

PP-R PIPING SOLUTIONS

**Hot & Cold Water
Chilled & Heating**

FINAL

TECHNICAL CATALOG




PLASTIK SDN. BHD.

Vesbo's first manufacturing facility outside of Turkey, Novaplast Malaysia, is located in the Iskandar Region of Johor (Malaysia) – about an hour's drive from Vesbo Asia Pacific office in Singapore. The plant offers a full range of VESBO® PP-R pipes and fittings with a total annual capacity of 10,000 metric tonnes of processed products. It is driven by a core team of experienced managers and technical supervisors from Vesbo headquarters in Europe. The EUR10-million regional facility is jointly invested by Arcon Germany, Novaplast Turkey and Vesbo Asia (Singapore), and is part of the global plan to invest EUR30 million in production facilities and logistic hubs over 7 years. It is a key milestone on Vesbo's strategic, long-term global development roadmap to deliver consistently high quality products to regional customers who have grown to be at home with VESBO®.




Handels GmbH

Arcon Handels GmbH 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.



PLASTIK SANAYI VE TICARET A.Ş.

Established in Istanbul in 1992, Novaplast joined Kar Group of Companies in the year of 1994, in which, it merges its operation with Camlica Yapi Ltd.Pti. to streamline its operations and take advantage of the economies of scale to manufacture VESBO® Polypropylene Random Copolymer (PP-R) pipes and fittings. Among various things, Novaplast also manufactures other types of thermoplastic products in extrusion and injection moulding.

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



Pte. Ltd.

VESBO® PP-R pipes and fittings were introduced to the far east markets in 1994. Located in Singapore, Vesbo Asia Pte Ltd is a subsidiary of Kar Group of Companies and is the Asia Pacific marketing arm of VESBO®. It is established to introduce, market and assign distributors for Novaplast Plastik's manufactured products in the Asia Pacific region.



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Characteristics

1.1 General

Raw Material

VESBO® PP-R pipes and fittings are manufactured from high quality, Polypropylene Random Co-polymer resins (PP-R Type 3). Its physical and chemical properties make VESBO® a versatile piping system in a wide range of applications in different industries.

Its advantages over 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

Property		Test Method	Unit	Value
Melt Flow Rate	MFR 190/5	ISO 1133	g/10min	0.5
	MFR 230/2.16	ISO 1133	g/10min	0.3
	MFR 230/5	-	g/10min	1.5
Density at 23°C		ISO 1183	g/cm ³	0.900
Tensile Stress at Yield		ISO 527	MPa	25
Elongation at Break		ISO 527	%	> 50
Modulus of Elasticity, Tensile Test		ISO 527	N/mm ²	900
Impact Strength (Charpy)	23°C	ISO 179/1eU	kJ/m ²	no failure
	0°C	ISO 179/1eU	kJ/m ²	no failure
	-10°C	ISO 179/1eU	kJ/m ²	no failure
Notched Impact Strength (Charpy)	23°C	ISO 179/1eA	kJ/m ²	20
	0°C	ISO 179/1eA	kJ/m ²	4
	-10°C	ISO 179/1eA	kJ/m ²	3
Coefficient of Linear Thermal Expansion		DIN 53 752	K ⁻¹	1.5x10 ⁻⁴
Thermal Conductivity at 20°C		DIN 52 612	W/mK	0.24
Specific Heat at 20°C		Adiabatic Calorimeter	kJ/kg K	2.0

ISO = International Organization for Standardization

Characteristics

1.3 Application Areas

- Potable Water, Hot & Cold Water, Chemicals, Irrigation
- Residential Apartments, Condominiums, Public Housing
- Commercial Shopping Centres, Office Buildings
- Industrial Plants dealing with Chemicals, Food Processing, Semi Conductors
- Hospitals
- Schools, Laboratories and Chemical Sewerage
- Hotels & Resorts
- Chilled Water and Heating Systems

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:

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

where

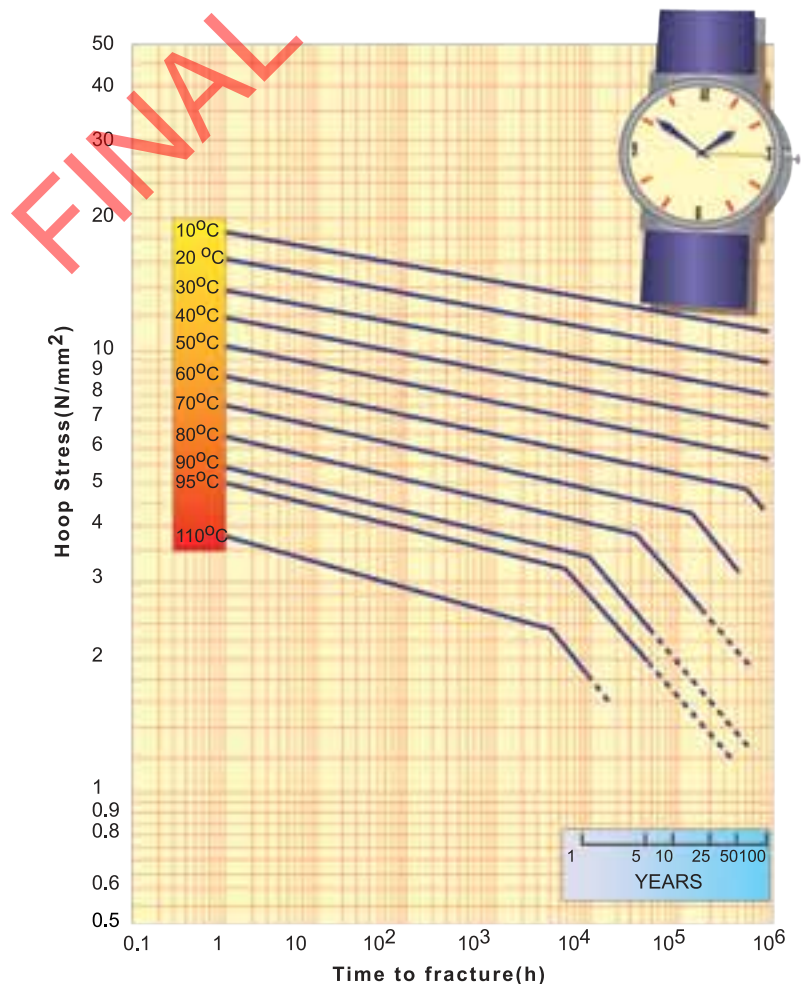
\mathcal{S} = Hoop stress (N/mm² or MPa)

P = Internal pressure (bar)

d = Outer diameter of pipe (mm)

s = Wall thickness of pipe (mm)

Time-Hoop Stress Graph



Characteristics

1.5 Permissible Operating Pressure

Projected Service Life

The following table provides 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.

Examples:

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 10.9 bars or 158 psi.

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 psi.

Temperature	Service Life, Yrs	For Water Installations, According to DIN 8077 Safety-Factor of 1.5			
		VESBO® Pipe SDR11	VESBO® Pipe SDR7.4	VESBO® Pipe SDR6	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	15.0	23.8	30.0	37.8
	5	14.1	22.3	28.1	35.4
	10	13.7	21.7	27.3	34.4
	25	13.3	21.1	26.5	33.4
	50	12.9	20.4	25.7	32.4
30°C	1	12.8	20.2	25.5	32.1
	5	12.0	19.0	23.9	30.1
	10	11.6	18.3	23.1	29.1
	25	11.2	17.7	22.3	28.1
	50	10.9	17.3	21.8	27.4
40°C	1	10.8	17.1	21.5	27.1
	5	10.1	16.0	20.2	25.5
	10	9.8	15.6	19.6	24.7
	25	9.4	15.0	18.8	23.7
	50	9.2	14.5	18.3	23.1
50°C	1	9.2	14.5	18.3	23.1
	5	8.5	13.5	17.0	21.4
	10	8.2	13.1	16.5	20.7
	25	8.0	12.6	15.9	20.0
	50	7.7	12.2	15.4	19.4
60°C	1	7.7	12.2	15.4	19.4
	5	7.2	11.4	14.3	18.0
	10	6.9	11.0	13.8	17.4
	25	6.7	10.5	13.3	16.7
	50	6.4	10.1	12.7	16.0
70°C	1	6.5	10.3	13.0	16.4
	5	6.0	9.5	11.9	15.0
	10	5.9	9.3	11.7	14.7
	25	5.1	8.0	10.1	12.7
	50	4.3	6.7	8.5	10.7
80°C	1	5.5	8.6	10.9	13.7
	5	4.8	7.6	9.6	12.0
	10	4.0	6.3	8.0	10.0
	25	3.2	5.1	6.4	8.0
	95°C	1	3.9	6.1	7.7
	5	2.5	4.0	5.0	6.3

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

Characteristics

1.6 Hygiene & Health Concerns

Health is taken as a major concern during production of VESBO® pipes and fittings.

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

To ensure the safety of VESBO® pipes and fittings 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
- **SS375** - Singapore Standard
- Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water

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.

For applications where constant UV exposure is needed, VESBO® UV / Solar pipes should be used. For prolong lifespan, a protective paint in Black or jacket should be used.

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® systems 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.

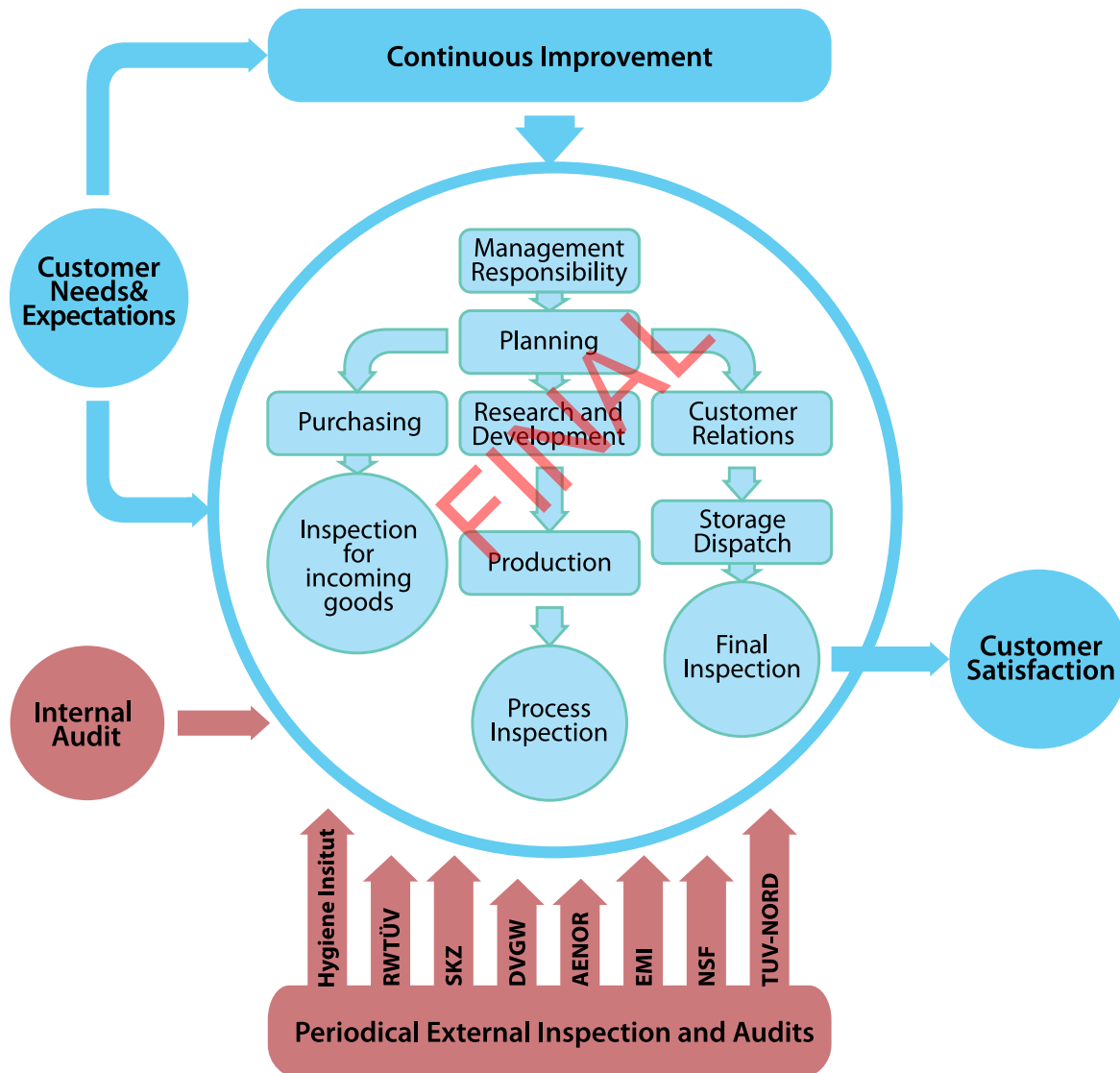
- Not Detrimental to Human Health
- Rust and Corrosion Free
- Rupture Free
- No Scaling
- High Resistance to Acids and Chlorides
- Noise Free At High Flow Rates
- High Pressure Tolerances and Rating
- Insulation Is Not Necessary for Interior Applications
- Light Weight
- Speed and Ease of Fusion Technology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

Quality Assurance

2.1 Quality as the Strategic Focus

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. VESBO® Quality System is designed to be a cycle:



Quality is engineered into 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.

Quality Assurance

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 specifications is not used for the production.



Thermal Reversion Properties

Thermal properties of plastic materials are equally 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 wall thickness shall comply with the DIN 8077 specifications.

Quality Assurance

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 the 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.



Quality Assurance

New Packaging and Labeling



Pipes Packaging



Pipe labels

New Pipe Marking



Vesbo pipes now come with 1 marking line and also 4 marking lines for special orders only. Vesbo IIb logo is also added and ARCON .

2.5 Standards

Pipes & Fittings

EN ISO 15874	Plastic Piping Systems for Hot and Cold Water Installations – Polypropylene (PP)
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 16928	Pipe Joints, Elements for Pipes, Laying – General Conditions
DIN 1988	Drinking Water Supply Systems, Materials, Components, Appliances, Design and Installation
DIN 2999	Threads for Pipes and Fittings
DVGW W 542	Composite Pipes for Drinking Water Installations – Quality Requirements and Testing
DVGW W 270	Reproduction of Microorganisms on Materials for Drinking Water Applications
KTW Requirements	Plastics Used for Drinking Water
DVS 2207	Welding of Thermoplastic Materials
DVS 2208	Machines and Instruments for Welding of Thermoplastic Materials

2.6 Quality Assurance & 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

Production Quality 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



SPAIN

- AENOR The Spanish Association for Standardization and Certification



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



ROMANIA

- ICECON Test Approval Certificate



POLAND

- TIN • PZH



TURKEY

- TSE Turkish Standards Institute



THE NETHERLANDS

- KIWA Test Report on Oxygen Permeability of PE-X Pipes



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

- MA / 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



- 1 TÜV-CERT EN ISO 9001
- 2 SKZ / Germany
- 3 DVGW / Germany
- 4 HYGIENE INSTITUT / Germany
- 5 AENOR / Spain
- 6 KIWA / The Netherlands
- 7 GOST-R / Russian Federation
- 8 China
- 9 PSB / Singapore
- 10 PORTUGAL

3.1 New Products

3.11 VESBO® Solar / UV pipes

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 pipes and 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.

In conjunction with the Solar / UV pipes, fittings are also specially manufactured with UV additives to complete the system as one UV protective system.

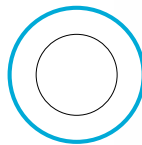
VESBO® Solar / UV pipes are subjected to weatherability test under constant UV exposure in the laboratory conditions as well as real conditions under sunlight. However, UV intensity varies in different countries.

The projected life span of VESBO® Solar / UV pipes is about 15 years. It is also suggested that exposed pipes to constant UV radiation to be concealed or painted with black paint or protected by black insulation material to further enhance the life span of the pipe through degradation.

VESBO® Solar / UV pipes comes in Blue coated layer. For aesthetic reasons, the coated layer with UV additives can be of any color but its desired life span may some what be compromised as dark colors like Black has better UV absorption properties.

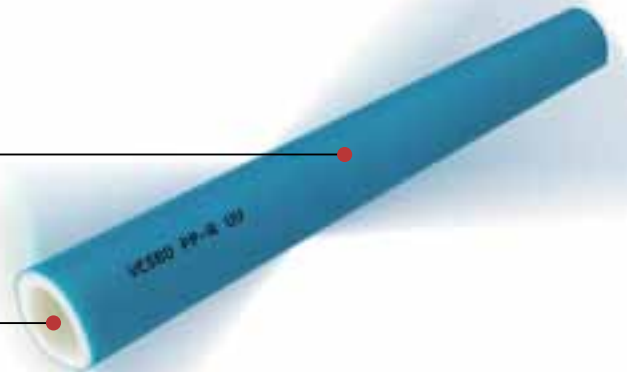
Designers and installers should note that although VESBO® Solar / UV pipes has a better resistance to UV degradation compared to normal PP-R pipes; depending on weather conditions, the degradation of the material under sunlight cannot be avoided completely.

VESBO® PP-R Pipe + UV Barrier =



Surface Layer including UV stabilizers

Polypropylene Random Copolymer Pipe (PP-R)



Product Range

3.12 VESBO® Composite Faser Pipe

VESBO® Faser Pipe is the latest addition to the PP-R pipe range.

It is a composite pipe consisting of 3 layers, with 20% glass fiber / PP-R, sandwiched between PP-R material in the inner layer and on the surface layer i.e. PP-R / GF / PP-R.

Faser pipes are used for chilled and hot water reticulation systems.

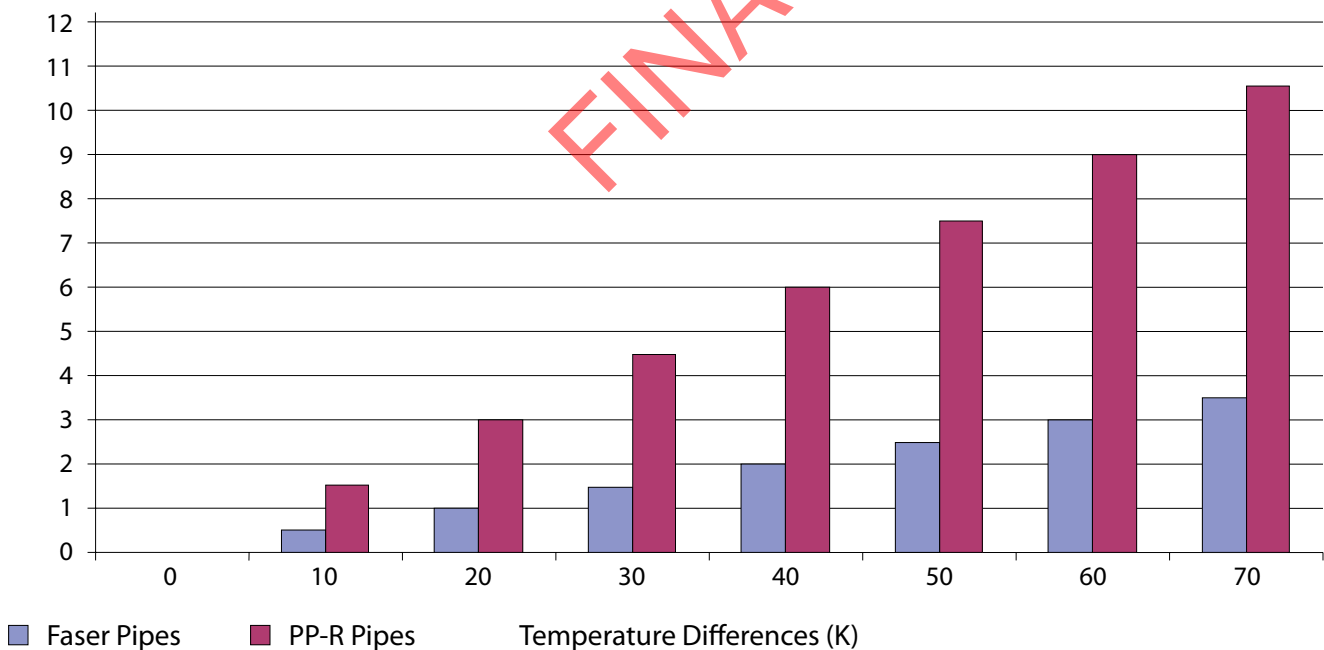
Linear Expansion

Compared to normal PP-R pipes, Faser pipes have a much lower extension when transporting hot water. As such, Faser pipes remain relatively straight at high temperatures. Pipe supports can be minimized.

Linear Expansion Comparison

Linear Expansion of PP-R and Faser Pipes

Linear Expansion (mm/m)



Coefficient of linear thermal expansion of VESBO® faser pipes is 0.04 mm/mK.

Product Range

Permissible Operating Pressure

Compared to normal PP-R pipes, Faser pipes has better and longer projected life span at higher temperatures and pressure.

Maximum operational pressures for pipes consisting of PP-R 80 for water with Safety Factor (SF) = 1.25 (acc. To DIN 8077: 2007-05)					
Heating Period	Temperature (°C)	Years of Operating	PN 16 SDR7.4(bar)	PN 20 SDR6(bar)	PN 25 SDR5(bar)
Continuously	70	50	8.1	10.2	12.8
Continuous working at 70 °C including 60 days per year with	75	45	8.1	10.2	12.8
	80	40	7.8	9.8	11.6
	85	35	7.1	8.9	11.2
	90	30	6.3	7.6	8.4
Continuous working at 70 °C including 90 days per year with	75	45	7.3	9.9	12.2
	80	37.5	7.0	9.1	11.5
	85	32.5	6.2	8.0	10.4
	90	25	5.7	7.3	8.2

Faser pipe is an alternative to the long established Stable pipe aluminum foiled pipes. Its advantages over Stable pipe are:

- Ease of installation with no necessity to peel of the aluminum foil layer. Jointing as per normal PP-R pipes.
- Lighter in weight
- Less expensive

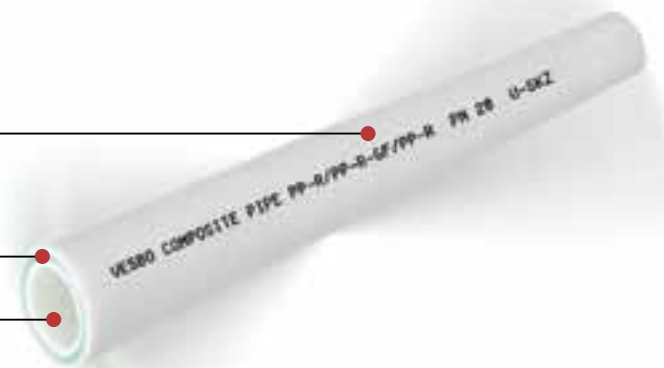
VESBO® PP-R Pipe + Glass Fiber =



Polypropylene Random Copolymer Pipe (PP-R)

Glass Fiber (GF)

Polypropylene Random Copolymer Pipe (PP-R)



Product Range

3.13 VESBO® Klimasu PP-R for Chilled and Hot Water Recticulation Systems

VESBO® KLIMASU PP-R pipes and fittings are highly suitable and commonly used by installers for the distributor of chilled and heating systems.

VESBO® KLIMASU PP-R pipes and fittings are manufactured from high quality Polypropylene Random Co-polymer (PP-R Type 3), with raw material having low melt flow rate, high molecular weight and good flexibility.

PP-R Type-3 has higher performance and superior qualities than Type-1 (PP-H) and Type-2 (PP-B) raw materials for the purposes of physical and chemical characteristics for specific applications. It is generally a more versatile material.

VESBO® KLIMASU PP-R's structure when reinforced with some additives provides high impact strength and resistance to low or high temperatures depending on whether it is chilled or heating applications.

With clear advantages, VESBO® KLIMASU PP-R pipes and fittings are increasingly offered as a solution in chilled and heating systems over metal pipes made of copper, galvanized steel or stainless steel.

Under external conditions, its temperature and impact resistance range is between -20°C to 95°C. For chilled water systems, where cold water distributed is in the temperature range of 4°C to 8°C, VESBO® KLIMASU PP-R is a choice material to use. It is an ideal pipe system especially for close system where corrosion and leakage is not acceptable.

For hot water reticulation systems for either centralized hot water system or heat radiating system where water temperature ranges from 50°C to 70°C VESBO® Klimasu or standard PP-R or Stable PP-R pipes can be used. Depending on application, your local distributor can advise you further. When used at appropriate pressure and temperature values, useful life of VESBO® KLIMASU PP-R pipes and fittings are more than 50 years.

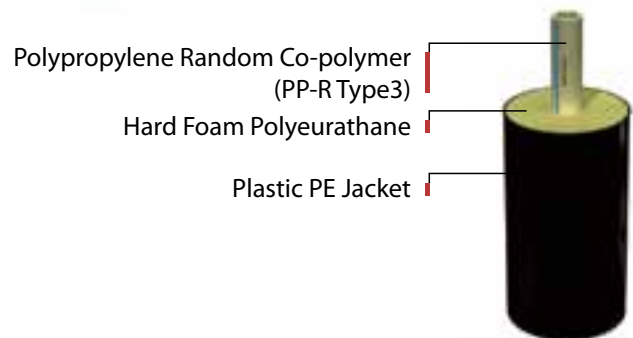
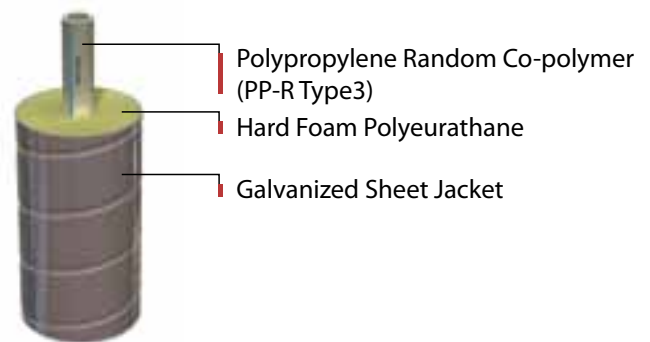
Insulation in Chilled Water Systems

In chilled water distribution, insulation has to be applied on VESBO® KLIMASU PP-R pipes and fittings so as to prevent condensation as well as maintaining the required temperature that is appropriate for the chilled water system.

Efficiency of insulation material is measured in $W/(m^2K)$ or watts per metre-kelvin, which is referred as a K value. As a temperature difference of 1K = a temperature difference of 1°C, K is the rate of heat loss in watts across a 1 metre thickness of the material, per square metre of area, per degree Celsius of temperature difference between the two sides of the material.

Polyurethane's K-value is 0.028 $W/(m^2k)$. The lower the K-value for a material, the better it insulates.

Insulation material commonly used currently and suggested are hard foam Polyurethane with a galvanized sheet jacket or plastic PE jacket as shown below.



Product Range

Insulation Thickness

The recommended thickness to be used are as follows:

OD(mm)	Materials and Layers	PE Overcoat OD(mm) × S(mm)	PUR Isolation Thickness(mm)
Ø 20	PP-R Pipe, PUR Insulation, PE/GS Jacket	75 × 2.2	25.3
Ø 25	PP-R Pipe, PUR Insulation, PE/GS Jacket	75 × 2.2	22.8
Ø 32	PP-R Pipe, PUR Insulation, PE/GS Jacket	90 × 2.2	26.8
Ø 40	PP-R Pipe, PUR Insulation, PE/GS Jacket	110 × 2.5	32.5
Ø 50	PP-R Pipe, PUR Insulation, PE/GS Jacket	110 × 2.5	27.5
Ø 63	PP-R Pipe, PUR Insulation, PE/GS Jacket	125 × 2.5	28.5
Ø 75	PP-R Pipe, PUR Insulation, PE/GS Jacket	140 × 3	29.5
Ø 90	PP-R Pipe, PUR Insulation, PE/GS Jacket	160 × 3	32.0
Ø 110	PP-R Pipe, PUR Insulation, PE/GS Jacket	200 × 3.2	41.8
Ø 125	PP-R Pipe, PUR Insulation, PE/GS Jacket	200 × 3.2	34.3
Ø 160	PP-R Pipe, PUR Insulation, PE/GS Jacket	225 × 3.5	29.0

Product Range

VESBO® KLIMASU PP-R pipes and fittings are available in 2 pressure ratings.

Pipe Length: Standard 4m. Other lengths available on customer's requirements.

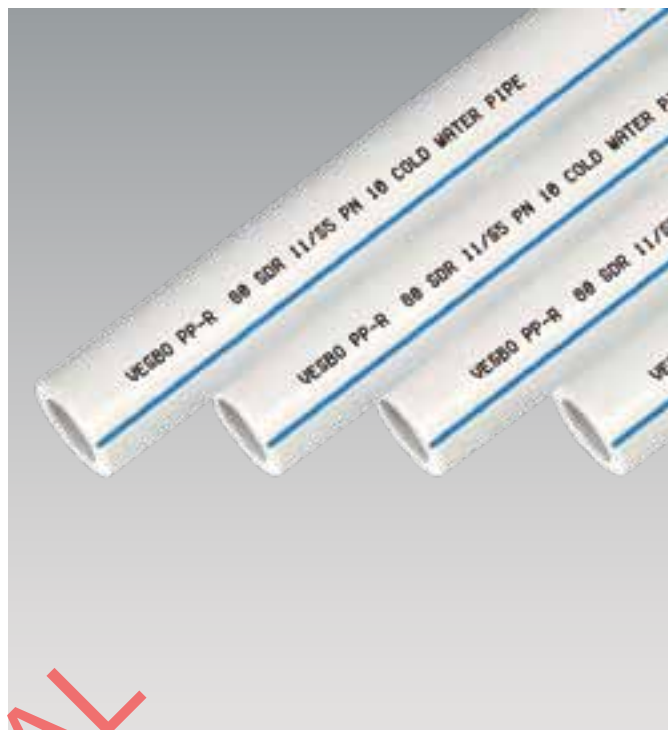
Colour: RAL 7032 / Light Grey

PN 10, SDR 11, S5				PN 16, SDR 7.4, S3.2				DN(mm)
OD(mm)	S(mm)	ID(mm)	Flow(l/m)	OD(mm)	S(mm)	ID(mm)	Flow(l/m)	
20	2.3	15.4	0.23	20	2.8	14.4	0.16	15
25	2.3	20.4	0.33	25	3.5	18.0	0.25	20
32	2.9	26.2	0.53	32	4.4	23.2	0.42	25
40	3.7	32.6	0.83	40	5.5	29.0	0.66	32
50	4.6	40.8	1.31	50	6.9	36.2	1.03	40
63	5.8	51.4	2.08	63	8.6	45.8	1.65	50
75	6.8	61.4	2.94	75	10.3	54.4	2.32	-
90	8.2	73.6	4.25	90	12.3	65.4	3.36	65
110	10.0	90.0	6.36	110	15.1	79.8	5.00	80
125	11.4	102.2	8.20	125	17.1	90.8	6.48	100
160	14.6	130.8	13.44	160	21.9	116.2	10.60	125

- PN 20 is also available upon request.

- All fittings are under standard VESBO® fittings for PP-R with socket fusion joints, transition joints, flanges and electrofusion fittings.

Product Range




FINAL

Mechanical & Thermal Properties:

VESBO® KLIMASU PP-R


Properties	Unit	Value
Density at 23°C	gr/cm ³	0,900
MFI 190/5	g/10min	0,5
Tensile Stress at Yield	Mpa	25
Elongation at Break	%	> 50
Modulus of Elasticity, Tensile Test	N/mm ²	900 - 1300
Coefficient of Linear Thermal Expansion	K ⁻¹	1.5×10 ⁻⁴
Thermal Conductivity at 20°C	W/mK	0,24
Specific Heat at 20°C	kJ/kg k	2,0

3.2 Pipes
PN10 (SDR11) PP-R Cold Water Pipe

	Code	Article No.	OD x Thickness (mm)	m / Pack
	111.1B.A15.EC4	2111 100	20 x 2.3	100
	111.1B.A15.FC4	2111 200	25 x 2.3	100
	111.1B.A15.GC4	2111 300	32 x 2.9	100
	111.1B.A15.HC4	2111 400	40 x 3.7	60
	111.1B.A15.IC4	2111 500	50 x 4.6	40
	111.1B.A15.JC4	2111 600	63 x 5.8	28
	111.1B.A15.KC4	2111 700	75 x 6.8	20
	111.1B.A15.LC4	2111 800	90 x 8.2	12
	111.1B.A15.MC4	2111 900	110 x 10.0	8
	211.1B.A15.NC4*	2111 1000	125 x 11.4	4
	211.1B.A15.PC4*	2111 1100	160 x 14.6	4


VESBO® PN 10 (SDR 11) Pipes are suitable for cold water installations and low pressure systems.

PN20 (SDR6) Stable Pipe, PP-R with Aluminum for Hot & Cold Water

	Code	Article No.	OD x Thickness (mm)	m / Pack
	111.1B.A22.E04	2121 100	20 x 2.8	100
	111.1B.A22.F04	2121 200	25 x 3.5	100
	111.1B.A22.G04	2121 300	32 x 4.4	60
	111.1B.A22.H04	2121 400	40 x 5.5	60
	111.1B.A22.I04	2121 500	50 x 6.9	40
	111.1B.A22.J04	2121 600	63 x 8.6	28
	111.1B.A22.K04	2121 700	75 x 10.3	20
	111.1B.A22.L04	2121 800	90 x 12.3	12
	111.1B.A22.M04	2121 900	110 x 15.1	8


VESBO® Stable Pipes are preferred mainly for exposed pipe installations thanks to the low linear expansion rate and reinforced structure.

PN16 (SDR7.4) PP-R Hot & Cold Water Pipe

	Code	Article No.	OD x Thickness (mm)	m / Pack
	111.1B.A13.EC4	2113 100	20 x 2.8	100
	111.1B.A13.FC4	2113 200	25 x 3.5	100
	111.1B.A13.GC4	2113 300	32 x 4.4	100
	111.1B.A13.HC4	2113 400	40 x 5.5	60
	111.1B.A13.IC4	2113 500	50 x 6.9	40
	111.1B.A13.JC4	2113 600	63 x 8.6	28
	111.1B.A13.KC4	2113 700	75 x 10.3	20
	111.1B.A13.LC4	2113 800	90 x 12.3	12
	111.1B.A13.MC4	2113 900	110 x 15.1	8
	211.1B.A13.NC4*	2113 1000	125 x 17.1	4
	211.1B.A13.PC4*	2113 1100	160 x 21.9	4

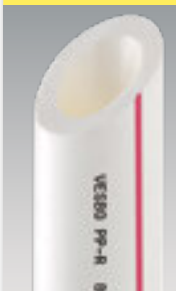
VESBO® PN 16 (SDR 7,4) Pipes are used for both hot & cold water installations and higher pressure systems.

PN25 (SDR5) Stable Pipe, PP-R with Aluminum for Hot & Cold Water

	Code	Article No.	OD x Thickness (mm)	m / Pack
	111.1B.A21.E04	2122 100	20 x 3.4	100
	111.1B.A21.F04	2122 200	25 x 4.2	100
	111.1B.A21.G04	2122 300	32 x 5.4	60
	111.1B.A21.H04	2122 400	40 x 6.7	60
	111.1B.A21.I04	2122 500	50 x 8.3	40
	111.1B.A21.J04	2122 600	63 x 10.5	28
	111.1B.A21.K04	2122 700	75 x 12.5	20
	111.1B.A21.L04	2122 800	90 x 15.0	12
	111.1B.A21.M04	2122 900	110 x 18.3	8


VESBO® Stable Pipes are preferred mainly for exposed pipe installations thanks to the low linear expansion rate and reinforced structure.

PN20 (SDR6) PP-R Hot & Cold Water Pipe

	Code	Article No.	OD x Thickness (mm)	m / Pack
	111.1B.A12.EC4	2112 100	20 x 3.4	100
	111.1B.A12.FC4	2112 200	25 x 4.2	100
	111.1B.A12.GC4	2112 300	32 x 5.4	100
	111.1B.A12.HC4	2112 400	40 x 6.7	60
	111.1B.A12.IC4	2112 500	50 x 8.3	40
	111.1B.A12.JC4	2112 600	63 x 10.5	28
	111.1B.A12.KC4	2112 700	75 x 12.5	20
	111.1B.A12.LC4	2112 800	90 x 15.0	12
	111.1B.A12.MC4	2112 900	110 x 18.3	8
	211.1B.A12.NC4*	2112 1000	125 x 20.8	4
	211.1B.A12.PC4*	2112 1100	160 x 26.6	4

VESBO® PN 20 (SDR 6) Pipes are used for both hot & cold water installations and higher pressure systems.

PN16 (SDR7.4) / PN20 (SDR6) UV PP-R Pipes for Hot & Cold Water

	Code	Article No.	Size (mm)	m / Pack
	111.1B.N45.E04	G2113 100	20	100
	111.1B.N45.F04	G2113 200	25	100
	111.1B.N45.G04	G2113 300	32	100
	111.1B.N45.H04	G2113 400	40	60
	111.1B.N45.I04	G2113 500	50	40
	111.1B.N45.J04	G2113 600	63	28
	111.1B.N45.K04	G2113 700	75	20
	111.1B.N45.L04	G2113 800	90	12
	111.1B.N45.M04	G2113 900	110	8

VESBO® UV Pipes are used for pipe installations under direct sunlight or UV radiation.

Product Range

PN16 (SDR7.4) Faser Pipe, Composite PP-R / Glass Fibre / PP-R for Hot & Cold Water

Code	Article No.	OD x Thickness (mm)	m / Pack
111.1B.A63.EC4	C2113 100	20 x 2.8	100
111.1B.A63.FC4	C2113 200	25 x 3.5	100
111.1B.A63.GC4	C2113 300	32 x 4.4	60
111.1B.A63.HC4	C2113 400	40 x 5.5	40
111.1B.A63.IC4	C2113 500	50 x 6.9	20
111.1B.A63.JC4	C2113 600	63 x 8.6	20
111.1B.A63.KC4	C2113 700	75 x 10.3	12
111.1B.A63.LC4	C2113 800	90 x 12.3	12
111.1B.A63.MC4	C2113 900	110 x 15.1	8

VESBO® PN16 (SDR7.4) Faser Pipes are used for both hot & cold water installations and higher pressure systems.

PN20 (SDR6) Faser Pipe, Composite PP-R / Glass Fibre / PP-R for Hot & Cold Water

Code	Article No.	OD x Thickness (mm)	m / Pack
111.1B.A62.EC4	C2113 100	20 x 3.4	100
111.1B.A62.FC4	C2113 200	25 x 4.2	100
111.1B.A62.GC4	C2113 300	32 x 5.4	60
111.1B.A62.HC4	C2113 400	40 x 6.7	40
111.1B.A62.IC4	C2113 500	50 x 8.3	20
111.1B.A62.JC4	C2113 600	63 x 10.5	20
111.1B.A62.KC4	C2113 700	75 x 12.5	12
111.1B.A62.LC4	C2113 800	90 x 15.0	12
111.1B.A62.MC4	C2113 900	110 x 18.3	8

VESBO® PN20 (SDR6) Faser Pipes are used for both hot & cold water installations and higher pressure systems.

3.3 Fittings

Reducer

Code	Article No.	Size (mm)	Pcs / Pack	Socket Size to Be Used (mm)
12.1B.A06.FE0	2202 210	25 / 20	200	25
112.1B.A06.GE0	2202 310	32 / 20	120	32
112.1B.A06.GF0	2202 320	32 / 25	120	32
112.1B.A06.HE0	2202 410	40 / 20	75	40
112.1B.A06.HF0	2202 420	40 / 25	75	40
112.1B.A06.HG0	2202 430	40 / 32	105	40
112.1B.A06.IE0	2202 510	50 / 20	40	50
112.1B.A06.IF0	2202 520	50 / 25	40	50
112.1B.A06.IG0	2202 530	50 / 32	45	50
112.1B.A06.IH0	2202 540	50 / 40	45	50
112.1B.A06.JE0	2202 610	63 / 20	30	63
112.1B.A06.JF0	2202 620	63 / 25	30	63
112.1B.A06.JG0	2202 630	63 / 32	30	63
112.1B.A06.JH0	2202 640	63 / 40	25	63
112.1B.A06.JI0	2202 650	63 / 50	24	63
112.1B.A06.KI0	2202 750	75 / 50	12	75
112.1B.A06.KJ0	2202 760	75 / 63	12	75
112.1B.A06.LJ0	2202 860	90 / 63	10	90
112.1B.A06.LK0	2202 870	90 / 75	6	90
112.1B.A06.ML0	2202 980	110 / 90	2	110
212.1B.A06.PM0*	2202 1109	160/110	1	-

VESBO® Reducers are used for joining bigger size pipelines to smaller size pipelines.

Socket

Code	Article No.	Size (mm)	Pcs / Pack
112.1B.A01.E00	2201 100	20	200
112.1B.A01.F00	2201 200	25	120
112.1B.A01.G00	2201 300	32	105
112.1B.A01.H00	2201 400	40	60
112.1B.A01.I00	2201 500	50	30
112.1B.A01.J00	2201 600	63	12
112.1B.A01.K00	2201 700	75	12
112.1B.A01.L00	2201 800	90	5
112.1B.A01.M00	2201 900	110	4
212.1B.A01.P00*	2201 1100	160	1

VESBO® Sockets are used to join two pipes.


90° Elbow

Code	Article No.	Size (mm)	Pcs / Pack
112.1B.A02.E00	2203 100	20	150
112.1B.A02.F00	2203 200	25	100
112.1B.A02.G00	2203 300	32	50
112.1B.A02.H00	2203 400	40	35
112.1B.A02.I00	2203 500	50	20
112.1B.A02.J00	2203 600	63	8
112.1B.A02.K00	2203 700	75	5
112.1B.A02.L00	2203 800	90	2
112.1B.A02.M00	2203 900	110	2
212.1B.A02.P00*	2203 1100	160	1

VESBO® Elbows are used where the pipeline makes a curve of 90°.


Product Range

45° Elbow

	Code	Article No.	Size(mm)	Pcs / Pack
	112.1B.A03.E00	2204 100	20	150
	112.1B.A03.F00	2204 200	25	80
	112.1B.A03.G00	2204 300	32	60
	112.1B.A03.H00	2204 400	40	35
	112.1B.A03.I00	2204 500	50	20
	112.1B.A03.J00	2204 600	63	8
	212.1B.A03.K00*	2204 700	75	5
	212.1B.A03.L00*	2204 800	90	2
	212.1B.A03.M00*	2204 900	110	2


VESBO® Elbows are used where the pipeline makes a curve of 45°.

Cap

	Code	Article No.	Size(mm)	Pcs / Pack
	112.1B.A07.E00	2207 100	20	300
	112.1B.A07.F00	2207 200	25	200
	112.1B.A07.G00	2207 300	32	100
	112.1B.A07.H00	2207 400	40	60
	112.1B.A07.I00	2207 500	50	40
	112.1B.A07.J00	2207 600	63	24
	112.1B.A07.K00	2207 700	75	10
	112.1B.A07.L00	2207 800	90	4
	112.1B.A07.M00	2207 900	110	4
	212.1B.A07.P00*	2207 1100	160	2

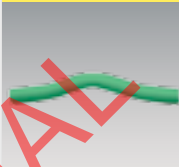
VESBO® Caps are used as a stopper at the pipeline ends.

T-Part

	Code	Article No.	Size(mm)	Pcs / Pack
	112.1B.A04.E00	2205 100	20	100
	112.1B.A04.F00	2205 200	25	60
	112.1B.A04.G00	2205 300	32	48
	112.1B.A04.H00	2205 400	40	30
	112.1B.A04.I00	2205 500	50	12
	112.1B.A04.J00	2205 600	63	6
	112.1B.A04.K00	2205 700	75	4
	112.1B.A04.L00	2205 800	90	2
	112.1B.A04.M00	2205 900	110	1
	212.1B.A04.P00*	2205 1100	160	1


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

Pipe Bridge

	Code	Article No.	Size(mm)	Pcs / Pack
	113.1B.M12.E00	5211 100	20	50
	113.1B.M12.F00	5211 200	25	40
	113.1B.M12.G00	5211 300	32	25


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

Unequal T

	Code	Article No.	Size(mm)	Pcs / Pack
	112.1B.A05.EFE	2206 121	20 x 25 x 20	75
	112.1B.A05.FEE	2206 211	25 x 20 x 20	75
	112.1B.A05.FEF	2206 212	25 x 20 x 25	75
	112.1B.A05.FFE	2206 221	25 x 25 x 20	75
	112.1B.A05.GEE	2206 311	32 x 20 x 20	45
	112.1B.A05.GEF	2206 312	32 x 20 x 25	45
	112.1B.A05.GEG	2206 313	32 x 20 x 32	40
	112.1B.A05.GFE	2206 321	32 x 25 x 20	40
	112.1B.A05.GFG	2206 323	32 x 25 x 32	48
	112.1B.A05.HEH	2206 414	40 x 20 x 40	30
	112.1B.A05.HFG	2206 423	40 x 25 x 32	30
	112.1B.A05.HFH	2206 424	40 x 25 x 40	30
	112.1B.A05.HGF	2206 432	40 x 32 x 25	30
	112.1B.A05.HGH	2206 434	40 x 32 x 40	30
	212.1B.A05.IEI	2206 525	50 x 20 x 50	12
	212.1B.A05.IFI	2206 515	50 x 25 x 50	12
	112.1B.A05.LHL	2206 848	90 x 40 x 90	2
	112.1B.A05.LIL	2206 858	90 x 50 x 90	2
	112.1B.A05.LJL	2206 868	90 x 63 x 90	2
	112.1B.A05.LKL	2206 878	90 x 75 x 90	2
	112.1B.A05.MIM	2206 959	110 x 50 x 110	1
	112.1B.A05.MJM	2206 969	110 x 63 x 110	1
	112.1B.A05.MKM	2206 979	110 x 75 x 110	1
	112.1B.A05.MLM	2206 989	110 x 90 x 110	1


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

Threaded Cap

	Code	Article No.	Size(mm)	Pcs / Pack
	112.1B.A08.E00	2403 100	20	300
	112.1B.A08.F00	2403 200	25	300
	112.1B.A08.G00	2403 300	32	150

VESBO® Threaded Caps are for sealing the pipe ends during the pressure tests.

Sleeve*

	Code	Article No.	Size(mm)	Pcs / Pack
	112.1B.A13.E00	2405 100	20	300
	112.1B.A13.F00	2405 200	25	200
	112.1B.A13.G00	2405 300	32	150
	112.1B.A13.H00	2405 400	40	100
	112.1B.A13.I00	2405 500	50	50
	112.1B.A13.J00	2405 600	63	25
	112.1B.A13.K00	2405 700	75	20

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

Product Range

Flange



Code	Article No.	Size(mm)	Pcs / Pack	
112.1B.A10.E00	2411 100	20	100	200
112.1B.A10.F00	2411 200	25	200	150
112.1B.A10.G00	2411 300	32	300	100
112.1B.A10.H00	2411 400	40	400	60
112.1B.A10.I00	2411 500	50	500	30
112.1B.A10.J00	2411 600	63	600	18
112.1B.A10.K00	2411 700	75	700	12
112.1B.A10.L00	2411 800	90	800	6
112.1B.A10.M00	2411 900	110	900	6
212.1B.A10.P00*	2411 1100	160	1100	2

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.

Adaptor Female



Code	Article No.	Size(mm)	Pcs / Pack	
112.1B.B11.EQ0	2301 100	20 x 1/2	100	120
112.1B.B11.ER0	2301 120	20 x 3/4	120	80
112.1B.B11.FQ0	2301 210	25 x 1/2	210	60
112.1B.B11.FR0	2301 220	25 x 3/4	220	60

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

Adaptor Male



Code	Article No.	Size(mm)	Pcs / Pack	
112.1B.B21.EQ0	2302 110	20 x 1/2	110	80
112.1B.B21.ER0	2302 120	20 x 3/4	120	60
112.1B.B21.FQ0	2302 210	25 x 1/2	210	60
112.1B.B21.FR0	2302 220	25 x 3/4	220	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.

Elbow Female



Code	Article No.	Size(mm)	Pcs / Pack	
112.1B.B12.EQ0	2305 110	20 x 1/2	110	80
112.1B.B12.FQ0	2305 210	25 x 1/2	210	60
112.1B.B12.FR0	2305 220	25 x 3/4	220	60
112.1B.B12.GS0	2305 330	32 x 1	330	20

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

Elbow Male



Code	Article No.	Size(mm)	Pcs / Pack	
112.1B.B22.EQ0	2306 110	20 x 1/2	110	60
112.1B.B22.FQ0	2306 210	25 x 1/2	210	40
112.1B.B22.FR0	2306 220	25 x 3/4	220	40
112.1B.B22.GS0	2306 330	32 x 1	330	16

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

T - Part Female



Code	Article No.	Size(mm)	Pcs / Pack	
112.1B.B13.EQ0	2307 111	20 x 1/2 x 20	111	60
112.1B.B13.ER0	2307 121	20 x 3/4 x 20	121	60
112.1B.B13.FQ0	2307 212	25 x 1/2 x 25	212	40
112.1B.B13.FR0	2307 222	25 x 3/4 x 25	222	40
112.1B.B13.GR0	2307 323	32 x 3/4 x 32	323	20

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

T - Part Male



Code	Article No.	Size(mm)	Pcs / Pack	
112.1B.B23.EQ0	2308 111	20 x 1/2 x 20	111	60
112.1B.B23.FQ0	2308 212	25 x 1/2 x 25	212	40
112.1B.B23.FR0	2308 222	25 x 3/4 x 25	222	40
112.1B.B23.GS0	2308 333	32 x 1 x 32	333	20

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

Hex. Female Adaptor



Code	Article No.	Size(mm)	Pcs / Pack	
112.1B.B11.GS0	2303 330	32 x 1	330	40
112.1B.B11.HT0	2303 440	40 x 1 1/4	440	20
112.1B.B11.IU0	2303 550	50 x 1 1/2	550	16
112.1B.B11.JV0	2303 660	63 x 2	660	10
112.1B.B11.KW0	2303 770	75 x 2 1/2	770	5

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

Product Range

Hex. Male Adaptor



Code	Article No.	Size(mm)	Pcs / Pack
112.1B.B21.GS0	2304 330	32 x 1	24
112.1B.B21.HT0	2304 440	40 x 1 1/4	12
112.1B.B21.IU0	2304 550	50 x 1 1/2	12
112.1B.B21.JV0	2304 660	63 x 2	10
112.1B.B21.KW0	2304 770	75 x 2 1/2	8

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.

Chromium Valve



Code	Article No.	Size(mm)	Pcs / Pack
212.1B.C30.EQ0	2311 100	20 x 1/2	20
212.1B.C30.FR0	2311 200	25 x 3/4	20
212.1B.C30.ER0	2311 120	20 x 3/4	20
212.1B.C30.GS0	2311 330	32 x 1	16

VESBO® Chromium Valves are stop valves that are preferred mostly for installations where aesthetic is important.

Union Female



Code	Article No.	Size(mm)	Pcs / Pack
112.1B.G12.EQ0	2313 110	20 x 1/2	80
112.1B.G12.FR0	2313 220	25 x 3/4	60
112.1B.G12.GS0	2313 330	32 x 1	40
112.1B.G12.HT0	2313 440	40 x 1 1/4	20
112.1B.G12.IU0	2313 550	50 x 1 1/2	16

VESBO® Female Unions are used in transition between fixed VESBO® and metal pipelines. These fittings are preferred mainly for the installations in which temporarily renovation of the intermediate parts (valves, batteries, etc.) is required.

Chromium Valve - Long



Code	Article No.	Size(mm)	Pcs / Pack
212.1B.C40.EQ0	2311 101	20 x 1/2	20
212.1B.C40.FR0	2311 201	25 x 3/4	20
212.1B.C40.GS0	2311 301	32 x 1	16

VESBO® Chromium Valves are stop valves that are preferred mostly for installations where aesthetic is important.

Union Male



Code	Article No.	Size(mm)	Pcs / Pack
112.1B.G22.EQ0	2314 110	20 x 1/2	60
112.1B.G22.FR0	2314 220	25 x 3/4	40
112.1B.G22.GS0	2314 330	32 x 1	24
112.1B.G22.HT0	2314 440	40 x 1 1/4	16

VESBO® Male Unions are used in transition between fixed VESBO® and metal pipelines. These fittings are preferred mainly for the installations in which temporarily renovation of the intermediate parts (valves, batteries, etc.) is required.

Valve



Code	Article No.	Size(mm)	Pcs / Pack
212.1B.C10.EQ0	2310 100	20 x 1/2	24
212.1B.C10.FR0	2310 200	25 x 3/4	20
212.1B.C10.GS0	2310 300	32 x 1	16
212.1B.C10.HT0	2310 400	40 x 1 1/4	15
212.1B.C10.IU0	2310 500	50 x 1 1/2	12
212.1B.C10.JV0	2310 600	63 x 2	6

VESBO® Valves are used as turn on/off and flow regulating units in pipelines.

Wall Connection Elbow



Code	Article No.	Size(mm)	Pcs / Pack
112.1B.B14.EQ0	2309 110	20 x 1/2	60
112.1B.B14.FQ0	2309 210	25 x 1/2	60

VESBO® Wall Connection Elbows with their additional back parts are used to fasten the pipelines to the wall.

Valve T-Part



Code	Article No.	Size(mm)	Pcs / Pack
614.1B.B01.EQ0	2312 100	20 x 1/2	60
614.1B.B01.FR0	2312 200	25 x 3/4	40
614.1B.B01.GS0	2312 300	32 x 1	32

Product Range

PP-R Ball Valve**

	Code	Article No.	Size(mm)	Pcs / Pack
	212.1B.A18.E00	2409 100	20	12
	212.1B.A18.F00	2409 200	25	12
	212.1B.A18.G00	2409 300	32	12
	212.1B.A18.H00	2409 400	40	12
	212.1B.A18.I00	2409 500	50	12
	212.1B.A18.J00	2409 600	63	12
	212.1B.A18.K00	2409 700	75	4
	212.1B.A18.L00	2409 800	90	1
	212.1B.A18.M00	2409 900	110	1

PP-R Ball Valves can be used as a flow regulating unit for cold water systems.

Plastic Ball Valve

	Code	Article No.	Size(mm)	Pcs / Pack
	112.1B.C20.EQ0	2406 100	20 x 1/2	20
	112.1B.C20.FR0	2406 200	25 x 3/4	16
	112.1B.C20.GS0	2406 300	32 x 1	8

VESBO® Ball Valves are preferred for a more practical usage with their handles to regulate the water flow.

PPR Brass Union Stop Valve

	Code	Article No.	Size(mm)	Pcs / Pack
	212.1B.D10.EQ0	2312 100	20	12
	212.1B.D10.FR0	2312 200	25	12
	212.1B.D10.GS0	2312 300	32	12
	212.1B.D10.HT0	2312 400	40	12

PPR Brass Union Ball Valve

	Code	Article No.	Size(mm)	Pcs / Pack
	212.1B.C50.EQ0	2314 100	20	12
	212.1B.C50.FR0	2314 200	25	12
	212.1B.C50.GS0	2314 300	32	12

Angle Valve

	Code	Article No.	Size(mm)	Pcs / Pack
	212.1O.H05.000 - Round	2315 101	1/2 x 1/2"	12
	212.1O.H06.000 - Square	2315 102	1/2 x 1/2"	12
	212.1O.H07.000 - Octagon	2315 103	1/2 x 1/2"	12
	212.1O.H04.000 - Normal	2315 104	1/2 x 1/2"	12
	212.1O.H08.000 - Round Handle	2316 105	1/2 x 3/8"	12
	212.1O.H09.000 - Round Plastic	2315 106	1/2 x 1/2"	12

PP-R Union**

	Code	Article No.	Size(mm)	Pcs / Pack
	212.1B.A17.E00	2408 100	20	50
	212.1B.A17.F00	2408 200	25	40
	212.1B.A17.G00	2408 300	32	20
	212.1B.A17.H00	2408 400	40	15
	212.1B.A17.I00	2408 500	50	10
	212.1B.A17.J00	2408 600	63	5
	212.1B.A17.K00	2408 700	75	2
	212.1B.A17.L00	2408 800	90	1

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

Collector

	Code	Article No.	Size(mm)	Pcs / Pack
	112.1B.A09.GE0	2220 300	32 - 20	30
	112.1B.A09.HE0	2220 400	40 - 20	20

VESBO® Collectors provide a direct installation of pipes to the consumption points and minimize number of the fittings used.

E-fit Electro Socket**


	Code	Article No.	Size(mm)	Pcs / Pack
	212.1B.D01.E00	2501 100	20	50
	212.1B.D01.F00	2501 200	25	40
	212.1B.D01.G00	2501 300	32	20
	212.1B.D01.H00	2501 400	40	15
	212.1B.D01.I00	2501 500	50	10
	212.1B.D01.J00	2501 600	63	5
	212.1B.D01.K00	2501 700	75	2
	212.1B.D01.L00	2501 800	90	2
	212.1B.D01.M00	2501 900	110	1

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.

** These accessories are not manufactured by VESBO; they are supplied from an outsource and can be subjected to modifications.


Product Range

Fusion Welding Machines**

	Code	Article No.	Size(mm)	Pcs / Pack
	214.20.1D0.A00	9423 002	Small Welding Set 20-32mm	1
	214.20.1D0.B00	9423 003	Classic Welding Set 20-40mm	1
	214.10.1D0.E00	9423 005	Maxi Welding Set 50-110mm	1
	214.10.1D0.F00	9423 009	Desktop Welding Set 20-160mm	1


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.

Welding Adaptor**

	Code	Article No.	Size(mm)	Pcs / Pack
	214.10.1A0.E00	9420 100	20	50
	214.10.1A0.F00	9420 200	25	50
	214.10.1A0.G00	9420 300	32	50
	214.10.1A0.H00	9420 400	40	40
	214.10.1A0.I00	9420 500	50	30
	214.10.1A0.J00	9420 600	63	20
	214.10.1A0.K00	9420 700	75	10
	214.10.1A0.L00	9420 800	90	4
	214.10.1A0.M00	9420 900	110	2
	214.10.1A0.N00	9420 1000	125	1


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

Aluminium Foil Shaver**

	Code	Article No.	Size(mm)	Pcs / Pack
	214.10.3B0.EF0	9423 014	20 - 25	1
	214.10.3B0.GH0	9423 015	32 - 40	1
	214.10.3B0.HI0	9423 016	40 - 50	1
	214.10.3B0.IJ0	9423 017	50 - 63	1
	214.10.3B0.KL0	9423 018	75 - 90	1
	214.10.3B0.LM0	9423 019	90 - 110	1


Aluminium Foil Shavers are used to remove the outer PP-R layer and aluminium foil of the VESBO® Stable Pipes' tips to be welded.

Plastic Foil Shaver**

	Code	Article No.	Size(mm)	Pcs / Pack
	214.10.3A0.EF0	9423 033	20 - 25	1
	214.10.3A0.GH0	9423 034	32 - 40	1
	214.10.3A0.HI0	9423 035	40 - 50	1


Plastic Foil Shavers are used to remove the outer PP-R layer and aluminium foil of the VESBO® Stable Pipes' tips to be welded.

Cutters & Blades**

	Code	Article No.	Size(mm)	Pcs / Pack
	214.10.2A0.E00	9423 012	20 - 40	1
	214.10.2A0.H00	9423 013	40 - 63	1
	214.10.2A4.000	9423 004	Cutter Blade	


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

Pipe Repair Kits**

	Code	Article No.	Size(mm)	Pcs / Pack
	214.10.1A0.020	9420 1001	Pipe Repair Adaptor 6 mm	1
	214.10.1A0.010	9420 1000	Pipe Repair Adaptor 10 mm	1
	112.1B.A11.000	2412 100	PP-R Patching Stick	

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

Other Supplies**

	Code	Article No.	Size(mm)	Pcs / Pack
	214.10.5O2.000	9423 008	Welding Adaptor Screw	1
	214.1M.4A0.000	1404 000	Water Leveller	1

** These accessories are not manufactured by VESBO; they are supplied from an outsource and can be subjected to modifications.

Colour Options for VESBO® Pipes and Fittings

Blue



White



Green

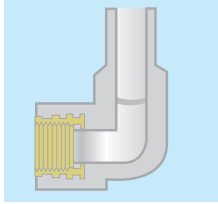


Grey



Joins, Fusion & Repairs

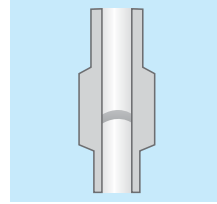
4.1 Homogeneous Joint



The result of a socket fusion or electrofusion joint is a homogeneous joint. This is one of the biggest advantages 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



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

Please refer to the operating manuals 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 the pipe to be welded is shaved by a special VESBO shaver to remove outside PP-R layer and aluminium foil. (This step is applicable only to 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 the table on section 4.5 for necessary information.



Step 4

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

Joins, Fusion & Repairs

4.4 VESBO® Desktop Welding Machine Operating Manual

VESBO® desktop welding machine is designed for an efficient and operative fusion for specifically large diameter (50mm to 110mm) 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 50cm 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 the table on section 4.5 for 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. Thus the fusion process is completed.

Joins, Fusion & Repairs

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. (It also applies to stable pipes.)

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 starts 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 try to 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:

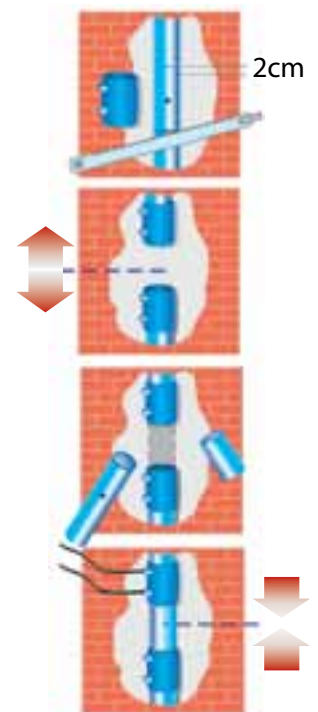
Pipe with Nail Holes (Not Concealed)

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 pictures on the right)

- Cut the damaged pipe perpendicularly, by a length equal to that of the corresponding electric socket plus 2cm.
- 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 into 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 the half the length of the socket.
- Weld the socket using an electrofusion welding kit.



Joints, Fusion & Repairs

Pipe with One Nail Hole (Concealed)

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



Step 1
Insert the repairing socket into the welding tool.



Step 2
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 +0.1mm to the wall thickness and moving the rings on the socket. The related data are given in the table on the right.



Step 3
If the hole diameter on the pipe surface is equal to or smaller than 5mm expand it with a 6mm tip. If it is equal to or smaller than 9mm use a 10mm tip.



Step 4
Ensure that the welding tool is hot enough.



Step 5
Insert the hole to be repaired into 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.



Step 6
Adhere to heating, welding and cooling periods for a good welding joint. Increase the periods by 50% when the air temperature is below +5°C.



Step 7
Insert the pipe repairing stick without exceeding the pipe's wall thickness.



Step 8
Cut the remaining part after the stick cools down.



Step 9
After an hour later, the 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 the repair is completed.

VESBO® Pipe	Other Diameter (mm)	Wall Thickness (mm)	Depth of Socket Clip on the Socket (mm)
SDR 11	20	2.3	2.4
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

Installation Technique

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 (SDR11) & PN 20 (SDR6)

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

Pipe Support Intervals(mm) for VESBO® Pipes PN 25 (Stable Pipes)

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

Installation Technique

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 (SDR6) pipes for hot water applications. No consideration is necessary for PN 25, Stable pipes as the coefficient of linear expansion is 3.0×10^{-5} (k^{-1}).

The coefficient of linear expansion for VESBO® PN 20 (SDR6) pipes is 15.0×10^{-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, 0.15mm/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 1.5m, normal cold water temperature is 25°C and hot water from water heater is set at 60°C.

$$\begin{aligned} \Delta l &= \alpha \times L \times \Delta t \\ &= 0.15 \times 1.5 \times 35 \end{aligned}$$

Linear expansion is 7.88~8mm

By reading off table PN 20 (SDR6)

Linear Expansion Table, $\Delta t(k)$

Linear Expansion Δl (mm)

Pipe Length L(m)	Difference in Temperature, $\Delta t(k)$							
	10	20	30	40	50	60	70	80
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	57.25	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 PN 25, stable pipes, the above can be obtained by dividing by 5.

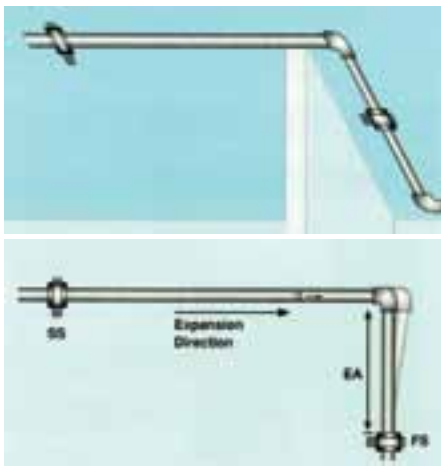
Installation Technique

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.

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.

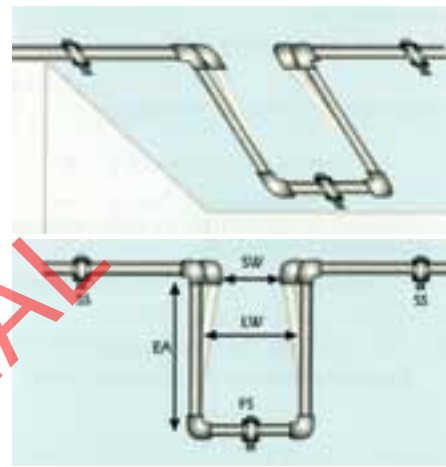
Example

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.

$$\begin{aligned} EA &= K \times (d \times \Delta l)^{1/2} \\ &= 15 \times (25 \times 8)^{1/2} \\ &= 212.13 \sim 212\text{mm} \end{aligned}$$

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 150mm

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

$$\begin{aligned} LW &= (2 \times \Delta l) + SW \\ &= (2 \times 8) + 150 \\ \text{The loop width is } &166\text{mm.} \end{aligned}$$

Installation Technique

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

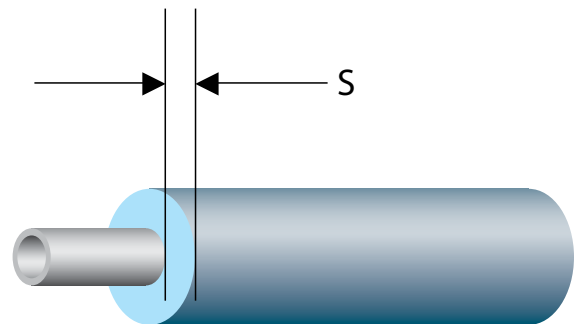
For chilled water of temperature less than 10°C, due to condensation that may take place, insulation is necessary but reduced considerably in thickness as compared to metal pipes. Heat loss for hot water pipe is reduced to a minimum.

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



Installation Technique

PIPE Ø 20×3.4										
Ti \ Te	26	27	28	29	30	31	32	33	34	Humidity
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 25×4.2										
Ti \ Te	26	27	28	29	30	31	32	33	34	Humidity
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 32×5.4										
Ti \ Te	26	27	28	29	30	31	32	33	34	Humidity
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 40×6.7										
Ti \ Te	26	27	28	29	30	31	32	33	34	Humidity
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 50×8.3										
Ti \ Te	26	27	28	29	30	31	32	33	34	Humidity
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 63×10.5										
Ti \ Te	26	27	28	29	30	31	32	33	34	Humidity
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 75×10.4										
Ti \ Te	26	27	28	29	30	31	32	33	34	Humidity
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 90×12.5										
Ti \ Te	26	27	28	29	30	31	32	33	34	Humidity
5	2.63	2.93	3.22	3.51	3.81	4.10	4.39	4.69	4.98	60%
7	1.89	2.19	2.49	2.79	3.09	3.40	3.70	4.00	4.30	
9	1.13	1.44	1.75	2.06	2.37	2.68	2.99	3.30	3.62	
5	11.78	12.32	12.86	13.40	13.93	14.47	15.01	15.55	16.09	80%
7	10.31	10.87	11.43	11.99	12.55	13.11	13.67	14.23	14.79	
9	8.81	9.39	9.98	10.56	11.14	11.73	12.31	12.89	13.48	

Note: Te and Ti in °C

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 10k 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)

Installation Technique

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 pressure + 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.

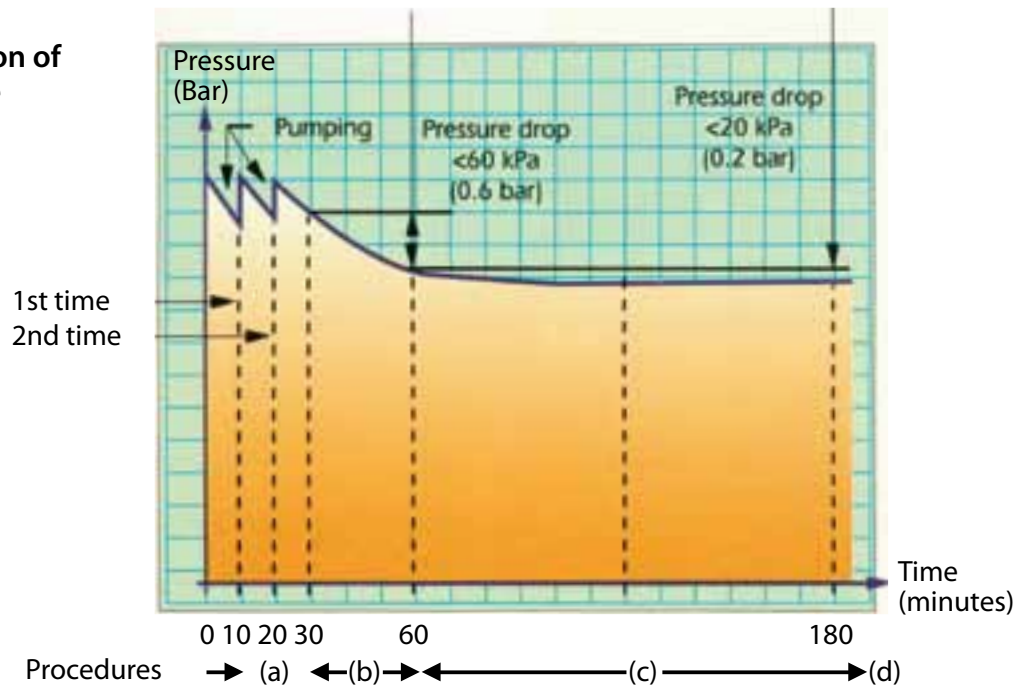
(c) If pressure drop is within 0.6 bars and no leakage detected, continue the test without restoring the required pressure for the next 120 minutes. During this time, it shall be checked if the pressure drop is more than 0.2 bars and no leakage is detected.

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



Installation Technique

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	

FINAL

5.7 Precautionary 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 50mm to 25mm, a socket 50mm must first be attached to the 50mm pipe followed by a reducer 50/25mm and followed by the 25mm pipe.
- When using VESBO® fittings with metal threaded parts, white 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. Normal hand tightening with sealing or white teflon tapes is about 20-30Nm. VESBO® metal inserts has a maximum torque value of 80Nm and is sufficient to prevent any normal tightening without causing leakages.
- 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.

Specification & Planning

6.1 Product Specification

Trade name: VESBO®

Materials:

Polypropylene Random Copolymer (PP-R Type 3)

Abbreviation: PP-R 80 or PP-R or PP-RC

Materials for the pipes and fittings for hot and cold water supply shall be tested with proof and certification for long term hydrostatic tests at 110C for 8760 hours.

Standards:

DIN 8077 BS 4991

DIN 8078 BS 6920: Part 2 & 3

DIN 16962 Part 1 to 12

ISO 15874

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 nickel. 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 (SDR6) Pipe
Pressure Rating: 20 Bar or 290 p.s.i

Application: Cold Water
Description: PN 10 (SDR11) Pipe
Pressure Rating: 10 Bar or 145 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

Dimension, OD (mm)	Thickness (mm)
20	1.9
25	2.3
32	3.0
40	3.7
50	4.6
63	5.8
75	6.9
90	8.2
110	10.0

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 of 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 Requirement:

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 O.D. (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.

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: 998.00Kg/m³

Viscosity: 1.02×10⁻⁶m²/s

VESBO®-pipe SDR11 (PN 10)

		\dot{V} = flow rate (l/s)		R = pressure gradient (mbar/m)				v = flow velocity (m/s)			
$d \times s \triangleright$		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	
\dot{V}	$d_i \triangleright$	15.4mm	20.4mm	26.2mm	32.6mm	40.8mm	51.4mm	61.4mm	73.6mm	90.0mm	
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	20.2	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)

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: 998.00Kg/m³

Viscosity: 1.02×10⁻⁶m²/s

VESBO®-pipe SDR11 (PN 10)

		\dot{V} = flow rate (l/s)		R = pressure gradient (mbar/m)					v = flow velocity (m/s)	
$d \times s \triangleright$		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
\dot{V}	$d_i \triangleright$	15.4mm	20.4mm	26.2mm	32.6mm	40.8mm	51.4mm	61.4mm	73.6mm	90.0mm
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)

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: 998.00Kg/m³

Viscosity: 1.02×10⁻⁶m²/s

VESBO®-pipe SDR11 (PN 10)

d×s ▶		\dot{V} = flow rate (l/s)			R = pressure gradient (mbar/m)			v = flow velocity (m/s)		
		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
\dot{V}	d _i ▶	15.4mm	20.4mm	26.2mm	32.6mm	40.8mm	51.4mm	61.4mm	73.6mm	90.0mm
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	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)

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: 998.00Kg/m³

Viscosity: 1.02×10⁻⁶m²/s

VESBO®-pipe SDR 6 (PN 20)

		\dot{V} = flow rate (l/s)		R = pressure gradient (mbar/m)			v = flow velocity (m/s)			
$d \times s \triangleright$		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
\dot{V}	$d_i \triangleright$	13.2mm	16.6mm	21.2mm	26.6mm	33.4mm	42.0mm	50.0mm	60.0mm	73.4mm
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)

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: 998.00Kg/m³

Viscosity: 1.02×10⁻⁶m²/s

VESBO®-pipe SDR6 (PN 20)

d×s ▶		\dot{v} = flow rate (l/s)		R = pressure gradient (mbar/m)			v = flow velocity (m/s)			
		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
\dot{v}	d _i ▶	13.2mm	16.6mm	21.2mm	26.6mm	33.4mm	42.0mm	50.0mm	60.0mm	73.4mm
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)

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: 998.00Kg/m³

Viscosity: 1.02×10⁻⁶m²/s

VESBO®-pipe SDR6 (PN 20)

		\dot{V} = flow rate (l/s)		R = pressure gradient (mbar/m)				v = flow velocity (m/s)			
d×s ▶		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	
\dot{V}	d _i ▶	13.2mm	16.6mm	21.2mm	26.6mm	33.4mm	42.0mm	50.0mm	60.0mm	73.4mm	
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)

Specification & Planning

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

Roughness: 0.0070mm

Temperature: 60°C

Density: 983.20Kg/m³

Viscosity: 0.47×10⁻⁶m²/s

VESBO®-pipe SDR6 (PN 20)

		\dot{v} = flow rate (l/s)		R = pressure gradient (mbar/m)					v = flow velocity (m/s)		
$d \times s \triangleright$		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	
\dot{v}	$d_i \triangleright$	13.2mm	16.6mm	21.2mm	26.6mm	33.4mm	42.0mm	50.0mm	60.0mm	73.4mm	
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	0.07	
	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)

Specification & Planning

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

Roughness: 0.0070mm
Temperature: 60°C
 Density: 983.20Kg/m³
 Viscosity: 0.47×10⁻⁶m²/s

VESBO®-pipe SDR6 (PN 20)

		\dot{V} = flow rate (l/s)				R = pressure gradient (mbar/m)		v = flow velocity (m/s)			
d×s ▶		16×2.7	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
\dot{V}	d _i ▶	10.6mm	13.2mm	16.6mm	21.2mm	26.6mm	33.4mm	42.0mm	50.0mm	60.0mm	73.4mm
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
0.10	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)

Specification & Planning

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

Roughness: 0.0070mm

Temperature: 60°C

Density: 983.20Kg/m³

Viscosity: 0.47×10⁻⁶m²/s

VESBO®-pipe SDR6 (PN 20)

		\dot{V} = flow rate (l/s)		R = pressure gradient (mbar/m)			v = flow velocity (m/s)			
d×s ▶		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
\dot{V}	d _i ▶	13.2mm	16.6mm	21.2mm	26.6mm	33.4mm	42.0mm	50.0mm	60.0mm	73.4mm
4.60	R	7334.37	2250.76	643.77	203.63	66.85	20.65	8.72	3.56	1.35
	V	33.61	21.56	13.03	8.28	5.31	3.32	2.34	1.63	1.09
4.80	R	7976.60	2446.49	699.21	220.97	72.47	22.37	9.44	3.85	1.46
	V	35.08	22.18	13.60	8.64	5.54	3.46	2.44	1.70	1.14
5.00	R	8645.73	2650.35	756.92	239.00	78.32	24.16	10.19	4.15	1.57
	V	36.54	23.10	14.16	9.00	5.78	3.61	2.55	1.77	1.19
5.20	R	9341.77	2862.34	816.90	257.74	84.39	26.01	10.96	4.47	1.69
	V	38.00	24.03	14.73	9.36	6.01	3.75	2.65	1.84	1.24
5.40	R		3082.46	879.14	277.17	90.67	28.03	11.76	4.79	1.81
	V		24.95	15.30	9.72	6.24	3.90	2.75	1.91	1.28
5.60	R		3310.71	943.67	297.30	97.18	30.02	12.59	5.13	1.94
	V		25.88	15.86	10.08	6.47	4.04	2.85	1.98	1.33
5.80	R		3547.09	1010.46	318.13	103.91	32.07	13.44	5.47	2.06
	V		26.80	16.43	10.44	6.70	4.19	2.95	2.05	1.38
6.00	R		3791.60	1079.52	339.65	110.86	34.19	14.33	5.83	2.20
	V		27.72	17.00	10.80	6.93	4.33	3.06	2.12	1.43
6.20	R		4044.24	1150.85	361.87	118.03	36.87	15.23	6.19	2.33
	V		28.65	17.56	11.16	7.16	4.48	3.16	2.19	1.47
6.40	R		4305.01	1224.45	384.79	125.42	38.62	16.17	6.57	2.47
	V		29.57	18.13	11.52	7.39	4.62	3.26	2.26	1.52
6.60	R		4573.91	1300.32	408.40	133.03	40.94	17.13	6.96	2.62
	V		30.50	18.70	11.88	7.62	4.76	3.36	2.33	1.57
6.80	R		4850.94	1378.47	432.71	140.87	43.32	18.12	7.35	2.77
	V		31.42	19.26	12.24	7.85	4.91	3.46	2.41	1.62
7.00	R		5136.09	1458.88	457.72	148.92	45.76	19.14	7.76	2.92
	V		32.34	19.83	12.60	8.09	5.05	3.57	2.48	1.66
7.50	R		5884.55	1669.84	523.29	170.01	52.16	21.88	8.83	3.32
	V		34.65	21.25	13.50	8.66	5.41	3.82	2.65	1.78
8.00	R		6683.80	1894.98	593.20	192.49	58.96	24.71	9.96	3.74
	V		36.96	22.66	14.40	9.24	5.77	4.07	2.83	1.90
9.00	R		8434.72	2387.82	746.09	241.55	73.80	30.86	12.42	4.66
	V		41.58	25.50	16.20	10.40	6.50	4.58	3.18	2.14
10.00	R			2937.39	916.37	296.12	90.26	37.67	15.21	5.66
	V			28.33	17.99	11.55	7.22	5.09	3.54	2.38

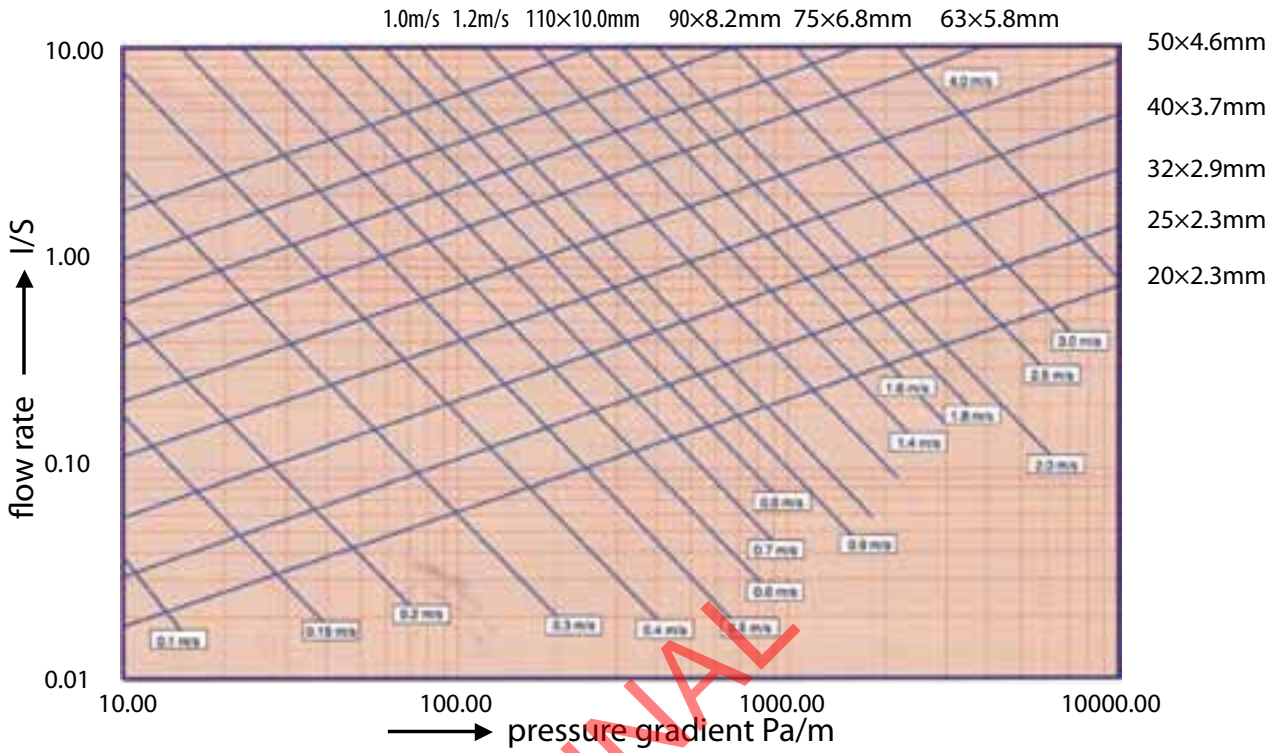
d = outside diameter (mm)

s = wall thickness (mm)

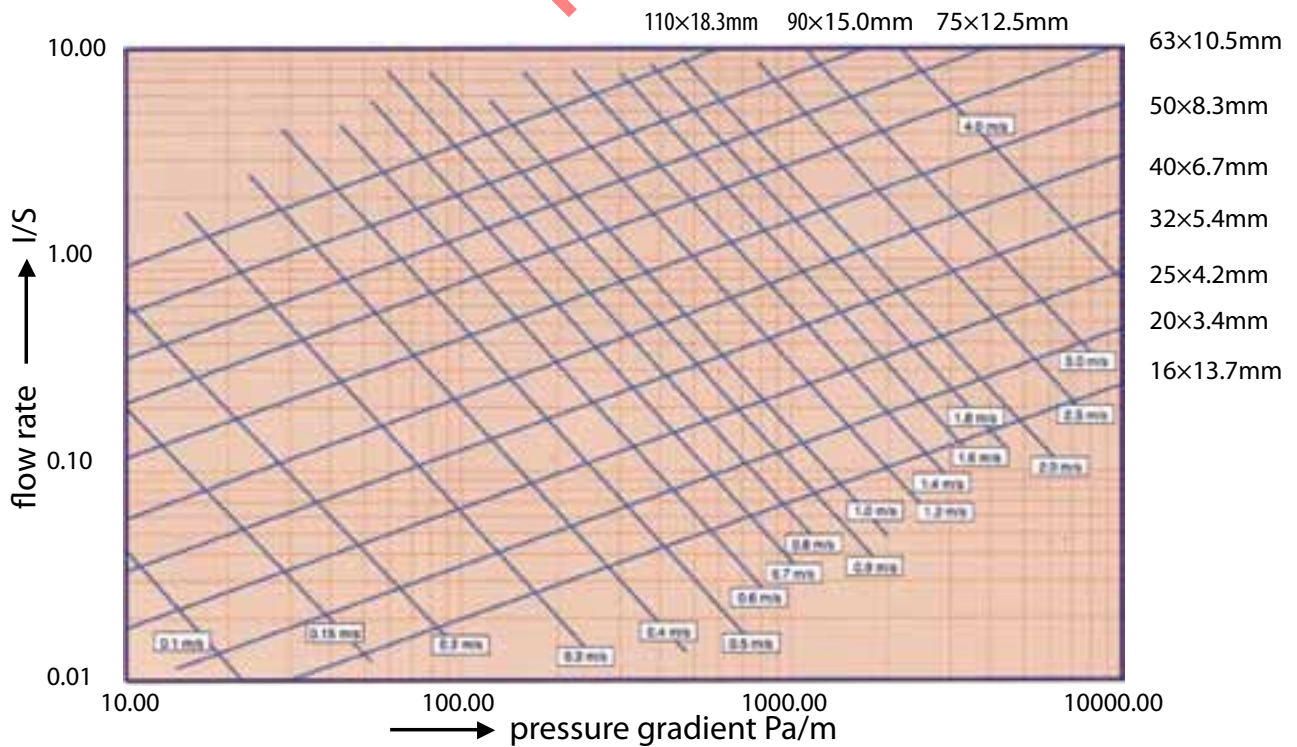
d_i = inside diameter (mm)

Specification & Planning

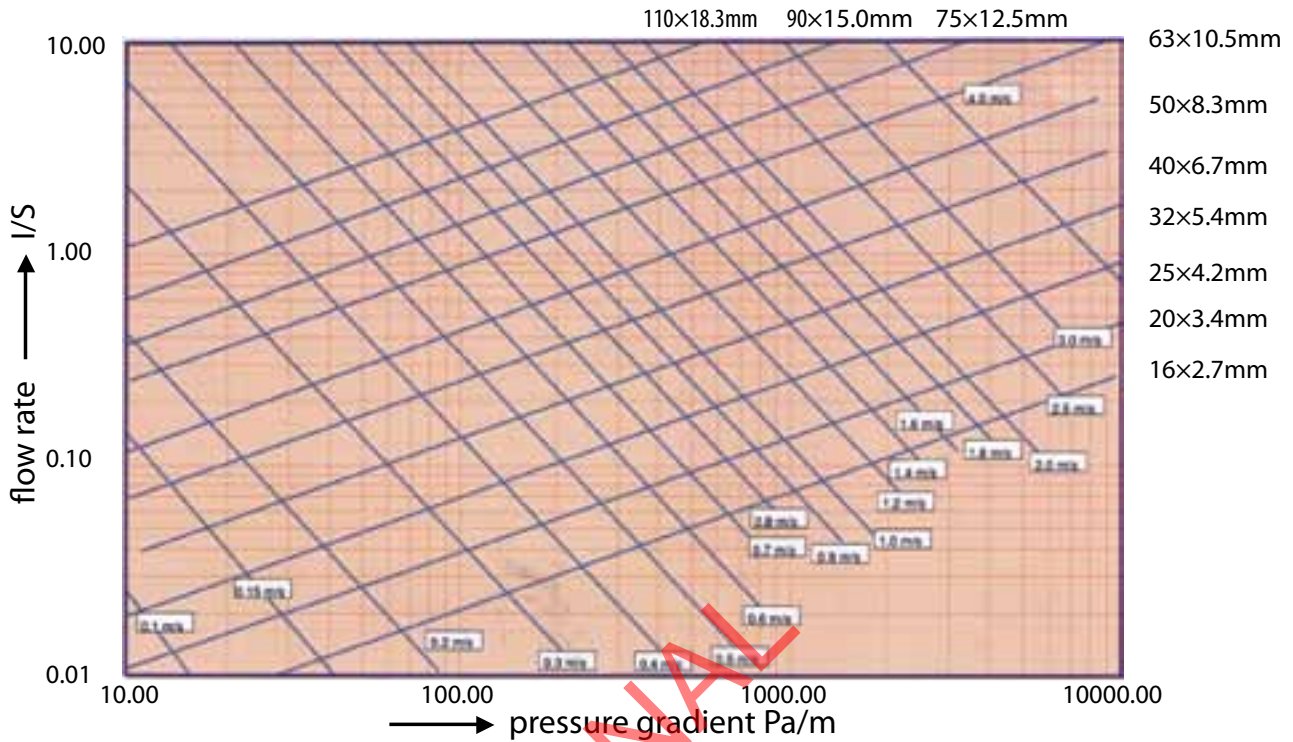
VESBO® PN 10 (SDR11) Pressure Drop Graphs at 20°



VESBO® PN 20 (SDR6) & PN 25 (Stable Pipe) Pressure Drop Graphs at 20°















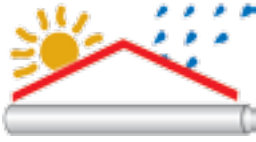

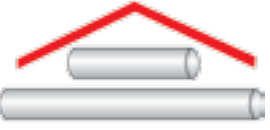
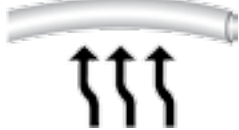




Specification & Planning

VESBO® PN 20 (SDR6) & PN 25 (Stable Pipe)
Pressure Drop Graphs at 20°

VESBO® Fittings Coefficient of Loss, ζ

Vesbo Fittings	Symbol	Consideration	Coeff. of loss ζ	Vesbo Fittings	Symbol	Consideration	Coeff. of loss ζ
Socket			0.25	Adaptor Female			0.50
Reducer		Reduce by 1 size	0.40	Adaptor Male			0.70
		Reduce by 2 size	0.50	Elbow Female			1.40
		Reduce by 3 size	0.60	Elbow Male			1.60
90° Elbow			1.20	T Part Female		20x3/4x20	1.40
45° Elbow			0.50			20x1/2x20	1.60
T Part		Passage	0.25			25x3/4x25	1.60
		Separation	1.20			25x1/2x25	1.80
		Conjunction	0.80	T Part Male		20x1/2x20	1.80
		Counter Separation	1.80	Valve		20	9.50
		Counter Conjunction	3.00			25	8.50
Unequal T	Sum of T Part and Reducer Values	32	7.60				

Handling

You must NOT	1 directly contact with hazardous chemical materials	2 subject the pipe ends to shock or impact	3 use pipes that are damaged or cracked at the interfaces	
				
	4 twist pipe or fittings after joining	5 use conical threads	6 expose VESBO® to UV radiation for a long period	7 use metal plugs as connectors
				
8 subject VESBO® to heavy shocks or falling stones	9 use excessive amounts of hemp when sealing in fittings	10 heat with a naked flame	11 bind up contaminated pipes or fittings	
				
You must	1 only consider UV pipes for exposure to sun	2 handle VESBO® with care	3 only use sharp tools to cut the pipe	
				
	4 not correct by more than 5° after joining	5 only use fittings with parallel threads, not tighten too firmly	6 store VESBO® sheltered from sun and rain	7 use plastic plugs
				
8 protect exposed pipes from damage	9 only heat with hot air for bending, max bending temperature 140°C	10 use sealing tape or sealing compound; apply hemp moderately	11 only install clean material	
				

General Instructions

8.1 Transport & Storage

- Store VESBO® sheltered from sun and rain. Do not expose to UV radiation for a long period.
- Handle VESBO® with care at low temperatures. Do not store at temperatures below 0°C. Impacts can form cracks on pipes.
- Protect exposed pipes from damage; do not subject the pipe to heavy shocks or falling stones.

8.2 Installation

- Install the VESBO® pipes and fittings according to the pressure, temperature and expansion limitations indicated in VESBO's Technical Catalogue or on www.vesbo.com.
- Do not use pipes that are damaged or cracked at the interfaces. Use only special pipe cutter to shorten the pipe.
- Install only clean material; do not bind up contaminated pipes and fittings. Before welding, be sure that both pipe and fitting surfaces should be removed from chemicals and paint. If it is required to paint the installation after welding, insulate VESBO pipeline to prevent the passage of chemicals inside the paint, which will cause contamination of water or affect the service life of the installation, through the pipe wall. VESBO does not warrant any responsibility regarding the exposure to chemicals and paints. The customers are strictly recommended to consult our technical department before the design stage of the project.
- Use only fittings with parallel threads, do not use conical threads and do not tighten too firmly.
- Do not use metal plugs as connectors, prefer using plastic plugs.
- While sealing in fittings use sealing tape or sealing compound. If you have to use hemp; apply hemp moderately; do not use excessive amounts of hemp.
- For hot bending of pipes, a hot air gun should be used, not an open flame.
- The hot air temperature meeting the PP-R pipe surface should not exceed 140°C.
- Do not twist pipes or fittings after joining; correct by not more than 5°.
- For exterior installation, it is necessary to insulate VESBO to prevent excessive heat loss and to protect from UV radiation.
- For a good welding joint, refer to the welding depths and periods that are indicated in VESBO's Technical Catalogue Part 4. Ensure that the indicator light on the welding tool signals that the tool is hot enough (260°C).
- It is recommended to cut the pipe ends by 4–5cm before the welding process.
- Temperature of the welding adaptors should be high enough for welding process. After the indicator light on the welding machine switches off, adaptors' temperature will be suitable for welding. Welding process should be carried out after this signal. Cold welding affects the stabilization of the raw material and service life of the product.
- Everyday usage of the machine may cause excess temperature of 300–320°C. Excessive heat causes excessive melting of the material. To prevent this, the operator should wait the 2nd signal of the indicator light, since the adaptors' temperature does not change and fixes at 260°C after the 2nd signal.
- VESBO Caps are used ONLY during the pressure tests which should be carried out after the installation of the piping system. Do not use as a permanent stopper at the pipeline ends. Prefer fittings with parallel threads.

8.3 Chemical Resistance

- Consult VESBO Technical Department for transportation of a chemical before installation.
- Remove the installation from chemicals that can affect the service life. VESBO does not warrant any responsibility for the contaminated water that has been affected by permeable chemicals.

Warning: VESBO products are not to be used with compressed air or gases. VESBO does not recommend that piping systems that include its products or components be tested with compressed air or compressed gases.

What the Consumer Should Do

What the Consumer Should Do

The original end user should immediately notify VESBO of any manufacturing defect and provide proof of the date of installation, as well as proof of property ownership, in order to provide VESBO an opportunity to investigate the claim and examine the material claimed to be defective. All notifications must be sent to Novaplast Plastik San. Ve, Tic. A.S., ATTN: Quality & Control Dept. If requested, the original end user must submit a sample of the allegedly defective material to VESBO for analysis (shipping to be paid by VESBO). VESBO will then investigate the claim and examine the material claimed to be defective. If a defect covered by this warranty is confirmed, VESBO, within a reasonable amount of time after the inspection, will make the necessary repair or replacement, per the terms of this warranty.

Disclaimer

VESBO accepts no responsibility or liability whatsoever with regard to the any failure, defect or damage caused by situations and events including, but not limited to, the following:

- Misuse, abuse, neglect or improper handling or storage.
- Improper installation or use of accessories not in strict adherence to VESBO's below mentioned written general instructions.
- Defects in other manufacturers' components incorporated during installation.
- Fire, earthquake, flood, lightning, hurricane, tornado or other casualty or acts of God.
- Exposure to chemicals and many other local influences over which VESBO has no control.
- Any other cause not involving inherent manufacturing defects in the pipes and fittings supplied by VESBO.

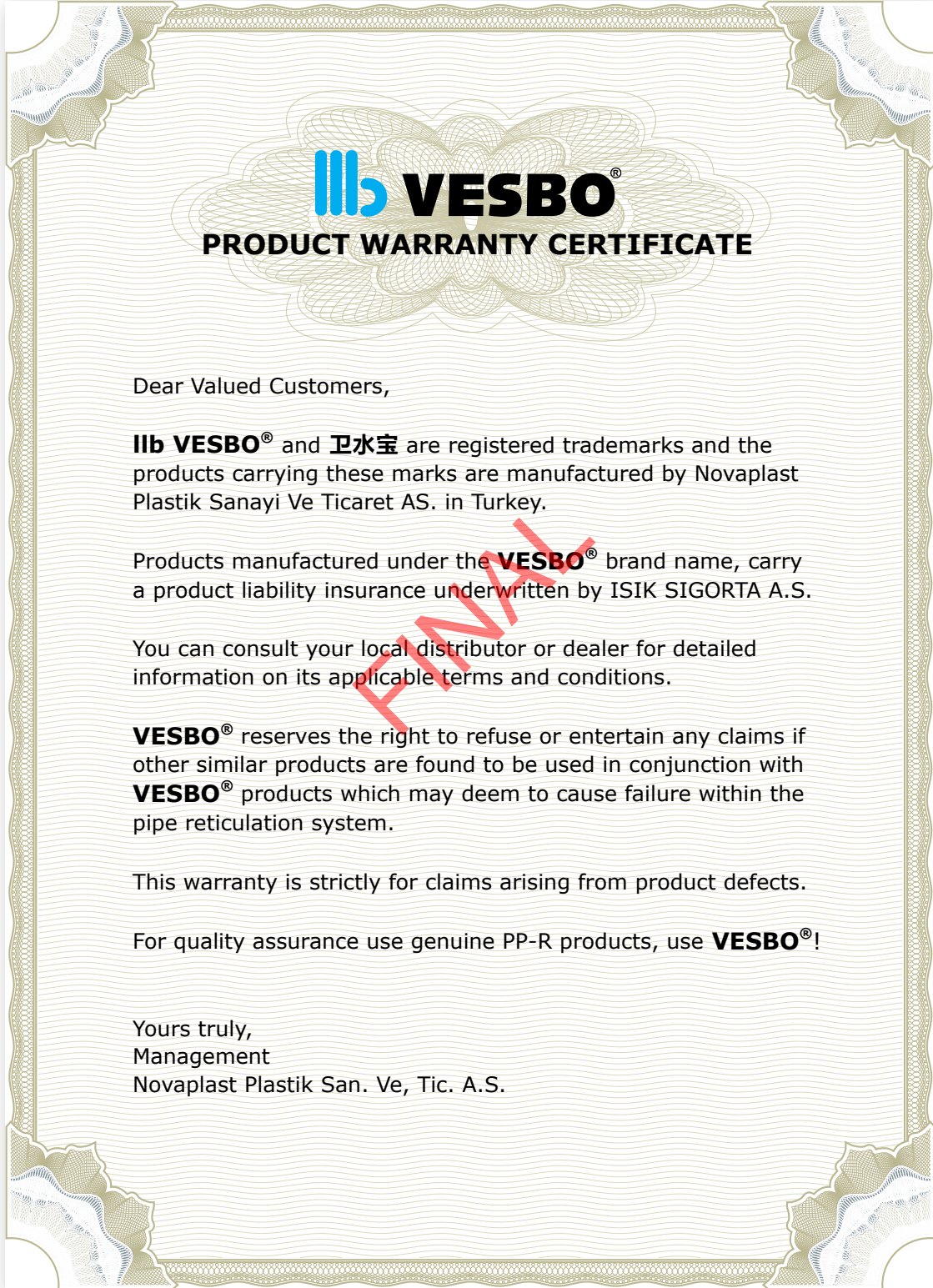
The pipes and fittings are not warranted against color discoloration or other damage caused by normal weathering resulting from exposure to the elements. Normal weathering is defined as exposure to sunlight and extremes of weather and atmosphere which will cause any colored surface to gradually fade or accumulate stains.

VESBO shall have sole discretion to determine whether the pipes and fittings are suffering from normal weathering, which conclusion shall be based on reasonable criteria. In the event the material weathers to a degree which is determined by VESBO to be beyond normal, then VESBO shall either repair or replace, at its option.

VESBO reserves the right to discontinue or modify any of its products.

VESBO® and 卫水宝 is a registered trademark of Novaplast Plastik San. ve Tic. A.S.

Product Warranty



Dear Valued Customers,

Ilb VESBO® and **卫水宝** are registered trademarks and the products carrying these marks are manufactured by Novaplast Plastik Sanayi Ve Ticaret AS. in Turkey.

Products manufactured under the **VESBO®** brand name, carry a product liability insurance underwritten by ISIK SIGORTA A.S.

You can consult your local distributor or dealer for detailed information on its applicable terms and conditions.

VESBO® reserves the right to refuse or entertain any claims if other similar products are found to be used in conjunction with **VESBO®** products which may deem to cause failure within the pipe reticulation system.

This warranty is strictly for claims arising from product defects.

For quality assurance use genuine PP-R products, use **VESBO®!**

Yours truly,
Management
Novaplast Plastik San. Ve, Tic. A.S.



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