RIFENG MULTILAYER PIPE SYSTEM

EPD®

THE INTERNATIONAL EPD® SYSTEM

ENVIRONMENTAL PRODUCT DECLARATION

Rifeng Multilayer PEX/AL/PEX pipes

This EPD is representative of the weighted average multilayer PEX/AL/PEX and in accordance with ISO 14025:2006 and EN15804 2012+A1:2013

Geographical area of application of this EPD : China

Year taken as a reference for the data: 2017.7.1-2018.6.30

Registration number S-P-01644

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50
YEARS
Future

An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules).

Environmental product declarations within the same product category from different programmes may not be comparable. EPD of construction products may not be comparable if they do not comply with EN 15804 2012+A1:2013

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CEN STANDARD EN15804 2012+A1:2013 SERVED AS THE CORE PCR	
PCR	Construction Products and Construction Services, Version 2.3(2018-11-15)
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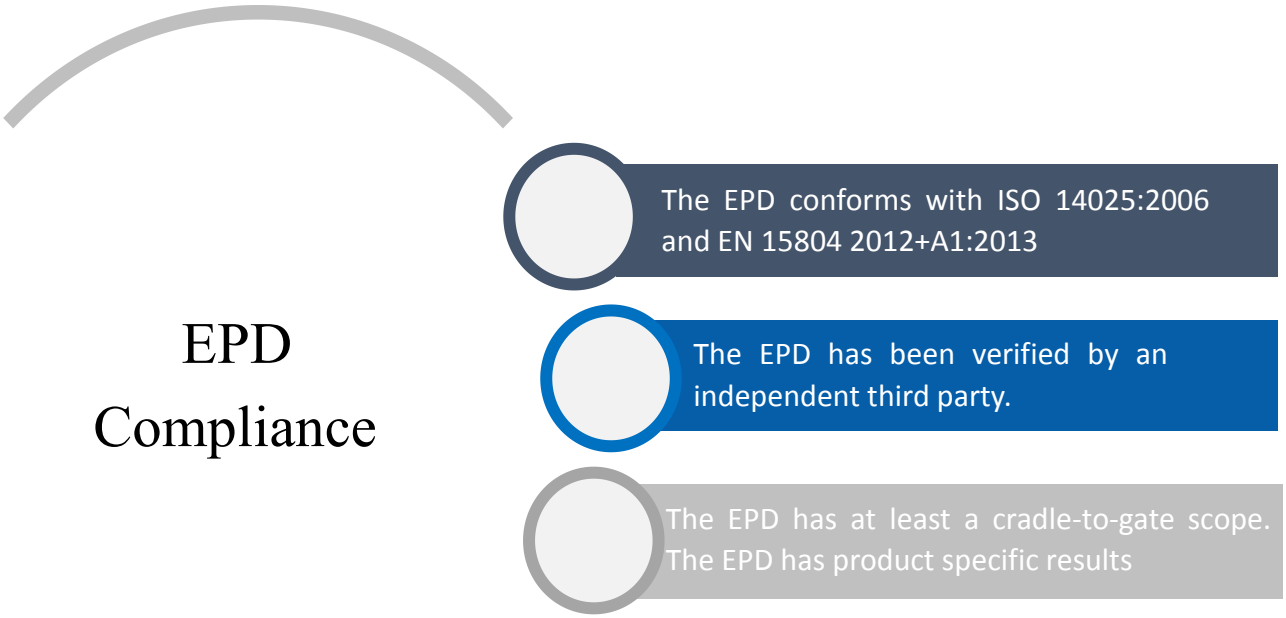
Accredited /approved by	EPD International AB
Independent external verification of the declaration and data, according to ISO 14025:2006	☐EPD process certification (Internal) ■EPD verification (External)

The Rifeng PEX/AL/PEX pipes EPD results can also be used to represent PEX/AL/PEX pipes products in Whole of Building Life Cycle Assessments.This EPD is complied with its requirement as below:



Rifeng Introduction

Rifeng Enterprise Group Co., Ltd., established in 1996, has been committed to developing high-quality and environmental - friendly piping products that cover the plumbing, indoor climate, drainage, electrical and gas fields with product systems ranging from multilayer pipes to PEX, PERT, PP-R, PVC, and brass hardware such as fittings, manifold and valves, under optional sizes from DN 09 to DN160 mm, to provide systematic solutions.

With over 5,000 employees and 6 manufacturing bases in China respectively located in Foshan, Shenyang, Tianjin, Shanxi, Hubei and Sichuan. It is only Foshan base has the business of export. Rifeng is increasingly taking an active role in the plastic piping markets and lays out a wide sales network over 67 countries.

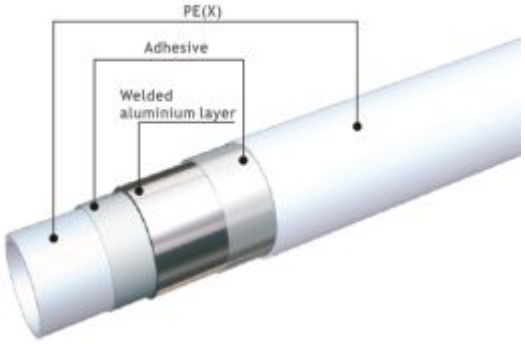
Investments for international talents, accurate testing instruments and advanced hardware equipments are yearly increasing in R&D sector and it founded 2 research institutes, named National Technical Center and CNAS Certification Laboratory. With more technical improvement and product innovation, Rifeng is confident to provide customers with more hygienic and secure piping products all the time.

Rifeng piping system has more than 50 certificates, such as NSF, DVGW, AENOR, WRAS WaterMark, StandardsMark etc. These certificates worldwide underline our technical and quality know-how, and we can provide you with 25 years system warranty backed up by an international insurance company. Rifeng always implement the concept of customer value to satisfy different demands, and continuously provide customers with piping solutions and technical supports.

Rifeng Multilayer PEX/AL/PEX Pipes

Rifeng is well experienced in multilayer pipe manufacturing for over 20 years.

Rifeng multilayer PEX/AL/PEX Pipes are structure for five-layer composite which



materials from inside to outside are respectively PEX, adhesive, aluminium, adhesive, PEX, that combines the advantages of a metal and plastic pipe. The Aluminium core is preformed tight by overlapped welded or butt welded to reliably prevent oxygen or gases from permeating into pipe. Inner layer and outer layer of PEX material achieve over specified cross-linking degree.

Complied with ISO 21003:2008 for cold and hot water supply and ISO 17484:2014 for gas installation, Rifeng multilayer PEX /AL/ PEX pipes are designed to be used under normal working pressure and temperature condition for 50 years. It offers a high degree of flexibility and toughness, coupled with high pressure and temperature resistance. It reduces snap-back force and minimizes thermal expansion.

Rifeng multilayer PEX/AL/PEX pipe could be used for hot and cold water supply, gas installation and air conditioning application. There are different colours for reference of outer and inner layers to indicate different application and to achieve specified performance. Normally, white, yellow and golden are widely accepted. Other colours like red, blue, purple, orange and be customized.

Due to the high quality raw material using, Rifeng multilayer PEX/AL/PEX pipe performs excellent not only in mechanical characteristics but also at chemical performance. It is absolutely safe from a toxicological point of view and is hygienic in contact with drinking water. In order to meet the market requirements, Rifeng can supply the multilayer PEX/AL/PEX pipe in the form of straight or coil pipe with dimension ranging from DN12mm to DN75mm.

In order to constitute a durable plumbing/gas/air conditioning system, it is advisable to use together with Rifeng brass press or compression fittings with multilayer pipes.

Table 1 Product characteristics of Rifeng multilayer PEX/AL/PEX pipes

Product names	Rifeng multilayer PEX/AL/PEX pipes see table 9 for individual product codes
UN CPC Code	36320 - Tubes, pipes and hoses, and fittings therefor, of plastics
Density	0.926 ~0.959 g/cm^3 (ISO 1183-1:2019)
Cross linking degree	＞65%　(ISO 21003:2008)
Modulus of Elasticity	7200Mpa(ASTM E111-17)
Thermal conductivity	0.45w/mK(ASTM D5930-17)
Coefficient of thermal expansion	0.025mm/mK (ASTM E831-19)
Nominal diameter	12~75mm

Table 2 - Content Declaration

Material	Percentage Content	CAS No.
polyethylene resin	94%	9002-88-4
Aluminium	＜5%	7429-90-5
Adhesive	＜1%	Confidential(nothing hazardous)
pigment	＜1%	Confidential(nothing hazardous)
Total	100%	

Rifeng multilayer PEX/AL/PEX piping system does not contain any substances as such or in concentration exceeding legal limits, which would adversely affect human health and the environment in any stages of its entire life cycle.

General

The life cycle of a building product is divided into three process modules according to EN 15804 2012+A1:2013 and ISO 14025: 2006, the Product Category Rules for Type III Environment Declaration of Construction Products of International EPD Program. Table 3 shows the scope and system boundary of Rifeng PEX/AL/PEX assessment. The scope is “cradle to gate” as defined by EN 15804 2012+A1:2013.

This EPD intent is to cover all environmental impacts of significant concern over the product life cycle based on “cradle to gate”scope. Modules C1-C4 were deemed not relevant (of negligible impact) due to the fact that the pipes are left in the ground at end of life with negligible potential environmental impact. Other than module A1~A3, all other use stage modules were also deemed not relevant.

Table 3- System boundary and scope of assessment

Product stage			Construction stage		Use stage							End of life stage			
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
Raw material supply	Transport	Manufacturing	Transport	Installation	Material emissions	Maintenance	Repair	Replacement	Refurbishment	Operational energy	Operational water	Deconstruction/Demolition	Transport	Waste processing	Disposal
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = module include in EPD
MND= module not declared (does not indicate zero impact result)

4.1 LIFE CYCLE OF RIFENG MULTILAYER PEX/AL/PEX PIPES

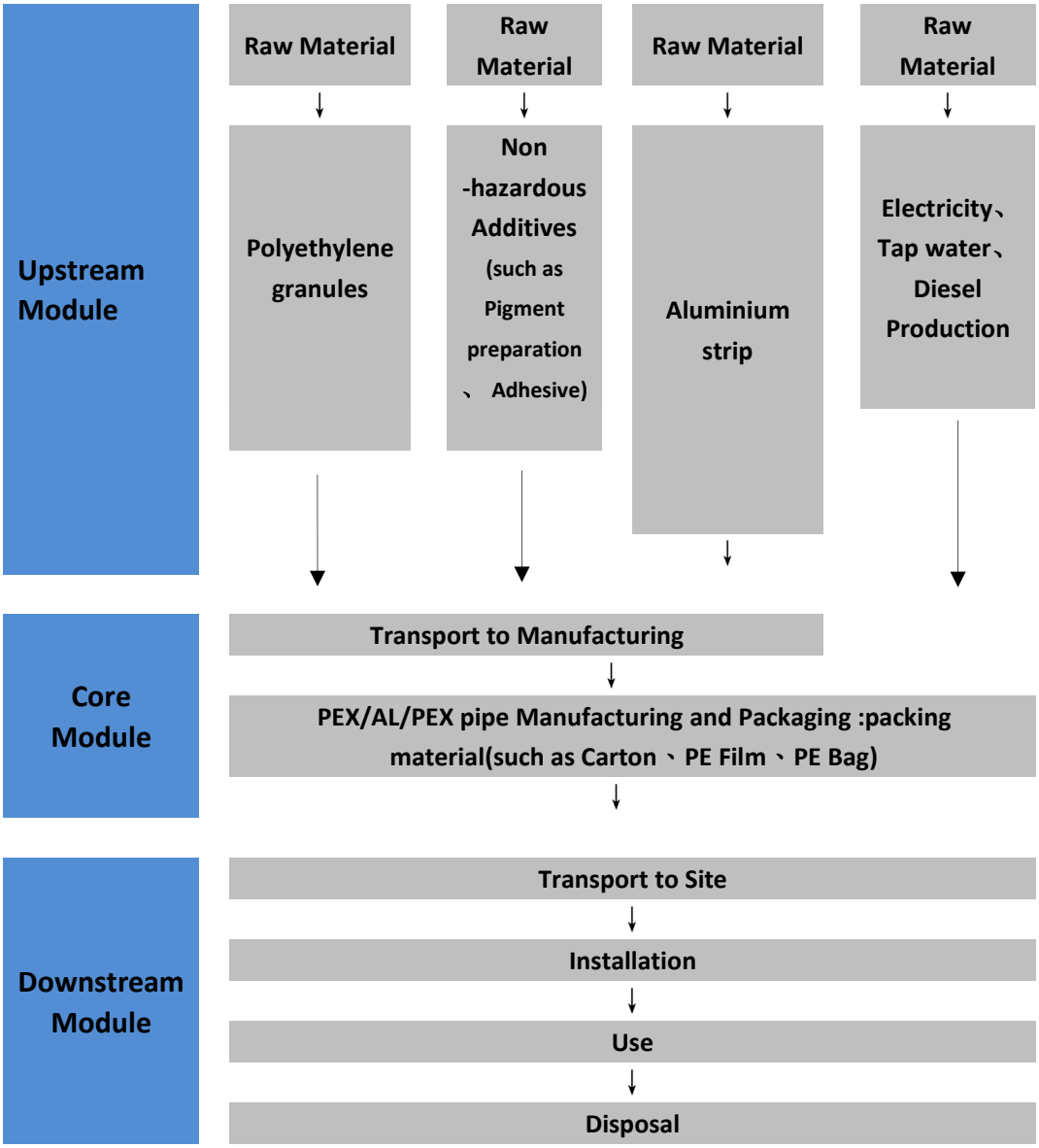


Figure 1 - life cycle diagram of multilayer PEX/AL/PEX pipe production

System boundary in this EPD involves the upstream module and core module refering to A1~A3 stage in table 3. Downstream module (A4~A5,B1~B7,C1~C4) is out of the scope of study.

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PEX/AL/PEX PIPE MANUFACTURE

4.2 MANUFACTURE STAGE

Rifeng multilayer PEX/AL/PEX pipes are manufactured from polyethylene resin, aluminium strip, adhesive and pigment using co-extrusion technology under technical control. These materials are delivered to Rifeng Foshan base by truck and unloaded into warehouse by forklift.

The main manufacture machine is screw extruder which consists of extrusion system, feeding system, transmission system, heating and cooling system as well as controlling system. During manufacturing, the aluminium strip is rolled up to be aluminium core by welding. The material compound is preheated to remove moisture and volatiles then mixed in the extruder barrel via computer control weighing system.

Aluminium welding and plastic extrusion are synchronous to finish the co-extrusion process. The temperature is carefully controlled to ensure no thermal degradation during melting and co-extrusion.The multilayer PEX/AL/PEX pipe is necessary to cool down by cold water. The finished pipe is drying prepared to be printed with marking information, which is complied with requirements of standards and customers. (Foshan base location of the map: F1-F14 No.1 Rifeng Road, Foshan, GuangDong, CHINA)

Finished Rifeng multilayer PEX/AL/PEX pipes will be inspected before package and shipment with PE bags,PE film and cartons.In the A2 stage(Transport), the transport distances and means of transportation, as below.

- ✓ The raw material transportation is a truck, and the total transportation distance is 1.13E-01km/per 1 kg of manufactured product.
- ✓ The packaging materials are transported as trucks with a total transport distance of 1.86E-04km/per 1 kg of manufactured product.

In the manufacturing stage, there will be defective scrapping of the products.For PEX/AL/PEX pipe, once occur defectiveness,they would be direct discarding and forward to waste recycling company for handling.

The results of this EPD are representative of the weighted average multilayer PEX/AL/PEX pipe production.It is based on 1kg product output to calculate the impact on environment in the phases of material supply, transport , manufacturing and packaging.

4.3 DISTRIBUTION STAGE

Rifeng has one multilayer PEX/AL/PEX pipe ,for export, manufacturing facility in China and the vast majority of pipes transportations are crossing a long way by ship to foreign region mainly in Asia, America, Australia and Europe.

4.4 INSTALLATION STAGE

Rifeng multilayer PEX/AL/PEX pipes applied for hot and cold water installation inside the building are typically concealed installed in wall and under floor before room decoration. Plumbers would deliver the pipes to residential area and position them according to the room layout. Gas application and air conditioning application are normally open installed inside the building.

During the installation process, it would be systematically assembled with brass press or compression fittings like reducer, elbow and tee etc. by mechanically connecting for different waterway transmission. It is manual operation and wastage of pipe is minimal as short lengths are often required elsewhere and easily reused on subsequent sites or within the same site. See figure 2 installation drawing.

Multilayer Gas Pipe + F5 (Electric)

Step 1: Pipe cutting

Cut the pipe vertically and precisely with rifeng pipe cutter.

Step 2: Rounding and beveling

Round and bevel the end holes of the pipe with the a plastic reamer.

Step 3: Inserting

Choose the right size sleeved-fitting for the pipe and aim the pipe end at the ring-shape hole of the fitting integrated with stainless steel sleeve. Push the pipe into the fitting up to the shoulder. Check the inserting depth by looking through the inspection holes on the sleeve shoulder, to ensure that the pipe is completely inserted.

Step4：Use the electric pressing tool for F5 fitting installation.Pressing the button on the bar and the pin will be released automatically.

Pressing the latch back onto position and the jaw will be locked onto the tool automatically.

Step5:Pressing

Pressing the tail to open the jaw. Insure the plastic block and sleeve are at the right position in the jaw; the margin of the block must be placed into the groove of the pressing section.

Operating the tool by trigger and holding the trigger until the pressing process is finished, a warming signal will sounds when the pressing is done.

Figure 2- installation drawing

4.5 USE STAGE

Maintenance of the piping systems is not required and not planned, because the pipe systems are designed to have a lifespan of 50 years,see below chart defined by ISO21003:2008. The pipes would be buried under the ground or inside the wall or exposure in a finished building. The failure rate is also extremely low and is consider to be inconsequential (not relevant) in this EPD. In case of pipe damaging, repair is simple cutting out the damaged section and replaced by the new ones.The damage part would be directly discarding and landfilling.

Table 1 — Classification of service conditions

Application class	Design temperature T_D °C	Time [b] at T_D years	T_{max} °C	Time at T_{max} years	T_{mal} °C	Time at T_{mal} h	Typical field of application
1 [a]	60	49	80	1	95	100	Hot water supply (60 °C)
2 [a]	70	49	80	1	95	100	Hot water supply (70 °C)
4 [b]	20 plus cumulative 40 plus cumulative 60	2,5 20 25	70	2,5	100	100	Underfloor heating and low-temperature radiators
5 [b]	20 plus cumulative 60 plus cumulative 80	14 25 10	90	1	100	100	High-temperature radiators

[a] A country may select either class 1 or class 2 in conformity with its national regulations.

[b] Where more than one design temperature for time and associated temperature appears for any class, they should be aggregated. "Plus cumulative" in the table implies a temperature profile of the mentioned temperature over time (e.g. the design temperature profile for 50 years for class 5 is 20 °C for 14 years followed by 60 °C for 25 years, 80 °C for 10 years, 90 °C for 1 year and 100 °C for 100 h).

NOTE For values of T_D, T_{max} and T_{mal} in excess of those in the table, this International Standard does not apply.

4.6 END OF LIFE STAGE

The Rifeng PEX/AL/PEX pipes which are installed under floor and inside wall are assumed to remain underground at the end of life. The multilayer PEX/AL/PEX pipes are inert and there is no incentive to dig them up to send for waste treatment.

Based on the provisions of 「CONSTRUCTION PRODUCTS AND CONSTRUCTION SERVICES PRODUCT CATEGORY RULES Chapter 7 GENERAL SYSTEM BOUNDARIES Table 2」, this announcement is "cradle-to-gate EPD", so product stage(A1 Raw material supply,A2 transport and A3 manufacturing are mandatory modules, but the remaining A4 ~ B7 are selective disclosure. Therefore, this EPD only discloses the necessary items for disclosure.

Chapter 4.3 to 4.6 are for reference only. They are not relevant in this EPD, so they are out of the study scope.

General

This section includes the main details of the LCA study as well as assumptions and methods of the assessment. A summary of the key life cycle assessment parameters is given in Table 4.

Table 4 - Details of LCA Study

Declared unit	1 kg of manufactured pipe
Geographical coverage	China
LCA scope	Cradle to gate

Life cycle thinking is a core concept in sustainable consumption and production for policy and business. Upstream and downstream consequences of decisions must be taken into account to help avoid the shifting of burdens from one type of environmental impact to another, from one political region to another, or from one stage to another in a product's life cycle from the cradle to the grave.

LCA is the compilation of the inputs, outputs and environmental impacts of a product system throughout its life cycle. It is a technique that enables industries to identify the resource flows and environmental impacts (such as greenhouse gas emissions, water and energy use) associated with the provision of products and services.

According to EN 15804 2012+A1:2013, EPDs of construction products may not be comparable if they do not comply with this standard, and EPDs might not be comparable, particularly if different functional units are used.

5.1 CORE DATA COLLECTION

Life cycle data has been sourced from material quantity data and production process data from:

- RIFENG reporting systems and staff
- RIFENG mix suppliers

Core manufacturing data was collected directly from RIFENG manufacturing sites.

- ✓ Electricity consumption was allocated to pipe via mass of pipe produced.
- ✓ Tap Water consumption was allocated to pipe via mass of pipe produced.
- ✓ Diesel consumption was allocated to pipe via mass of pipe produced.

5.2 BACKGROUND DATA

Generic background data was sourced for raw materials in the upstream module, and transport and manufacturing in the core module.

The LCA analysis method is adapted to Simapro 8.2.3 CML V3.02 (release by CML in April 2013 version 4.2) , and use the ecoinvent v3.0 database. For the EPD database, we used the 「Electricity, low voltage {CN}| market for | Alloc Def, S;1.17 KgCO2e/kWh」.This general value means that when using 1 kWh electric power in China, there would be 1.17 Kg CO2e generating and we can see the different used energy sources as below:

Non-renewable energy	
Energy, gross calorific value, in biomass	0.83%
Energy, gross calorific value, in biomass, primary forest	0.00%
Oil, crude	1.47%
Gas, mine, off-gas, process, coal mining/m3	0.52%
Coal, brown	0.09%
Coal, hard	90.58%
Gas, natural/m3	1.12%
Renewable energy	
Energy, kinetic (in wind), converted	0.13%
Energy, solar, converted	0.00%
Energy, geothermal, converted	0.00%
Energy, potential (in hydropower reservoir), converted	5.27%

Emission factor for calculate carbon emissions from electricity use. Almost all background data used for calculation of results are not older than 10 years. Exceptions (reference year not older than 2000) have only a minor impact on the overall results and can be considered representative for the period under review.

5.3 CUT OFF CRITERIA

Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary. All other reported data were incorporated and modelled using the best available life cycle inventory data.

5.4 ALLOCATION

Allocation was carried out in accordance with the PCR, section 7.7. No allocation between co-products in the core module as there were no coproducts created during manufacturing.

5.5 VARIATION

The project report does not have tested a variation between different manufacturing locations, , because RIFENG just has one site to produce RIFENG MULTILAYER PIPES (PEX/AL/PEX) supplied to the market.

5.6 MULTILAYER PEX/AL/PEX PIPES ENVIRONMENTAL PERFORMANCE

The potential environmental impacts used in this EPD are explained in Table 5 and the results for RIFENG MULTILAYER PIPES (PEX/AL/PEX) are shown in Table 6. The use of energy and fresh water resources is shown in Table 7. The use of secondary material and secondary material used as energy resources is listed as 'INA' (indicator not assessed). Table 8 shows the generation of waste throughout the product life cycle.

Table 5 - Environmental indicators used in the EPD

Environmental Indicator		Unit	Description
ADPE (kgSb eq)	Abiotic Depletion Potential – Elements / minerals	Kg antimony equivalents	The extraction of non-living and nonrenewable elements and minerals. These resources are essential in our everyday lives and many are currently being extracted at an unsustainable rate.
ADPF (MJ)	Abiotic Depletion Potential – Fossil Fuels	MJ net calorific value	The extraction of non-living and nonrenewable fossil fuels. These resources are essential in our everyday lives and many are currently being extracted at an unsustainable rate.
GWP (kgCO2 eq)	Global Warming Potential	kg carbon dioxide equivalents	Increase in the Earth's average temperature, mostly through the release of greenhouse gases. A common outcome of this is an increase in natural disasters and sea level rise.
ODP (kgCFC11 eq)	Ozone Depletion Potential	kg CFC-11 equivalents	The decline in ozone in the Earth's stratosphere. The depletion of the ozone layer increases the amount of UVB that reaches the Earth's surface. UVB is generally accepted to be a contributing factor to skin cancer, cataracts and decreased crop yields.
POCP (kgC2H4 eq)	Photochemical Ozone Creation Potential	kg ethylene equivalents	Ozone in the troposphere is a constituent of smog that is caused by a reaction between sunlight, nitrogen oxide and volatile organic compounds (VOCs). This is a known cause for respiratory health problems and damage to vegetation.
AP (kgSO2 eq)	Acidification Potential	kg sulphur dioxide equivalents	A process whereby pollutants are converted into acidic substances which degrade the natural environment. Common outcomes of this are acidified lakes and rivers, toxic metal leaching, forest damage and destruction of buildings.
EP (kgPO4 3- eq)	Eutrophication Potential	Kg phosphate equivalents	An increase in the levels of nutrients released to the environment. A common outcome of this is high biological productivity that can lead to oxygen depletion, as well as significant impacts on water quality, affecting all forms of aquatic and plant life.

Life cycle impact assessment methods used: Simapro 8.2.3 CML V3.02 (release by CML in April 2013 version 4.2)

Table 6 - Potential environmental impacts per 1 kg of manufactured pipe

	A1	A2	A3
ADPE (kgSb eq)	2.10E-05	2.28E-07	3.45E-07
ADPF (MJ)	8.97E+01	1.99E+00	6.43E+00
GWP (kgCO2 eq)	4.11E+00	1.16E-01	6.42E-01
ODP (kgCFC11 eq)	5.81E-07	2.30E-08	1.95E-08
POCP (kgC2H4 eq)	1.78E-03	1.96E-05	2.12E-04
AP (kgSO2 eq)	2.60E-02	3.49E-04	5.31E-03
EP (kgPO4 3- eq)	1.09E-02	7.88E-05	5.00E-04

ADPE = Abiotic Resource Depletion Potential – Elements,
ADPF = Abiotic Resource Depletion Potential – Fossil Fuel,
GWP = Global Warming Potential,
ODP = Ozone Depletion Potential,
POCP = Photochemical Oxidant Formation Potential,
AP = Acidification Potential,
EP = Eutrophication Potential

Table 7 - Use of resources per 1 kg of manufactured pipe

	A1	A2	A3
PERE (MJ)	3.25E+00	1.46E-02	3.66E-01
PERM (MJ)	0.00E+00	0.00E+00	0.00E+00
PERT (MJ)	3.25E+00	1.46E-02	3.66E-01
PENRE (MJ)	1.07E+02	1.93E+00	3.26E+00
PENRM (MJ)	0.00E+00	0.00E+00	0.00E+00
PENRT (MJ)	1.07E+02	1.93E+00	3.26E+00
SM (kg)	INA	INA	INA
RSF (MJ)	INA	INA	INA
NRSF (MJ)	INA	INA	INA
FW (m3)	1.72E+01	8.03E-02	1.60E-03

PERE = Use of renewable primary energy excluding 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 raw materials,
PENRM = Use of non-renewable primary energy resources used as raw materials,
PENRT = Total use of non-renewable primary energy resources,
SM = Use of secondary material,
RSF = Use of renewable secondary fuels,
NRSF = Use of non-renewable secondary fuels,
FW = Use of net fresh water,
INA = Indicator not accessed due to a limitation of the LCA tools and databases used to calculate the required resource flows. INA does not imply zero impact.

Table 8 - Generation of waste per 1 kg of manufactured pipe

	A1	A2	A3
HWD (kg)	4.69E-02	5.21E-03	0.00E+00
NHWD (kg)	1.09E-01	1.22E-02	6.80E-02
RWD (kg)	0.00E+00	0.00E+00	0.00E+00
HWD = Hazardous waste disposed, NHWD = Non-hazardous waste disposed, RWD = Radioactive waste disposed			

5.7 INTERPRETATION OF LCA RESULTS

The majority of environmental impact lies within the raw material supplied to RIFENG manufacturing site – comparatively little impact is caused by the MULTILAYER PIPES (PEX/AL/PEX) manufacturing at RIFENG site.

From the input materials, PEX resin and Aluminium are responsible for the majority of all environmental impacts and use of resources, although additives were still found to have a significant impact.

- ✓ PEX resin：
  - ✧ Approximately 50.46% of the environmental impact indicators of Abiotic depletion (fossil fuels).
  - ✧ Approximately 30.43% of the environmental impact indicators of Global warming (GWP100a).

- ✓ Aluminium：
  - ✧ Approximately 37.88% of the environmental impact indicators of Abiotic depletion (fossil fuels).
  - ✧ Approximately 58.93% of the environmental impact indicators of Global warming (GWP100a).

From the manufacturing stage, Electricity is responsible for the majority of all environmental impacts (more than 98%).

6.1 PRODUCT SPECIFICATION

The product model declared by this EPD includes a total of products. After LCIA analysis, the difference does not exceed ± 10% of the range(Because the functional units are set to be per kilogram of this type of product, so all of the following products are included in the inventory). Therefore, the LCA results announced by this EPD can be applied to the following products.

Table 9- The specification of Rifeng PEX/AL/PEX pipes.

Application	Product code	Outside diameter (mm)	Inside diameter (mm)	Pipe thickness (mm)
Hot and cold water installation and Gas application	B1-1014	14×2.0	10	2
	B1-1216	16x2.0	12	2
	B1-1418	18x2.0	14	2
	B1-1620	20x2.0	16	2
	B1-2025	25x2.5	20	2.5
	B1-2632	32x3.0	26	3
	B1-3240	40x4.0	32	4
	B1-4150	50x4.5	41	4.5
	B1-5163	63x6.0	51	6
	B1-6075	75x7.5	60	7.5
Air conditioning application	H-0912	12×1.9	09	1.9
	H-1216	16x2.0	12	2
	H-1620	20x2.0	16	2
	H-1825	25x2.5	18	2.5

6.2 OTHER TECHNICAL INFORMATION

For the full overview of the environmental benefits and product features of Rifeng PEX/AL/PEX piping systems please refer to Rifeng website: www.rifeng.com

1. Simapro 8.2.3 CML V3.02 (release by CML in April 2013 version 4.2)
2. PRODUCT CATEGORY RULES, Construction Products and Construction Services, Version 2.3,2018-11-15
3. EN 15804:2012+A1:2013 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
4. ISO 21930:2017 Environmental declaration of building products
5. ISO 14025:2006 Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures
6. ISO 14040:2006 Environmental management -- Life cycle assessment -- Principles and framework
7. ISO 14044:2006 Environmental management -- Life cycle assessment -- Requirements and guidelines
8. ISO21003:2008 Multilayer piping systems for hot and cold water installations inside buildings —Part 1:General
9. ISO21003:2008 Multilayer piping systems for hot and cold water installations inside buildings -- Part 2: pipes
10. ISO21003:2008 Multilayer piping systems for hot and cold water installations inside buildings -- Part 3: Fittings
11. ISO21003:2008 Multilayer piping systems for hot and cold water installations inside buildings –Part 5:Fitness for purpose of the system
12. ISO17484:2014 Plastics piping systems-Multilayer pipe systems for indoor gas installations with a maximum operating pressure up to and including 5 bar(500kPa)
13. ASTM F1281-17 : Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe
14. ISO1183-1:2019 Plastics -methods for determining the density of non-cellular plastics
15. ASTM E111-17 Standard Test Method for Young's Modulus, Tangent Modulus, and Chord Modulus
16. ASTM D5930-17 Standard Test Method for Thermal Conductivity of Plastics by Means of a Transient Line-Source Technique
17. ASTM E831-19 Standard Test Method for Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis

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