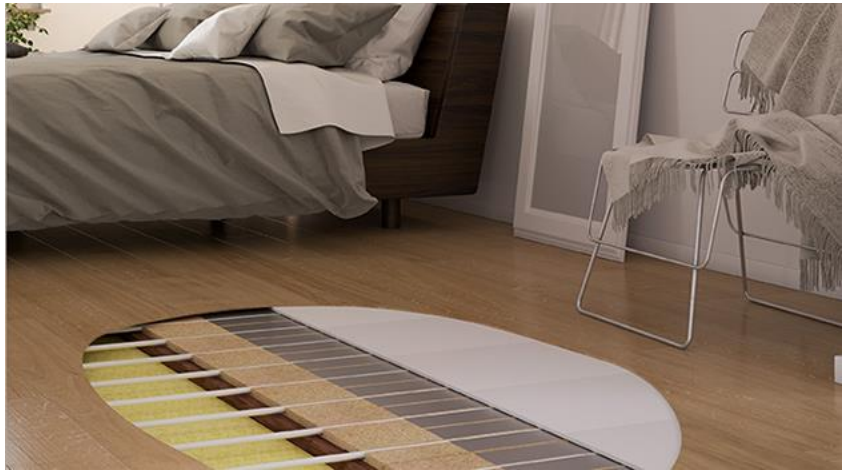
Figure 2 shows the process flow for crosslinked pipe (PE-Xa) step by step, excluding the outer corrugated pipe for the product Pipe In Pipe.

Transport (A4)

Transportation impacts represent the transport from the final product´s delivery to the construction site. The transport distance is based on average distance. The transportation is performed by truck with fuel.

Product end of life (C1-C4, D)

The product end of life (C1) is assumed zero since the installation of pipes takes place behind floors and walls and therefor the assumption of de-construction demolition has been excluded. Assumption has resulted that the pipe ends up in combustible waste (C3) when the building, where the pipe is installed, is demolished. The product assumed to be sent to the nearest waste facility. The benefits in the resource recovery stage (D) will therefore be energy recovery. The corrugated pipe that is included in Pipe in pipe is made of polypropylene (PP) and can be recycled, but it has been assumed that the whole product will end up in combustible waste and therefore the benefits will be energy recovery.



Cut-off rules

Life cycle inventory data shall according to EN 15804 include a minimum of 95% of total inflows (mass and energy) per module. In addition, if less than 100% of the inflows are accounted for, proxy data or extrapolation should be used to achieve 100% completeness. Transport of waste packaging to waste treatment has excluded from the study, since it is outside the system boundary (A5).

Background data

The data quality of the background data is considered good. All specific data that includes processes, volume of different materials, energy use, water consumption and transport distance has been collected by questionnaire and personal contact with the manufacturer. Ecoinvent database has been used. Ecoinvent is the world's biggest LCI data library and contains data for the specific geographical regions relevant for this study, that have been analysed to be the most suitable for the various steps in the process. Information on biogenic carbon content is calculated with the formula from EN 350-2 and information from IVL.
Collected data represent average yearly data for 2021 and assumed to be representative for the EPDs period of validity of 5 years.

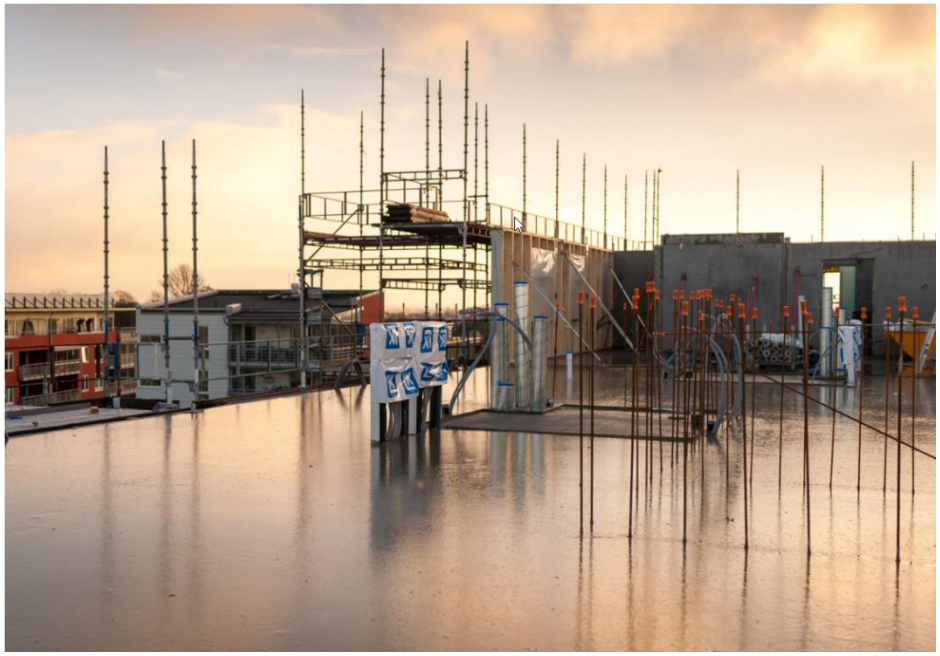
Electricity data

The electricity consumption in the A3 module accounts for less than 30% of the total energy use in module A1-A3. The electricity used is residual mix for Sweden that is modulated with Ecoinvent 3.7.1. and represent 12,5% renewable energy.

Allocation and assumptions

The declare unit values for 1 kg of product that are used in this study and are calculated, based on the total product weight produced during the year studied. The study includes several types of pipes, since the production processes for these products are similar and are done in the same factory. The content of raw material can vary slightly between the different articles and are examined with high accuracy that they variation of GWP-GHG stay within 10%. Data is allocated for the energy use of the declared unit. The allocation is based on production rate with complexity and high accuracy. The raw material necessary for the manufacturing and the amount of packaging is allocated to product based on the amount of material used to manufacture the declare unit, including waste. Allocation is made with complexity and high accuracy. The declared unit is based on the Pipe in pipe that has the highest GWP-GHG of all pipes that are declared. The variance of the declared products are less than 10%, that is based according to data quality requirements outlined in PCR 2019:14.

The used pipe is assumed to be transported 50 km to the nearest waste disposal facility. The waste treatment assumption has resulted in the pipe ending up in combustible waste, even if the corrugated pipe is recyclable. The waste treatment builds and presupposes that the pipe is installed in the building and that the pipes are not separates and recycled when a building demolished. The pipe is assumed to be incinerated with energy recovery efficiency at 61%.



Environmental information

Potential environmental impact – mandatory indicators according to EN 15804.
Results of declared unit of the study.

Results per declared unit

Indicator	Unit	A1	A2	A3	Tot.A1-A3	A4	C1	C2	C3	C4	D
GWP-fossil	kg CO2 eq.	2,22E+00	8,58E-02	5,90E-01	2,90E+00	7,43E-02	0	6,55E-03	0	3,84E-02	1,91E+00
GWP-biogenic	kg CO2 eq.	1,70E-02	2,06E-04	3,75E-02	5,48E-02	1,78E-04	0	1,59E-05	0	3,22E-04	-3,04E-01
GWP-luluc	kg CO2 eq.	5,91E-04	2,89E-05	5,80E-04	1,20E-03	2,50E-05	0	2,23E-06	0	3,94E-05	-4,66E-03
GWP-total	kg CO2 eq.	2,24E+00	8,61E-02	6,29E-01	2,95E+00	7,45E-02	0	6,57E-03	0	3,87E-02	1,60E+00
ODP	kg CFC 11 eq.	4,27E-08	1,95E-08	2,41E-08	8,63E-08	1,69E-08	0	1,51E-09	0	1,57E-08	-1,02E-07
AP	mol H+ eq.	7,68E-03	3,44E-04	1,20E-03	9,23E-03	2,98E-04	0	3,68E-05	0	4,24E-04	-3,38E-03
EP-freshwater[3]	kg PO_4^{3-} eq.	9,95E-04	1,77E-05	2,71E-04	1,28E-03	1,53E-05	0	1,42E-06	0	4,21E-05	-2,31E-04
EP-freshwater[3]	kg P eq.	3,24E-04	5,77E-06	8,82E-05	4,18E-04	4,99E-06	0	4,61E-07	0	1,37E-05	-7,52E-05
EP-marine	kg N eq.	1,41E-03	1,05E-04	4,70E-04	1,98E-03	9,11E-05	0	1,35E-05	0	1,62E-04	-6,27E-04
EP-terrestrial	mol N eq.	1,47E-02	1,15E-03	3,39E-03	1,93E-02	9,94E-04	0	1,47E-04	0	1,83E-03	-8,60E-03
POCP	kg NMVOC eq.	7,23E-03	3,51E-04	7,82E-04	8,36E-03	3,04E-04	0	4,20E-05	0	4,87E-04	-1,92E-03
ADP-minerals & metals[2]	kg Sb eq.	1,58E-05	3,09E-07	9,54E-07	1,71E-05	2,68E-07	0	2,27E-08	0	3,88E-07	-2,99E-05
ADP-fossil[2]	MJ	7,88E+01	1,30E+00	2,43E+01	1,04E+02	1,12E+00	0	1,01E-01	0	4,51E-01	-7,41E+00
WDP[2]	m3	1,73E+00	3,69E-03	2,93E-01	2,02E+00	3,20E-03	0	3,16E-04	0	2,74E-02	-1,42E-01

Acronyms

GWP-fossil = Global Warming Potential fossil fuels; 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; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption

Potential environmental impact – additional mandatory indicators according to EN 15804.

Results per declared unit

Indicator	Unit	A1	A2	A3	Tot.A1-A3	A4	C1	C2	C3	C4	D
Particulate matter	disease inc.	6,65E-08	5,94E-09	1,50E-08	8,75E-08	5,15E-09	0	5,90E-10	0	3,49E-09	-3,37E-08
Ionnising radiation[1]	kBq U-235 eq	1,39E-01	6,78E-03	1,83E+00	1,98E+00	5,87E-03	0	5,28E-04	0	3,74E-03	-4,89E-02
Ecotoxicity, freshwater[2]	CTUe	1,12E+01	9,92E-01	7,95E+00	2,02E+01	8,59E-01	0	7,83E-02	0	7,41E-01	-3,48E+01
Human toxicity, cancer[2]	CTUh	6,29E-10	3,54E-11	2,02E-10	8,66E-10	3,06E-11	0	3,40E-12	0	3,07E-10	-3,08E-10
Human toxicity, non-cancer[2]	CTUh	1,03E-08	1,01E-09	3,14E-09	1,45E-08	8,73E-10	0	8,79E-11	0	5,43E-10	-7,79E-09
Land use[2]	Pt	2,13E+00	8,94E-01	4,70E+00	7,72E+00	7,74E-01	0	8,62E-02	0	1,32E-01	-1,55E+02

Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

Disclaimer 3 EP-freshwater: This indicator is calculated both in kg PO4 eq and kg P eq as required in the characterization model.

Climate impact IPCC 2013 GWP 100

Results per declared unit

Indicator	Unit	A1	A2	A3	Tot.A1-A3	A4	C1	C2	C3	C4	D
GWP-GHG	kg CO2 eq.	2,14E+00	8,52E-02	6,00E-01	2,82E+00	7,37E-02	0	6,50E-03	0	3,78E-02	1,91E+00

The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus almost equal to the GWP indicator originally defined in EN 15804:2012+A1:2013.

Use of resources

Results per declared unit

Indicator	Unit	A1	A2	A3	Tot.A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1,22E+00	1,75E-02	1,55E+00	2,79E+00	1,51E-02	0	1,39E-03	0	4,13E-020	-8,80E+00
PERM	MJ	0	0	1,33E+00	1,33E+00	0	0	0	0	0	0
PERT	MJ	1,22E+00	1,75E-02	2,88E+00	4,12E+00	1,51E-02	0	1,39E-03	0	4,13E-020	-8,80E+00
PENRE	MJ	8,46E+01	1,38E+00	2,45E+01	1,10E+02	1,19E+00	0	1,07E-01	0	4,82E-01	-7,97E+00
PENRM	MJ	0	0	0	0	0	0	0	0	0	0
PENRT	MJ	8,46E+01	1,38E+00	2,45E+01	1,10E+02	1,19E+00	0	1,07E-01	0	4,82E-01	-7,97E+00
SM	kg	0	0	7,23E-02	7,23E-02	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0
FW	m3	5,89E-03	2,2E-04	9,0E-04	7,01E-03	1,9E-4	0	1,88E-05	0	1,28E-3	-3,43E-3

Acronyms

PERE = Use of renewable primary energy excluding renewable primary energy resources 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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

Waste production and output flows

Waste production

Results per declared unit

Indicator	Unit	A1	A2	A3	Tot.A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed	kg	0	0	0	0	0	0	0	0	0	0
Non-hazardous waste disposed	kg	0	0	0	0	0	0	0	0	0	0
Radioactive waste disposed	kg	0	0	0	0	0	0	0	0	0	0

Note: Ecoinvent database include all waste treatment processes within the system boundaries, i.e. there are no waste flows exiting the system boundaries and the waste indicators to be declared are therefore zero.

Output flows

Results declared unit

Indicator	Unit	A1	A2	A3	Tot.A1-A3	A4	C1	C2	C3	C4	D
Components for re-use	kg	0	0	0	0	0	0	0	0	0	0
Material for recycling	kg	0	0	0	0	0	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0	0	0	0	0
Exported energy, electricity	MJ	0	0	0	0	0	0	0	0	0	0
Exported energy, thermal	MJ	0	0	0	0	0	0	0	0	0	0

Information on biogenic carbon content

Results per functional or declared unit

BIOGENIC CARBON CONTENT	Unit	QUANTITY
Biogenic carbon content in product	kg C	0
Biogenic carbon content in packaging	kg C	0,16

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO2.

Technical specifications

Storage and handling

LK pipes must not be stored or mounted so that they are exposed to direct sunlight (maximum 3 months). This also applies to LK Pipe-in-pipe. Packaging provides adequate protection against UV radiation. After completion of the building, it is assumed that the pipes are not exposed to direct sunlight other than temporarily. Window glass provides sufficient protection against UV radiation and therefore, does not affect the good long-term properties of the pipe.

Applications areas for the products

Table 3, shows an overview of applications areas for the products.

Product	Dimension	Application		Pressure class	Temperature range			Standards
		Tap water	Heat/cooling system		Max continuously	Max current	Min allowed	
LK Underfloor heating pipe PE-Xa	12/8		x	PN6	70 °C	95 °C	- 20 °C	EN ISO 15875
LK Underfloor heating pipe PE-Xa	16		x	PN10	70 °C	95 °C	- 20 °C	EN ISO 15875
LK Underfloor heating pipe PE-RT	16		x	PN6	60 °C	70 °C	- 20 °C	EN ISO 22391
LK Ground heating pipe PE-RT	20		x	PN6	60 °C	70 °C	- 20 °C	EN ISO 22391
LK Heating pipe PE-Xa RiR	25/32		x	PN6	70 °C	95 °C	- 20 °C	EN ISO 15875
LK Heating pipe PE-X	25		x	PN6	70 °C	95 °C	- 20 °C	EN ISO 15875
LK PE-X Universal pipe	16/20/25	x	x	PN10	70 °C	95 °C	- 20 °C	EN ISO 15875
LK PE-X Universal pipe X with corrugated pipe PiP (Pipe-in-Pipe)	16/20/25	x	x	PN10	70 °C	95 °C	- 20 °C	EN ISO 15875/ Sintef Norge TG 20312
LK PE-X Universal pipe X16 replacement pipe PiP (Pipe-in-Pipe)	16	x	x	PN10	70 °C	95 °C	- 20 °C	EN ISO 15875/ Sintef Norge TG 20312

Bending of pipes

The pipes can be bend on site to suit the installation with cold- or hot bending.

Table 4, shows bending methods

Bending method	Minimum bending radius for pipe dim.			
	16	20	25	32
Cold bending without fixture	80	130	180	260
Cold bending with fixture	55	110	140	210
Hot bending with pipe bend support	34	45	60	95

Replacement of pipe in corrugated pipe

A damaged LK PE-X Universal pipe dimension 16x2.0 can normally be replaced without destructive intervention in the building. This is provided that the installation has been carried out in with the instructions, for more instructions visit https://www.lksystems.se/.

Recycling of packaging and product

Within the framework of producer responsibility, LK are affiliated with FTI, the Packaging and Newspaper Collection, which is the business community's collection system for recycling packaging.
Packaging shall recycle as carton. No pipes in LK Universal Systems or LK Underfloor heating systems are classified as hazardous waste and are handled as combustible waste. The corrugated pipe that is included in Pipe in pipe is made of polypropylene (PP) and can be recycled as plastic and thus encouraged that the pipes are separated and that the corrugated pipe is sorted into plastic recycling.

References

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EUTREND model, Struijs et al, 2009b, as implemented in ReCiPe; http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

Residual mix, Sweden: https://www.ei.se/bransch/ursprungsmarkning-av-el/residualmix