PVC PIPES AND CONDUITS

EPD®

THE INTERNATIONAL EPD® SYSTEM

ENVIRONMENTAL PRODUCT DECLARATION

Rifeng PVC drainage and conduit pipes

This EPD is representative for the weighted average PVC drainage and conduit pipes production 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

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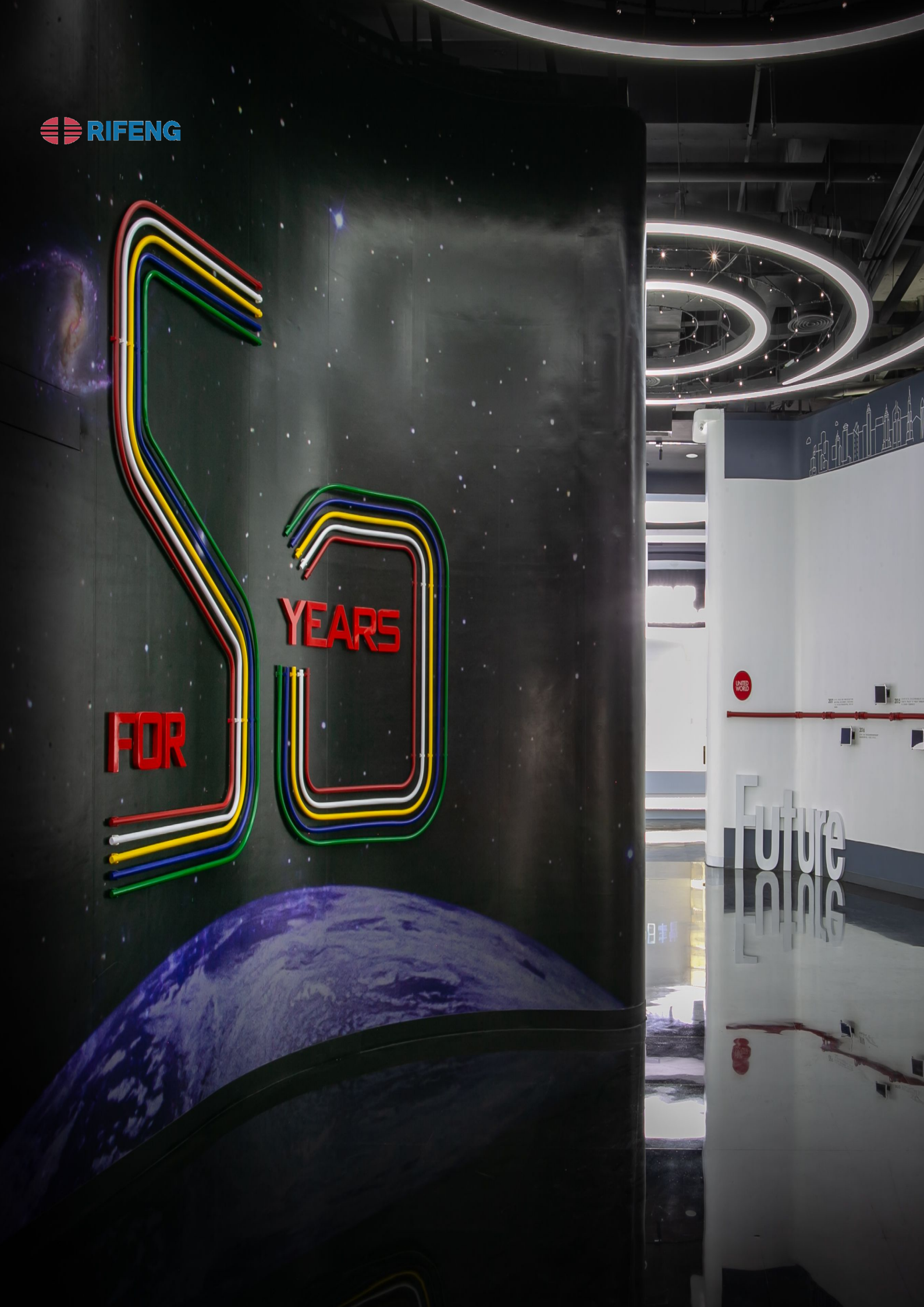
RIFENG


RIFENG
FOR
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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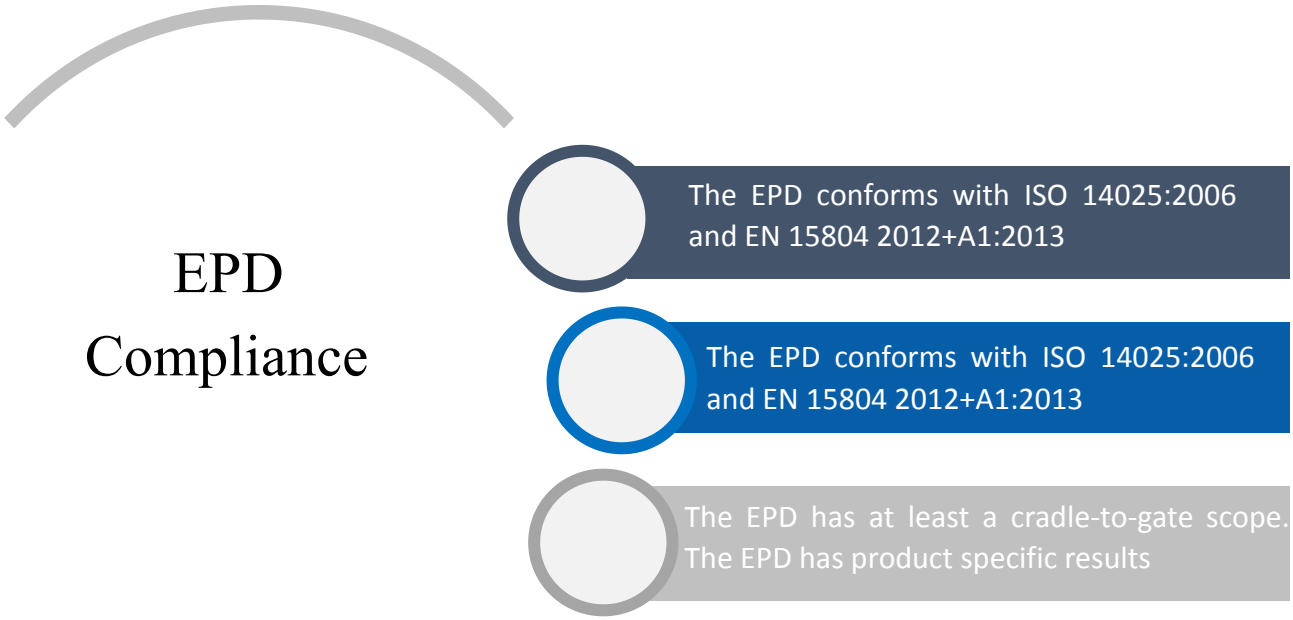
CEN STANDARD EN15804 2012+A1:2013 SERVED AS THE CORE PCR	
PCR	Construction Products and Construction Services, Version 2.3 (2018-11-15)
PCR prepared by	IVL Swedish Environmental Research Institute Moderator: Martin Erlandsson, martin.erlandsson@ivl.se
Accredited /approved by	EPD International AB
Independent external verification of the declaration and data, according to ISO 14025:2006	☐EPD process certification (Internal) ■EPD verification (External)

The Rifeng PVC drainage and conduits pipes EPD results can also be used to represent Rifeng PVC drainage and conduits pipes products in Whole of Building Life Cycle Assessments.This EPD is complied with its requirement as below.



Rifeng Introduction

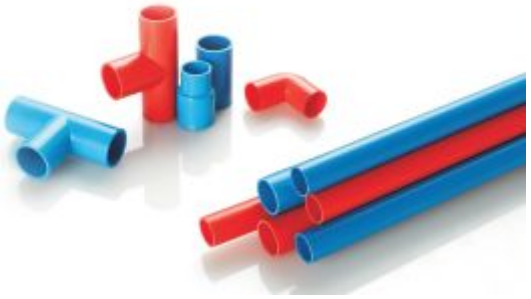
Rifeng Enterprise Group Co., Ltd., established in 1996, has been committed to developing high-quality and environmental - friendly piping products that cover the plumbing, indoor climate, drainage, electrical and gas fields with product systems ranging from multilayer pipes to PEX, PERT, PP-R, PVC, and 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 PVC Drainage and Conduits Pipes



In this EPD product scope for Rifeng PVC pipes include PVC drainage pipes, PVC electrical conduits. Pipes and conduits are all produced from PVC-U which is PVC unplasticised and contains no phthalates or other plasticisers. It is a kind of polymer generated from vinyl chloride monomer by chemical process.

Rifeng PVC pipes have sorts of high impact resistance, low noise and ultra-fast drained. It combines solid drainage pipe series and helix low-noise pipe series, focuses on solving drainage problems for high-rise building. It is suitable for over ten floors as well as can be used on multistory building and low-rise building with dimension ranging from 32mm to 315mm. The colours of Rifeng PVC drained pipe can be decided by the agreement between manufacturer and purchaser, usually be white or grey.

Rifeng electric conduits are used as system with diameter ranging from 16mm to 32mm. According to its mechanical performance, Rifeng PVC conduit system would be classified into light, medium and heavy duty. The colours of conduits could be white, red or blue, and other colours can be decided by the agreement between manufacturer and purchaser. What is worth mentioned is that Rifeng has launched its red and blue series, in order to make a difference between intense electric current and feeble electric current.

PVC-U is PVC Unplasticised and contains no phthalates or other plasticisers, is a kind of PVC polymer generated from vinyl chloride monomer by chemical process. The pipes and conduits characteristics are shown in Table 1 and the content declaration in Table 2.

Table 1 Product characteristics of Rifeng PVC drainage pipes and conduits pipes

Product names	Rifeng PVC pipes covered in this EPD are: Rifeng PVC pipes for drainage Rifeng conduits for electrical application see table 9 for individual product codes
UN CPC Code	36320 - Tubes, pipes and hoses, and fittings therefore, of plastics
Density	1350~1550kg/m^3 (ISO 1183-1:2019)
Vicat softening temperature	≥79℃ (ISO 306:2013)
Tensile Strength	≥40Mpa(ISO 527- 1: 2012)
Falling weight impact test TIR	≤10%(ASTM D2444-17)
Longitudinal shrinkage	≤5%(ISO 2505:2005)
Nominal diameter	32~315mm for drainage pipes and 16~32 for conduits

Table 2 - Content Declaration

Material	Percentage Content	CAS No.
PVC resin	84.7	9002-86-2
Calcium carbonate	5.1	471-34-1
Calcium based stabilizer	4.7	Confidential(nothing hazardous)
Titanium white	1.7	13463-67-7
Lubricant	1.7	monoglyceride(nothing hazardous)
Pigments	0.008	Confidential(nothing hazardous)
methyl methacrylate	0.013	80-62-6
Total	100%	

Rifeng PVC pipes and conduits do not contain any substances as such or in concentration exceeding legal limits, which can 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 PVC pipes 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
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 PVC DRAINAGE AND CONDUITS PIPES

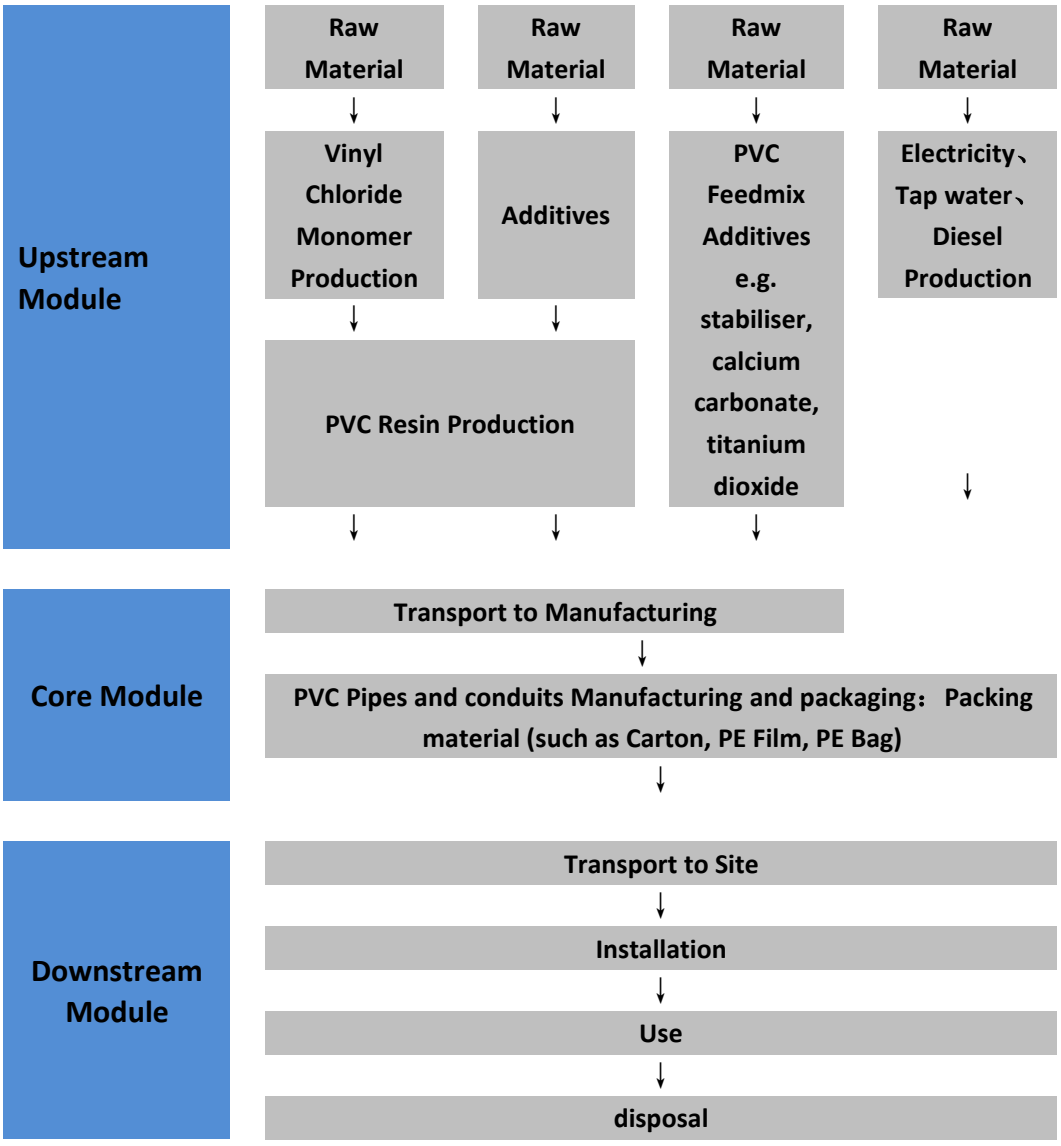


Figure 1 - life cycle diagram of PVC pipes and conduits production

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.

4.2 MANUFACTURE STAGE

RIFENG PVC PIPES Manufacture

Rifeng PVC drainage and conduit pipes are manufactured from PVC resin and additives, such as titanium dioxide, calcium carbonate, pigment, calcium based stabilizer and lubricants. As the main ingredient of PVC fittings, the PVC resin is manufactured from vinyl chloride monomer produced in China.

PVC materials are delivered to Rifeng Foshan base by truck and unloaded into warehouse by forklift after confirming the quality of the material, it would be pre-heated and dried before blending in line. We use extruder to finish PVC drainage and conduit pipes production. See below process.

During manufacturing, the various materials are mixed in the extruder barrel via computer control weighing system. The temperature is carefully controlled to ensure no thermal degradation during extrusion. Through the heating system to extrude PVC pipes and conduits, it is then to form the final structure by vacuum shaping and cool them down. The finished pipe is drying prepared to be printed with marking information, which is complied with requirements of standards and customers. Rifeng PVC pipes and conduits would be cut into straight pipes and sent to conduct the controlling test before packing and shipment. (Foshan base location of the map: F1-F14 No.1 Rifeng Road, Foshan, GuangDong, CHINA)

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

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 2.39E+00 km/per 1 kg of manufactured product.
- ✓ The packaging materials are transported as trucks with a total transport distance of 9.28E-06 km/per 1 kg of manufactured product.

In the manufacturing stage, there will be defective scrapping of the products, but these pipes can be recycled and reused through the crushing technology, and then can be put into remanufacturing.

4.3 DISTRIBUTION STAGE

Rifeng has one PVC drainage and conduit pipes, 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, Australia and Europe.

4.4 INSTALLATION STAGE

Rifeng PVC pipes for drainage application is mostly installed along exterior wall of the building for the purpose of rainwater discharge and it is also installed inside the building for the domestic water discharge. Rifeng PVC conduit pipes for residential electrical application are installed along on the ceiling, at the corner or in wall cavities. Both kind of PVC products are mainly open installed. The installation could be done without extra tools. PVC pipes usually connect with PVC fittings by solvent cement while conduits connect mechanically according to installation instruction.

4.5 USE STAGE

Maintenance of the pipe system is not required and not planned. The failure rate is also extremely low and is considered to be 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 discarding and landfilling

4.6 END OF LIFE STAGE

PVC pipes and conduits have a very long serve life and the all of them are still in their first lifetime. PVC plastic is readily recyclable. All the pre-consumer PVC pipes and conduits waste is recycled at manufacturing factory while post-consumer pipes and conduits waste is collected by authorized agency then put into recycling. In recent years, authorized agencies are on the rise in China.

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 co-products 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 PVC pipes and conduits product supplied to the market.

5.6 PVC PIPES AND CONDUITS ENVIRONMENTAL PERFORMANCE

The potential environmental impacts used in this EPD are explained in Table 5 and the results for RIFENG PVC non-pressure pipe and conduits 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)	8.43E-07	7.97E-10	2.97E-07
ADPF (MJ)	6.98E+01	6.96E-03	4.28E+00
GWP (kgCO2 eq)	5.29E+00	4.05E-04	5.12E-01
ODP (kgCFC11 eq)	7.23E-08	8.01E-11	3.70E-09
POCP (kgC2H4 eq)	1.69E-03	6.86E-08	1.92E-04
AP (kgSO2 eq)	3.03E-02	1.22E-06	5.03E-03
EP (kgPO4 3- eq)	4.34E-03	2.75E-07	4.54E-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)	9.45E-01	2.43E-02	3.66E-01
PERM (MJ)	0.00E+00	0.00E+00	0.00E+00
PERT (MJ)	9.45E-01	2.43E-02	3.66E-01
PENRE (MJ)	5.36E+01	3.21E+00	1.63E+00
PENRM (MJ)	0.00E+00	0.00E+00	0.00E+00
PENRT (MJ)	5.36E+01	3.21E+00	1.63E+00
SM (kg)	INA	INA	INA
RSF (MJ)	INA	INA	INA
NRSF (MJ)	INA	INA	INA
FW (m3)	8.06E-01	1.34E-01	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)	9.94E-03	1.10E-03	0.00E+00
NHWD (kg)	2.98E-03	3.31E-04	8.56E-05
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 PVC pipe manufacturing at RIFENG site.

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

- ✓ PVC resin：
  - ✧ Approximately 95.35% of the environmental impact indicators of Abiotic depletion (fossil fuels).
  - ✧ Approximately 95.44% 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%).

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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.

6.2 OTHER TECHNICAL INFORMATION

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

Table 9- the specification of Rifeng PVC drainage and conduit pipes.

Application	specification	Product code	Diameter (mm)	Wall thickness (mm)	straight length (m)
Drainage application	Solid pipe	PVC-U-40x2.0	40	2.0	5.8
		PVC-U-50x2.0	50	2.0	5.8
		PVC-U-75x2.3	75	2.3	5.8
		PVC-U-110x3.2	110	3.2	5.8
		PVC-U-160x4.0	160	4.0	5.8
		PVC-U-200x4.9	200	4.9	5.8
		PVC-U-250x6.2	250	6.2	5.8
		PVC-U-315x7.8	315	7.8	5.8
	Helix pipe	PVC-U-75x2.3	75	2.3	4
		PVC-U-110x3.2	110	3.2	4
		PVC-U-160x4.0	160	4.0	4
	Hollow spiral pipe	PVC-U-50*4.8	50	4.8	5.8
		PVC-U-75x5.0	75	5.0	5.8
		PVC-U-110x6.0	110	6.0	5.8
		PVC-U-160x7.0	160	7.0	5.8
Conduits application	Conduits pipe GY.205	PVC-GY.205-D16*1.0	16	1.0	120/160
		PVC-GY.205-D20*1.1	20	1.1	90/120
		PVC-GY.205-D25*1.3	25	1.3	90/120
		PVC-GY.205-D32*1.5	32	1.5	60/80
	Conduits pipe GY.305	PVC-GY.305-D16*1.2	16	1.2	120/160
		PVC-GY.305-D20*1.3	20	1.3	90/120
		PVC-GY.305-D25*1.5	25	1.5	90/120
		PVC-GY.305-D32*1.7	32	1.7	60/80
	Conduits pipe GY.405	PVC-GY.405-D16*1.6	16	1.6	120/160
		PVC-GY.405-D20*1.8	20	1.8	90/120
		PVC-GY.405-D25*1.9	25	1.9	90/120
		PVC-GY.405-D32*2.3	32	2.3	60/80

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. AS/NZS 1260: 2017 PVC-U pipes and fittings for drain, waste and vent applications
9. EN 61386-21: 2004 conduit systems for cable management- part 21: particular requirements-rigid conduit systems
10. ISO1183-1:2019 Plastics -methods for determining the density of non-cellular plastics
11. ISO 527-1:2012 Plastics - Determination of tensile properties -- Part 1: General
12. ISO 306:2013 Plastics -- Thermoplastic materials -- Determination of Vicat softening temperature (VST)
13. ISO 2505:2005 Thermoplastics pipes -- Longitudinal reversion -- Test method and parameters
14. ASTM D2444-17 Standard Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

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