BERKE PLASTİK SAN.TİC.A.Ş.

BERKE PPR PRODUCTS TECHNICAL BROCHURE

Contents

1. COMPANY

Berke has three different production facilities for PPR pipes and fittings all located in Sakarya.

The company is certified with ISO 9001:2008 as customer satisfaction, environment, occupational health and safety are very important to Berke.

Polypropylene Product Range
Polypropylene Pipe & Fittings Systems
PP-glass fiber-PP pipe
PP-aluminum-foil-PP pipe

2. TECHNICAL SPECIFICATIONS OF THE RAW MATERIAL

Our raw material PP-R (Polypropylene Random Copolymer Type 3) is a proven, high performance random copolymer that enables the production of top quality solutions for hot & cold water piping applications.

Physical, Thermal and Mechanical Properties

Properties	Testing Methods	Unit	Values
Physical properties			
Density, at 23° C	ISO 1183	g/cm^3	0.9
Melt flow index (MFI) 190 C°/ 5 kg	ISO 1133	g/10 min	<0.8
Melt flow index (MFI) 230 C°/ 2.16 kg	ISO 1133	g/10 min	<0.5
Linear expansion coefficient	DIN 8078	K^{-1}	1.5 x 10^{-4}
Heat conductivity	DIN 8078	WK^{-1}m^{-1}	0.23
Surface resistance, (min)	DIN 8078	Ω	>10^{12}
Elasticity module	DIN 8078	N/mm²	800
Thermal properties			
Melting point	DSC	°C	146–150
Subjective heat	Calorimeter	Kj/kgK	1.73
Coefficent of linear expansion	ASTM D 696	mm / m(°C)	0.15
Deflection temperature under load 1.8MPa	ISO 75A–1, -2	°C	46
VICAT softening point	ISO 306	°C	132
Mechanical properties			
Tensile stress at Yield, at 50 mm/min		Mpa	25
Elongation at yield, at 50 mm/min	ISO 527–1,-2	%	13
Elongation at break at 50mm/min		%	>500
Charpy impact strength (0 °C)	ISO 179	15J	No break

Thanks to its high exceptional heat stability, extraction resistance, stable processing characteristics, and ease of welding and installation, random copolymer enables pipes with reliable performance to be manufactured.

-Extremely long life of at least 50 years

-Taste and odour neutral

-Excellent weldability

-Good chemical resistance

-Bacteriologically neutral

-Physiologically harmless

3. TECHNICAL SPECIFICATIONS OF THE PRODUCTS

3.1 - Long service life
With all water carrying pipes, resistance to internal pressure is an important factor affecting long life characteristics.

To assure optimal life performance, straight and curved pipes have been subjected to extensive hydrostatic pressure testing at a variety of temperatures in the laboratory.

3.2 - Long-lasting performance
Random copolymer that is used for production of Berke pipes and fittings can withstand temperatures up to 70° C without losing shape, and handle short duration temperatures of up to 100° C.

Combined with good chemical resistance and impact strength, Berke pipes can simply be installed and forgotten about for at least 50 years.

Particularly important for domestic water installations, is the fact that random copolymer type 3 is physiologically harmless, and taste and colour neutral.

3.3 - Excellent stability
In use, the formulation of Berke pipes is such that it offers a high molecular weight, plus excellent mechanical properties. Additional benefits include high heat stability as well as excellent resistance to extraction.

Berke pipes and fittings conform to DIN 8077/78, EN ISO 15874 -1,2,3 and DIN 16962 standards.

3.4 - Easy installation, cost-effective
Whatever the complexity of a domestic water installation, Berke pipes have the ability to be shaped to conform to even the most complex layouts.

Berke pipes' easy weldability also makes them faster and simpler to install.

3.5 - Measuring hydrostatic pressure performance

Hydrostatic pressure is calculated according to the below formula:

$$P = \sigma \times \frac{2e_{min}}{(d_{em} - e_{min})}$$

P = internal pressure, MPa

d_{em} = outside diameter of the pipe, mm

e_{min} = minimum wall thickness of the pipe, mm

σ = Hydrostatic stress, MPa

1 Mpa = 10 bar

3.6 - Service life DIN 8077 (SF=1.5 PP-R)

Temperature	services Life	Pipe Series (S) - Standard Dimension Rate (SDR)							
		5	11	3.2	7.4	2.5	6	2	5
°C	(Year)	PN 10		PN 16		PN 20		PN 25	
		pressure (bar)							
20	1	15.0		23.7		29.9		37.7	
	5	14.1		22.3		28.1		35.4	
	10	13.7		21.7		27.4		34.5	
	25	13.2		21.0		26.4		33.3	
	50	12.9		20.4		25.7		32.4	
40	1	10.8		17.1		21.6		27.2	
	5	10.1		16.0		20.2		25.4	
	10	9.8		15.5		19.6		24.7	
	25	9.4		15.0		18.8		23.7	
	50	9.2		14.5		18.3		23.1	
60	1	7.7		12.2		15.4		19.4	
	5	7.1		11.3		14.3		18.0	
	10	6.9		11.0		13.9		17.5	
	25	6.6		10.5		13.3		16.7	
	50	6.4		10.2		12.9		16.2	
70	1	6.5		10.3		12.9		16.3	
	5	6.0		9.5		12.0		15.1	
	10	5.8		9.2		11.6		14.6	
	25	5.0		8.0		10.0		12.7	
	50	4.2		6.7		8.5		10.7	
80	1	5.4		8.6		10.8		13.7	
	5	4.8		7.6		9.6		12.1	
	10	4.0		6.4		8.1		10.2	
	25	3.2		5.1		6.5		8.1	
95	1	3.8		6.1		7.6		9.6	
	5	2.6		4.1		5.2		6.5	

3.7 - Metal component compatibility

Where metal inserts are to be used in an installation the recommended choice is nickel-plated brass components in order not to harm raw material properties. All the metal inserts used in production of Berke metal/plastic fittings are nickel-plated brass components that do not harm the raw material.

3.8 - Chemical resistance

Polypropylene has very good chemical resistance.

Chemical Resistance of Polypropylene. at 20. 60 and 100°C

Chemical or Product	Concentration	Temperature °C		
		20	60	100
Acetic acid	Up to 40 %	S	S	-
Acetic acid	50 %	S	-	-
Acetic acid. Glacial	> 96 %	S	L	NS
Acetic anhydride	100 %	S	-	-
Acetone	100 %	S	S	-
Aceptophenone	100 %	S	L	-
Acrylonitrile	100 %	S	-	-
Air		S	S	S
Allyl alcohol	100 %	S	S	-
Almond oil		S	-	-
Alum	Sol	S	S	-
Ammonium acetate	Sat.sol	S	S	-
Ammonium fluoride	Up to 20%	S	S	-
Ammonium hydrogen carbonate	Sat.sol	S	S	-
Ammonium metaphosphate	Sat.sol	S	S	S
Ammonium nitrate	Sat.sol	S	S	S
Ammonium persulphate	Sat.sol	S	S	-
Ammonium sulphide	Sat.sol	S	S	-
Amyl acetate	100 %	L	-	-
Amyl alcohol	100 %	S	S	S
Aniline	100 %	S	S	-
Apple juice		S	-	-
Barium bromide	Sat.sol	S	S	S
Barium carbonate	Sat.sol	S	S	S
Barium hydroxide	Sat.sol	S	S	S
Barium sulphide	Sat.sol	S	S	S
Benzene	100 %	L	NS	NS
Benzoic acid	Sat.sol	S	S	-
Benzyl alcohol	100 %	S	L	-
Boron trifluoride	Sat.sol	S	-	-
Bromine. Gas		NS	NS	NS
Bromine. Liquid	100 %	NS	NS	NS
Butanol	100 %	S	L	L
Butyl acetate	100 %	L	NS	NS
Butyl glycol	100 %	S	-	-
Butyl phenols	Sat.sol	S	-	-
Butyl phthalate	100 %	S	L	L

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Chemical or Product	Concentration	Temperature °C		
		20	60	100
Calcium carbonate	Sat.sol	S	S	S
Calcium chlorate	Sat.sol	S	S	-
Calcium chloride	Sat.sol	S	S	S
Calcium hydroxide	Sat.sol	S	S	S
Calcium hypochlorite	Sol	S	-	-
Calcium nitrate	Sat.sol	S	S	-
Carbon dioxide. dry gas		S	S	-
Carbon dioxide. wet gas		S	S	-
Carbon disulphide	100 %	S	NS	NS
Carbon monoxide. Gas		S	S	-
Carbon tetrachloride	100 %	NS	NS	NS
Castor oil	100 %	S	S	-
Caustic soda	Up to 50%	S	L	L
Chlorine. dry gas	100 %	NS	NS	NS
Chlorine. Liquid	100 %	NS	NS	NS
Chloroacetic acid	Sol	S	-	-
Chloroethanol .	100%	S	-	-
Chloroform	100%	L	NS	NS
Chlorosulphonic acid	100%	NS	NS	NS
Chrome alum	Sol	S	S	-
Chromic acid	Up to 40%	S	L	NS
Citric acid	Sat.sol	S	S	S
Coconut oil		S	-	-
Copper (ll) chloride	Sat.sol	S	S	-
Copper (ll) nitrate	Sat.sol	S	S	S
Copper (ll)	Sat.sol	S	S	-
Corn oil		S	L	-
Cottonseed oil		S	S	-
Cyclohexane	100%	S	-	-
Cyclohexanol	100%	S	L	-
Cyclohexanone	100%	L	NS	NS
Dextrin	Sol	S	S	-
Dextrose	Sol	S	S	S
Dibutyl phthalate	100%	S	L	NS
Dichloroacetic acid	100%	L	-	-
Dichloroethylene (A and B)	100%	L	-	-
Diethanolamine	100%	S	-	-
Diethyl ether	100%	S	L	-
Diethylene glycol	100%	S	S	-
Diglycolic acid	Sat.sol	S	-	-
Diisooctyl	100%	S	L	-
Dimethyl amine. Gas		S	-	-
Dimethyl formamide	100%	S	S	-
Dioctyl phthalate	100%	L	L	-
Distilled water	100%	S	S	S
Ethanolamine	100%	S	-	-
Ethyl acetate	100%	L	NS	NS

Chemical or Product	Concentration	Temperature °C		
		20	60	100
Ferric chloride	Sat.sol	S	S	S
Formic acid	10 %	S	S	L
Formic acid	85 %	S	NS	NS
Fructose	Sol	S	S	S
Fruit juice		S	S	S
Gasoline. petrol (aliphatic hydrocarbons)		NS	NS	NS
Gelatine		S	S	-
Glucose	20 %	S	S	S
Glycerine	100 %	S	S	S
Glycolic acid	30 %	S	-	-
Hexane	100 %	S	L	-
Hydrochloric acid	Up to 20 %	S	S	S
Hydrochloric acid	30 %	S	L	L
Hydrochloric acid	From 35 to 36 %	S	-	-
Hydrofluoric acid	Dil.sol	S	-	-
Hydrofluoric acid	40 %	S	-	-
Hydrogen	100 %	S	-	-
Hydrogen chloride. dry gas	100 %	S	S	-
Hydrogen peroxide	Up to 30 %	S	L	-
Hydrogen sulphide. dry gas	100 %	S	S	-
Iodine. in alcohol		S	-	-
Isopropyl alcohol	100 %	S	S	S
Isopropyl ether	100 %	L	-	-
Lactic acid	Up to 90 %	S	S	-
Lanoline		S	L	-
Linseed oil		S	S	S
Magnesium carbonate	Sat.sol	S	S	S
Magnesium chloride	Sat.sol	S	S	-
Magnesium hydroxide	Sat.sol	S	S	-
Magnesium sulphate	Sat.sol	S	S	-
Maleic acid	Sat.sol	S	S	-
Mercury (ll) chloride	Sat.sol	S	S	-
Mercury (ll) cyanide	Sat.sol	S	S	-
Mercury (l) nitrate	Sol	S	S	-
Mercury	100 %	S	S	-
Methyl acetate	100 %	S	S	-
Methyl amine	Up to 32 %	S	-	-
Methyl bromide	100 %	NS	NS	NS
Methyl ethyl ketone	100 %	S	-	-
Methylene chloride	100 %	L	NS	NS
Milk		S	S	S
Monochloroacetic acid	>85 %	S	S	-

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Chemical or Product	Concentration	Temperature °C		
		20	60	100
Nickel chloride	Sat.sol	S	S	-
Nickel nitrate	Sat.sol	S	S	-
Nickel sulphate	Sat.sol	S	S	-
Nitric acid	From 40 to 50 %	L	NS	NS
Nitric acid. fujming (with nitrogen dioxide)		NS	NS	NS
Oleic acid	100 %	S	L	-
Oleum (sulphuric acid with 60 % of SO3)		S	L	-
Olive oil		S	S	L
Oxalic acid	Sat.sol	S	L	NS
Oxygen. Gas		S	-	-
Paraffin oil (FL65)		S	L	NS
Peanut oil		S	S	-
Peppermint oil		S	-	-
Perchloric acid	(2N) 20%	S	-	-
Petroleum ether (ligroin)		L	L	-
Phenol	5%	S	S	-
Phenol	90%	S	-	-
Phosphine.gas		S	S	-
Phosphorus oxychloride	100%	L	-	-
Picric acid	Sat.sol	S	-	-
Potassium bicarbonate	Sat.sol	S	S	S
Potassium borate	Sat.sol	S	S	-
Potassium bromated	Up to 10%	S	S	-
Potassium bromide	Sat.sol	S	S	
Potassium carbonate	Sat.sol	S	S	
Potassium chlorate	Sat.sol	S	S	
Potassium chlorite	Sat.sol	S	S	
Potassium chromate	Sat.sol	S	S	
Potassium cyanide	Sol	S	-	
Potassium dichromate	Sat.sol	S	S	S
Potassium ferricyanide	Sat.sol	S	S	-
Potassium fluride	Sat.sol	S	S	-
Ptassium iodide	Sat.sol	S	-	-
Potassium nitrate	Sat.sol	S	S	-
Potassium perchlorate	10%	S	S	-
Potassium permanganate	(2 N) 30%	S	-	-
Potassium persulphate	Sat.sol	S	S	-
Propionic acid	>50%	S	-	-
Pyridine	100%	L	-	-
Sea water		S	S	S
Silver nitrate	Sat.sol	S	S	L
Sodium acetate	Sat.sol	S	S	S
Sodium benzoate	35%	S	L	-
Sodium bicarbonate	Sat.sol	S	S	S
Sodium carbonate	Up to 50%	S	S	L
Sodium chlorite	20%	S	L	NS

Chemical or Product	Concentration	Temperature °C		
		20	60	100
Sodium dichromate	Sat.sol	S	S	S
Sodium hydrogen carbonate	Sat.sol	S	S	S
Sodium hydrogen sulphate	Sat.sol	S	S	-
Sodium hydrogen sulphite	Sat.sol	S	-	-
Sodium hypochlorite	5%	S	S	-
Sodium hypochlorite	10%-15%	S	-	-
Sodium hypochlorite	20%	S	L	-
Sodium metaphosphate	Sol	S	-	-
Sodium nitrate	Sat.sol	S	S	-
Sodium perorate	Sat.sol	S	S	-
Sodium phısohate (neutral)		S	S	S
Sodium silicate	Sol	S	S	-
Sodium sulphate	Sat.sol	S	S	-
Sodium sulphide	Sat.sol	S	-	-
Sodium sulphite	40%	S	S	S
Sodium thiosulphate (hypo)	Sat.sol	S	-	-
Say-bean oil		S	L	-
Succinic acid	Sat.sol	S	S	-
Sulphur acid	From 10 to 30 %	S	S	-
Sulphuric acid	50 %	S	L	L
Sulphuric acid	96 %	S	L	NS
Sulphurous acid	Up to 30 %	S	-	-
Tartaric acid	Sat.sol	S	S	-
Tetrahydrofuran	100 %	L	NS	NS
Tetralin	100 %	NS	NS	NS
Thiophene	100 %	S	L	-
Tin(IV) chloride	Sol	S	S	-
Tin (II) chloride	Sat.sol	S	S	-
Toluene	100 %	L	NS	NS
Trichloroacetic acid	Up to 50 %	S	S	-
Trichloroethylene	100 %	NS	NS	NS
Triethanolamine	Sol	S	-	-
Turpentine		NS	NS	NS
Urea	Sat.sol	S	S	-
Vinegar		S	S	-
Water brackish. mineral. potable		S	S	S
Wines		S	S	-
Xylene	100%	NS	NS	NS
Yeast	Sol	S	S	S
Zinc chloride	Sat.sol	S	S	-
Zinc sulphate	Sat.sol	S	S	-

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S = Satisfactory

L = Limited

NS = Not Satisfactory

Sat. sol= Saturated aqueous solution. prepared at 20°C

Sol = Aqueous solution at a concentration higher than 10% but not saturated

Dil. sol = Dilute aqueous solution at a concentration equal to or lower than 10%

Work. sol= Aqueous solution having the usual concentration for industrial use

3.9 - Thermal expansion of Berke pipes and support intervals

Pipes elongate when heated. These changes in longitude should be taken into consideration especially during installation of hot water installations.

To prevent unwanted bendings the pipes should be supported at designated intervals. Freely selected fixed supports should be arranged so as to balance the length changes via changing the direction of the flow in the installation.

If it is possible to balance such an expansion, as in the case of straight pipelines in between the two fixed supports, resilience balancers are applied. During the assembly of the resilience balancers longitudinal changes caused by the functioning of the installation and by the changes in the environmental temperatures should be taken into account.

3.9.1 - Thermal expansion of BERKE pp-r pipe

Calculation of thermal expansion is as follows:

$\Delta L = L * \Delta T * \lambda$

where

ΔT= variation of working temperature in Kelvin degrees (K) or Celsius (°C)

ΔL= variation of length in mm

L = initial length of the pipe in m

λ = coefficient of linear thermal expansion. The value of λ is $1.5 * 10^{-4}$ (K^{-1}) for pp-r pipe.
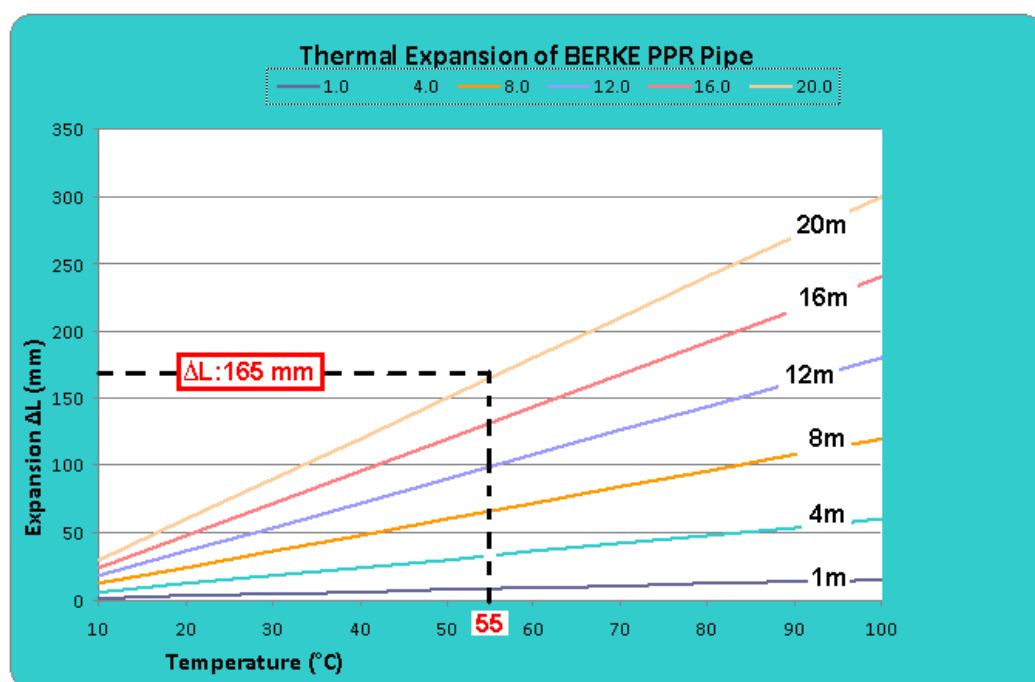
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Pipe length (m)	Temperature variation ΔT in K										
	5	10	20	30	40	50	60	70	80	90	100
	Linear expansion ΔL (mm)										
1.0	0.75	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0
4.0	3,0	6.0	12.0	18.0	24.0	30.0	36.0	42.0	48.0	54.0	60.0
8.0	6,0	12.0	24.0	36.0	48.0	60.0	72.0	84.0	96.0	108.0	120.0
12,0	9,0	18.0	36.0	54.0	72.0	90.0	108.0	126.0	144.0	162.0	180.0
16,0	12,0	24.0	48.0	72.0	96.0	120.0	144.0	168.0	192.0	216.0	240.0
20,0	15,0	30.0	60.0	90.0	120.0	150.0	180.0	210.0	240.0	270.0	300.0

3.9.2 - *Thermal expansion of BERKE pp-r aluminum-foil pipe*

Calculation of thermal expansion is as follows:

$$\Delta L = L * \Delta T * \lambda$$

where

ΔT= variation of working temperature in Kelvin degrees (K) or Celsius (°C)
ΔL= variation of length in mm
L = initial length of the pipe in m
λ = coefficient of linear thermal expansion. The value of λ is $0,3 * 10^{-4}$ (K^{-1}) for pp-r foil tubes.
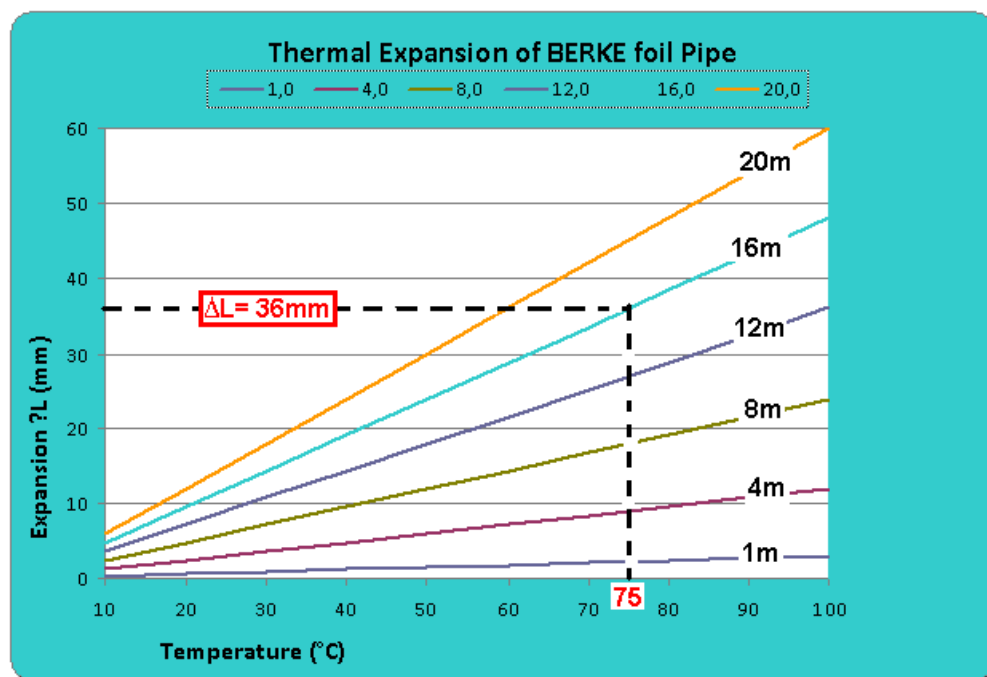
Thermal Expansion of BERKE foil Pipe

Pipe length (m)	Temperature variation ΔT in K										
	5	10	20	30	40	50	60	70	80	90	100
	Linear expansion ΔL (mm)										
1.0	0,15	0,30	0,60	0,90	1,20	1,50	1,80	2,10	2,40	2,70	3,00
4.0	0,60	1,20	2,40	3,60	4,80	6,00	7,20	8,40	9,60	10,80	12,00
8.0	1,20	2,40	4,80	7,20	9,60	12,00	14,40	16,80	19,20	21,60	24,00
12,0	1,80	3,60	7,20	10,80	14,40	18,00	21,60	25,20	28,80	32,40	36,00
16,0	2,40	4,80	9,60	14,40	19,20	24,00	28,80	33,60	38,40	43,20	48,00
20,0	3,00	6,00	12,00	18,00	24,00	30,00	36,00	42,00	48,00	54,00	60,00

3.9.3 - Thermal expansion of BERKE pp-r fiberglass pipe

Calculation of thermal expansion is as follows:

$$\Delta L = L * \Delta T * \lambda$$

where

ΔT = variation of working temperature in Kelvin degrees (K) or Celsius (°C)

ΔL = variation of length in mm

L = initial length of the pipe in m

λ = coefficient of linear thermal expansion. The value of λ is $0,35 * 10^{-4}$ (K^{-1}) for pp-r fiberglass pipe.
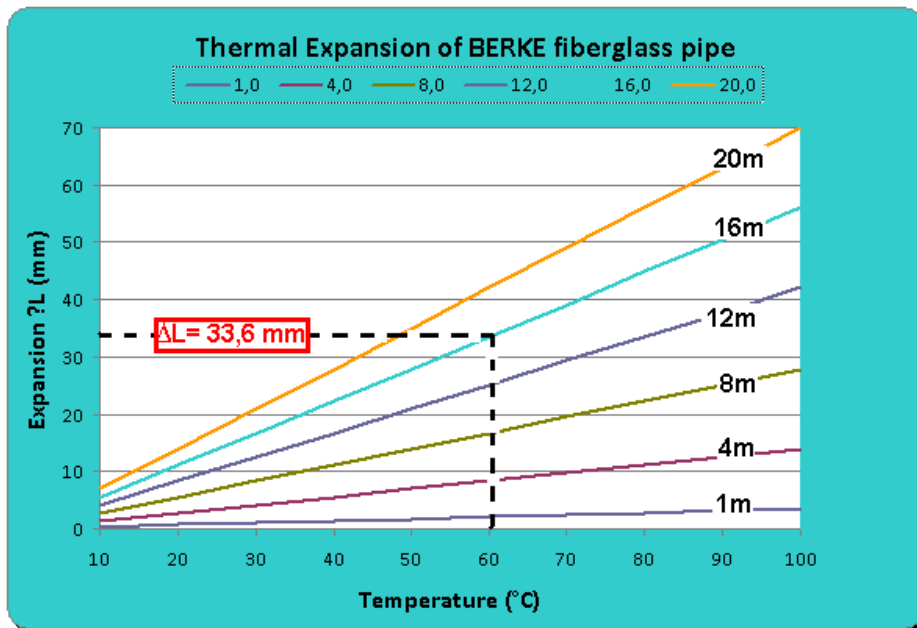
Pipe length (m)	Temperature variation ΔT in K										
	5	10	20	30	40	50	60	70	80	90	100
	Linear expansion ΔL (mm)										
1.0	0,17	0,35	0,70	1,05	1,40	1,75	2,10	2,45	2,80	3,15	3,50
4.0	0,70	1,40	2,80	4,20	5,60	7,00	8,40	9,80	11,20	12,60	14,00
8.0	1,40	2,80	5,60	8,40	11,20	14,00	16,80	19,60	22,40	25,20	28,00
12,0	2,10	4,20	8,40	12,60	16,80	21,00	25,20	29,40	33,60	37,80	42,00
16,0	2,80	5,60	11,20	16,80	22,40	28,00	33,60	39,20	44,80	50,40	56,00
20,0	3,50	7,00	14,00	21,00	28,00	35,00	42,00	49,00	56,00	63,00	70,00

3.9.4 - Calculation of elongation

Length of the flexible pipe side is calculated with the following formula.

$$Ls = K\sqrt{d \times \Delta L}$$

Ls = Length of the flexible pipe side, mm

d = Outer dimater of the Borex pipe, mm

ΔL = Variation of length, mm

K = 15 (material based constant of Berke pipe)

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FP =Fixed Point
MP =Moving Point

FP = Fixed Point
MP =Moving Point

FP = Fixed Point
MP = Moving Point
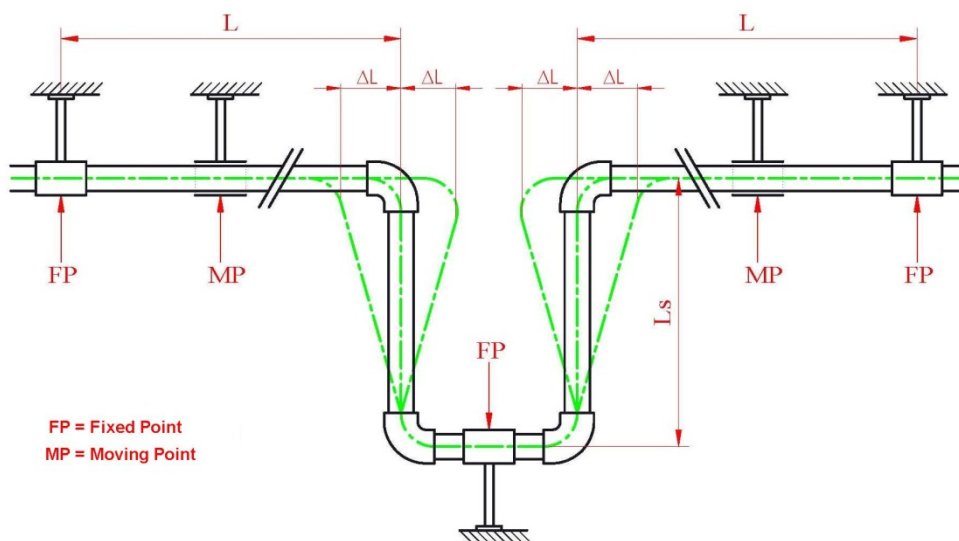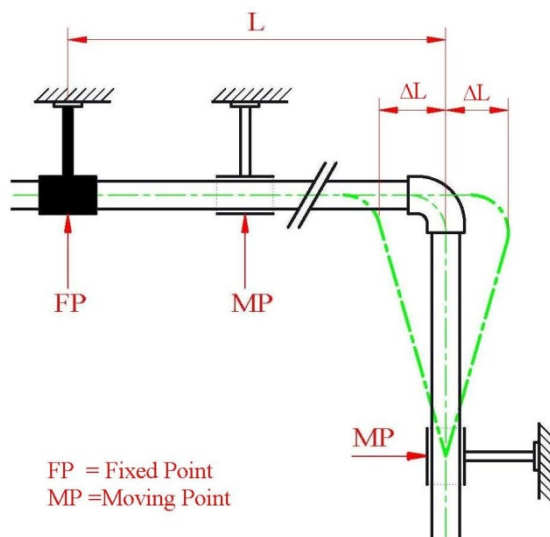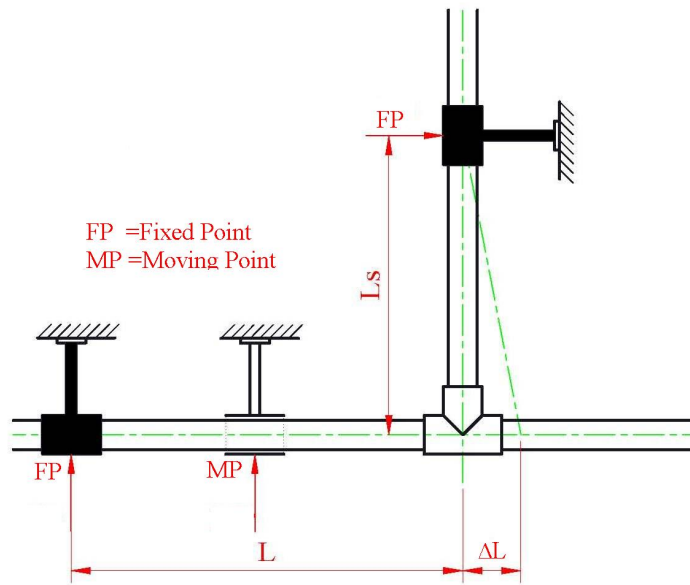
Example :

L = 5m	$\Delta L = L * \Delta T * \lambda$	Ls = K $\sqrt{d}$ x ΔL
ΔT = 50 °C	ΔL = 5*50*0,15	Ls = 15$\sqrt{40}$*37,5
Ød = 40mm	ΔL = 37,5 mm	Ls = 580 mm
Ls =?		

1. Calculation of thermal expansion:

Temperature difference between cold water and environment:

Input

λ = 0.15 mm/m-K

L = 2.0 m

ΔT = 40K (ºC)

Required

$\Delta L = \lambda \times \Delta T \times L$

ΔL = 0.15x 40x2.0 = 12 mm

2. The calculation of the shortest flexible length:

d = 40 mm

ΔL = 12 mm

K = 15

$Ls = K * \sqrt{d} * \Delta L$

$Ls = 15 * \sqrt{40} * 12 = 328$ mm

3.9.5 - Support intervals

Berke PP-R pipe SDR:6 – SDR:7.4 (PN20 – PN16)

Temperature ΔT (K)	Pipe diameter d (mm)								
	20	25	32	40	50	63	75	90	110
	Support intervals in cm								
20	60	70	90	100	120	140	150	160	180
30	60	70	90	100	120	140	150	160	180
40	60	70	80	90	110	130	140	150	170
50	60	70	80	90	110	130	140	150	170
60	50	60	70	80	100	110	120	140	160
70	50	60	70	80	90	100	110	120	140

Assembly Principles

Radial and axial expansion of the pipe should not be prevented to obtain good results during outdoor assembly. Fixed supports should be chosen in such a way that they do not damage the outer surface of the pipe.

Fixed Support

Fixed supports are used to fix the pipe at certain points against undesired pipe movements. Fixed supports should be stronger compared to the moving supports. At the points where direction changes fixed supports should not be used. The distance between the fixed supports must be chosen according to calculation of Elongation in 3.9.4.

Type of Assembly for Installation of the Flat

To allow for subsequent linear expansion of the pipes, one of the techniques below should be used for making the connections at the entrances of flats.
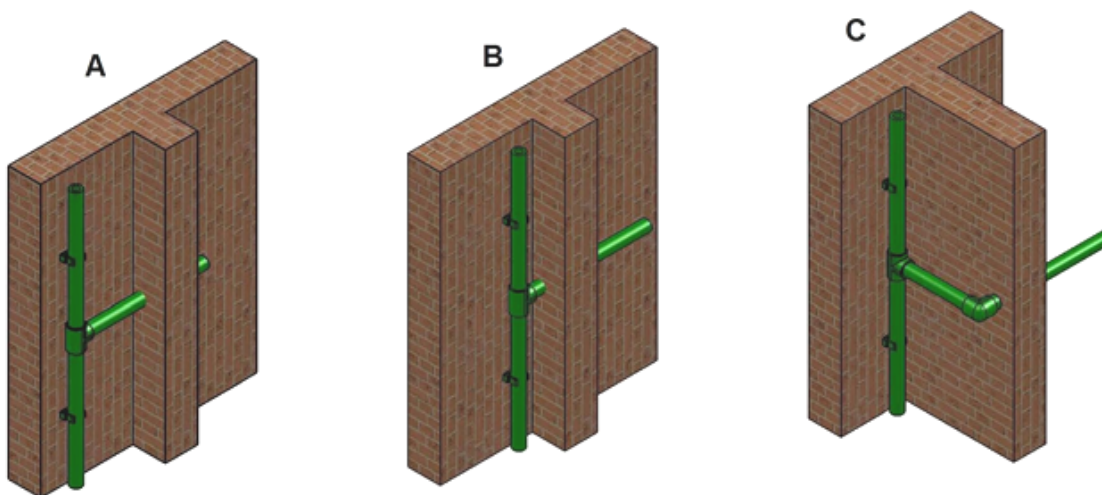
A: This connection should be made particularly with a distance from the wall

B: The connec should be made allowing awide hole at the point where the pipe enters the flat.

C: The pipe can be inserted into the entrance point of the flat, through an "L" formed arm.

3.9.6 - Insulation

PPR tubes require less insulation compared to other types of pipes under the same conditions. Nevertheless, in cold and hot climates some insulation is required against freezing and heat loss over heating. These are caused by factors such as sun light, rain, snow when the pipes are laid outside. Another advantage of the insulation layer is the protection it provides against impacts.

General

Pipe insulation shall be designed to meet the following requirements:

a) Legal and other obligations
b) Insulation material shall be adequately protected against moisture.
c) Insulation material shall ensure that the water is maintained at the designed operating temperature.

The insulating effect is mainly a function of the thickness of the insulation and its thermal conductivity, and increases in direct proportion to the temperature. The performance of insulating materials is impaired if they are moist. Open-cell and fibrous insulating materials shall be provided with a vapour barrier bonded to the outher surface of the insulation.

Condensation can form on any insulating material if the cold water pipes are inadequately lagged. Unsuitable material may lead to the moisture penetrating to the pipe. Thus, closed-cell materials with a high moisture resistance should be used to insulate cold water pipes. All but joints, cuts, seams and ends shall be sealed.

If pipes are located in areas where frost damage is likely, even insulation cannot always prevent freezing if the system is not in service. The pipes shall, therefore, be drained or otherwise protected.

Protection of cold water system against warmth and condensation.

Cold water pipework shall be adequately protected against heat sources and condensation, if necessary.

Cold water pipe shall be installed sufficiently far away from heat sources (e.g. hot pipes, chimneys, boilers). Where this is not possible, the pipes shall be insulated so that the water quality is not impaired by the heat.

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For residential applications, the insulation thickness specified in table A shall be used, assuming normal service conditions. Insulation will not provide permanent protection of the water against warming.

The specifications of table A are also applicable where the protection against condensation on the outer surface of the insulation is concerned, assuming a water temperature of 10°C.

Protection against condensation is not required if the pipe is provided with a suitable sheathing (e.g. ducted pipe).

Table A - Recommended minimum thickness of insulation for cold water pipes

Location of pipe	Insulation Thickness λ=0,040 W/mK *)
Exposed pipes, in unheated room (e.g. cellar)	4 mm
exposed pipes, in heated room	9 mm
Ducted pipes, (cold water only)	4 mm
Ducted pipes, (cold and hot water)	13 mm
Chased pipes, risers	4mm
Pipes in wall recess, next to hot pipes	13 mm
Pipes on concrete floor	4 mm
*) for other values of λ, the thickness is to be obtained by conversion, on the basis of a pipe diameter of 20 mm.	

Protection of hot water pipes against heat loss

The minimum requirements specified in the heizungsanlagen-verordnung (heating system regulation) shall be complied with for restricting the heat loss of hot pipes, including circulation pipes.

Thermal insulation of warm water pipes

The decree for energy saving thermal protection and energy saving technique for buildings. Decree for energy saving (EnEV) regulates the thermal insulation of pipes and fittings in Germany.

Table B - Minimum Thickness of insulation warm water pipes

line	Type of pipe / fitting	Minimum Thickness of insulation refered to thermal conductivity of λ=0,035 W/mK
1	Inner diameter up to 22 mm	20 mm
2	Inner diameter more than 22 mm up to 35	30 mm
3	Inner diameter more than 35 mm up to 100	Same as inner diameter
4	Inner diameter more than 100 mm	100 mm

Insulation Thickness

Pipe Outer Diameter	Available Thickness Acc.to 2 HAVO λ=0,035 W/mK	Insulation Thickness in BERKE Pipes λ=0,035 W/mK
20x3,4 mm	20 mm	20 mm
25x4,2 mm	20 mm	20 mm
32x5,4 mm	20 mm	20 mm
40x6,7 mm	30 mm	30 mm
50x8,3 mm	30 mm	30 mm
63x10,5 mm	42 mm	42 mm
75x12,5 mm	50 mm	50 mm
90x15,0mm	60 mm	60 mm
110x18,3mm	73,4 mm	73,4 mm

4. STANDARDS

DIN 8077 Polypropylene(PP) pipes. PP-H. PP-B. PP-R. PP-RCT dimensions

DIN 8078 Polypropylene (PP) pipes. PP-H. PP-B. PP-R. PP-RCT general quality requirements and testing

DIN 16962- Pipe fittings and joint assemblies for polypropylene(PP) pressure pipes. Part 5- General Quality Requirements and Testing. Part 6- Injection Moulded Elbows for socket- welding Dimension. Part 9 Injection Moulded reducers and nipples for socket welding Dimension.

DIN 1988 – Drinking water supply systems – Part 1 General, Part 2 Materials, components, appliances, design and installation.

EN ISO 15874 -plastic piping systems for hot and cold water installations Polypropylene(PP)-Part 1 – general. Part 2 – pipe. Part 3 – fittings. Part 5- fitness for purpose of the system. Part 7 – guidance for the assessment of conformity

DVGW W 544 - Plastic pipes in the drinking water installation; Requirements and testing

DVGW W 270 – Hygienic and toxicological tests

SKZ HR 3.10 : Specification for Tests and inspection-pressure pipe system made of PP

RP 001.52-AENOR mark specific rules for plastics piping systems for hot and cold water installations

DVS 2207- Welding of thermoplastics materials heated tool welding of piping system and sheets of PP.

5. TRANSPORTING, UNLOADING AND STORAGE FOR PRODUCT

It is important to choose the right storage area for the products. PP pipes should be placed horizontally on clear surfaces, pipes should not be bent to avoid damage during transportation and storage.

During transportation, unloading and storage of products avoid contact with hard objects to prevent damages like tearing of product packaging or others. Place the product into pipe cages.

During transportation, loading and unloading of products, two people should carry the two ends of the pipes.

At temperatures below 0 ° C, due to the nature of PPR raw materials, impact strength are reduced and the products become more fragile. Therefore unloading and storage of products must be done more carefully during cold weather. The products should not be bent and dropped.

As UV rays have negative effects on physical and chemical properties of PPR, PPR products must be protected from UV in closed storage areas.

6. PIPE LAYING INFORMATION

6.1 – PRINCIPLES OF WELDING

INTRODUCTION

The quality of welding joints depends on the qualification of the welder, the suitability of the used equipment and devices as well as on observance of welding standards. The welding work must be monitored by a supervisor.

It is an important requirement to record the welding data into the attached welding protocol sheet. (Attachment no 1)

For quality assurance purposes, it is necessary to perform welding on test samples before and during the welding.

The welding must be done by a qualified and certified welder.

WELDING PROCEDURE

a) In heated tool socked welding (Figure 1), pipe and pipeline component are welded in overlapped condition. Pipe end and fitting are heated up to the welding temperature by a socked or spigot-shaped heated tool and subsequently joined together.
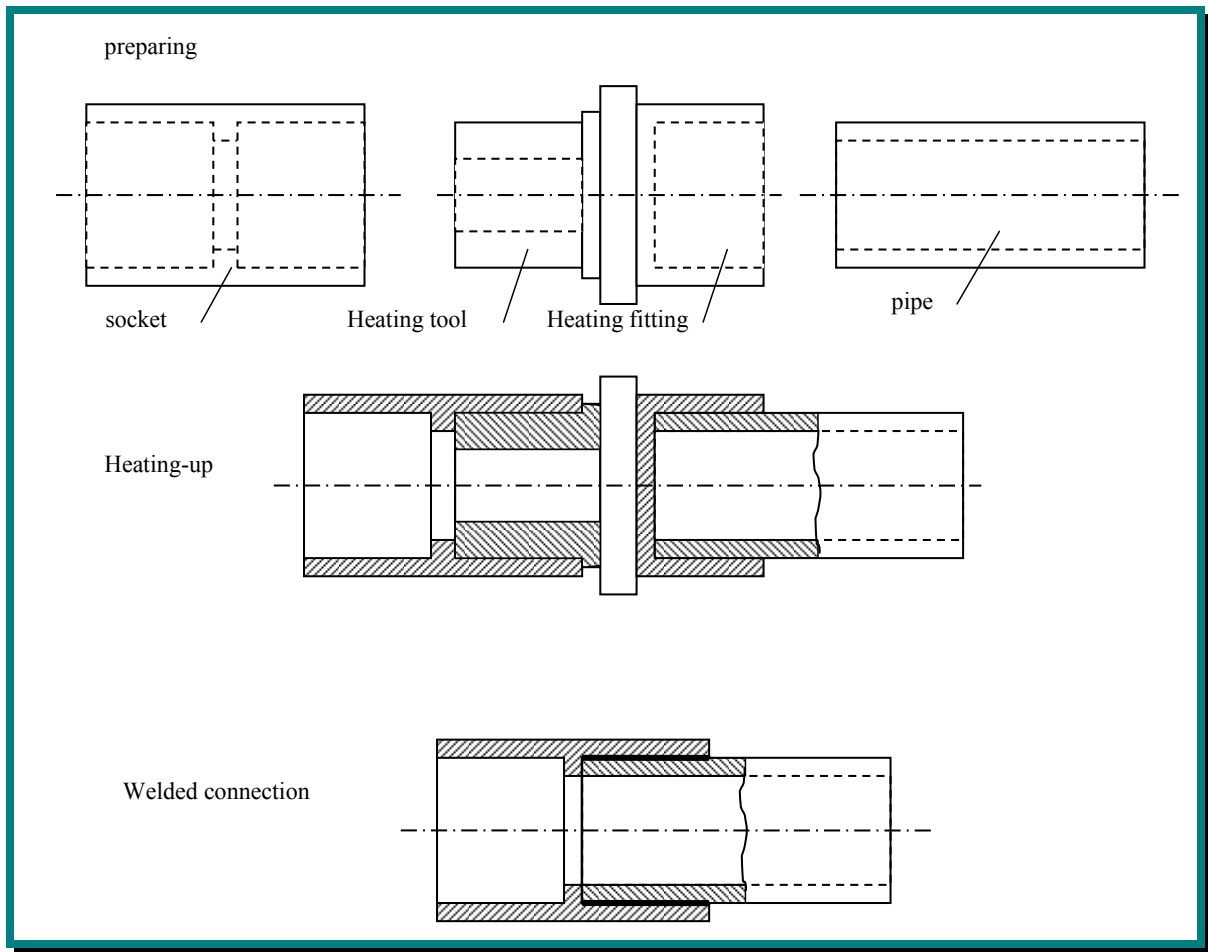
Figure 1: Heated tool socked welding

b) Heating tools and fittings must be of same dimension. Heated tool socket welding can be performed manually up to 50 mm pipe diameter. At diameters after 63 mm, a welding device is required because of the higher joining force.

c) The heated tools are heated electrically and are coated with anti-adhesive material.

d) In manual welding process, insert depth should be marked on the pipe. Insert depth measurements are given Table 1.

Table 1: Insert depth

Pipe diameter d (mm)	Insert depth l (mm)
16	13
20	14
25	15
32	17
40	18
50	20
63	26
75	29
90	32
110	35

e) The joining areas have to be cleaned thoroughly with a degreasing agent (e.g. technical clean spirit) and absorbent, non fuzzy and non-colored paper.

f) Before welding starts, the welding temperature (260±10°C) set on the heated tool has to be controlled. This checking is done by means of a fast-indicating surface temperature measuring device. The heating must not be started sooner than 10 minutes after the welding temperature has been reached.

g) Heating socket and heating spigot must be free of contaminations and should be cleaned before welding by means of a degreasing agent (e.g. technical clean spirit) and absorbent, non-fuzzy and non-colored paper. The anti-adhesive coating of the heating spigot and heating socket must be free of damages in the welding area.

h) Pipe and fitting are marked when placing them into the heater. (a portion as much as 'I')
Pipe and fitting are placed into the heater as much as this marked portion and then waited for a while.
As soon as the placing process is completed, heating is performed as per the heating period given in table 2, column 2.

i) After the heating time has elapsed, fitting and pipe should be withdrawn sharply from the heated tool and pushed together immediately without any twisting until the stop or mark (for maximum change-over time see Table 2, column 4).

j) The connection may be loaded only after cooling time is over (see Table 2, column 5).

Table 2: Recommended values for the heated tool socked welding of pipes and pipeline components out of PP, at ambient temperature of 20°C and at moderate air flow

Pipe outside diameter mm	Heating time for PN 10,16, 20 SDR 11, 7.4, 6[2)	Heating time for PN 6 SDR 17.6, 17[2)	Removal of heated tool Change-over time maximum time s	Cooling time fixed s	Total cooling time min
16	5		4	6	2
20	5		4	6	2
25	7	[1)	4	10	2
32	8	[1)	6	10	4
40	12	[1)	6	20	4
50	12	[1)	6	20	4
63	24	10	8	30	6
75	30	15	8	30	6
90	40	22	8	40	6
110	50	30	10	50	8
125	60	35	10	60	8

[1) Due to the low wall thickness, the welding method is not recommended.

[2) Standard Dimension Ratio ~ d/s
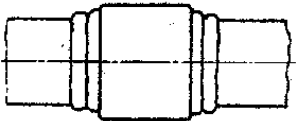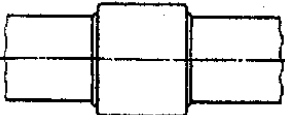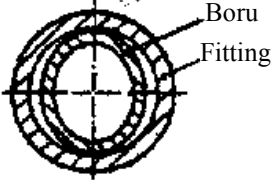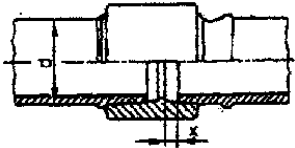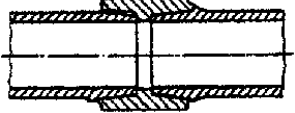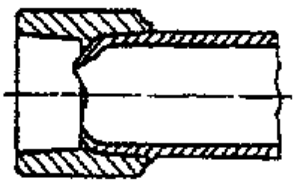
SOCKET WELDING INSTRUCTIONS
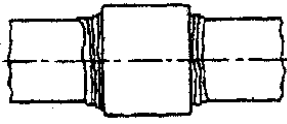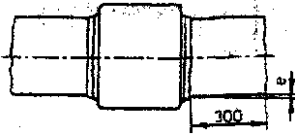
1. Provide working conditions that conform to regulations, e.g. use welding tent in cold environments.

2. Connect the welding equipment to the electric source or alternating current generator and control the function.

3. Clean the heating tools with a degreasing agent (e.g. technical clean spirit) and absorbent, non-fuzzy and non-colored paper.

4. Check the welding temperature (260±10°C).

5. All treated joining areas have to be cleaned with a degreasing agent (e.g. technical clean spirit) and absorbent, non- fuzzy and non-colored paper.

6. Insert the fitting and pipe simultaneously in to the heating device. The pipe end may not contact the end of the heating socket.

7. Keep the heating time according to Table 2, column 2.

8. Push the fitting and pipe swiftly and axially until the stop resp. mark (for maximum changeover time see Table 2, column 4) and hold on this position (see Table 2, column 5).

9. Cool down the connection. Never apply mechanical load on the connection before cooling time ends according to Table 2, column 6.

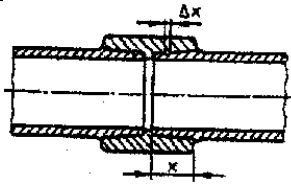10. Complete the welding protocol (Attachment no 1)

Attachment no 1

Protocol form for the butt welding of pipes and pipelines components	☐ laid overground ☐ laid underground	Material	Sheet

<table>
<tr><td>Customer</td><td colspan="2">Executive company</td><td>Welding equipment</td><td>Weather
1 = sunny</td><td>Preventive measures
1 = none</td></tr>
<tr><td></td><td>Name of welder</td><td>Identification No</td><td>Lbel :
Type :</td><td>2 = dry
3 = rain or snow
4 = windly</td><td>2 = umbrella
3 = tent
4 = heating</td></tr>
<tr><td></td><td colspan="2">Name and company of the welding supervisor</td><td>Machine no :
Year of cons :</td><td colspan="2">Order as above in case of multiple nominations (e.g: 34 = rain and wind)</td></tr>
</table>

Weld no	Date	Pipe dimensions Φdxs mm	Data of fitting [1]			Temperature reading on the heater °C	Heating timei [2] s	Extraction time of the heater [2] s	cooling [2]		Enviromental Temperat °C	Code-no	
			A	B	Serial no.				cooling time (pipe and cuff) s	Cooling time(total min		Weather	Preventive measures

Welder signatureı:	Date and signature of welding supervisior :

[1] Fill used depending on the system if possible.
[2] Enter measured values.

| A = Manufacturer's code | 1 = cuff | 2 = fork | 3 = t-piece |
| B = Fitting code | 5 = fuze | 6 = coupling piece | 7 = fitting |

Welding problems and causes (DVS 2202-1)
Table 3.

No	Feature	Description
External state of joint		
1		
1.1	Faulty welding flash formation see note [1] 	Variable welding flash formation or no welding flash present on one or both sides (over part or whole of weld length) due to - Excessive heated tool temperature - Excessive heating times - Impermissible tolerances see note [2]
1.2		Variable welding flash formation or no welding flash present on one or both sides (over part or whole of weld length) due to - Insufficient heating time - Insufficient heated toll temperature

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			- Impermissible tolerances
1.3			Variable welding flash formation or no welding flash present on one or both sides (over part or whole of weld length) due to - Unprocessed joint faces - Contaminated joint faces - Heated tool temperature too high
2	Angular deflection(defect of form) 		Pipe welded into fitting at angle on one or both sides, or with slightly faulty gripping, caused by, for example - Machine fault - Layout fault
3			
3.1	Lack of fusion due to deformation Boru Fitting		Deformation or ovality of pipe end or fitting with locally insufficient welded pressure , - Insufficient radii of curvature on collars - Faulty storage of pipe and/or fitting - Unsuitable clamping device
3.2	Lack of fusion due to incomplete insertion of pipe 		Insufficient weld length with fully or only partially fused joint faces, caused by, for example - Insufficient warming-up time - Pipe ends not at right angles - Heated tool temperature too low - Axial movement during cooling period - Reversal time too long
3.3	Lack of fusion due to insufficiently closed form 		Local, extensive ,axial or circular channel formation, caused by, for example - notches in pipe faces - Diameter tolerances on pipe or fitting exceeded - Faulty mechanical manipulation - Pipe not aligning in socket
3.4	Lack of fusion due to insufficient melting		Local or extensive incomplete welding with separation in the joint plane, caused by, for example - Thermal damage - Contaminated joint faces - Wrong material pairing - Residues on heated tool
4	Compressed pipe cross-section 		Pipe inserted too far in during heating or joining, caused by, for example -excessive joint pressure -welding of thin-walled pipes -excessive warming-up up time -excessive welding temperature
5	Pores caused by inclusion of foreign matter		Isolated , numerously dispersed or locally concentrated pores or inclusions , for example due to

		- vapour formation during welding (water, solvent) - dirty heated tool

6.2 - Points to pay attention when installing PPR pipes and fittings

1. Due to their brittle characteristic and behavior below 0 ° C, pipes should not be used where water can freeze in pipes, or they should be prevented from freezing.

2. PPR pipes and fittings should not be exposed to sunlight (UV).

3. During the installation, products should be kept away from sharp objects.

4. Before welding, pipes and fittings should be cleaned.

5. Damaged pipes and pipes with cut/cracked ends should not be used.

6. Products should be protected against hits and shocks.

7. Use only sharp tools for cutting pipes.

8. Welding length should be marked on pipe before welding.

9. Open fire should not be used to heat the pipes.

10. Welding waiting time should be followed.

11. During melting and after welding, pipe and fittings definitely should not be turned.

12. Welding die should be cleaned before use, and dies with damaged coating should not be used.

13. Excessive tightening should be avoided for metal fittings.

14. To prevent leakage, teflon tape should be used.

15. Plastic end-plugs should be used instead of metal end-plugs.

16. After finishing pipe installation, leakage test must be done according to water test instructions. Please look at the leakage test procedure below.

17. After the leakage test, the water in the installation should be completely emptied against the freezing danger.

18. Pipe and fittings installed outside buildings should be protected from sunlight (UV) and freezing.

6.3 - Leakage test procedure

Finished installation, completely filtered and vacuumed must be filled completely with water.

Pressure testing shall be carried out in two stages. The first stage is sufficient for smaller sections of the system (e.g. for testing supply pipes and branch pipes in wet rooms.)

a) For the first stage, a test pressure equal to the permissible working pressure plus 5 bar shall be produced twice within 30 minutes at 10-minute intervals. Than it shall be checked whether, over a further period of 30 minutes, the pressure has dropped by more than 0,6 bar (with a rate of 0,1 bar per minute) and leakage has occurred.

b) The second stage shall follow the first stage without interval and shall last two hours. Then, it shall be checked whether the pressure has dropped by more than 0,2 bar and the pipework shows any signs of leakage.

Please note that test must be done according to DIN 1988-2, tests out of standards should be avoided.