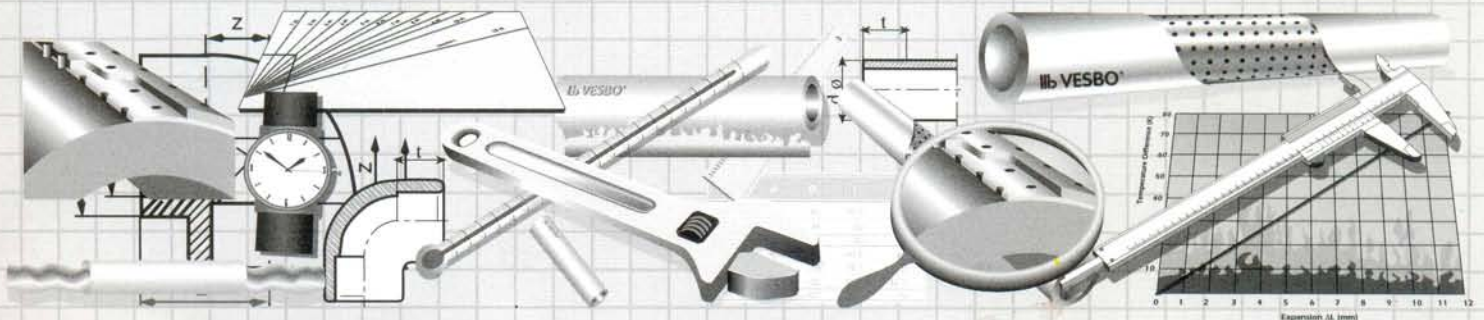




PP-R PIPES AND FITTINGS

TECHNICAL CATALOGUE





PP-R PIPES AND FITTINGS

TECHNICAL CATALOGUE





ARCON HANDELS GmbH

Arcon was established in 1982 in Munich and joined Kar Group of Companies in 1987. Being the engineering arm of Vesbo PP-R pipes and fittings, Arcon is responsible for the research and product development of Vesbo products as well as the supply of machineries and raw materials from Germany.

NOVAPLAST Co.

Established in 1992, Novaplast Co. joined Kar Group of Companies in the year of 1994, in which, it merges its operation with Camlica Co. to streamline its operations and take advantage of the economies of scale to manufacture Vesbo Polypropylene Random Co-polymer pipes and fittings. Among other things, Novaplast also manufactures other types of thermoplastic products in extrusion and injection moulding.

Its export department is responsible for European, Mediterranean and Middle East markets.

VESBO ASIA Pte. Ltd.

Vesbo was introduced to the Far East Markets in 1994. At present, Vesbo Asia Pte. Ltd., a subsidiary of Kar Group of Companies, is the Asian marketing arm of Vesbo, with its head office in Singapore and its representative office in Shanghai. It is established to further introduce, market and assign distributors to spread its networks in the Asia Pacific region.



VESBO[®]
PP-R PIPES AND FITTINGS

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CHỢ XÂY DỰNG

1.1 General

Raw Material

Vesbo PP-R pipes and fittings are manufactured from high quality, Polypropylene Random Co-polymer resins (PP Type 3 raw material).

Its physical and chemical properties make Vesbo a versatile piping system in a wide range of applications in different industries.

Its advantages over other PP types 1 or 2 and other thermoplastic pipes in the potable water industries are its high impact strength and resistance to high temperatures.

1.2 Mechanical & Thermal Properties

Polypropylene Random Co-polymer (PP Type 3)



Property	Test Method	Unit	Value	
Viscosity Number J	ISO 1628 T3	cm ³ /g	430	
Melt Flow Rate	MFR 190/5	g/10 min	0.5	
	MFR 230/2.16	g/10 min	0.3	
	MFR 230/5	g/10 min	1.5	
Density at 23 °C	ISO 1183	g/cm ³	0.898	
Crystalline Melting Temperature	DIN 53736 B2	°C	150-154	
Tensile Stress At Yield	ISO 527	N/mm ²	23	
Tensile Strength At Break	Speed 50 mm/min	N/mm ²	40	
Elongation at Break	Test Specimen 1B	%	>50	
Ball Indentation Hardness	ISO 2039 T1 (132N)	N/mm ²	43	
Flexural Stress at 3,5%	DIN 53452	N/mm ²	20	
Outer Fibre Strain				
Modulus of Elasticity, Tensile Test	ISO 527	N/mm ²	700	
Shear Modulus	ISO 537 Method A	-10°C	N/mm ²	1100
		0°C	N/mm ²	770
		10°C	N/mm ²	500
		20°C	N/mm ²	370
		30°C	N/mm ²	300
		40°C	N/mm ²	240
		50°C	N/mm ²	180
60°C	N/mm ²	140		
Mechanical Strength Properties Determined by Impact Strength at 0°C	DIN 8078		no failure	
Impact Strength (Charpy)	ISO 179/1eU	RT	kJ/m ²	no failure
		0°C	kJ/m ²	no failure
		-10°C	kJ/m ²	no failure
Notched Impact Strength (Charpy)	ISO 179/1eA	RT	kJ/m ²	20
		0°C	kJ/m ²	4
		-20°C	kJ/m ²	3
Coefficient of Linear Thermal Expansion	VDE 0304 Part 1&4	K ⁻¹	1.5x10 ⁻⁴	
Thermal Conductivity at 20°C	DIN 52612	W/mK	0.24	
Specific Heat at 20°C	Adiabatic Calorimeter	kJ/kg K	2.0	

ISO = International Organization for Standardization VDE=Verband Deutscher Elektrotechniker

The test specimens were made and the test methods selected in accordance with DIN 16774, Part 2.

1.3 Application Areas

Potable Water, Hot & Cold Water, Chemical, Irrigation

Residential apartments, Condominiums, Public Housing

Commercial shopping centres, Office Buildings

Industrial factories dealing with chemicals, food processing, Semi Conductors

Hospitals

Schools-Laboratories and Chemical Sewerage

Hotels & Resorts

1.4 Behaviour of Vesbo According to DIN 8078 Under Long Term Hoop Stress

The service life of Vesbo depends on the internal hoop stress over time subject to the temperature.

Hoop stress is given as follows:

$$\delta = \frac{P \times (d-s)}{20 \times s}$$

where

δ = Hoop stress (N/mm² or MPa)

P = Internal pressure (bar)

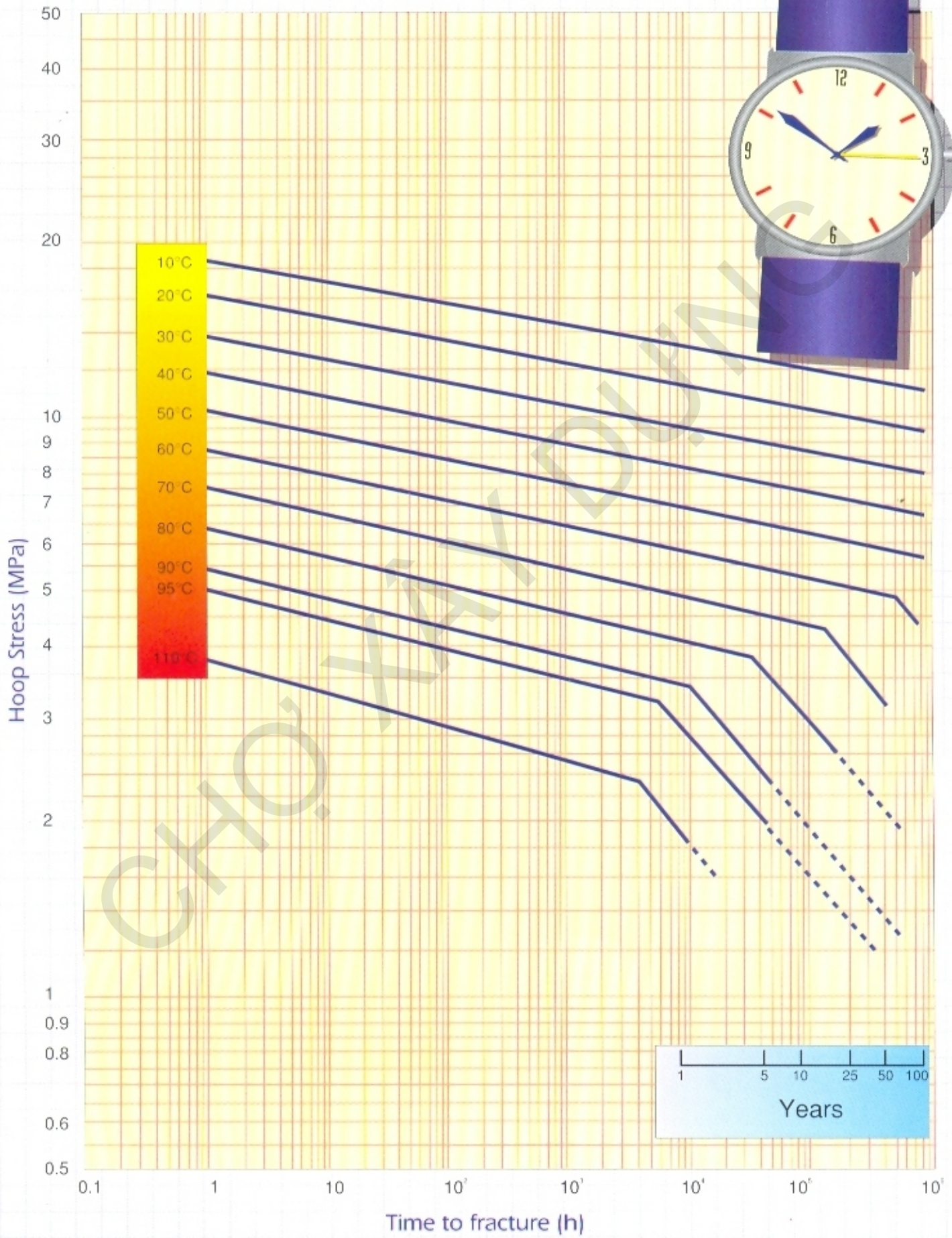
d = Outer diameter of pipe (mm)

s = Wall thickness of pipe (mm)

1. CHARACTERISTICS

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Time - Hoop Stress Graph



1. CHARACTERISTICS

Chợ xây dựng: <http://choxaydung.vn>

1.5 Permissible Operating Pressure

Projected Service Life

The following table provides a more detailed information with regards to the permissible pressure of various pipe pressure rating at various temperatures. These values are derived from the hoop stress chart and formula.

Under normal working pressures and conditions, the average service life of Vesbo pipes is projected to be 50 years or more.

Example

A PN 10, cold water pipe, transporting water at a temperature of 30°C can last for more than 50 years under normal conditions with an operating pressure of 11.1 bars or 161 P.S.I.

A PN 20, hot water pipe, transporting water at a temperature of 70 °C can last for more than 50 years under normal conditions with an operating pressure of 8.5 bars or 123 P.S.I.

Temperature	Service Life, Yrs	For Water Installations, According to DIN 8077 Safety-Factor of 1.5			
		Vesbo Pipe SDR 11	Vesbo Pipe SDR 7.4	Vesbo Pipe SDR 6	Vesbo Stable Pipe
		Nominal Pressure in bars			
		PN 10, Cold Water	PN 16, Hot & Cold Water	PN 20, Hot & Cold Water	PN 25, Hot & Cold Water
Permissible Working Pressure at Various Temperatures (bars)					
20 °C	1	15.1	23.8	30.7	37.7
	5	14.0	22.3	28.0	35.0
	10	13.5	21.7	27.1	33.8
	25	13.2	21.1	26.4	33.0
	50	12.9	20.4	25.9	32.3
30 °C	1	12.8	20.2	25.6	32.0
	5	12.0	19.0	24.0	30.0
	10	11.7	18.3	23.5	29.3
	25	11.3	17.7	22.7	28.3
	50	11.1	17.3	22.1	27.7
40 °C	1	11.1	17.1	22.1	27.7
	5	10.4	16.0	20.8	26.0
	10	10.1	15.6	20.3	25.3
	25	9.7	15.0	19.5	24.3
	50	9.2	14.5	18.4	23.0
50 °C	1	9.5	14.5	18.9	23.7
	5	8.9	13.5	17.9	22.3
	10	8.7	13.1	17.3	21.7
	25	8.0	12.6	16.0	20.0
	50	7.3	12.2	14.7	18.3
60 °C	1	8.3	12.2	16.5	20.7
	5	7.6	11.4	15.2	19.0
	10	7.2	11.0	14.4	18.0
	25	6.1	10.5	12.3	15.3
	50	5.5	10.1	10.9	13.7
70 °C	1	6.7	10.3	13.3	16.7
	5	6.0	9.5	12.0	15.0
	10	5.3	9.3	10.7	13.3
	25	4.5	8.0	9.1	11.3
	50	4.3	6.7	8.5	10.7
80 °C	1	8.7	8.6	12.3	13.7
	5	4.3	7.6	10.7	10.8
	10	3.9	6.3	9.3	9.8
	25	3.7	5.1	7.5	9.2
	50	3.8	6.1	7.6	8.4
95 °C	1	3.8	6.1	7.6	8.4
	5	2.9	4.0	5.7	6.3

SDR=Standard Dimension Ratio (Diameter/Wall Thickness Ratio)
SDR=d/s [s=Pipes series index from ISO 4065]

1.6 Hygiene & Health Concerns

Vesbo products are manufactured with health concerns in mind.

- Connection of pipes does not require additives such as cement solvent or fluxes or solder.

To ensure the safety of Vesbo pipes and fitting for usage relating to human contact and consumption with potable water, the following are strictly adhered to:-

- DIN 1988 Part 2
- Drinking Water Supply Systems, Materials, Components, Appliances, Design and Installation.
- KTW-Recommendations
- Federal Health Office, Germany
- DVGW
- Test Certificate based on KTW recommendations for Materials in Contact with Drinking Water
- WRc
- Test Certificate
- Water Bylaws Scheme/Wrc, Tests of Effect on Water Quality based on BS 6920

1.7 UV Resistance

Vesbo products are produced with UV stabilisers. However, like all other piping systems including metals, pipe works should not be left exposed under direct sunlight without insulating or protection from direct sunlight or UV radiation.

1.8 Fire Classification

Vesbo pipes and fittings comply and are classified under the requirements of the fire classification, B2 (Normally inflammable) according to DIN 4102. In case of a fire outbreak of temperature >800°C, under ideal conditions, with sufficient oxygen, only carbon dioxide and water vapour are produced as the raw material of Polypropylene Random Co-polymer is a hydrocarbon chain. Toxic fumes or dioxin will not be emitted.

1.9 Sound Insulation

Compared to metallic pipes, Vesbo does not need further insulation to decrease the decibel level when water flows at relatively high speeds. The reason is simply that metals transmit noises quicker and louder, whereas, plastics dampen the noises. Hence "whistling" and noises resulting from water hammer effect are largely reduced to non-existence.

1.10 Advantages of Using Vesbo

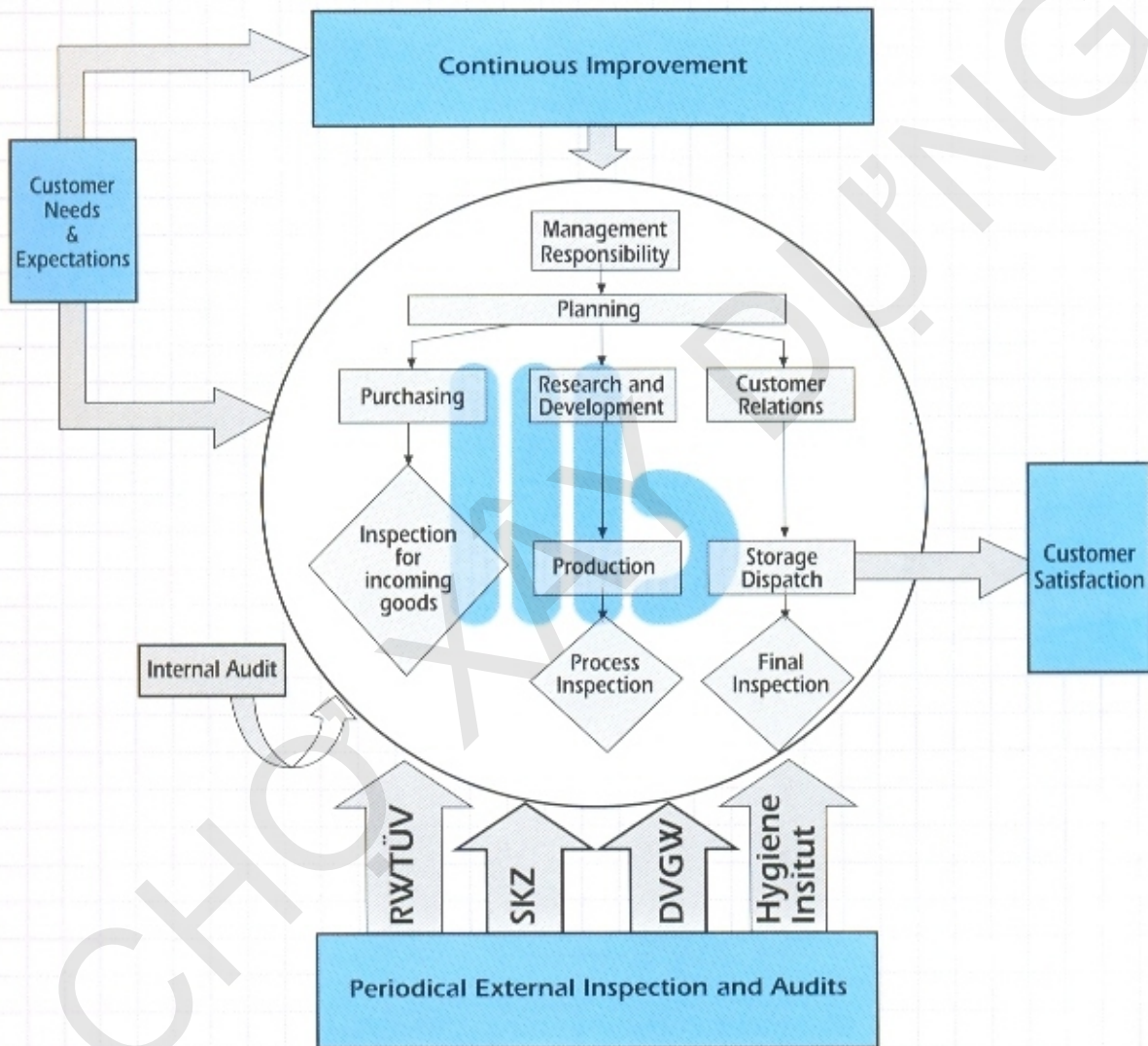
From the above properties of Vesbo system and application areas, compared to other conventional metal or plastic piping systems Vesbo has the following advantages which makes it THE SYSTEM OF THE NEW MILLENIUM.

- Not Detrimental to Human Health
- Rust and Corrosion Free
- Rupture Free
- No Scaling
- High Resistance to Acids and Chlorides
- Noise Free At High Flow Rates
- High Pressure Tolerances and Rating
- Insulation Is Not Necessary for Interior Applications
- Light Weight
- Speed and Ease of Fusion Technology
- Extensive Savings in Time and Labour

2.1 Quality as the Strategic Focus...

The Quality Process is an integral part of everything Vesbo does. Quality action teams of Vesbo throughout the world are continually working to improve products, processes and procedures to better meet customer requirements.

We have learned and adapted many of the best practices of successful quality management systems to create our own VESBO Quality System. There is no end for Quality. The VESBO Quality System is designed to be a cycle;



Quality is engineered into the Vesbo products during the entire manufacturing process. The three phases of quality control involve the incoming raw material, the pipe production, and the finished product. The combination of all three areas ensures that the final product will fulfill the requirements and meet the desired specifications.

2.2 Internal Control

Vesbo pipes and fittings are periodically subjected to the following extensive test program according to the standards.

Material Characterization Tests

Testing the incoming resin is the first step in the quality control program. It is usually checked for contamination, melt index and density. Any resin that does not meet the raw material specification is not used for the production.



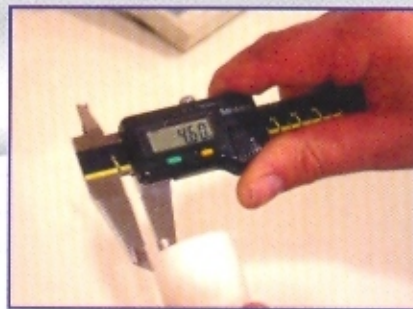
Thermal Reversion Properties

Thermal properties of plastic materials are equally as important as mechanical properties. Unlike metals, plastics are extremely sensitive to changes in temperature. This difference in the coefficient of thermal expansion develops internal stresses and stress concentrations in the polymer. Pipes are subjected to thermal stresses inside a thermostatic chamber with a continuous air circulation to observe shrinkage in accordance with DIN 8078.



Dimensional Tests

Pipe diameter, wall thickness, ovality, and length are measured on a regular basis to insure compliance with the prevailing specification. The outside diameter and wall thickness shall comply with the DIN 8077 specifications.



2. QUALITY ASSURANCE

Chợ xây dựng: <http://choxaydung.vn>

Mechanical Tests

The mechanical properties, among all the properties of plastic materials, are often the most important properties because virtually all service conditions and majority of end-use applications involve some degree of mechanical loading.

Impact Strength

Impact resistance is the ability of a material to resist breaking under a shock loading. Standard test specimens prepared from Vesbo pipes are subjected to a pendulum type impact load in accordance with DIN 8078.



Creep Strength Test

Vesbo Pipes are subjected to creep tests according to DIN 8078 that determines their service life and that provides required information about the mechanical characteristics of the pipe. The long-term burst strength of pipes is determined by subjecting the pipes to constant internal pressure and observing time-to-failure.



Separation Test

Strength of the binding layers between the internal and aluminium layer of Vesbo Stable Pipes is examined by separation test.

2.3 External Control

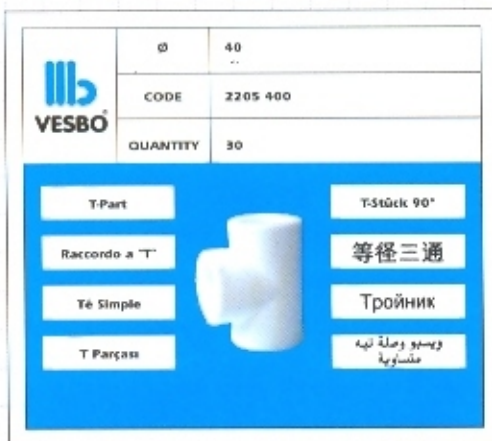
Beside the internal controls which are planned and maintained by qualified VESBO technical departments, there are also periodic external controls carried out by independent international organizations like SKZ, DVGW, Hygiene Institute and RWTÜV. These controls include both product testing according to the relevant standards and whole quality system controls. Therefore external controls are the main tools for us to ensure the highest quality products hence satisfying our customers' expectations.

2.4 Locate & Trace Tools

Locate and Trace Tools make easier the handling (H), loading (L), storing (S) and tracing (T) processes with visual locating and comprehensive feedback data.

Multilingual Fittings Labels (H, L, S)

On each Vesbo fitting box you will find a blue tag on which article's dimension, code, and quantity are mentioned. You could also see the article's name in eight languages as follows:



Pipe Tag (H, L, S, T)

Pipe tags found in the front side of the pipe sacks make available an easy storage. They help to distinguish the pipe types both with the information given on them and with their different colors.

Bar codes on the tags provide a dispatching from the plant without any problem and an easy counting & storing process in the customers' warehouses. Furthermore, each tag includes a dispatching number which provides an easy data feedback for us.



Barcode (H, L)

The barcode system is another check point in VESBO Quality System. It is one of the end-product of the continuous improvement. The possible quality problems like shortage of goods during the packaging or dispatching are eliminated with barcode system.



QC Tag (T)

The Quality Control Tags which will be found in the fittings' bags are the tools for us to improve VESBO Quality System. The feedbacks from our customers giving the follow-up numbers of fittings having defects enable us to maintain traceability. The raw material properties, the production date and hour, the machine and its set and actual values during the production, the start-up values, the final inspection values and the packing information of that fitting can be obtained. All those results lead us to revise and improve the quality system.

QUALITY CONTROL TAG	
SHOULD THERE BE ANY QUALITY PROBLEM, PLEASE INDICATE THE FOLLOW UP NUMBER BELOW	
FOLLOW UP NUMBER :	24025
<small>Form No: VCF-205 Rev.00</small>	

2.5 Standards

Pipes & Fittings

DIN 8077	Polypropylene Pipes, Dimensions
DIN 8078	Polypropylene Pipes, General Quality Requirements and Testing
DIN 16962	Pipe Joints and Elements for Polypropylene Pressure Pipes
DIN 1988 PART 2	Drinking Water Supply Systems, Materials, Components, Appliances, Design and Installation
DIN 16928	Pipe Joints, Elements for Pipes, Laying-General Directions
DIN 700	Design, Installation, Testing and Maintenance of Services Supplying Water for Domestic Use within Buildings and their Curtilages
DVS 2207	Welding of Thermoplastics
DVS 2208	Welding Machines and Devices for Thermoplastics

2.6 Quality & Health Certificates

Production Quality Certificates

- ISO 9001 : 2000 / EN ISO 9001: 2000 Production and Marketing of Vesbo Pipes and Fittings and miscellaneous parts
- SKZ German Plastic Institute, Testing and Monitoring of Production

Product Quality & Health Certificates



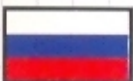
GERMANY

- SKZ German Plastic Institute
- KTW Federal Health Office
- DVGW German Technical and Scientific Association for Gas and Water - Test Certificate based on KTW recommendations for materials in contact with drinking water



UK

- WRC Water Byelaws Scheme/Wrc ,Test Effect on Water Quality based on BS 6920



RUSSIAN FEDERATION

- GOST R State Committee of the Russian Federation for Standardization and Metrology
- Russian Federation Ministry of Health - Sewerage Department, Recommendations for materials in contact with drinking water



UKRAINE

- DSTU State Committee of Ukraine for Standardization, Metrology and Certification
- Ukraine Ministry of Health - Sewerage Department, Recommendations for materials in contact with drinking water



MOLDOVA

- Moldova Committee for Standardization



BELARUS

- Belarus Ministry of Health - Sewerage Department, Recommendations for materials in contact with drinking water

2. QUALITY ASSURANCE

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ROMANIA

- ICECON Test Approval Certificate



BULGARIA

- Bulgaria Ministry of Health- Sewerage Department, Recommendations for materials in contact with drinking water



TURKEY

- TSE Turkish Standards Institute



PHILIPPINES

- Industrial Technology Development Institute Standards and Testing Division



SINGAPORE

- PSB Productivity & Standards Board, Public Utilities Board, Singapore Ministry of Environment Sewerage Department (Project Basis), Test Effect on Water Quality based on BS 6920



MALAYSIA

- SIRIM
- Jabatan Bekalan Air, Selangor
- Syarikat Air Johor, Johor
- Jabatan Bekalan Air, Pahang
- Pihak Berkuasa Air Pulau Pinang, Penang
- Jabatan Bekalan Air, Negeri Sembilan
- Lembaga Air Perak, Perak
- JBA, Sabah
- JBA, Sarawak



CHINA

- MVM Ministry of Health
- Beijing, Approved Building Material Certification
- Beijing, Health Bureau Certification
- Shanghai, Approved Building Material Certification
- Shanghai, Health Bureau Certification
- Sichuan Province, Approved Building Material Certification
- Sichuan, Health Bureau Certification
- Dalian



INDONESIA



VIETNAM



MALDIVES

Chợ xây dựng: <http://choxaydung.vn>



DVGW DW-8201AT2544

СЕРТИФИКАТ СООТВЕТСТВИЯ ГОСТ Р
СТАНДАРТ РОССИИ
№ РОСТ TR.А064.100408
Срок действия с 09.04.2002. до 09.04.2005.



ZERTIFIKAT

The TÜV CERT Certification Body of RWTÜV Systems GmbH

hereby certifies in accordance with TÜV CERT procedure that
NOVAPLAST
Plastik San. ve Tic. Ltd. Şti.
Sanayi Cad. Genç Osman Sk. No.14
34530 Yenibosna, Istanbul / Turkey
has established and applies a quality system for
Production and marketing of vesbo pipes and fittings and miscellaneous thermoplastic parts

An audit was performed, Report No. 2.5-1861/2001

The certificate is valid until January 2006

Registration No. 041008535

been certified since



ДЕРЖАВНИЙ КОМІТЕТ УКРАЇНИ
СТАНДАРТИЗАЦІЇ, МЕТРОЛОГІЇ ТА СЕРТИФІКАЦІЇ
(ДЕРЖСТАНДАРТ УКРАЇНИ)
Система сертифікації UkrCERT

№ 8008

ДОДАТОК (ПРИЛОЖЕ

- до сертифіката відповідності (в сертифікату соотв

- до свідоцтва про внесення (в свідоцтві закордонні) (1 сторінка)

№ UA.1.052.56

17.09.2001

Ідентифікована належним чином продукція - труби з поліпропілену (PP-R тип-3) системи "VESBO" марок PN-20, PN-25 випробувана

ZERTIFIKAT

Verleihungs-Urkunde

Das Süddeutsche Kunststoff-Zentrum verleiht der Firma
Arcon Handels GmbH
Elektrastraße 13
81925 München



A 339

für nachstehende Kunststoffereignisse
Druckrohre aus PP-R
Gruppe I und II

Mit der Führung des SKZ-Zeichens ist die Verpflichtung der Herstellung und Prüfung der Erzeugnisse die vorg. Bestimmungen einzuhalten.

24 Juli 2002

Hygiene-Institut des Ruhrgebiets

Institut für Umwelthygiene und Umweltmedizin
Leiter: Prof. Dr. rer. nat. L. Danneberg
Meyerstrasse - Postfach 10 12 55 - 46112 Gelsenkirchen

Gelsenkirchen
Arbeitspartner: Herr Dr. Schriener
Durchwahl: 210214 Fax: 212
Internet: www.hyg.de
E-Mail: schriener@hyg.de

Unser Zeichen: C 2844/01st

PROFUEGNIS
entsprechend KTW-Empfehlungen
(Bundgesundheitsblatt 20. Jahrgang, S. 10, 1977)

NOVAPLAST
Sanayi Cad. Genç Osman Sok. No. 14
TR-34030 Yenibosna / Istanbul
TÜRKİYE

VESBO SUPER PP-R Stabi Verbundrohr

Produktprüfung Zulassungsprüfung Überwachungsprüfung

Verfahren erfüllt gemäß Prüfbericht Nr.: C 2844/01st vom 04.12.2001 die Anforderungen gemäß

Medium	Temperaturbereich(e)		
	Kalteswasser	Warmwasser	Heißwasser
Druck	erfüllt	erfüllt	---
Temperatur	erfüllt	erfüllt	---
Stabilität	erfüllt	erfüllt	---
Lebensdauer	erfüllt	erfüllt	---

Das Verfahren beginnt mit dem Ausstellungsdatum, endet bei unveränderten Voraussetzungen
zu 20 oder mindestens Gültigkeitsdauer von 10 Jahren auf Antrag verlängert werden.

Der Direktor des Instituts
L.A.



3.2 Fittings

VESBO SOCKET



Vesbo Sockets are used to join two pipes.

ARTICLE NO.	DESCRIPTION	PCS / PACK
2201 100	SOCKET 20 mm	200
2201 200	SOCKET 25 mm	120
2201 300	SOCKET 32 mm	105
2201 400	SOCKET 40 mm	60
2201 500	SOCKET 50 mm	30
2201 600	SOCKET 63 mm	12
2201 700	SOCKET 75 mm	12
2201 800	SOCKET 90 mm	5
2201 900	SOCKET 110 mm	4

VESBO REDUCER



Vesbo Reducers are used for joining bigger size pipelines to smaller size pipelines.

ARTICLE NO.	DESCRIPTION	PCS / PACK
2202 210	REDUCER 25/20 mm	200
2202 310	REDUCER 32/20 mm	120
2202 320	REDUCER 32/25 mm	120
2202 410	REDUCER 40/20 mm	75
2202 420	REDUCER 40/25 mm	75
2202 430	REDUCER 40/32 mm	105
2202 510	REDUCER 50/20 mm	40
2202 520	REDUCER 50/25 mm	40
2202 530	REDUCER 50/32 mm	45
2202 540	REDUCER 50/40 mm	45
2202 610	REDUCER 63/20 mm	30
2202 620	REDUCER 63/25 mm	30
2202 630	REDUCER 63/32 mm	30
2202 640	REDUCER 63/40 mm	25
2202 650	REDUCER 63/50 mm	24
2202 750	REDUCER 75/50 mm	12
2202 760	REDUCER 75/63 mm	12
2202 860	REDUCER 90/63 mm	10
2202 870	REDUCER 90/75 mm	6
2202 980	REDUCER 110/90 mm	2

VESBO 90° ELBOW



Vesbo Elbows are used where the pipeline makes a curve of 90°

VESBO 45° ELBOW



Vesbo Elbows are used where the pipeline makes a curve of 45°

VESBO T-PART



Vesbo T Parts are used to join branches on the main pipeline.

ARTICLE NO.	DESCRIPTION		PCS / PACK
2203 100	90° ELBOW	20 mm	150
2203 200	90° ELBOW	25 mm	100
2203 300	90° ELBOW	32 mm	50
2203 400	90° ELBOW	40 mm	35
2203 500	90° ELBOW	50 mm	20
2203 600	90° ELBOW	63 mm	8
2203 700	90° ELBOW	75 mm	5
2203 800	90° ELBOW	90 mm	2
2203 900	90° ELBOW	110 mm	2

ARTICLE NO.	DESCRIPTION		PCS / PACK
2204 100	45° ELBOW	20 mm	150
2204 200	45° ELBOW	25 mm	80
2204 300	45° ELBOW	32 mm	60
2204 400	45° ELBOW	40 mm	35
2204 500	45° ELBOW	50 mm	20
2204 600	45° ELBOW	63 mm	8
2204 700	45° ELBOW	75 mm	6

ARTICLE NO.	DESCRIPTION		PCS / PACK
2205 100	T-PART	20 mm	100
2205 200	T-PART	25 mm	60
2205 300	T-PART	32 mm	48
2205 400	T-PART	40 mm	30
2205 500	T-PART	50 mm	12
2205 600	T-PART	63 mm	6
2205 700	T-PART	75 mm	4
2205 800	T-PART	90 mm	2
2205 900	T-PART	110 mm	1

3. PRODUCT RANGE

Chợ xây dựng: <http://choxaydung.vn>

VESBO UNEQUAL T



Vesbo Unequal T parts are used for both joining branches on pipelines and for transitions to different diameters like reducer parts.

ARTICLE NO.	DESCRIPTION	PCS / PACK
2206 121	UNEQUAL T 20x25x20 mm	75
2206 211	UNEQUAL T 25x20x20 mm	75
2206 212	UNEQUAL T 25x20x25 mm	75
2206 221	UNEQUAL T 25x25x20 mm	75
2206 311	UNEQUAL T 32x20x20 mm	45
2206 312	UNEQUAL T 32x20x25 mm	45
2206 313	UNEQUAL T 32x20x32 mm	40
2206 321	UNEQUAL T 32x25x20 mm	40
2206 323	UNEQUAL T 32x25x32 mm	48
2206 414	UNEQUAL T 40x20x40 mm	30
2206 423	UNEQUAL T 40x25x32 mm	30
2206 424	UNEQUAL T 40x25x40 mm	30
2206 432	UNEQUAL T 40x32x25 mm	30
2206 434	UNEQUAL T 40x32x40 mm	30
2206 848	UNEQUAL T 90x40x90 mm	15
2206 858	UNEQUAL T 90x50x90 mm	15
2206 868	UNEQUAL T 90x63x90 mm	15
2206 878	UNEQUAL T 90x75x90 mm	15
2206 959	UNEQUAL T 110x50x110 mm	10
2206 969	UNEQUAL T 110x63x110 mm	10
2206 979	UNEQUAL T 110x75x110 mm	10
2206 989	UNEQUAL T 110x90x110 mm	10

VESBO CAP



Vesbo Caps are used as a stopper at the pipeline ends.

ARTICLE NO.	DESCRIPTION	PCS / PACK
2207 100	CAP 20 mm	300
2207 200	CAP 25 mm	200
2207 300	CAP 32 mm	100
2207 400	CAP 40 mm	60
2207 500	CAP 50 mm	40
2207 600	CAP 63 mm	24
2207 700	CAP 75 mm	10
2207 800	CAP 90 mm	4
2207 900	CAP 110 mm	4

VESBO PIPE BRIDGE



Vesbo Pipe Bridges are used where a pipeline has to pass over the other pipeline.

ARTICLE NO.	DESCRIPTION	PCS / PACK
5211 100	PIPE BRIDGE 20 mm	50
5211 200	PIPE BRIDGE 25 mm	40
5211 300	PIPE BRIDGE 32 mm	25

VESBO THREADED CAP



Vesbo Threaded Caps are used for sealing the pipe ends during the pressure tests.

ARTICLE NO.	DESCRIPTION	PCS / PACK
2403 100	THREADED CAP 20 mm	300
2403 200	THREADED CAP 25 mm	300

VESBO SLEEVE



Vesbo Sleeves are used to fix the pipelines on ground or walls.

ARTICLE NO.	DESCRIPTION	PCS / PACK
2405 100	SLEEVE 20 mm	300
2405 200	SLEEVE 25 mm	200
2405 300	SLEEVE 32 mm	150

VESBO FLANGE



Vesbo Flanges are used for joining big size pipes to each other and for transition of Vesbo pipelines to other pipe systems (copper, steel, PVC, PB, etc.) without any plastic or metal threaded parts. Moreover, the joint could be separated easily when required.

ARTICLE NO.	DESCRIPTION	PCS / PACK
2411 500	FLANGE 50 mm	30
2411 600	FLANGE 63 mm	18
2411 700	FLANGE 75 mm	12
2411 800	FLANGE 90 mm	6
2411 900	FLANGE 110 mm	6

3. PRODUCT RANGE

Chợ xây dựng: <http://choxaydung.vn>

VESBO ADAPTOR FEMALE



ARTICLE NO.	DESCRIPTION	PCS / PACK
2301 110	ADAPTOR FEMALE 20 x 1/2"	120
2301 120	ADAPTOR FEMALE 20 x 3/4"	80
2301 210	ADAPTOR FEMALE 25 x 1/2"	60
2301 220	ADAPTOR FEMALE 25 x 3/4"	60

Vesbo Female Adaptors are used as transition parts between Vesbo and metal pipelines. These fittings are preferred mostly for permanent joints.

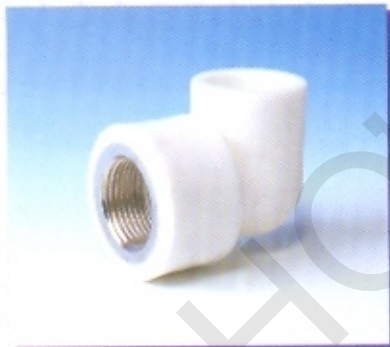
VESBO ADAPTOR MALE



ARTICLE NO.	DESCRIPTION	PCS / PACK
2302 110	ADAPTOR MALE 20 x 1/2"	80
2302 120	ADAPTOR MALE 20 x 3/4"	60
2302 210	ADAPTOR MALE 25 x 1/2"	60
2302 220	ADAPTOR MALE 25 x 3/4"	60

Vesbo Male Adaptors are used in transition of Vesbo pipeline to metal threaded parts and pipelines. These fittings are preferred mostly for permanent joints.

VESBO ELBOW FEMALE



ARTICLE NO.	DESCRIPTION	PCS / PACK
2305 110	ELBOW FEMALE 20 x 1/2"	80
2305 210	ELBOW FEMALE 25 x 1/2"	60
2305 220	ELBOW FEMALE 25 x 3/4"	60
2305 330	ELBOW FEMALE 32 x 1"	20

Vesbo Female Elbows are used in transition between Vesbo pipeline and metal threaded parts (battery, tap, etc.).

VESBO ELBOW MALE



ARTICLE NO.	DESCRIPTION	PCS / PACK
2306 110	ELBOW MALE 20 x 1/2"	60
2306 210	ELBOW MALE 25 x 1/2"	40
2306 220	ELBOW MALE 25 x 3/4"	40
2306 330	ELBOW MALE 32 x 1"	16

Vesbo Male Elbows are used in transition between Vesbo pipeline and metal threaded parts (battery, tap, etc.).

3. PRODUCT RANGE

VESBO T-PART FEMALE



Vesbo Female T parts are used in joints between Vesbo pipelines and metal threaded parts.

ARTICLE NO.	DESCRIPTION		PCS / PACK
2307 111	T-PART FEMALE	20 x 1/2" x 20	60
2307 121	T-PART FEMALE	20 x 3/4" x 20	60
2307 212	T-PART FEMALE	25 x 1/2" x 25	40
2307 222	T-PART FEMALE	25 x 3/4" x 25	40

VESBO T-PART MALE



Vesbo Male T parts are used in joints between Vesbo pipelines and metal threaded parts.

ARTICLE NO.	DESCRIPTION		PCS / PACK
2308 111	T-PART MALE	20 x 1/2" x 20	60

VESBO HEX. FEMALE ADAPTOR



Vesbo Hexagonal Female Adaptors are used as transition parts between Vesbo and metal pipelines. These fittings are preferred mostly for permanent joints.

ARTICLE NO.	DESCRIPTION		PCS / PACK
2303 220	HEX. FEMALE ADAPTOR	20 x 1/2"	40
2303 330	HEX. FEMALE ADAPTOR	32 x 1"	40
2303 440	HEX. FEMALE ADAPTOR	40 x 1 1/4"	20
2303 550	HEX. FEMALE ADAPTOR	50 x 1 1/2"	16
2303 660	HEX. FEMALE ADAPTOR	63 x 2"	10
2303 770	HEX. FEMALE ADAPTOR	75 x 2 1/2"	5

VESBO HEX. MALE ADAPTOR



Vesbo Hexagonal Male Adaptors are used in transition of Vesbo pipeline to metal threaded parts and pipelines. These fittings are preferred mostly for permanent joints.

ARTICLE NO.	DESCRIPTION		PCS / PACK
2304 220	HEX. MALE ADAPTOR	20 x 1/2"	40
2304 330	HEX. MALE ADAPTOR	32 x 1"	24
2304 440	HEX. MALE ADAPTOR	40 x 1 1/4"	12
2304 550	HEX. MALE ADAPTOR	50 x 1 1/2"	12
2304 660	HEX. MALE ADAPTOR	63 x 2"	10
2304 770	HEX. MALE ADAPTOR	75 x 2 1/2"	8

3. PRODUCT RANGE

VESBO PP-R UNION*



PP Unions, which are preferred for cold water systems, are composed of 3 parts and there is no need to twist the pipes for joining.

ARTICLE NO.	DESCRIPTION	PCS / PACK
2408 100	PP-R UNION 20 mm	50
2408 200	PP-R UNION 25 mm	40
2408 300	PP-R UNION 32 mm	20
2408 400	PP-R UNION 40 mm	15
2408 500	PP-R UNION 50 mm	10
2408 600	PP-R UNION 63 mm	5
2408 700	PP-R UNION 75 mm	2

VESBO ELECTRO SOCKET*



EF Sockets are used to join two pipes with electrofusion method. This method is preferred at the points where it is not easy to make welding through hand fusion sets, such as high points, corners, inside ducts, risers or other places that are difficult to reach.

ARTICLE NO.	DESCRIPTION	PCS / PACK
2501 100	ELECTRO SOCKET 20 mm	
2501 200	ELECTRO SOCKET 25 mm	
2501 300	ELECTRO SOCKET 32 mm	
2501 400	ELECTRO SOCKET 40 mm	
2501 500	ELECTRO SOCKET 50 mm	
2501 600	ELECTRO SOCKET 63 mm	
2501 700	ELECTRO SOCKET 75 mm	
2501 800	ELECTRO SOCKET 90 mm	
2501 900	ELECTRO SOCKET 110 mm	

VESBO FUSION WELDING MACHINES*



ARTICLE NO.	DESCRIPTION	PCS / PACK
9423 002	SMALL WELDING SET 20 - 32 mm	
9423 003	CLASSIC WELDING SET 20 - 40 mm	
9423 005	MAXI SET 90 - 110 mm	
9423 009	DESKTOP WELDING KIT 50 - 110 mm	
9423 010	ELECTRO WELDING KIT 20 - 110 mm	

Fusion Welding Machines are used for joining the pipes and fittings with socket fusion method.

Desktop Welding Kits are recommended for the pipe sizes over 50 mm.

Electro Welding Kits are used for joining pipes and fittings with electrofusion method which is preferred mostly at the points where it is difficult to make welding through hand fusion sets.

VESBO WELDING ADAPTOR*



Welding Adaptors are used for heating the pipe ends and fittings to be welded.

ARTICLE NO.		DESCRIPTION			PCS / PACK
9420	100	WELDING ADAPTOR	20 mm		1
9420	200	WELDING ADAPTOR	25 mm		1
9420	300	WELDING ADAPTOR	32 mm		1
9420	400	WELDING ADAPTOR	40 mm		1
9420	500	WELDING ADAPTOR	50 mm		1
9420	600	WELDING ADAPTOR	63 mm		1
9420	700	WELDING ADAPTOR	75 mm		1
9420	800	WELDING ADAPTOR	90 mm		1
9420	900	WELDING ADAPTOR	110 mm		1

VESBO ALUMINIUM FOIL SHAVER*



Aluminium Foil Shavers are used to remove outside PP-R layer and Aluminium foil of the Vesbo Stable Pipes' tips to be welded.

ARTICLE NO.		DESCRIPTION		
9423	014	ALU. FOIL SHAVER	20x25 mm	1
9423	015	ALU. FOIL SHAVER	32x40 mm	1
9423	016	ALU. FOIL SHAVER	40x50 mm	1
9423	017	ALU. FOIL SHAVER	63x75 mm	1

VESBO PLASTIC FOIL SHAVER*



Plastic Foil Shavers are used to remove outside PP-R layer and Aluminium foil of the Vesbo Stable Pipes' tips to be welded.

ARTICLE NO.		DESCRIPTION			PCS / PACK
9423	033	PLASTIC FOIL SHAVER	20x25 mm		1
9423	034	PLASTIC FOIL SHAVER	32x40 mm		1

3. PRODUCT RANGE

VESBO CUTTERS & BLADES*



ARTICLE NO.	DESCRIPTION		PCS / PACK
9423 001	PIPE CUTTER	20-40 mm	1
9423 004	PIPE CUTTER	40-63 mm	1
9422 004	CUTTER BLADE		

Cutters are used to shorten the pipes to the required length.

VESBO REPAIR KITS*



ARTICLE NO.	DESCRIPTION		PCS / PACK
9420 1001	PIPE REPAIR ADAPTOR	7 mm	1
9420 1000	PIPE REPAIR ADAPTOR	12 mm	1
2412 100	PP-R PATCHING STICK		

Repair Kits are used for repairing holes accidentally drilled on the surface of the pipes.

VESBO - OTHER SUPPLIES*



ARTICLE NO.	DESCRIPTION		PCS / PACK
9423 008	WELDING ADAPTOR SCREW		1
1404 000	WATER LEVELLER		1

* These accessories are not manufactured by Vesbo; they are obtained from other manufacturers and could be subjected to modifications.

COLOUR OPTIONS FOR VESBO PIPES AND FITTINGS

Blue 

White 

Green 

Note: The above colour options are available for all our pipe and fitting products.

3.3 Vesbo UV Pipe

All thermosetting and thermoplastic materials are susceptible to ultraviolet (UV) degradation upon prolonged exposure to sunlight. Evidence of such degradation could be observed as a colour change. The rate at which degradation may occur varies based on the availability of air, water, oxygen and other oxidizing agents.

The use of blue pigments in Vesbo UV fittings will improve weathering characteristics by helping to screen out the ultraviolet light. Pigments are incorporated into the resin system to act as a further barrier to UV penetration into the laminate.

Since UV degradation is a surface phenomenon the most efficient means of prolonging the integrity of the reinforcement is to place a resin-rich protective layer on the surface of the pipe. On account of this, Vesbo UV pipes are also over-wrapped with an organic barrier layer to provide even greater UV resistance.

Vesbo PP-R Pipe + UV Barrier =

Surface Layer including UV stabilizers



Polypropylene Pipe (PP-R)

- The surface layer which includes UV Stabilizers increases the service life of the PP-R pipe for around 5 years.
- UV stabilizers operates only on the surface layer; never contact with the inside liquid and PP-R Pipe transports water safely.
- Designers and installers should note that although Vesbo UV pipe has a better resistance to UV degradation compared with normal PP-R pipes; depending on the weather conditions, the degradation of the material under the sunlight cannot be avoided completely.

4.1 Homogeneous Joint

The result of a socket fusion or electrofusion joint is a homogeneous joint. Such, is one of the biggest advantage of using Vesbo system:-

- 100% leak-proof
- No maintenance
- Visual inspection possible
- Perfect for concealed installation that needs corrosion-free joining system.

4.2 Fusion Tools Operating Guidelines

- Socket Fusion Welding Tool
- Desktop Welding Machine
- Electrofusion Welding Kit

Please refer to the operating manual of various welding tools

4.3 Four-Step Fusion Process

Step 1

Cut pipe to the required length using a cutter, mark the welding depth on the pipe, ensure that the indicator light on the welding tool signals that the tool is hot enough (260°C) for welding.

Step 2

The tip of pipe to be welded is shaved by a special Vesbo shaver to remove outside PP-R layer and aluminium foil. (applicable only to PN 25 Stable pipes with aluminium foil)

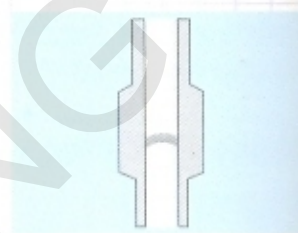
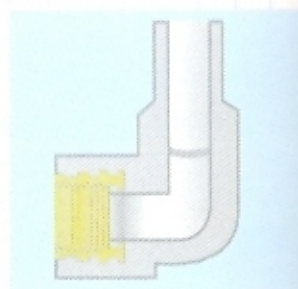
Step 3

Push the pipe and fitting into the welding adaptors, applying even strength at both ends. Do not twist or turn the pipe and fitting while pushing. Wait until heating time is reached.

See table in 4.5 for the necessary information.

Step 4

When the welding heating time is reached, remove both pipe and fittings together, again without twisting or turning while pulling out of the welding adaptor. Almost immediately, push both pipe and fitting together until the depth is reached. It is possible to adjust the joints for more than 5 degrees during this time. Joint is now completed.



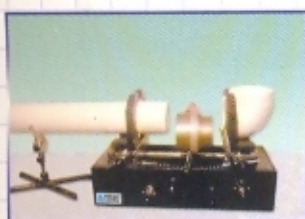
4.4 Vesbo Desktop Welding Machine Operating Manual

VESBO desktop welding machine is designed for an efficient and operative fusion for specifically big diameter (\varnothing 50 to 110 mm) pipes. Because of its simple appliance, it is not necessary to use complicated equipments.



Step 1

To prevent formation of gaps inside the joint, check the pipe and the fitting which are placed into clamping jaws whether they fit well into each other before the welding process. Use a pipe support if the pipe is longer than 50 cm for a correct alignment.



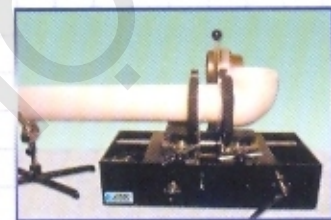
Step 2

Operate the welding machine by turning the switch on and ensure that the indicator light on the welding machine signals that the welding sockets are hot enough (260°C) for welding.



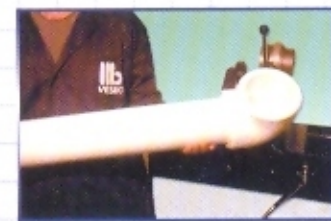
Step 3

Insert the pipe and fitting into the sockets of the adaptor plate slowly by using the handle and wait until heating time is reached. See table in 4.5 for the necessary information.



Step 4

When the welding time is reached, separate the sockets from the pipe and fitting by using the handle and lift the adaptor plate up. Almost immediately, push both pipe and fitting together until the required depth is reached by using the handle.



Step 5

Keep the joint under stress for 1 minute without turning the handle back. Then wait until the cooling time is reached. Release the grips of the clamping jaws. Joint is now completed.

4. JOINTS, FUSION & REPAIRS

Chợ xây dựng: <http://choxaydung.vn>

4.5 Welding Depth, Heating, Welding and Cooling Time

The table below provides the necessary information for a good welding joint for various Vesbo pipe and fitting sizes (applies to Stable Pipes also)

Pipe Diameter (mm)	Welding Depth (mm)	Heating Time (sec.)	Welding Time (sec.)	Cooling Time (min.)
20	14.0	5	4	2
25	15.0	7	4	2
32	16.5	8	6	4
40	18.0	12	6	4
50	20.0	18	6	4
63	24.0	24	8	6
75	26.0	30	8	8
90	29.0	40	8	8
110	32.5	50	10	8

Note: Heating time start when both pipe and fitting are pushed into correct depth. Welding time begins when joints are connected. Cooling time is the time taken for the joint to be completely cured. Never reduce cooling time by pouring water or by other means.

4.6 Pipe Repair

Pipe repair may be carried out by one of the following methods depending on the following:

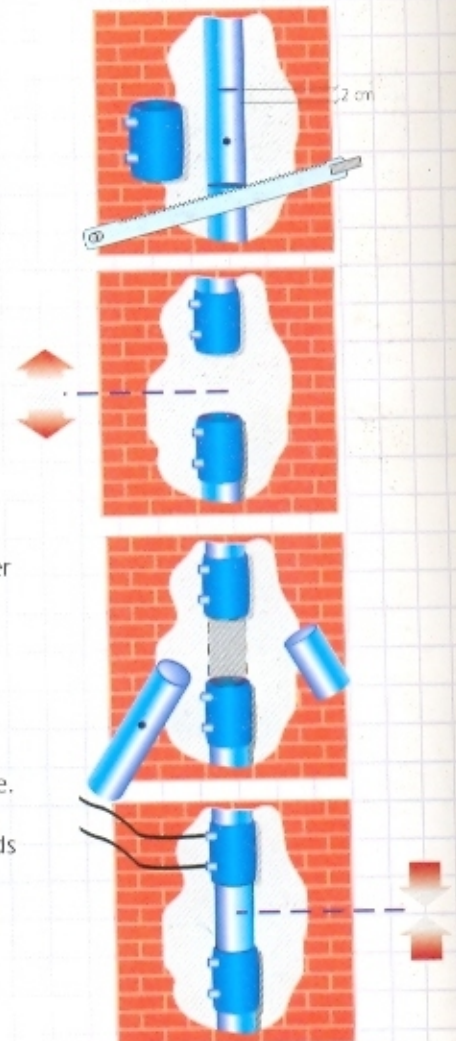
Pipe with nail holes (not concealed)

If the damaged part of the pipe is not concealed yet (before the pressure test is conducted), the recommended procedure is to cut out that part and replace it by a new part through normal welding of a socket.

Pipe concealed with two through holes

Using Electrofusion Fittings (see the pictures on the right)

- Cut the damaged pipe perpendicularly, by a length equal to that of the corresponding electric socket plus 2 cm.
- Remove the section of the damaged pipe.
- Carefully clean the surfaces of the two pipe sections to be joined, using sandpaper and solvent liquid and wait until the parts of the pipe are perfectly dry.
- Remove the inner stops from 2 electric sockets.
- Fully insert the electric sockets into the pipe sections.
- Cut a pipe section having the same diameter and length as the damaged one.
- Fit it in the place of the previous one. Make the 2 electric sockets slide towards the middle of the new pipe piece, by a section equal to half the length of the socket.
- Weld the socket using an electrofusion welding kit.



Pipe with one nail hole (concealed)

With a pipe repairing kit, you can easily repair holes (max. 10 mm diameter) on the surface of the pipes. This system makes the repairing process easier especially for the pipes installed in places where are difficult to reach. You need only a welding kit, a pipe repairing socket, a pipe repairing stick and a drill with a 6 mm or 10 mm tip.



Insert the repairing socket to the welding tool.



Adjust the pipe clip on the socket according to the wall thickness of the pipe to be repaired. It is adjusted by adding a tolerance of +0.1 mm to the wall thickness and moving the rings on the socket. The related data are given in the table on the right.



If the hole diameter on the pipe surface is equal to or smaller than 5 mm, expand it with a 6 mm tip, if it is equal to or smaller than 9 mm use a 10 mm tip.



Ensure that the welding tool is hot enough.



Insert the hole to be repaired to the male part of the socket to heat the plastic around the hole and insert the repairing stick to the female part of the socket to heat it.



Adhere to the heating, welding and cooling periods for a good welding joint. Increase the periods by 50% when the air temperature is below +5° C



Insert the pipe repairing stick without exceeding the pipe's wall thickness.



Cut the remaining parts after the pipe repairing stick cools down.



After an hour later, pipe should be subjected to a pressure test with its normal operating pressure to see whether it will leak. If the pressure test is successful, pipe repairing is now completed.

Vesbo Pipe	Outer Diameter (mm)	Wall Thickness (mm)	Depth of Socket Clip on the Socket (mm)
SDR 11	20	2.3	2.3
SDR 11	25	2.3	2.4
SDR 11	32	2.9	3.0
SDR 11	40	3.7	3.8
SDR 11	50	4.6	4.7
SDR 11	63	5.8	5.9
SDR 11	75	6.8	6.9
SDR 11	90	8.2	8.3
SDR 11	110	10.0	10.1
SDR 6	20	3.4	3.5
SDR 6	25	4.2	4.3
SDR 6	32	5.4	5.5
SDR 6	40	6.7	6.8
SDR 6	50	8.3	8.4
SDR 6	63	10.5	10.6
SDR 6	75	12.5	12.6
SDR 6	90	15.0	15.1
SDR 6	110	18.3	18.4
SDR 7.4	20	2.8	2.9
SDR 7.4	25	3.5	3.6
SDR 7.4	32	4.4	4.5
SDR 7.4	40	5.5	5.6
SDR 7.4	50	6.9	7.0
SDR 7.4	63	8.6	8.7
SDR 7.4	75	10.3	10.4
SDR 7.4	90	12.3	12.4
SDR 7.4	110	15.1	15.2

Chợ xây dựng: <http://choxaydung.vn>

Installation

Installation for Vesbo piping system is not different from any other conventional piping systems, except for the superior leak proof fusion joining system.

However, there are some finer points and guidelines that need special attention when installing Vesbo.

5.1 Support Intervals

For visible pipe works that need aesthetics, proper support intervals are necessary. This will prevent unsightly but common "snaking" or sagging found in plastic pipe systems.

Pipe Support Intervals (mm) for Vesbo Pipes PN 10 (SDR 11) & PN 16 (SDR 7.4) & PN 20 (SDR 6)

Temperature Difference (°C)	VESBO Pipe Diameter (mm)								
	20	25	32	40	50	63	75	90	110
20	600	750	900	1000	1200	1400	1500	1600	1800
30	600	750	900	1000	1200	1400	1500	1600	1800
40	600	700	800	900	1100	1300	1400	1500	1700
50	600	700	800	900	1100	1300	1400	1500	1700
60	550	650	750	850	1000	1150	1250	1400	1600
70	500	600	700	800	950	1050	1150	1250	1400

Pipe Support Intervals (mm) for Vesbo Pipes PN 25 (Stable Pipes)

Temperature Difference (°C)	VESBO Pipe Diameter (mm)								
	20	25	32	40	50	63	75	90	110
20	1200	1300	1500	1700	1900	2100	2200	2300	2500
30	1200	1300	1500	1700	1900	2100	2200	2300	2400
40	1100	1200	1400	1600	1800	2000	2100	2200	2300
50	1100	1200	1400	1600	1800	2000	2100	2200	2100
60	1000	1100	1300	1500	1700	1900	2000	2100	2000
70	900	1000	1200	1400	1600	1800	1900	2000	2000

5.2 Exposed Installation

Ducts

Cold Water Risers

There is no need for expansion joint as there will be no linear expansion for Vesbo cold water pipes. Vertical Support is necessary like all other piping system.

Ceiling & Walls

During the planning and laying of visible pipes for hot water on ceiling or walls, besides taking into account the support intervals, special attention must be given to the linear expansion due to temperature. This will also prevent sagging and "snaking" of pipe lines. No consideration is necessary for Stable pipes. Hence, to prevent unsightly installation, the following appropriate procedure must be observed:

5.3 Linear Expansion

For transportation of hot water, like all metal or plastic pipes, we have to deal with its linear expansion. This applies only to PN 20 (SDR 6) and PN 16 (SDR 7.4) for hot water applications. No consideration is necessary for PN 25, Stable pipes as the coefficient of linear expansion is $3.0 \times 10^{-5} (K^{-1})$.

The coefficient of linear expansion for Vesbo PN 20 (SDR 6) and PN 16 (SDR 7.4) pipes is $15.0 \times 10^{-5} (K^{-1})$.

Step 1. Determine the Linear Expansion

By calculation formula:

$$\Delta l = \alpha \times L \times \Delta T$$

Where: Δl = linear expansion, mm
 α = coeff. of linear expansion, constant
for Vesbo pipes, 0.15 mm/mK
 L = pipe length, m
 ΔT = temperature difference between normal water temperature and desired operating hot water temperature, K

Example

Pipe of diameter 25mm, length of 1.5 m, normal cold water temperature is 25°C and hot water from water heater is set at 60°C.

$$\Delta l = \alpha \times L \times \Delta T$$

$$= 0.15 \times 1.5 \times 35$$

Linear expansion is 7.88-8mm

5. INSTALLATION TECHNIQUE

By reading off table PN 20 (SDR 6) & PN 16 (SDR 7.4)

Difference in Temperature, $\Delta T(K)$	10	20	30	40	50	60	70	80
Pipe Length L(m)	Linear Expansion Δl (mm)							
0.1	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20
0.2	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40
0.3	0.45	0.90	1.35	1.80	2.25	2.70	3.15	3.60
0.4	0.60	1.20	1.80	2.40	3.00	3.60	4.20	4.80
0.5	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00
0.6	0.90	1.80	2.70	3.60	4.50	5.40	6.30	7.20
0.7	1.05	2.10	3.15	4.20	5.25	6.30	7.35	8.40
0.8	1.20	2.40	3.60	4.80	6.00	7.20	8.40	9.60
0.9	1.35	2.70	4.05	5.40	6.75	8.10	9.45	10.80
1.0	1.50	3.00	4.50	6.00	7.50	9.00	10.50	12.00
1.5	2.25	4.50	6.75	9.00	11.25	13.50	15.75	18.00
2.0	3.00	6.00	9.00	12.00	15.00	18.00	21.00	24.00
2.5	3.75	7.50	11.25	15.00	18.75	22.50	26.25	30.00
3.0	4.50	9.00	13.50	18.00	22.50	27.00	31.50	36.00
3.5	5.25	10.50	15.75	21.00	26.25	31.50	36.75	42.00
4.0	6.00	12.00	18.00	24.00	30.00	36.00	42.00	48.00
4.5	6.75	13.50	20.25	27.00	33.75	40.50	47.25	54.00
5.5	8.25	16.50	24.75	33.00	41.25	49.50	57.75	66.00
6.0	9.00	18.00	27.00	36.00	45.00	54.00	63.00	72.00
6.5	9.75	19.50	29.25	39.00	48.75	58.50	68.25	78.00
7.0	10.50	21.00	31.50	42.00	52.50	63.00	73.50	84.00
7.5	11.25	22.50	33.75	45.00	56.25	67.50	78.75	90.00
8.0	12.00	24.00	36.00	48.00	60.00	72.00	84.00	96.00

Note: For PN25, stable pipes, the above can be obtained by dividing by 5.

Step 2. Once the Linear Expansion is established, compensation for this expansion can be made by either an **Expansion Elbow** or **Expansion Loop**.

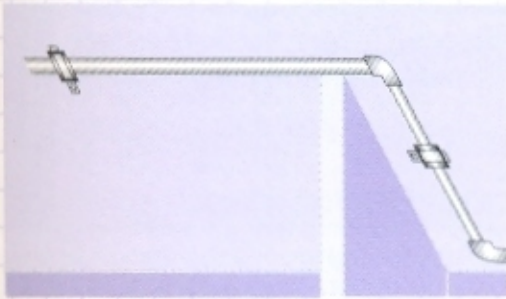
The Expansion Elbow method uses the principle of directional change (elbow joint), to compensate for linear expansion. In cases where compensation with direction change is not possible, i.e. a straight pipe length passing through pipe sleeves and in between 2 beams, an Expansion Loop is then used.

5. INSTALLATION TECHNIQUE

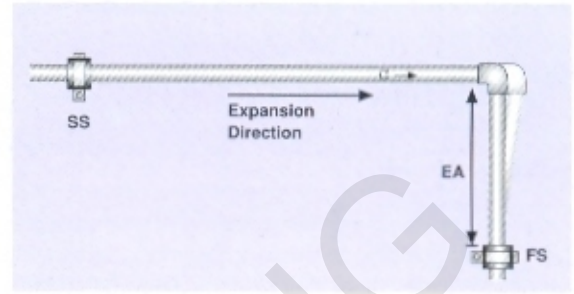
Expansion Elbow

FS= Fixed Support

SS= Sliding Support



EA= Elbow Arm



Formula to determine the length of Elbow Arm, EA:

$$EA = k \times (d \times \Delta l)^{1/2}$$

where k = constant, 15
 Δl = linear expansion
 d = pipe diameter

Note:

In an elbow expansion joint, the FS must be located at the EA section and the EA perpendicular to direction of expansion

Example

Pipe of diameter 25mm, length of 1.5m, normal cold water temperature is 25°C and hot water from water heater is set at 60°C.

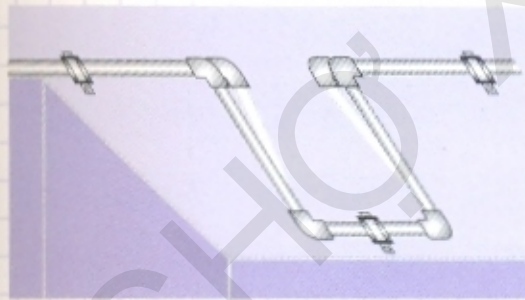
$$EA = k \times (d \times \Delta l)^{1/2}$$

$$= 15 \times (25 \times 8)^{1/2}$$

$$= 212.13 - 212 \text{ mm}$$

Expansion Loop

FS= Fixed Support SS= Sliding Support EA= Elbow Arm



Formula to determine the Loop Width, LW:

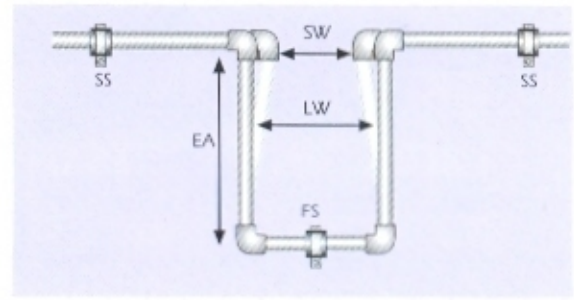
$$LW = (2 \times \Delta l) + SW$$

Where SW= Safety Width, assigned as 150 mm

Δl = Linear expansion

Note:

In an expansion loop, the FS is located at the pipe section of LW. All other pipe supports must be SS. Calculation of EA is the same as above Expansion Elbow example.



Example:

Pipe of diameter 25 mm, length of 1.5m normal cold water temperature is 25° C and hot water from water heater is set at 60°C

$$LW = (2 \times \Delta l) + SW$$

$$= (2 \times 8) + 150$$

The loop width is 166 mm.

5.4 Concealed Installation

In concealed installation, for both cold and hot water pipe lines, it is not necessary to take into account linear expansion. Pipes can be encased or embedded in walls, concrete and plaster as with other metal pipes.

The expansion of pipe due to temperature will not damage the wall plastering as the linear expansion is prevented by the compressive strain and tensile stress of concrete and plaster, it will be absorbed through the material itself.

5.5 Insulation

Hot Water System

Normally for hot water systems, it may not be necessary to insulate Vesbo pipes in tropical countries for interior or concealed installation. This is due to the low thermal conductivity property of Vesbo (0.24W/mK) Heat loss will be minimum. However, for application where central boiler is used for distribution of hot water and the circulation of hot water being continuous, it is necessary to insulate distribution lines to prevent excessive loss heat and energy wastage. Because of the low thermal conductivity of Vesbo Pipes, insulation thickness is greatly reduced. Following is the recommended insulation thickness.

Insulation Thickness for Exposed Hot Water Pipes

Thermal Conductivity, (W/mK) of Insulation Material	0.030	0.035
Dimension [mm]	Recommended Minimum Insulation Thickness	
20	6 mm or 1/4"	10 mm or 3/8"
25	6 mm or 1/4"	10 mm or 3/8"
32	10 mm or 3/8"	13 mm or 1/2"
40	10 mm or 3/8"	13 mm or 1/2"
50	10 mm or 3/8"	13 mm or 1/2"
63	13 mm or 1/2"	20 mm or 1/2"
75	20 mm or 1/2"	20 mm or 1/2"
90	20 mm or 1/2"	25 mm or 3/4"
110	25 mm or 3/4"	32 mm or 1"

Chilled Water System

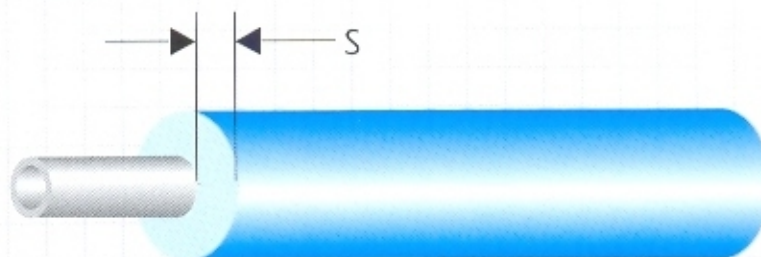
For chilled water of temperature less than 10°C, due to condensation that may take place, insulation is necessary but reduced considerably in thickness as compared to metal pipes. Heat loss for hot water pipe is reduced to a minimum.

Table shows the insulation thickness for Vesbo pipes in cold countries and chilled water systems so as to prevent condensation.

S = Insulation thickness, mm (0.038 W/mK Conductivity)

Te = Outside surrounding temperature, °C

Ti = Internal water temperature, °C



PIPE Ø 20x3.4

Te (°C)	26	27	28	29	30	31	32	33	34	Humidity %
Ti (°C)	Insulation Thickness (mm)									
5	3.7	3.9	4.1	4.3	4.6	4.0	5.0	5.3	5.5	60
7	3.0	3.3	3.5	3.8	4.0	4.2	4.5	4.7	5.0	
9	2.4	2.7	2.9	3.2	3.4	3.7	3.9	4.2	4.4	
5	10.5	10.9	11.3	11.7	12.1	12.4	12.8	13.2	13.6	80
7	9.5	9.9	10.3	10.7	11.1	11.5	11.9	12.3	12.7	
9	8.4	8.8	9.2	9.6	10.0	10.5	10.9	11.3	11.7	

PIPE Ø 25x4.2

Te (°C)	26	27	28	29	30	31	32	33	34	Humidity %
Ti (°C)	Insulation Thickness (mm)									
5	3.6	3.8	4.1	4.3	4.6	4.8	5.1	5.3	5.6	60
7	3.0	3.2	3.5	3.7	4.0	4.2	4.5	4.8	5.0	
9	2.3	2.6	2.9	3.1	3.4	3.7	3.9	4.2	4.4	
5	10.9	11.3	11.7	12.1	12.5	12.9	13.3	13.7	14.1	80
7	9.7	10.2	10.6	11.0	11.4	11.9	12.3	12.7	13.1	
9	8.6	9.0	9.5	9.9	10.3	10.8	11.2	11.7	12.1	

PIPE Ø 32x5.4

Te (°C)	26	27	28	29	30	31	32	33	34	Humidity %
Ti (°C)	Insulation Thickness (mm)									
5	3.5	3.8	4.0	4.3	4.5	4.8	5.0	5.3	5.5	60
7	2.9	3.1	3.4	3.6	3.9	4.2	4.4	4.7	5.0	
9	2.2	2.5	2.7	3.0	3.3	3.6	3.8	4.1	4.4	
5	11.1	11.6	12.0	12.4	12.9	13.3	13.7	14.1	14.6	80
7	10.0	10.4	10.9	11.3	11.8	12.2	12.7	13.1	13.5	
9	8.7	9.2	9.7	10.1	10.6	11.1	11.6	12.0	12.5	

PIPE Ø 40x6.7

Te (°C)	26	27	28	29	30	31	32	33	34	Humidity %
Ti (°C)	Insulation Thickness (mm)									
5	3.4	3.6	3.9	4.2	4.4	4.7	4.9	5.2	5.5	60
7	2.7	3.0	3.2	3.5	3.8	4.1	4.3	4.6	4.9	
9	2.0	2.3	2.6	2.8	3.1	3.4	3.7	4.0	4.3	
5	11.3	11.8	12.3	12.8	13.2	13.6	14.4	14.5	15.0	80
7	10.1	10.6	11.0	11.5	12.0	12.5	12.9	13.4	13.9	
9	8.8	9.3	9.8	10.3	10.8	11.3	11.8	12.3	12.8	

PIPE Ø 50x8.3

Te (°C)	26	27	28	29	30	31	32	33	34	Humidity %
Ti (°C)	Insulation Thickness (mm)									
5	3.1	3.4	3.7	4.0	4.2	4.5	4.8	5.0	5.3	60
7	2.4	2.7	3.0	3.3	3.6	3.8	4.1	4.4	4.7	
9	1.7	2.0	2.3	2.6	2.9	3.2	3.5	3.8	4.1	
5	11.5	11.9	12.4	12.9	13.4	13.8	14.3	14.8	15.3	80
7	10.1	10.6	11.1	11.6	12.1	12.6	13.1	13.6	14.1	
9	8.8	9.3	9.8	10.4	10.9	11.4	11.9	12.4	13.0	

PIPE Ø 63x10.5

Te (°C)	26	27	28	29	30	31	32	33	34	Humidity %
Ti (°C)	Insulation Thickness (mm)									
5	2.8	3.1	3.4	3.7	4.1	4.2	4.5	4.8	5.1	60
7	2.1	2.4	2.7	3.0	3.3	3.6	3.8	4.1	4.4	
9	1.4	1.7	2.0	2.3	2.6	2.9	3.2	3.5	3.8	
5	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	80
7	10.1	10.6	11.2	11.7	12.2	12.7	13.2	13.8	14.3	
9	8.7	9.2	9.8	10.3	10.9	11.4	12.0	12.5	13.1	

PIPE Ø 75x12.5

Te (°C)	26	27	28	29	30	31	32	33	34	Humidity %
Ti (°C)	Insulation Thickness (mm)									
5	2.5	2.8	3.1	3.4	3.7	3.9	4.2	4.5	4.8	60
7	1.8	2.1	2.4	2.7	3.0	3.3	3.5	3.8	4.1	
9	1.0	1.3	1.6	1.9	2.2	2.6	2.9	3.2	3.5	
5	11.4	11.9	12.4	13.0	13.5	14.0	14.5	15.0	15.6	80
7	10.0	10.5	11.1	11.6	12.1	12.7	13.2	13.8	14.3	
9	8.5	9.1	9.7	10.2	10.8	11.3	11.9	12.5	13.0	

PIPE Ø 90x15.0

Te (°C)	26	27	28	29	30	31	32	33	34	Humidity %
Ti (°C)	Insulation Thickness (mm)									
5	2.6	2.9	3.2	3.5	3.8	4.1	4.4	4.7	5.0	60
7	1.9	2.2	2.5	2.8	3.1	3.4	3.7	4.0	4.3	
9	1.1	1.4	1.8	2.1	2.4	2.7	3.0	3.3	3.6	
5	11.8	12.3	12.9	13.4	14.0	14.5	15.0	15.6	16.1	80
7	10.3	10.9	11.4	12.0	12.6	13.1	13.7	14.2	14.8	
9	8.8	9.4	10.0	10.6	11.1	11.7	12.3	12.9	13.5	

5.6 Pressure Test

After installing Vesbo piping system, it is necessary to go through a pressure test. Unlike metal pipes, Vesbo like all other plastic pipe systems, has to follow different pressure test procedure owing to their mechanical properties of expansion when subject to pressure, temperature difference and coefficient of expansion. A change in temperature of 10 K corresponds to a pressure change of 0.5-1.0 bar. Thus, the test medium shall as far as possible, be kept at a constant temperature throughout the test.

Test Procedure (According to DIN 1988 Part 2 or BS 6700: 1977)

Preparation for Filling & Testing the System

For pressure testing, pressure gauges that allow reading of changes in pressure of 0.1 bar shall be used, fitted at the lowest possible point in the system.

Pressure testing for leakages must be conducted while pipe works are still accessible and before concealing or plastering.

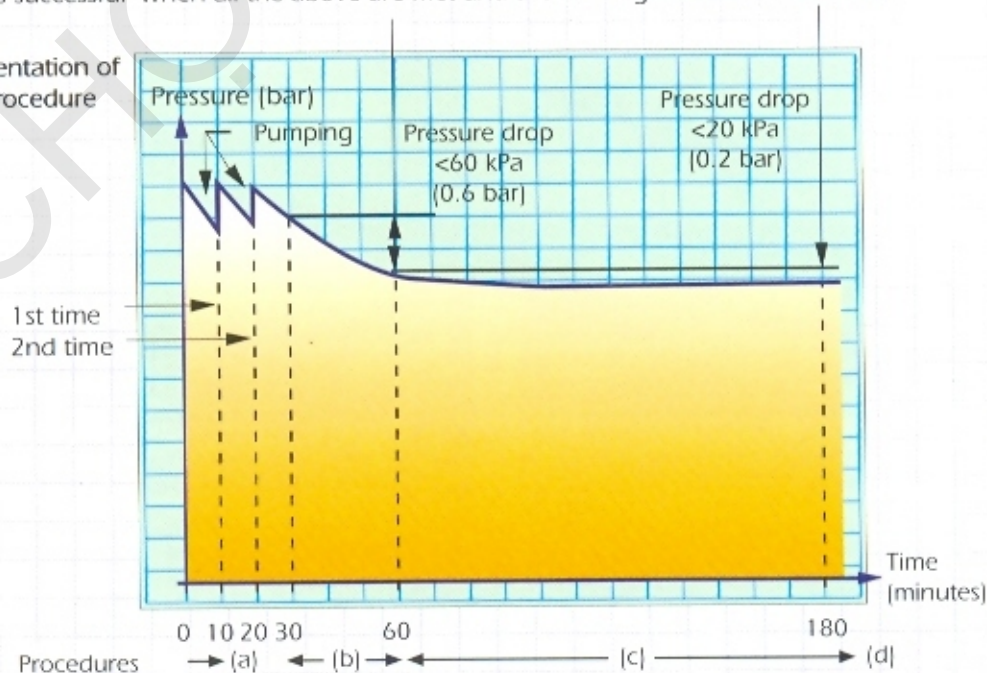
Finished pipe work must be completely fitted with filtered water and vented.

Procedure

After pipe work is filled with water and completely vented to release air locks in the system, testing can begin:

- (a) Test pressure= [permissible working pessage + 5 bars] shall be produced 2 times within 30 minutes at 10 minute intervals.
 Note: Restore by hand pump to required test pressure after the 10 minute interval if the pressure drops.
 If leakage is detected, rectify the leakage area and repeat procedure.
- (b) If no leakage is detected, for the next 30 minutes, check if the pressure has dropped by more than 0.6 bars and if there is any visible signs of leakage.
 Note: If leakage is detected, rectify the leakage area and repeat procedure.
 If pressure drops by more than 0.6 bars within this period, leakage must have occurred. Detect and rectify.
- (c) If pressure drop is within 0.6 bars and no leakage detected, continue the test without restoring the required pressure for the next 120 minutes. During this time, it shall be checked if the pressure drop is more than 0.2 bars and no leakage is detected.
 Note: If leakage is detected, rectify the leakage area and repeat procedure.
 If pressure drops by more than 0.2 bars within this period, leakage must have occurred. Detect, rectify and repeat procedure.
- (d) Pressure test is successful when all the above are met and the readings should be recorded.

Graphical Representation of Pressure Test Procedure



Test Record

PRESSURE TEST RECORD VESBO SYSTEM INSTALLATION			
Development			
Client/Owner		Date of Installation	
Address		Date of Pressure Test	

	Pressure Reading	Results	Test Criteria	Remarks
Test Procedure (a)	bar/P.S.I	Pass/Fail		
Pump to required test pressure, check for leakage			Check for leakage	
1st 10 min. record reading, restore to test pressure			Check for leakage	
2nd 10 min. record reading, restore to test pressure			Check for leakage	
Test Procedure (b)				
Next 30 min record reading, do not restore to test pressure			Pressure drop < 0.6 bars and no leakage	
Test Procedure (c)				
Next 120 min record reading			Pressure drop < 0.2 bars and no leakage	

5.7 Precautional Measures During Installation

- To reduce from a larger diameter pipe to a smaller diameter pipe, a socket must be used in conjunction with a reducer. For example, to reduce from pipe diameter of 50 mm to 25 mm, a socket 50 mm must first be attached to the 50 mm pipe followed by a reducer 50/25 mm and followed by the 25 mm pipe.
- When using Vesbo fittings with metal threaded parts, while Teflon sealing tapes must be applied adequately to prevent leakage from threads.
- Overtightening of fixtures to Vesbo fittings with metal parts may cause damages and leakage problems. Care must be taken to prevent overtightening.
- During fusion welding:
 - Fusion parts must be free from sand and particles.
 - Welding time and depths must be observed.
 - Do not twist and turn pipes and fittings while inserting and detaching from welding machine.
- Metal plugs must be used during pressure tests.
- Pressure test must be conducted BEFORE concealing pipe works.

6.1 Product Specification

Materials:

POLYPROPYLENE RANDOM CO-POLYMER (PP-R TYPE 3), OPAQUE

Materials for the pipe and fitting for cold and hot water supply shall be Polypropylene Random Co-polymer (PP-R) Type 3 in white* colour which shall comply with the following standards.

Standards:

- DIN 8077 BS 4991
- DIN 8078 BS 6920: Part 2 & 3
- DIN 16962 Part 1 to 12

To interface with other fittings, Vesbo PP-R threaded male or female with de-zincification resistance (DZR) brass inserts complying with BS 6920 for use on drinking water. These DZR fittings are injection moulded and threads are of BS parallel and plated with chrome. All fittings shall be in accordance with the description in the prescribed standards.

Description and Dimension of Pipes:

APPLICATION : HOT AND COLD WATER
 DESCRIPTION : PN 20 (SDR 6) PIPE
 PRESSURE RATING : 20 bars or 290 P.S.I

DIMENSION, OD (mm)	THICKNESS (mm)
20	3.4
25	4.2
32	5.4
40	6.7
50	8.3
63	10.5
75	12.5
90	15.0
110	18.3

APPLICATION : HOT AND COLD WATER
 DESCRIPTION : PN 16 (SDR 7.4) PIPE
 PRESSURE RATING : 16 bars or 232 P.S.I

DIMENSION, OD (mm)	THICKNESS (mm)
20	2.8
25	3.5
32	4.4
40	5.5
50	6.9
63	8.6
75	10.3
90	12.3
110	15.1

APPLICATION : COLD WATER
 DESCRIPTION : PN 10 (SDR 11) PIPE
 PRESSURE RATING : 10 bars or 145 P.S.I

DIMENSION, OD (mm)	THICKNESS (mm)
20	2.3
25	2.3
32	2.9
40	3.7
50	4.6
63	5.8
75	6.8
90	8.2
110	10.0

* May be green or blue also.

Fittings:

All Vesbo pipes must be used in conjunction with Vesbo PP-R fittings and Vesbo PP-R fittings with DZR brass inserts.

Thermal Conductivity:

The thermal conductivity of the pipes and fittings shall not exceed 0.24 W/mK at 20°C for water.

Installation:

Vesbo PP-R pipes and fittings must be installed in accordance with the instructions given by the manufacturer's recommendations and that as stated in:

- DIN 16928 Pipes of thermoplastic, pipe fittings, elements of pipes laying
- DVS 2207, PART 11 Welding of thermoplastic materials, PP pipes and fittings
- DVS 2208, PART 1 Machines and equipment for welding of PP

Pressure Test and Requirements:

Before commissioning of pipe works, procedures and requirements specified by relevant local water authorities must be adhered to. For Pressure test, DIN 1988 Part 2 or BS 6700 is used.

6.2 Other Pipe Equivalent

VESBO PIPES OD (mm)	Equivalence (inches)	COPPER TUBES NOM. DIA. (mm)
20	1/2	15
25	3/4	22
32	1	28
40	1 1/4	35
50	1 1/2	42
63	2	54
75	2 1/2	67
90	3	76
110	4	108

6.3 Pipe Sizing

During the design stage, consideration for pipe sizes to be used is determined by the type of pipe used, flow rate required, pressure loss due to the piping system for both pipe and fitting. The following information will assist the engineer to optimise the usage of Vesbo system.

Pipe friction factor R
and calculated flow rate \dot{V} in dependence on the flow velocity [v]

Roughness : 0.0070mm
Temperature : 20°C
 Density : 998.00 kg/m³
 K. Viscosity : 1.02 x 10⁻⁶ m²/s

Vesbo Pipe SDR 11 (PN 10)

\dot{V} = flow rate (l/s)		R=pressure gradient [mbar/m]						v=flow velocity [m/s]		
dxs ▶		20x2.3	25x2.3	32x2.9	40x3.7	50x4.6	63x5.8	75x6.8	90x8.2	110x10.0
\dot{V}	d _i ▶	15.4 mm	20.4 mm	26.2 mm	32.6 mm	40.8 mm	51.4 mm	61.4 mm	73.6 mm	90.0 mm
0.01	R	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	v	0.05	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00
0.02	R	0.12	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00
	v	0.10	0.06	0.04	0.02	0.02	0.01	0.01	0.00	0.00
0.03	R	0.18	0.07	0.03	0.01	0.00	0.00	0.00	0.00	0.00
	v	0.15	0.09	0.06	0.04	0.02	0.01	0.01	0.01	0.00
0.04	R	0.50	0.17	0.04	0.01	0.01	0.00	0.00	0.00	0.00
	v	0.19	0.12	0.08	0.05	0.03	0.02	0.01	0.01	0.01
0.05	R	0.74	0.25	0.08	0.02	0.01	0.00	0.00	0.00	0.00
	v	0.24	0.15	0.09	0.06	0.04	0.02	0.02	0.01	0.01
0.06	R	1.01	0.34	0.11	0.02	0.01	0.00	0.00	0.00	0.00
	v	0.29	0.18	0.11	0.07	0.05	0.03	0.02	0.01	0.01
0.07	R	1.32	0.44	0.14	0.05	0.01	0.00	0.00	0.00	0.00
	v	0.34	0.21	0.13	0.08	0.05	0.03	0.02	0.02	0.01
0.08	R	1.66	0.56	0.18	0.06	0.02	0.00	0.00	0.00	0.00
	v	0.39	0.24	0.15	0.10	0.06	0.04	0.03	0.02	0.01
0.09	R	2.03	0.68	0.22	0.07	0.03	0.01	0.00	0.00	0.00
	v	0.44	0.28	0.17	0.11	0.07	0.04	0.03	0.02	0.01
0.10	R	2.44	0.82	0.26	0.09	0.03	0.01	0.00	0.00	0.00
	v	0.49	0.31	0.19	0.12	0.08	0.05	0.03	0.02	0.02
0.12	R	3.35	1.12	0.35	0.12	0.04	0.01	0.01	0.00	0.00
	v	0.58	0.37	0.23	0.14	0.09	0.06	0.04	0.03	0.02
0.14	R	4.39	1.46	0.46	0.16	0.06	0.02	0.01	0.00	0.00
	v	0.68	0.43	0.26	0.17	0.11	0.07	0.05	0.03	0.02
0.16	R	5.55	1.85	0.58	0.20	0.07	0.02	0.01	0.00	0.00
	v	0.78	0.49	0.30	0.19	0.12	0.08	0.05	0.04	0.03
0.18	R	6.84	2.27	0.72	0.24	0.08	0.03	0.01	0.01	0.00
	v	0.87	0.55	0.34	0.22	0.14	0.09	0.06	0.04	0.03
0.20	R	8.23	2.73	0.86	0.29	0.10	0.03	0.01	0.01	0.00
	v	0.97	0.61	0.38	0.24	0.15	0.10	0.07	0.05	0.03
0.30	R	16.93	5.59	1.75	0.59	0.20	0.07	0.03	0.01	0.00
	v	1.46	0.92	0.57	0.36	0.23	0.14	0.10	0.07	0.05
0.40	R	28.37	9.32	2.91	0.99	0.34	0.11	0.05	0.02	0.01
	v	1.94	1.22	0.75	0.48	0.31	0.19	0.14	0.09	0.06
0.50	R	42.45	13.89	4.32	1.46	0.50	0.17	0.07	0.03	0.01
	v	2.43	1.53	0.94	0.60	0.38	0.24	0.17	0.12	0.08
0.60	R	59.11	19.28	5.98	2.02	0.69	0.23	0.10	0.04	0.02
	v	2.91	1.84	1.13	0.72	0.46	0.29	0.20	0.14	0.09
0.70	R	78.31	25.46	7.87	2.65	0.90	0.30	0.13	0.05	0.02
	v	3.40	2.14	1.32	0.84	0.54	0.34	0.24	0.16	0.11

d = outside diameter (mm)
 s = wall thickness (mm)
 d_i = inside diameter (mm)

6. SPECIFICATION & PLANNING

Chợ xây dựng: <http://choxaydung.vn>

Pipe friction factor R
and calculated flow rate \dot{V} in dependence on the flow velocity (v)

Roughness : 0.0070mm
Temperature : 20°C
 Density : 998.00 kg/m³
 K. Viscosity : 1.02 x 10⁻⁶ m²/s

Vesbo Pipe SDR 11 (PN 10)

\dot{V} = flow rate (l/s)		R=pressure gradient (mbar/m)								v=flow velocity (m/s)	
dxs▶		20x2.3	25x2.3	32x2.9	40x3.7	50x4.6	63x5.8	75x6.8	90x8.2	110x10.0	
\dot{V}	d _i ▶	15.4 mm	20.4 mm	26.2 mm	32.6 mm	40.8 mm	51.4 mm	61.4 mm	73.6 mm	90.0 mm	
0.80	R	100.01	32.43	10.01	3.36	1.15	0.38	0.17	0.07	0.03	
	v	3.88	2.45	1.51	0.96	0.61	0.39	0.27	0.19	0.13	
0.90	R	124.19	40.18	12.37	4.15	1.41	0.47	0.20	0.08	0.03	
	v	4.37	2.75	1.70	1.08	0.69	0.43	0.31	0.21	0.14	
1.00	R	150.84	48.69	14.96	5.01	1.70	0.56	0.24	0.10	0.04	
	v	4.85	3.06	1.88	1.20	0.76	0.48	0.34	0.24	0.16	
1.20	R	211.46	67.99	20.81	6.95	2.36	0.78	0.34	0.14	0.05	
	v	5.82	3.67	2.26	1.44	0.92	0.58	0.41	0.28	0.19	
1.40	R	281.77	90.28	27.55	9.18	3.11	1.02	0.44	0.18	0.07	
	v	6.79	4.28	2.64	1.68	1.07	0.67	0.48	0.33	0.22	
1.60	R	361.70	115.54	35.16	11.69	3.95	1.30	0.56	0.23	0.09	
	v	7.76	4.9	3.01	1.92	1.22	0.77	0.54	0.38	0.25	
1.80	R	451.22	143.73	43.63	14.48	4.88	1.60	0.69	0.29	0.11	
	v	8.73	5.51	3.39	2.16	1.38	0.87	0.61	0.42	0.28	
2.00	R	552.07	174.84	52.94	17.54	5.90	1.94	0.84	0.35	0.13	
	v	9.70	6.12	3.77	2.40	1.53	0.96	0.68	0.47	0.31	
2.20	R	660.78	208.86	63.11	20.87	7.02	2.30	0.99	0.41	0.16	
	v	10.67	6.73	4.14	2.64	1.68	1.06	0.75	0.52	0.35	
2.40	R	778.98	245.77	74.11	24.47	8.21	2.69	1.16	0.48	0.18	
	v	11.64	7.34	4.52	2.88	1.84	1.16	0.82	0.56	0.38	
2.60	R	906.64	285.56	85.94	28.33	9.50	3.10	1.34	0.55	0.21	
	v	12.61	7.95	4.90	3.11	1.99	1.25	0.88	0.61	0.41	
2.80	R	1043.75	328.23	98.61	32.46	10.87	3.55	1.53	0.63	0.24	
	v	13.58	8.57	5.27	3.35	2.14	1.35	0.95	0.66	0.44	
3.00	R	1190.30	373.77	112.10	36.85	12.32	4.02	1.73	0.71	0.27	
	v	14.55	9.18	5.65	3.59	2.29	1.45	1.02	0.71	0.47	
3.20	R	1346.28	423.56	126.42	41.50	13.86	4.52	1.94	0.80	0.30	
	v	15.52	9.79	6.03	3.83	2.45	1.54	1.09	0.75	0.50	
3.40	R	1511.68	474.89	141.56	46.41	15.49	5.04	2.17	0.89	0.34	
	v	16.50	10.40	6.40	4.07	2.60	1.64	1.16	0.80	0.53	
3.60	R	1686.50	529.07	157.51	51.58	17.19	5.59	2.40	0.99	0.38	
	v	17.47	11.01	6.78	4.31	2.75	1.73	1.22	0.85	0.57	
3.80	R	1870.73	586.10	174.29	57.00	18.98	6.17	2.65	1.09	0.41	
	v	18.44	11.63	7.16	4.55	2.91	1.83	1.29	0.89	0.60	
4.00	R	2064.37	645.97	191.88	62.69	20.86	6.77	2.91	1.19	0.45	
	v	19.41	12.24	7.53	4.79	3.06	1.93	1.36	0.94	0.63	
4.20	R	2267.41	708.68	210.78	68.63	22.81	7.40	3.18	1.30	0.49	
	v	20.38	12.85	7.91	5.03	3.21	2.02	1.43	0.99	0.66	
4.40	R	2479.85	774.22	229.50	74.82	24.85	8.06	3.46	1.42	0.54	
	v	21.35	13.46	8.29	5.27	3.37	2.12	1.50	1.03	0.69	

d = outside diameter (mm)

s = wall thickness (mm)

d_i = inside diameter (mm)

6 SPECIFICATION & PLANNING

Pipe friction factor R
and calculated flow rate \dot{V} in dependence on the flow velocity [v]

Roughness : 0.0070mm
Temperature : 20°C
 Density : 998.00 kg/m³
 K. Viscosity : 1.02 x 10⁻⁵ m²/s

Vesbo Pipe SDR 11 (PN 10)

\dot{V} = flow rate (l/s)		R=pressure gradient (mbar/m)								v=flow velocity (m/s)	
d x s ▶		20x2.3	25x2.3	32x2.9	40x3.7	50x4.6	63x5.8	75x6.8	90x8.2	110x10.0	
\dot{V}	d _i ▶	15.4 mm	20.4 mm	26.2 mm	32.6 mm	40.8 mm	51.4 mm	61.4 mm	73.6 mm	90.0 mm	
4.60	R	2701.69	842.61	249.53	81.27	26.97	8.74	3.75	1.54	0.58	
	v	22.32	14.07	8.66	5.51	3.52	2.22	1.56	1.08	0.72	
4.80	R	2932.92	913.82	271.35	87.98	29.17	9.44	4.05	1.66	0.63	
	v	23.09	14.69	9.04	5.75	3.67	2.31	1.63	1.13	0.75	
5.00	R	3173.54	987.87	293.03	94.93	31.45	10.17	4.36	1.78	0.68	
	v	24.26	15.30	9.42	5.99	3.82	2.41	1.70	1.18	0.79	
5.20	R	3423.56	1064.75	315.52	102.14	33.81	10.93	4.68	1.92	0.73	
	v	25.23	15.91	9.79	6.23	3.98	2.51	1.77	1.22	0.82	
5.40	R	3682.96	1144.96	338.82	109.61	36.26	11.71	5.01	2.05	0.78	
	v	26.20	16.52	10.17	6.47	4.13	2.60	1.84	1.27	0.85	
5.60	R	3951.74	1227.00	362.92	117.32	38.78	12.52	5.36	2.19	0.83	
	v	27.17	17.13	10.55	6.71	4.28	2.70	1.90	1.32	0.88	
5.80	R	4229.92	1312.72	387.82	125.29	41.39	13.35	5.71	2.33	0.88	
	v	28.14	17.75	10.92	6.95	4.44	2.80	1.97	1.36	0.91	
6.00	R	4517.48	1400.00	413.53	133.51	44.07	14.21	6.07	2.48	0.94	
	v	29.11	18.36	11.30	7.19	4.59	2.89	2.04	1.14	0.94	
6.20	R	4814.42	1491.58	440.05	141.98	46.83	15.09	6.45	2.63	1.00	
	v	30.08	18.97	11.68	7.43	4.47	2.99	2.11	1.46	0.97	
6.40	R	5120.74	1585.42	467.37	150.70	49.68	16.00	6.83	2.79	1.06	
	v	31.05	19.58	12.05	7.67	4.90	3.08	2.18	1.50	1.01	
6.60	R	5436.44	1682.09	495.48	159.67	52.60	16.93	7.23	2.95	1.12	
	v	32.02	20.19	12.43	7.91	5.05	3.18	2.24	1.55	1.04	
6.80	R	5761.53	1781.58	524.41	168.89	55.60	17.89	7.63	3.12	1.18	
	v	32.99	20.80	12.81	8.15	5.20	3.28	2.31	1.60	1.07	
7.00	R	6095.99	1883.89	554.13	178.37	58.69	18.87	8.05	3.28	1.24	
	v	33.96	21.42	13.18	8.39	5.35	3.37	2.38	1.65	1.10	
7.50	R	6973.19	2152.02	631.95	203.89	66.74	21.43	9.13	3.72	1.14	
	v	36.39	22.95	14.13	8.99	5.74	3.61	2.55	1.76	1.18	
8.00	R	7908.99	2437.78	714.76	230.26	75.28	24.14	10.28	4.19	1.58	
	v	38.81	24.48	15.07	9.58	6.12	3.86	2.72	1.88	1.26	
9.00	R	9956.40	3062.18	895.39	287.67	93.85	30.02	12.77	5.19	1.96	
	v	43.66	27.54	16.95	10.78	6.88	4.34	3.06	2.12	1.41	
10.00	R	3757.04	1095.99	351.27	114.38	114.38	36.51	15.50	6.30	2.37	
	v	30.59	18.83	11.98	7.65	4.82	3.40	2.35	1.57		

d = outside diameter [mm]
 s = wall thickness [mm]
 d_i = inside diameter [mm]

6. SPECIFICATION & PLANNING

Pipe friction factor R
and calculated flow rate \dot{V} in dependence on the flow velocity [v]

Roughness : 0.0070mm
Temperature : 20°C
Density : 998.00 kg/m³
K. Viscosity : 1.02 x 10⁻⁵ m²/s

Vesbo Pipe SDR 6 (PN 20)

\dot{V} = flow rate (l/s)		R=pressure gradient (mbar/m)								v=flow velocity (m/s)	
d _{xs} ▶		20x3.4	25x4.2	32x5.4	40x6.7	50x8.3	63x10.5	75x12.5	90x15.0	110x18.3	
\dot{V}	d _i ▶	13.2 mm	16.6 mm	21.2 mm	26.6 mm	33.4 mm	42.0 mm	50.0 mm	60.0 mm	73.4 mm	
0.01	R	0.14	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	
	v	0.07	0.05	0.03	0.02	0.01	0.01	0.01	0.00	0.00	
0.02	R	0.27	0.11	0.04	0.02	0.01	0.00	0.00	0.00	0.00	
	v	0.15	0.09	0.06	0.04	0.02	0.01	0.01	0.01	0.00	
0.03	R	0.81	0.16	0.06	0.02	0.01	0.00	0.00	0.00	0.00	
	v	0.22	0.14	0.08	0.05	0.03	0.02	0.02	0.01	0.01	
0.04	R	1.33	0.45	0.14	0.03	0.01	0.01	0.00	0.00	0.00	
	v	0.37	0.23	0.14	0.09	0.06	0.04	0.03	0.02	0.01	
0.05	R	1.94	0.66	0.21	0.07	0.02	0.01	0.00	0.00	0.00	
	v	0.37	0.23	0.14	0.09	0.06	0.04	0.03	0.02	0.01	
0.06	R	2.66	0.90	0.28	0.10	0.02	0.01	0.00	0.00	0.00	
	v	0.44	0.28	0.17	0.11	0.07	0.04	0.03	0.02	0.01	
0.07	R	3.48	1.17	0.37	0.13	0.04	0.01	0.00	0.00	0.00	
	v	0.51	0.32	0.20	0.13	0.08	0.05	0.04	0.02	0.02	
0.08	R	4.39	1.48	0.46	0.16	0.06	0.02	0.01	0.00	0.00	
	v	0.58	0.37	0.23	0.14	0.09	0.06	0.04	0.03	0.02	
0.09	R	5.39	1.81	0.57	0.19	0.07	0.02	0.01	0.00	0.00	
	v	0.66	0.42	0.25	0.16	0.10	0.06	0.05	0.03	0.02	
0.10	R	6.48	2.17	0.68	0.23	0.08	0.03	0.01	0.00	0.00	
	v	0.73	0.46	0.28	0.18	0.12	0.07	0.05	0.04	0.02	
0.12	R	8.92	2.99	0.93	0.32	0.11	0.04	0.02	0.01	0.00	
	v	0.88	0.55	0.34	0.22	0.14	0.09	0.06	0.04	0.03	
0.14	R	11.71	3.91	1.22	0.42	0.15	0.05	0.02	0.01	0.00	
	v	1.02	0.65	0.40	0.25	0.16	0.10	0.07	0.05	0.03	
0.16	R	14.83	4.94	1.54	0.52	0.18	0.06	0.03	0.01	0.00	
	v	1.17	0.74	0.45	0.29	0.18	0.12	0.08	0.06	0.04	
0.18	R	18.28	6.08	1.89	0.64	0.22	0.07	0.03	0.01	0.01	
	v	1.32	0.83	0.51	0.32	0.21	0.13	0.09	0.06	0.04	
0.20	R	22.05	7.32	2.27	0.77	0.27	0.09	0.04	0.02	0.01	
	v	1.46	0.92	0.57	0.36	0.23	0.14	0.10	0.07	0.05	
0.30	R	45.61	15.05	4.64	1.57	0.55	0.18	0.08	0.03	0.01	
	v	2.19	1.39	0.85	0.54	0.35	0.22	0.15	0.11	0.07	
0.40	R	76.78	25.21	7.74	2.61	0.90	0.29	0.13	0.05	0.00	
	v	2.92	1.85	1.13	0.72	0.46	0.29	0.20	0.14	0.09	
0.50	R	115.34	37.70	11.53	3.87	1.34	0.44	0.19	0.08	0.03	
	v	3.65	2.31	1.42	0.90	0.58	0.36	0.25	0.18	0.12	
0.60	R	161.16	52.48	16.00	5.35	1.85	0.60	0.26	0.11	0.04	
	v	4.38	2.77	1.70	1.08	0.69	0.43	0.31	0.21	0.14	
0.70	R	214.16	69.50	21.13	7.05	2.43	0.79	0.34	0.14	0.06	
	v	5.12	3.23	1.98	1.26	0.81	0.51	0.36	0.25	0.17	

d = outside diameter (mm)

s = wall thickness (mm)

d_i = inside diameter (mm)

6. SPECIFICATION & PLANNING

Pipe friction factor R
and calculated flow rate \dot{V} in dependence on the flow velocity (v)

Roughness : 0.0070mm
Temperature : 20°C
 Density : 998.00 kg/m³
 K. Viscosity : 1.02 x 10⁻⁶ m²/s

Vesbo Pipe SDR 6 (PN 20)

\dot{V} = flow rate (l/s)		R=pressure gradient (mbar/m)						v=flow velocity (m/s)		
dxs▶		20x3.4	25x4.2	32x5.4	40x6.7	50x8.3	63x10.5	75x12.5	90x15.0	110x18.3
\dot{V}	d _i ▶	13.2 mm	16.6 mm	21.2 mm	26.6 mm	33.4 mm	42.0 mm	50.0 mm	60.0 mm	73.4 mm
0.80	R	274.25	88.74	26.90	8.96	3.08	1.00	0.43	0.18	0.07
	v	5.85	3.70	2.27	1.44	0.92	0.58	0.41	0.28	0.19
0.90	R	341.40	110.17	33.31	11.08	3.80	1.23	0.53	0.22	0.09
	v	6.58	4.16	2.55	1.62	1.04	0.65	0.46	0.32	0.21
1.00	R	415.58	133.77	40.36	13.39	4.59	1.48	0.64	0.27	0.10
	v	7.31	4.62	2.83	1.80	1.16	0.72	0.51	0.35	0.24
1.20	R	584.86	187.44	56.32	18.63	6.37	2.05	0.89	0.37	0.14
	v	8.77	5.54	3.40	2.16	1.39	0.87	0.61	0.42	0.29
1.40	R	784.32	249.67	74.74	24.65	8.41	2.70	1.17	0.49	0.19
	v	10.23	6.47	3.97	2.52	1.62	1.01	0.71	0.50	0.33
1.60	R	1009.36	320.39	95.60	31.45	10.70	3.43	1.48	0.62	0.24
	v	11.69	7.39	4.53	2.88	1.85	1.15	0.81	0.57	0.38
1.80	R	1261.97	399.56	118.88	39.02	13.25	4.24	1.83	0.76	0.29
	v	13.15	8.32	5.10	3.24	2.08	1.30	0.92	0.64	0.43
2.00	R	1542.10	487.13	144.56	47.34	16.05	5.13	2.21	0.92	0.35
	v	14.61	9.24	5.67	3.60	2.31	1.44	1.02	0.71	0.48
2.20	R	1849.71	584.92	172.62	56.42	19.09	6.10	2.63	1.09	0.42
	v	16.08	10.17	6.23	3.96	2.54	1.59	1.12	0.78	0.52
2.40	R	2184.77	689.39	203.06	66.24	22.38	7.14	3.07	1.28	0.49
	v	17.54	11.06	6.80	4.32	2.77	1.73	1.22	0.85	0.57
2.60	R	2547.26	802.20	235.86	76.81	25.91	8.25	3.55	1.47	0.57
	v	19.00	12.01	7.37	4.68	3.00	1.88	1.32	0.92	0.62
2.80	R	2937.15	923.33	271.02	88.12	29.69	9.44	4.06	1.68	0.65
	v	20.46	12.94	7.93	5.04	3.23	2.02	1.43	0.99	0.67
3.00	R	3354.43	1052.78	308.54	100.16	33.70	10.70	4.59	1.90	0.73
	v	21.92	13.86	8.50	5.40	3.47	2.17	1.53	1.06	0.71
3.20	R	3799.10	1190.54	348.40	112.93	37.95	12.04	5.16	2.14	0.87
	v	23.38	14.79	9.07	5.76	3.70	2.31	1.63	1.13	0.76
3.40	R	4271.13	1336.61	391.92	126.44	42.43	13.45	5.76	2.39	0.91
	v	24.85	15.71	9.63	6.12	3.93	2.45	1.73	1.20	0.81
3.60	R	4770.53	1490.96	436.53	140.68	47.16	14.93	6.39	2.65	1.01
	v	26.31	16.63	10.20	6.48	4.16	2.60	1.83	1.27	0.86
3.80	R	5297.29	1653.61	483.48	155.64	52.11	16.48	7.06	2.92	1.17
	v	27.77	17.56	10.77	6.84	4.39	2.74	1.94	1.34	0.90
4.00	R	5851.39	1824.55	532.75	171.33	57.30	18.10	7.75	3.20	1.23
	v	29.23	18.48	11.33	7.20	4.62	2.89	2.04	1.41	0.95
4.20	R	6432.84	2003.76	584.35	187.74	62.73	19.80	8.47	3.50	1.34
	v	30.69	19.41	11.90	7.56	4.85	3.03	2.14	1.49	1.00
4.40	R	7041.63	2191.26	638.28	204.87	68.39	21.57	9.22	3.80	1.45
	v	32.15	20.33	12.46	7.92	5.08	3.18	2.24	1.56	1.05

d = outside diameter (mm)

s = wall thickness (mm)

d_i = inside diameter (mm)

6. SPECIFICATION & PLANNING

Chợ xây dựng: <http://choxaydung.vn>

Pipe friction factor R
and calculated flow rate \dot{V} in dependence on the flow velocity (v)

Roughness : 0.0070mm

Temperature : 20°C

Density : 998.00 kg/m³

K. Viscosity : 1.02 x 10⁻³ m²/s

Vesbo Pipe SDR 6 (PN 20)

\dot{V} = flow rate (l/s)		R=pressure gradient (mbar/m)						v=flow velocity (m/s)		
d _{xs} ▶		20x3.4	25x4.2	32x5.4	40x6.7	50x8.3	63x10.5	75x12.5	90x15.0	110x18.3
\dot{V}	d _i ▶	13.2 mm	16.6 mm	21.2 mm	26.6 mm	33.4 mm	42.0 mm	50.0 mm	60.0 mm	73.4 mm
4.60	R	7677.76	2387.03	694.53	222.73	74.28	23.40	9.99	4.12	1.58
	v	33.61	21.25	13.03	8.28	5.31	3.32	2.34	1.63	1.03
4.80	R	8341.23	2591.07	753.10	241.30	80.40	25.31	10.80	4.45	1.70
	v	35.08	22.18	13.60	8.64	5.54	3.46	2.44	1.70	1.09
5.00	R	9032.03	2803.39	813.99	261.55	86.75	27.29	11.64	4.80	1.83
	v	36.54	23.10	14.16	9.00	5.78	3.61	2.55	1.77	1.19
5.20	R	9750.16	3023.97	877.20	281.60	93.33	29.33	12.51	5.15	1.97
	v	38.00	24.03	14.73	9.36	6.01	3.75	2.65	1.84	1.24
5.40	R		3252.82	942.73	302.37	100.15	31.45	13.40	5.52	2.11
	v		24.95	15.30	9.72	6.24	3.90	2.75	1.91	1.28
5.60	R		3489.94	1010.58	323.85	107.19	33.64	14.33	5.90	2.25
	v		25.88	15.86	10.08	6.47	4.04	2.85	1.98	1.33
5.80	R		3735.32	1080.74	346.04	114.46	35.89	15.28	6.29	2.40
	v		26.80	16.43	10.44	6.70	4.19	2.95	2.05	1.38
6.00	R		3988.97	1153.21	368.95	121.96	38.22	16.26	6.69	2.55
	v		27.72	17.00	10.80	6.93	4.33	3.06	2.12	1.43
6.20	R		4250.88	1228.00	392.58	129.69	40.61	17.27	7.10	2.70
	v		28.65	17.56	11.16	7.16	4.48	3.16	2.19	1.47
6.40	R		4521.05	1305.10	416.92	137.65	43.07	18.31	7.52	2.87
	v		29.57	18.13	11.52	7.39	4.62	3.26	2.26	1.52
6.60	R		4799.49	1384.52	441.97	145.84	45.60	19.38	7.96	3.03
	v		30.50	18.70	11.88	7.62	4.76	3.36	2.33	1.57
6.80	R		5086.18	1466.24	467.74	154.25	48.20	20.48	8.41	3.20
	v		31.42	19.26	12.24	7.85	4.91	3.46	2.41	1.62
7.00	R		5381.13	1550.28	494.21	162.90	50.87	21.60	8.86	3.27
	v		32.34	19.83	12.60	8.09	5.05	3.57	2.48	1.66
7.50	R		6154.64	1770.48	563.52	186.21	57.84	24.53	10.06	3.82
	v		34.65	21.25	13.50	8.66	5.41	3.82	2.65	1.78
8.00	R		6979.76	2005.11	637.28	210.27	65.24	27.64	11.32	4.30
	v		36.96	22.66	14.40	9.24	5.77	4.07	2.83	1.90
9.00	R		8784.80	2517.66	798.11	262.63	81.30	34.39	14.06	5.33
	v		41.58	25.50	16.20	10.40	6.50	4.58	3.18	2.14
10.00	R			3087.89	976.68	320.63	99.05	41.83	17.08	6.47
	v			28.33	17.99	11.55	7.22	5.09	3.54	2.38

d = outside diameter (mm)

s = wall thickness (mm)

d_i = inside diameter (mm)

6. SPECIFICATION & PLANNING

Chợ xây dựng: <http://choxaydung.vn>

Pipe friction factor R
and calculated flow rate \dot{V} in dependence on the flow velocity [v]

Roughness : 0.0070mm
Temperature : 60°C
Density : 983.20 kg/m³
K. Viscosity : 0.47 x 10⁻⁶ m²/s

Vesbo Pipe SDR 6 (PN 20)

\dot{V} = flow rate [l/s]		R=pressure gradient [mbar/m]								v=flow velocity [m/s]	
d_{xs}		20x3.4	25x4.2	32x5.4	40x6.7	50x8.3	63x10.5	75x12.5	90x15.0	110x18.3	
\dot{V}	d_i	13.2 mm	16.6 mm	21.2 mm	26.6 mm	33.4 mm	42.0 mm	50.0 mm	60.0 mm	73.4 mm	
0.01	R	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
	v	0.07	0.05	0.03	0.02	0.01	0.01	0.00	0.00	0.00	
0.02	R	0.32	0.11	0.03	0.01	0.00	0.00	0.00	0.00	0.00	
	v	0.15	0.09	0.06	0.04	0.02	0.01	0.01	0.01	0.00	
0.03	R	0.64	0.22	0.07	0.02	0.01	0.00	0.00	0.00	0.00	
	v	0.22	0.14	0.08	0.05	0.03	0.02	0.02	0.01	0.01	
0.04	R	1.06	0.36	0.11	0.04	0.01	0.00	0.00	0.00	0.00	
	v	0.29	0.18	0.11	0.07	0.05	0.03	0.02	0.01	0.01	
0.05	R	1.56	0.52	0.16	0.06	0.02	0.01	0.00	0.00	0.00	
	v	0.37	0.23	0.14	0.09	0.06	0.04	0.03	0.02	0.01	
0.06	R	2.15	0.72	0.22	0.08	0.03	0.01	0.00	0.00	0.00	
	v	0.44	0.28	0.17	0.11	0.07	0.04	0.03	0.02	0.01	
0.07	R	2.83	0.94	0.29	0.10	0.04	0.01	0.01	0.00	0.00	
	v	0.51	0.32	0.20	0.13	0.08	0.05	0.04	0.02	0.02	
0.08	R	3.59	1.19	0.37	0.13	0.04	0.01	0.01	0.00	0.00	
	v	0.58	0.37	0.23	0.14	0.09	0.06	0.04	0.03	0.02	
0.09	R	4.42	1.47	0.46	0.15	0.05	0.02	0.01	0.00	0.00	
	v	0.66	0.42	0.25	0.16	0.10	0.06	0.05	0.03	0.02	
0.10	R	5.34	1.77	0.55	0.19	0.06	0.02	0.01	0.00	0.00	
	v	0.73	0.46	0.28	0.18	0.12	0.07	0.05	0.04	0.02	
0.12	R	7.40	2.45	0.76	0.26	0.09	0.03	0.01	0.01	0.00	
	v	0.88	0.55	0.34	0.22	0.14	0.09	0.06	0.04	0.03	
0.14	R	9.76	3.22	0.99	0.34	0.12	0.04	0.02	0.01	0.00	
	v	1.02	0.65	0.40	0.25	0.16	0.10	0.07	0.05	0.03	
0.16	R	12.47	4.13	1.27	0.43	0.14	0.05	0.02	0.01	0.00	
	v	1.17	0.74	0.45	0.29	0.18	0.12	0.08	0.06	0.04	
0.18	R	15.38	5.05	1.55	0.52	0.18	0.06	0.03	0.01	0.00	
	v	1.32	0.83	0.51	0.32	0.21	0.13	0.09	0.06	0.04	
0.20	R	18.63	6.11	1.87	0.63	0.22	0.07	0.03	0.01	0.01	
	v	1.46	0.92	0.57	0.36	0.23	0.14	0.10	0.07	0.05	
0.30	R	39.19	12.74	3.88	1.30	0.45	0.14	0.06	0.03	0.01	
	v	2.19	1.39	0.85	0.54	0.35	0.22	0.15	0.11	0.07	
0.40	R	66.77	21.56	6.53	2.17	0.75	0.24	0.10	0.04	0.02	
	v	2.92	1.85	1.13	0.72	0.46	0.29	0.20	0.14	0.10	
0.50	R	101.28	32.54	9.80	3.25	1.11	0.36	0.16	0.06	0.03	
	v	3.65	2.31	1.42	0.90	0.58	0.36	0.25	0.18	0.12	
0.60	R	142.66	45.63	13.68	4.52	1.54	0.50	0.21	0.09	0.03	
	v	4.38	2.77	1.70	1.08	0.69	0.43	0.31	0.21	0.14	
0.70	R	191.41	60.82	18.17	5.98	2.04	0.65	0.28	0.12	0.05	
	v	5.12	3.23	1.98	1.26	0.81	0.51	0.36	0.25	0.17	

d = outside diameter (mm)

s = wall thickness (mm)

d_i = inside diameter (mm)

6. SPECIFICATION & PLANNING

Chợ xây dựng: <http://choxaydung.vn>

Pipe friction factor R
and calculated flow rate \hat{V} in dependence on the flow velocity (v)

Roughness : 0.0070mm
Temperature : 60°C
Density : 983.20 kg/m³
K. Viscosity : 0.47 x 10⁻⁶ m²/s

Vesbo Pipe SDR 6 (PN 20)

\hat{V} = flow rate (l/s)		R=pressure gradient (mbar/m)								v=flow velocity (m/s)	
d _{xs} ▶		16x2.7	20x3.4	25x4.2	32x5.4	40x6.7	50x8.3	63x10.5	75x12.5	90x15.0	110x18.3
\hat{V}	d _i ▶	10.6 mm	13.2 mm	16.6 mm	21.2 mm	26.6 mm	33.4 mm	42.0 mm	50.0 mm	60.0 mm	73.4 mm
0.80	R	746.30	246.48	78.10	23.26	7.64	2.60	0.83	0.36	0.15	0.06
	v	9.07	5.85	3.70	2.27	1.44	0.92	0.58	0.41	0.28	0.19
0.90	R	936.14	308.34	97.45	28.94	9.48	3.22	1.03	0.44	0.18	0.07
	v	10.20	6.58	4.16	2.55	1.62	1.04	0.65	0.46	0.32	0.21
1.00	R	1147.21	376.96	119.25	35.20	11.51	3.90	1.24	0.54	0.22	0.09
	v	11.33	7.31	4.62	2.83	1.80	1.16	0.72	0.51	0.35	0.24
1.20	R	1633.00	534.49	168.32	49.49	16.12	5.44	1.73	0.74	0.31	0.12
	v	13.60	8.77	5.54	3.40	2.16	1.39	0.87	0.61	0.42	0.29
1.40	R	2203.62	719.03	225.60	66.10	21.45	7.21	2.29	0.98	0.41	0.16
	v	15.86	10.23	6.47	3.97	2.52	1.62	1.01	0.71	0.50	0.33
1.60	R	2859.02	930.53	291.06	85.30	27.51	9.23	2.92	1.25	0.52	0.20
	v	18.13	11.69	7.39	4.53	2.88	1.85	1.15	0.81	0.57	0.38
1.80	R	3599.19	1168.99	364.69	106.55	34.28	11.47	3.63	1.55	0.64	0.25
	v	20.40	13.15	8.32	5.10	3.24	2.08	1.30	0.92	0.64	0.43
2.00	R	4424.11	1434.39	446.49	130.10	41.77	13.95	4.40	1.88	0.78	0.48
	v	22.66	14.61	9.24	5.67	3.60	2.31	1.44	1.02	0.71	0.48
2.20	R	5333.78	1726.73	536.44	155.94	49.97	16.65	5.24	2.24	0.92	0.35
	v	24.93	16.08	10.17	6.23	3.96	2.54	1.59	1.12	0.78	0.52
2.40	R	6328.19	2045.99	634.54	184.06	59.09	19.58	6.15	2.62	1.08	0.41
	v	27.20	17.54	11.09	6.80	4.32	2.77	1.73	1.22	0.75	0.57
2.60	R	7407.34	2392.18	740.78	214.47	68.72	22.74	7.13	3.04	1.25	0.48
	v	29.46	19.00	12.01	7.37	4.68	3.00	1.88	1.32	0.92	0.62
2.80	R	8571.21	2765.29	855.16	247.16	79.05	26.13	8.18	3.48	1.43	0.55
	v	31.73	20.46	12.94	7.93	5.04	3.23	2.02	1.43	0.99	0.67
3.00	R	9819.81	3165.32	977.69	282.12	90.09	29.73	9.30	3.95	1.62	0.62
	v	34.00	21.92	13.86	8.50	5.40	3.47	2.17	1.53	1.06	0.71
3.20	R		3592.26	1108.35	319.37	101.83	33.57	10.48	4.45	1.83	0.70
	v		23.38	14.79	9.07	5.76	3.70	2.31	1.63	1.13	0.76
3.40	R		4046.11	1247.15	358.89	114.27	37.63	11.74	4.98	2.04	0.78
	v		24.75	15.71	9.63	6.12	3.93	2.45	1.73	1.20	0.81
3.60	R		4526.88	1394.09	400.68	127.42	42.06	13.06	5.53	2.27	0.86
	v		26.31	16.63	10.20	6.48	4.16	2.60	1.83	1.27	0.86
3.80	R		5034.56	1549.16	444.76	141.26	46.58	14.44	6.12	2.50	0.95
	v		27.77	17.56	10.77	6.84	4.39	2.74	1.94	1.34	0.90
4.00	R		5569.15	1712.36	491.10	155.80	51.31	15.89	6.73	2.75	1.04
	v		29.23	18.48	11.33	7.20	4.62	2.89	2.04	1.41	0.95
4.20	R		6130.65	1883.69	539.72	171.05	56.27	17.41	7.36	3.01	1.14
	v		30.69	19.41	11.90	7.56	4.85	3.03	2.14	1.49	1.00
4.40	R		6719.05	2063.16	590.61	186.99	61.45	19.00	8.03	3.28	1.24
	v		32.15	20.33	12.46	7.96	5.08	3.18	2.24	1.56	1.05

d = outside diameter (mm)

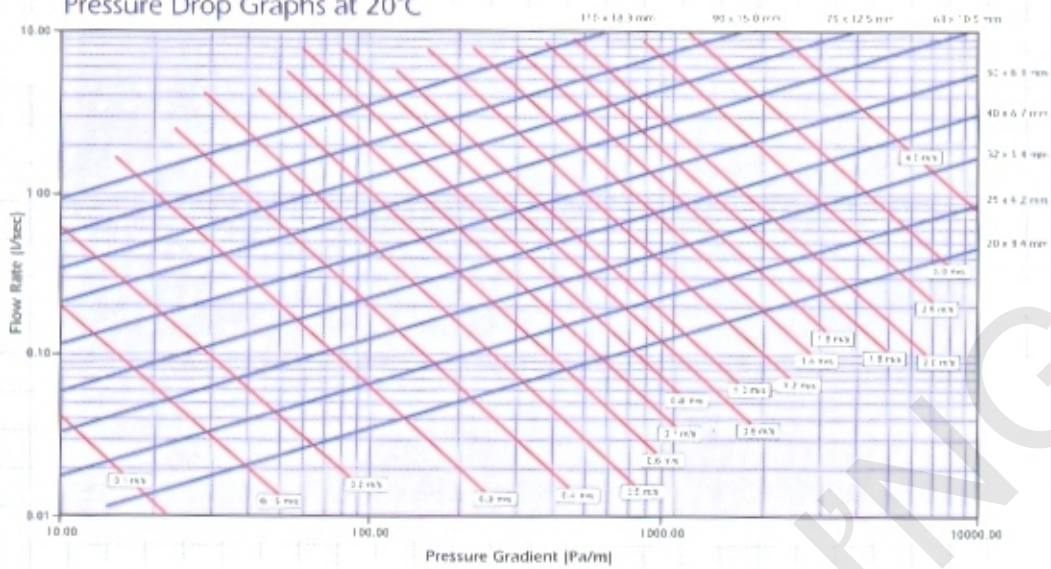
s = wall thickness (mm)

d_i = inside diameter (mm)

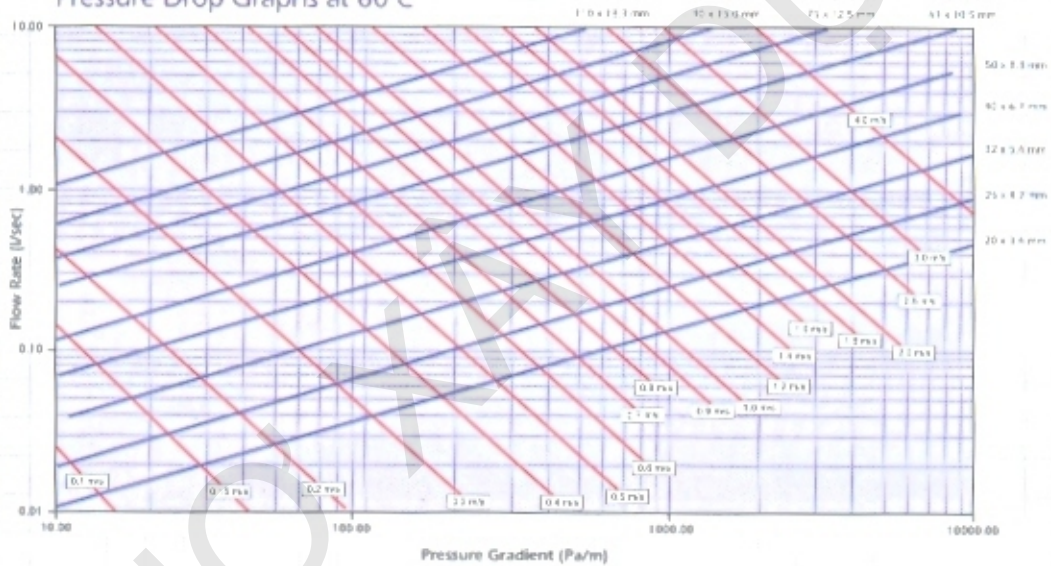
6. SPECIFICATION & PLANNING

Chợ xây dựng: <http://choxaydung.vn>

Vesbo PN 20 (SDR 6) & PN 25 (Stable Pipe)
Pressure Drop Graphs at 20°C



Vesbo PN 20 (SDR 6) & PN 25 (Stable Pipe)
Pressure Drop Graphs at 60°C



Vesbo Fittings

Coefficient of Loss, ζ

Vesbo Fittings	Symbol	Consideration	Coeff. of Loss ζ
Socket			0.25
Reducer		Reduce by 1 size	0.40
		Reduce by 2 sizes	0.50
		Reduce by 3 sizes	0.60
90° Elbow			1.20
45° Elbow			0.50
T Part		Passage	0.25
		Separation	1.20
		Conjunction	0.80
		Counter Separation	1.80
		Counter Conjunction	3.00
Unequal T	Sum of T part and Reducer values		
Adaptor Female			0.50
Adaptor Male			0.70
Elbow Female			1.40
Elbow Male			1.60
T-Part Female		20 x 3/4 x 20	1.40
		20 x 1/2 x 20	1.60
		25 x 3/4 x 25	1.60
		25 x 1/2 x 25	1.80
T-Part Male		20 x 1/2 x 20	1.80
Valve		20	9.50
		25	8.50
		32	7.60

7. CHEMICAL RESISTANCE

7.1 General

Vesbo has high resistance to various acids and chlorides due to the chemical properties of polypropylene. As such, Vesbo is highly suitable for transportation of hard or soft water or potable water with consumable amount of chlorine, fluids, DI water or industrial chemicals.

7.2 Chemical Resistance Chart

The following chart is given for our customers to have an idea for the chemical resistance of Vesbo Pipes and Fittings. The customers are strictly recommended to consult our technical department (technical@vesbo.com) before the design stage of the project.

G: Good **S**: Satisfactory **NS**: Non Satisfactory

Reagent	Concentration	Temperature		
		20°C	60°C	100°C
acetic anhydride	100%	G	-	-
acetic acid: di-tri-chloro acetic acid	sol.	G	-	-
acetic acid	up to 40%	G	G	-
acetic acid	50%	G	G	S
acetic glacial acid	over 96%	G	S	NS
acetone	100%	G	S	-
acetophenone anhydride	100%	G	S	-
acrylonitrile	100%	G	-	-
air		G	G	G
almond oil		G	-	-
alum	sol.	G	-	-
ammonia (gas)	100%	G	-	-
ammonia (saturated in water)		G	G	-
ammonia liquor	up to 30%	G	G	-
ammonium acetate	sat. sol.	G	G	-
ammonium bicarbonate	sat. sol.	G	G	-
ammonium chloride	sat. sol.	G	G	-
ammonium fluoride	sol.	G	G	-
ammonium hydroxide	sol.	G	-	-
ammonium methaphosphate	sat. sol.	G	G	G
ammonium nitrate	sat. sol.	G	G	G
ammonium phosphate	sat. sol.	G	G	-
ammonium sulphate	sat. sol.	G	G	G
amyl acetate	100%	S	-	-
amyl alcohol	100%	G	G	G
aniline	100%	S	-	-
anisole	100%	S	-	-
apple juice		G	G	-
barium carbonate	sat. sol.	G	G	G
barium chloride	sat. sol.	G	G	G
barium hydroxide	sat. sol.	G	G	G
barium sulphate	sat. sol.	G	G	G
benzoic acid	sat. sol.	G	-	-
benzoyl acid	100%	G	G	-
benzoil alcohol	100%	G	S	-
borax	sol.	G	G	-
boric acid	sat. sol.	G	G	-

7. CHEMICAL RESISTANCE

G: Good **S**: Satisfactory **NS**: Non Satisfactory

Reagent	Concentration	Temperature		
		20°C	60°C	100°C
butane	100%	G	G	-
butanol	100%	G	S	S
butyglycol	100%	G	-	-
butyphenol	cold sat. sol.	G	-	-
butly phtalate	100%	G	S	S
calcim carbonate	sat. sol.	G	G	G
calcium chloride	sat. sol.	G	G	G
calcium hydroxide	sat. sol.	G	G	-
calcium nitrate	sat. sol.	G	G	-
carbon dioxide, gaseous, dry	100%	G	G	-
carbon dioxide, gaseous, wet		G	G	-
carbon di-sulphide	100%	NS	NS	NS
carbon tetrachloride	100%	NS	NS	NS
castor-oil	100%	G	G	-
chloroethanol [2-Chlorethanol]	100%	G	-	-
chrome alum	sat. sol.	G	G	-
chromic acid	up to 40%	S	S	NS
citric acid	10%	G	G	G
coconut-oil		G	-	-
corn-oil		G	S	-
cotton-oil		G	S	-
cresol	over 90%	G	-	-
cupric chloride	sat. sol.	G	G	-
cupric nitrate	30%	G	G	G
cupric sulphate	sat. sol.	G	G	-
cyclohexane	100%	G	-	-
cyclohexanol	100%	G	S	-
dextrin	sol.	G	G	-
dextrose	sol.	G	G	-
di-butly phtalate	100%	G	S	NS
di-chloroacetic acid	100%	S	-	-
di-chloroethylene	100%	S	-	-
di-ethanolamine	100%	G	-	-
di-ethyl ether	100%	G	S	-
di-ethylen glycol	100%	G	G	-
di-glycolic acid	sat. sol.	G	-	-
di-isooctyl phtalate	100%	G	S	-
di-methylamine	100%	G	-	-
di-methylformamide	100%	G	G	-
di-octyl phtalate	100%	S	S	-
dioxan	100%	S	S	-
ethanolamine	100%	G	-	-
ethylalcohol (ethanole)	up to 95%	G	G	-
ethylene chloride	100%	NS	NS	-
ethyleneglycole	100%	G	G	G
formaldehyde	40%	G	-	-
formic acid	10%	G	G	S

7. CHEMICAL RESISTANCE

G: Good **S:** Satisfactory **NS:** Non Satisfactory

Reagent	Concentration	Temperature		
		20°C	60°C	100°C
formic acid	85%	S	NS	NS
formic acid (anhydrous)	100%	S	S	S
fructose	sol.	G	G	G
fruit juice		G	G	G
glucose	20%	G	G	G
glycerine	100%	G	G	G
glycolic acid	30%	G	-	-
hexane	100%	S	S	-
hydrobromic, acid	up to 48%	G	S	NS
hydrochloric acid	2%	G	G	G
hydrochloric acid	10	G	G	-
hydrochloric acid	30%	G	S	S
hydrochloric acid	35%	G	-	-
hydrochloric acid, gas, dry	100%	G	G	-
hydrofluoric acid	dil. sol.	G	-	-
hydrofluoric acid	40%	G	-	-
hydrogen	100%	G	-	-
hydrogen peroxide	up to 10%	G	-	-
hydrogen peroxide	up to 30%	G	-	-
hydrogen sulphide, gas, dry	100%	G	G	-
iodine (alcoholic solution)		G	-	-
isopropylalcohol	100%	G	G	G
isopropylether	100%	S	-	-
jelly	100%	G	G	-
lactic acid	up to 90%	G	G	-
lanolin		G	S	-
linseed-oil		G	G	-
magnesium carbonate	sat. sol.	G	G	G
magnesium chloride	sat. sol.	G	G	-
mercurous nitrate	sol.	G	G	-
mercury	100%	G	G	-
methyl acetate	100%	G	-	-
methyl alcohol	5%	G	S	S
methyl ethyl ketone	100%	G	-	-
methylamine	up to 32%	G	-	-
milk		G	G	G
monochloroacetic acid	over 85%	G	G	-
naphta		G	NS	NS
nickel chloride	sat. sol.	G	G	-
nickel nitrate	sat. sol.	G	G	-
nickel sulphate	sat. sol.	G	G	-
nitric acid	10%	G	NS	NS
nitric acid	30%	S	-	-
nitric acid, fuming		NS	NS	NS
nitrobenzene	100%	G	S	-
olive-oil		G	G	S
oxalic acid	sat. sol.	G	S	NS

7. CHEMICAL RESISTANCE

G: Good **S**: Satisfactory **NS**: Non Satisfactory

Reagent	Concentration	Temperature		
		20°C	60°C	100°C
oxygen	100%	G	-	-
peanut-oil		G	G	-
peppermint-oil		G	-	-
perchloric acid	2N	G	-	-
petroleum-ether (ligroin)		S	S	-
phenol	5%	G	G	-
phenol	90%	G	-	-
phosphoric acid	up to 85%	G	G	G
phosphorous oxychloride	100%	S	-	-
picric acid	sat. sol.	G	-	-
potassium bicarbonate	sat. sol.	G	G	-
potassium borate	sat. sol.	G	G	-
potassium bromate	up to 10%	G	G	-
potassium bromite	sat. sol.	G	G	-
potassium carbonate	sat. sol.	G	G	-
potassium chlorate	sat. sol.	G	G	-
potassium chloride	sat. sol.	G	G	-
potassium chromate	sat. sol.	G	G	-
potassium cyanide	sol.	G	-	-
potassium fluoride	sat. sol.	G	G	-
potassium hydroxide	up to 50%	G	G	G
potassium iodite	sat. sol.	G	-	-
potassium nitrate	sat. sol.	G	G	-
potassium perchlorate	10%	G	G	-
potassium permanganate	2N	G	-	-
potassium persulphate	V	G	G	-
potassium sulphate	V	G	G	-
propane	100%	G	-	-
propionic acid	over 50%	G	-	-
pyridine	100%	G	-	-
silicone-oil		G	G	G
silver	sat. sol.	G	G	G
sodium acetate	sat. sol.	G	G	G
sodium benzoate	35%	G	S	-
sodium bicarbonate	sat. sol.	G	G	G
sodium bisulfite	sol.	G	G	-
sodium bisulphate	sat. sol.	G	G	-
sodium carbonate	up to 50%	G	G	S
sodium chlorate	sat. sol.	G	-	-
sodium chloride	10%	G	G	G
sodium chlorite	2%	G	N	NS
sodium chlorite	20%	G	S	NS
sodium dichromate	sat. sol.	G	G	G
sodium hydroxide	1%	G	G	G
sodium hydroxide	up to 60%	G	G	G
sodium hypochlorite	5%	G	-	-
sodium hypochlorite	10%	G	-	-

7. CHEMICAL RESISTANCE

G: Good **S:** Satisfactory **NS:** Non Satisfactory

Reagent	Concentration	Temperature		
		20°C	60°C	100°C
sodium hypochlorite	20%	S	-	-
sodium metaphosphate	sol.	G	-	-
sodium nitrate	sat. sol.	G	G	-
sodium ortho-phosphate	sat. sol.	G	G	-
sodium perborate	sat. sol.	G	-	-
sodium silicate	sol.	G	G	-
sodium sulfide	sat. sol.	G	-	-
sodium sulfite	40%	G	G	G
sodium sulphate	sat. sol.	G	G	-
sodium thiosulphate	sat. sol.	G	-	-
soybean-oil		G	S	-
stannic chloride	sat. sol.	G	G	-
succinic acid	sat. sol.	G	G	-
sulphur dioxide, dry gas	100%	G	-	-
sulphur dioxide, wet gas	100%	G	-	-
sulphuric acid	up to 10%	G	G	G
sulphuric acid	100%	G	G	-
sulphuric acid	50%	G	S	G
sulphuric acid	96%	G	S	NS
sulphurous acid	sol.	G	-	-
tartaric acid	10%	G	G	-
thiophene	100%	G	S	-
trichloroacetic acid	up to 50%	G	G	-
triethanolamine	sat. sol.	G	-	-
urea	sat. sol.	G	-	-
vinegar		G	G	-
water , brackish		G	G	G
water , distilled	100%	G	G	G
water , potable		G	G	G
water , mineral		G	G	G
water (sea water)		G	G	G

General Remark: PP-R should not be used at 100 °C; maximum temperature for transportation of these chemicals is 70 °C.

8. HANDLING

You must not

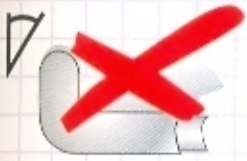
1- subject the pipe ends to shock or impact



2- use pipes that are damaged or cracked at the interfaces



3- twist pipe or fittings after joining



4- use conical threads



5- expose VESBO to UV radiation for a long period



6- use metal plugs as connectors



7- subject VESBO to heavy shocks or falling stones



8- use excessive amounts of hemp when sealing in fittings



9- heat with a naked flame



10- bind up contaminated pipes or fittings



You must

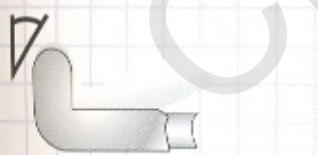
1- handle VESBO with care



2- only use sharp tools to cut the pipe



3- not correct by more than 5° after joining



4- only use fittings with parallel threads, not tighten too firmly



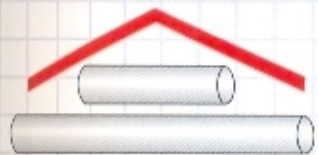
5- store VESBO sheltered from sun and rain



6- use plastic plugs



7- protect exposed pipes from damage



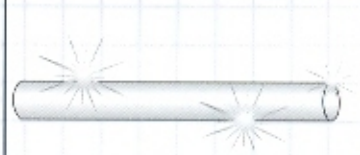
8- only heat with hot air for bending, max bending temperature 140°C



9- use sealing tape or sealing compound; apply hemp moderately



10- only install clean material



Quantity	SI Unit	Alternate SI Unit	Conversion Factor		U.S. Unit	Conversion Factor	
			K	1/K		K	1/K
Length	m		1	1	in (inch)	39.370	2.54×10^{-2}
					ft (foot)	3.281	0.305
					mi (mile)	6.214×10^{-4}	1609.344
Area	m ²	hectare	10 ⁴	10 ⁴	in ²	1550	6.452×10^{-4}
					ft ²	10.764	0.093
					mi ²	3.861×10^{-7}	2.590×10^6
Volume	m ³	dm ³ = l	1000	0.001	ft ³	35.315	0.0283
					gal (gallon)	264.172	3.785×10^{-3}
					gal (gallon) UK	219.969	4.546×10^{-3}
Mass	kg	ton	1000	0.001	lbm (pound)	2.205	0.454
					gr (grain)	15432.4	6.479×10^{-5}
					oz (ounce)	35.274	2.835×10^{-2}
					lbf	0.225	4.448
Force	N	kgf	0.102	9.807			
		dyn	10 ⁵	10 ⁵			
Pressure	N/mm ² =MPa	kgf/mm ²	0.102	9.807	psi (lbf/in ²)	145	6.895×10^{-3}
		bar	10	0.1	mmHg=torr(0°)	7500.62	1.333×10^{-4}
		dyn/cm ²	10 ⁷	10 ⁷			
Energy	J	kgf-m	0.102	9.807	lbf-ft	0.738	1.356
		erg	10 ⁷	10 ⁷	cal	0.239	4.184
					BTU	9.478×10^{-4}	1055.06
Power	W	kcal/hr	0.860	1.162	BTU/hr	3.415	0.293
Temperature (absolute)	K				°R (Rankine)	1.8	0.555
Temperature (difference)	K, °C					1.8	0.555
Viscosity (dynamic)	Pa s = N s/m ²	kgf s/m ²	0.102	9.807	lbf s/ft ²	0.0209	47.880
		cP	1000	0.001			
Viscosity (kinematic)	m ² /s				ft ² /s	10.764	0.093
Density	kg/m ³	g/cm ³	0.001	1000	lb/ft ³	0.0624	16.018
Thermal Conductivity	W/m K	kcal/m h °C	0.860	1.162	BTU in/ft ² hr °F	6.933	0.144
					BTU/ft hr °F	0.578	1.731
Specific Entropy	kJ/kg K	kcal/kg °C	2.390×10^4	4.184	BTU/lbm °R	2.388×10^4	4.187




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