

# PP-R Fiber Layer Pipes & Fittings



PnC TECH BUSAN CO., LTD.

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## 1. General information

**Abbreviations:** Following abbreviations are used in this manual

|      |   |
|------|---|
| d    | Outside diameter of pipe                                  |
| s    | Wall thickness of pipe                                    |
| DN   | Nominal diameter  |
| R    | Tapered male thread (pressure tight in thread)            |
| Rp   | Parallel female thread (pressure tight in thread)         |
| G    | Parallel thread (not pressure tight)                      |
| PN   | Nominal pressure at 20°C                                  |
| IMO  | International Maritime Organization                       |
| DIN  | German industry standard                                  |
| ISO  | International Standard                                    |
| DVS  | Code published by German institute for welding technology |
| S    | Pipe series   |
| SDR  | Standard dimension ratio (d / s)                          |
| PP-R | Polypropylene Random Copolymer                            |
| l    | Liter / length  |
| m    | Meter   |
| W    | Watt  |

### Technical standards and codes relevant for this product line:

|                       |  |  |
|-----------------------|--|--|
| Main product standard | ISO 15874  | Plastic piping systems for hot and cold water installations – Polypropylene PP                       |
|                       | DIN 8077   | PP pipes sizes   |
|                       | DIN 8078   | PP pipes quality assurance standard  |
| Reference standards   | A.753 (18)   | IMO RESOLUTION   |
|                       | ISO 9080   | Determination of long term hydrostatic strength  |
|                       | ISO10508   | Plastic piping systems for hot and cold water installations – Guidance for classification and design |
|                       | ISO/TR 10501   | Plastic piping systems for the transport of liquids under pressure – calculation of head losses      |
|                       | ISO/TR10358  | Plastic pipes and fittings – combined chemical resistance classification table                       |
|                       | DIN 16962  | Pipe joints and elements for Polypropylene pressure pipelines  |
|                       | DVS 2207-11  | Welding of thermoplastics – heated tool welding of pipes, piping parts and panels made of PP         |
| DVS 2210-1            | Industrial Pipelines made of thermoplastics – Planning and Execution of above ground pipes systems |  |

## 2. Features – Applications

The **PnC** system is a highly versatile full plastic piping system using PP-R (Poly Propylene – Random Copolymer) as base material. PP-R is one of the most versatile plastic materials available for plastic piping systems. Its characteristics of high temperature and pressure resistance and outstanding impact strength make it ideally suited for various applications in the Marine and Industrial field.

The **PnC** system has been design with focus on the Marine and Industrial field utilizing state of the art European design technology and highly engineered production facilities.

**PnC** system can be used for a wide range of applications:

- Potable hot and cold water up to 95°C
- Sea Water sanitary pipes
- Air conditioning pipes in accommodation spaces
- Other non essential systems

### IMO RESOLUTION A.753 (18) GUIDELINES FOR THE APPLICATION OF PLASTIC PIPES ON SHIPS:

| PIPING SYSTEMS                                     | Location                       |                                       |                  |                   |                       |             |                |                     |  |  |            |
|--|--------------------------------|---------------------------------------|------------------|-------------------|-----------------------|-------------|----------------|---------------------|--|--|------------|
|  | A                              | B                                     | C                | D                 | E                     | F           | G              | H                   | I  | J  | K          |
|  | Machinery spaces of category A | Other machinery spaces and pump rooms | Cargo pump rooms | RO/RO cargo holds | Other dry cargo holds | Cargo tanks | Fuel oil tanks | Ballast water tanks | Cofferdams void spaces pipe tunnel and ducts | Accommodation service and control spaces | Open decks |
| 1 Cargo (Flammable cargoes f.p. < 60°C) Cargo      | NA                             | NA                                    | L1               | NA                | NA                    | 0           | NA             | 0 10/               | 0  | NA                                       | L1 2/      |
| 2 Crude oil washing lines                          | NA                             | NA                                    | L1               | NA                | NA                    | 0           | NA             | 0 10/               | 0  | NA                                       | X          |
| 3 Vent lines                                       | NA                             | NA                                    | NA               | NA                | NA                    | 0           | NA             | 0 10/               | 0  | NA                                       | X          |
| 4 Inert Gas Water seal effluent line               | NA                             | NA                                    | 0 1/             | NA                | NA                    | 0 1/        | 0 1/           | 0 1/                | 0 1/   | NA                                       | 0          |
| 5 Scrubber effluent line                           | 0 1/                           | 0 1/                                  | NA               | NA                | NA                    | NA          | NA             | 0 1/                | 0 1/   | NA                                       | 0          |
| 6 Main line  | 0                              | 0                                     | L1               | NA                | NA                    | NA          | NA             | NA                  | 0  | NA                                       | L1 6/      |
| 7 Distribution lines                               | NA                             | NA                                    | L1               | NA                | NA                    | 0           | NA             | NA                  | 0  | NA                                       | L1 2/      |
| 8 Flammable liquids (f.p. > 60°C) Cargo lines      | X                              | X                                     | L1               | X                 | X                     | NA 3/       | 0              | 0 10/               | 0  | NA                                       | L1         |
| 9 Fuel oil   | X                              | X                                     | L1               | X                 | X                     | NA 3/       | 0              | 0                   | 0  | L1                                       | L1         |
| 10 Lubricating                                     | X                              | X                                     | L1               | X                 | X                     | NA          | NA             | NA                  | 0  | L1                                       | L1         |
| 11 Hydraulic oil                                   | X                              | X                                     | L1               | X                 | X                     | 0           | 0              | 0                   | 0  | L1                                       | L1         |
| 12 Seawater1 Bilge main branches                   | L1 7/                          | L1 7/                                 | L1               | X                 | X                     | NA          | 0              | 0                   | 0  | NA                                       | L1         |
| 13 Fire main and water spray                       | L1                             | L1                                    | L1               | X                 | NA                    | NA          | NA             | 0                   | 0  | X  | L1         |
| 14 Foam system                                     | L1                             | L1                                    | L1               | NA                | NA                    | NA          | NA             | NA                  | 0  | L1                                       | L1         |
| 15 Sprinkler system                                | L1                             | L1                                    | L3               | X                 | NA                    | NA          | NA             | 0                   | 0  | L3                                       | L3         |
| 16 Ballast   | L3                             | L3                                    | L3               | L3                | X                     | 0 10/       | 0              | 0                   | 0  | L2                                       | L2         |
| 17 Cooling water, essential services               | L3                             | L3                                    | NA               | NA                | NA                    | NA          | NA             | 0                   | 0  | NA                                       | L2         |
| 18 Tank cleaning services fixed machines           | NA                             | NA                                    | L3               | NA                | NA                    | 0           | NA             | 0                   | 0  | NA                                       | L3 2/      |
| 19 Non-essential systems                           | 0                              | 0                                     | 0                | 0                 | 0                     | NA          | 0              | 0                   | 0  | 0  | 0          |
| 20 Freshwater cooling water essential services     | L3                             | L3                                    | NA               | NA                | NA                    | NA          | 0              | 0                   | 0  | L3                                       | L3         |
| 21 Condensate return                               | L3                             | L3                                    | L3               | 0                 | 0                     | NA          | NA             | NA                  | 0  | 0  | 0          |
| 22 Non-essential systems                           | 0                              | 0                                     | 0                | 0                 | 0                     | NA          | 0              | 0                   | 0  | 0  | 0          |
| 23 Sanitary/Drains/Scuppers Deck drains (internal) | L1 4/                          | L1 4/                                 | NA               | L1 4/             | 0                     | NA          | 0              | 0                   | 0  | 0  | 0          |
| 24 Sanitary/Drains (internal)                      | 0                              | 0                                     | NA               | 0                 | 0                     | NA          | 0              | 0                   | 0  | 0  | 0          |
| 25 Scuppers and discharges (overboard)             | 0 1.8/                         | 0 1.8/                                | 0 1.8/           | 0 1.8/            | 0 1.8/                | 0           | 0              | 0                   | 0  | 0 1.8/                                   | 0          |
| 26 Sounding/air water tanks/dry spaces             | 0                              | 0                                     | 0                | 0                 | 0                     | 0 10/       | 0              | 0                   | 0  | 0  | 0          |
| 27 Oil tanks (f.p. > 60°C)                         | X                              | X                                     | X                | X                 | X                     | X 3/        | 0              | 0 10/               | 0  | X  | X          |
| 28 Miscellaneous control air                       | L1 5/                          | L1 5/                                 | L1 5/            | L1 5/             | L1 5/                 | NA          | 0              | 0                   | 0  | L1 5/                                    | L1 5/      |
| 29 Service air (non-essential)                     | 0                              | 0                                     | 0                | 0                 | 0                     | NA          | 0              | 0                   | 0  | 0  | 0          |
| 30 Brine   | 0                              | 0                                     | NA               | 0                 | 0                     | NA          | NA             | NA                  | 0  | 0  | 0          |
| 31 Auxiliary low pressure steam (< 7 bar)          | L2                             | L2                                    | 0 9/             | 0 9/              | 0 9/                  | 0           | 0              | 0                   | 0  | 0 9/                                     | 0 9/       |

⓪ : No fire endurance test required (=plastic pipes permitted), ① / ② / ③ : Fire Endurance Test required , Ⓝ : Not applicable, ⓧ : Metallic material having a melting point higher than 925°

### 3. Features – Advantages

Weight savings: The **PnC** system is up to 8 times lighter than metal systems

| 1m of Pipe | PP-R    | Copper (A) | Steel (SCH40) |
|------------|---------|------------|---------------|
| d20 – 1/2" | 0.15 kg | 0.57 kg    | 1.27 kg       |
| d63 – 2"   | 1.45 kg | 3.06 kg    | 5.45 kg       |
| d90 – 3"   | 2.90 kg | 5.99 kg    | 11.3 kg       |

Corrosion resistant: Corrosion free solution even with sea water, aggressive waters and chemicals. No leakages or discolorations of the water throughout the operation period of the piping system.

Welded connection: Heat fusion produces homogeneous joints between pipes and fittings. Joints can withstand equal or higher pressure and temperatures than the fittings and pipes and are not affected by corrosion and vibrations.

Safe connection method: Heat fusion of PP-R pipes and fittings is simple and can be done following the instructions in this manual. An electrical heating element is used to melt pipe and fittings, no open flame is necessary for welding.

Fire safety: PP-R has passed the low flame spread and burns halogen free and is therefore safe to install onboard ships.

Low heat loss: The heat loss of PP-R pipes is much lower than metal pipes. Therefore insulation materials can be omitted or reduced.

Fast installation: PP-R is fast and easy to install. The system can be pressurized directly after cooling periods. Pipe joints can be made in seconds without the need of a fire watch or heavy installation equipments. Pipes and fitting are light and can all be carried, lifted and installed by hand.

Fiber Layer Pipe: The fiber layer increases pressure and temperature resistance of the pipe and allows for absolutely rigid installation with a linear expansion and contraction similar to metal pipes.

Environmentally friendly: Fully recyclable. Used PP-R pipes can be re-used for production of various plastic articles like waste bins, plastic pallets, packing materials and so forth. Production of plastic pipes requires far less energy than the production of steel and copper pipes.

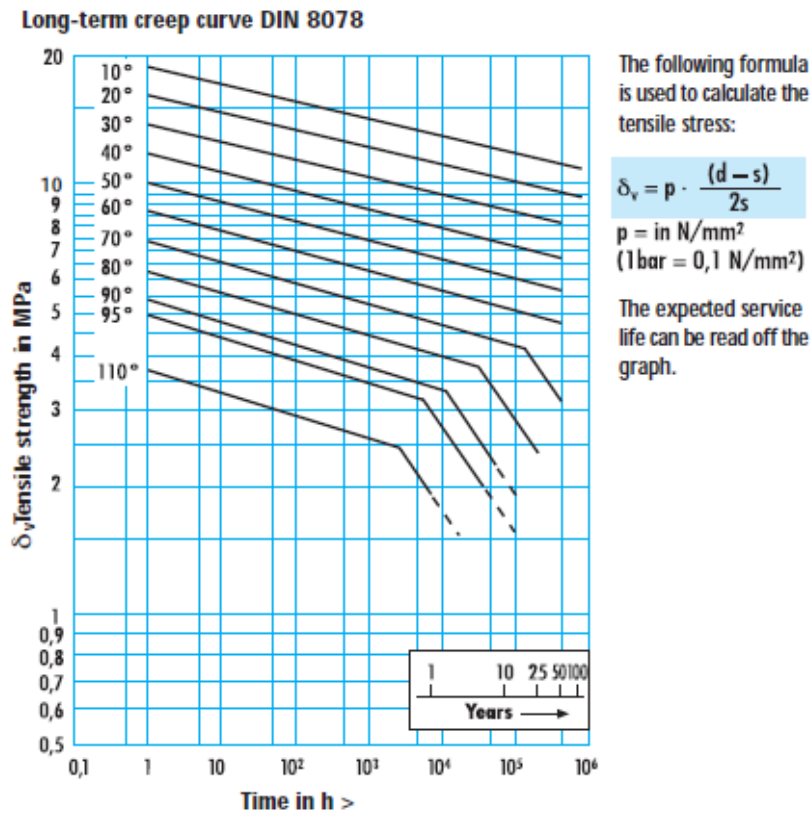
## 4. General Precautions

|   |  |   |   |
|---|--|---|---|
|    | Avoid sharp impacts and strokes to the pipes, especially at low temperatures. Do not throw when unloading. Protect pipes from falling objects. |    | Put down pipes or pipe bundles carefully. Cover pipes in areas of falling rocks, etc. |
|    | Do not use cracked or damaged pipes.   |    | Only cut pipes with sharp cutters.  |
|   | Do not expose pipes to UV radiation for extended periods of time.  |   | Shelter stored pipes from sun and rain.   |
|  | During polyfusion welding, do not twist the pipe or fitting; push the pipe and fitting joint together in a straight manner.                    |  | Minor corrections can only be made immediately during jointing.                       |
|  | Protect pipes filled with water from freezing.   |  | Drain lines in danger of freezing.  |

### **Pipe Bending**

Do not bend the fiber reinforced pipes by using hot air or open flame.

## 5. Features – Material Properties and Characteristics



Because of its characteristics of high dimensional stability strength PP-R is one of the most suitable materials for piping systems for hot and cold water transportation. All materials are subject to ageing. PP-R is no exception to this rule. The "long-term hydrostatic creep curves", which are determined by temperature and stress, are proof of the long service life and outstanding safety of PP-R piping systems:

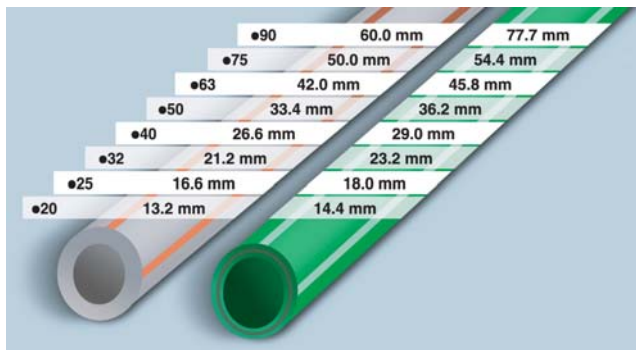
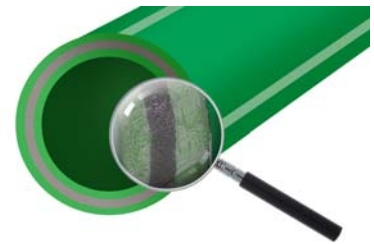
| Properties                   | Standard  | Unit              | Values |
|------------------------------|-----------|-------------------|--------|
| Melt Index. 190/5            | ISO 1133  | g/10 min          | 0.45   |
| Melt Index. 230/2.16         | ISO 1133  | g/10 min          | 0.25   |
| Density at 23°C              | ISO 1183  | g/cm <sup>3</sup> | 0.91   |
| VICAT Softening Point        | ISO 306   | °C                | 130    |
| Melting Point                | ISO 3146  | °C                | 141    |
| Thermal Conductivity at 23°C | DIN 52612 | W/mK              | 0.22   |
| Thermal Expansion Factor     | DIN 53752 | mm/m°K            | 0.15   |
| Tensile Strength at Yield    | ISO 527   | MPa               | 27     |
| Breakage Elongation          | ISO 527   | %                 | >400   |
| Flexural Modulus             | ISO 178   | MPa               | 850    |

## 6. Features – Fiber Reinforced Pipe

In cooperation with laboratories and industry experts our R&D team has developed a unique fiber reinforced PP-R pipe. The fiber reinforcement increases the temperature stability and strength of the pipe far above normal PP-R pipes.

This three layer fiber pipe brings numerous advantages to end users and installers:

- Higher safety and increase in pressure and temperature resistance
- Hygienically safe because fibers do not have medium contact
- Rigid pipes require less pipe supports
- Fiber reinforcement reduces thermal expansion to a minimum
- Homogenous connection method by heat fusion
- High flow rate because of large inner diameter



**Difference of inner diameter compared between a standard SDR6 Pipe and the PnC Fiber reinforced pipe**

## 7. Operation Pressure, temperature and service life of Fiber Reinforced Pipes

| Temp | Years of Operation                   |      |      |      |      |
|------|--------------------------------------|------|------|------|------|
|      | 1                                    | 5    | 10   | 25   | 50   |
|      | Continuous Operation pressure in bar |      |      |      |      |
| 20°C | 28.1                                 | 26.3 | 25.6 | 24.8 | 24.1 |
| 30°C | 23.9                                 | 22.4 | 21.7 | 20.9 | 20.4 |
| 40°C | 20.2                                 | 18.9 | 18.4 | 17.6 | 16.7 |
| 50°C | 17.2                                 | 15.9 | 15.5 | 14.9 | 14.4 |
| 60°C | 14.4                                 | 13.4 | 12.9 | 12.5 | 11.9 |
| 70°C | 12.2                                 | 11.2 | 11.0 | 9.5  | 8.0  |



## 8. Calculation of expansion and contraction

Plastic pipes are subject to thermal expansion and contraction far greater than metal pipes. The special fiber layer of the **PnC** pipe reduces expansion and contraction significantly compared to standard plastic (PP-R) pipes.

Thermal expansion coefficient of standard PP-R pipe: 0.15 mm/m°C

Thermal expansion coefficient of **PnC** fiber PP-R pipe: 0.035 mm/m°C

The thermal expansion of a **PnC** fiber pipe is therefore similar to that of a copper pipe.

Calculation of change in length:

For straight loops of more than 40m and temperature changes of more than 40°C it is necessary to control and take measures to absorb thermal expansion and contraction.

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

where:

$\Delta L$  = change in length (mm)

$L$  = initial pipe length (m)

$\Delta T$  = temperature difference (°C)

$\alpha$  = expansion coefficient (mm/m°C)

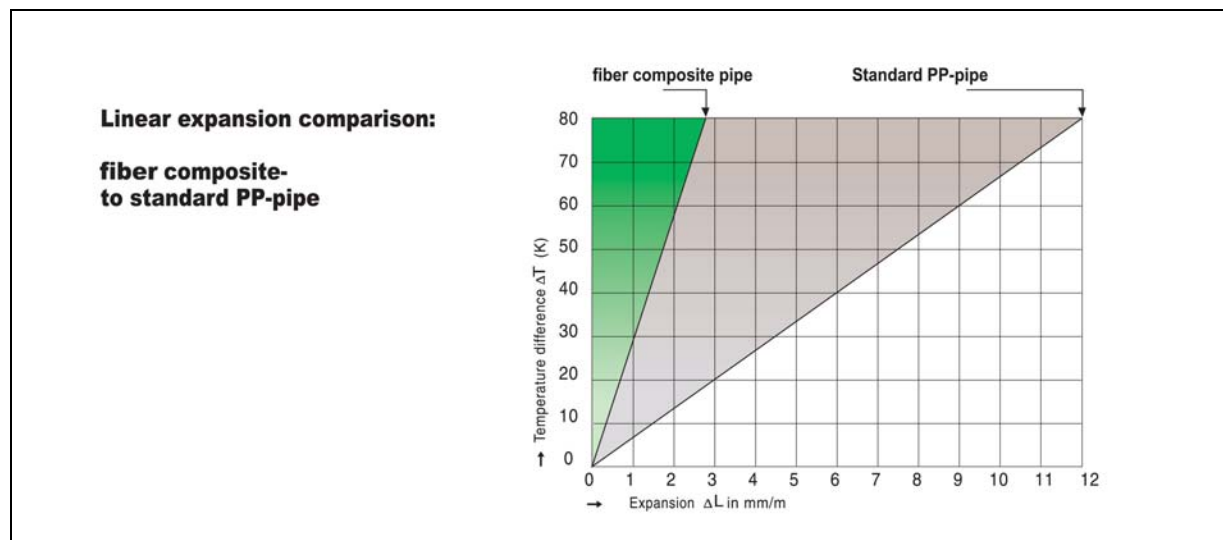
**Example:**

$L = 40\text{m}$

$\Delta T = 40^\circ\text{C}$

$\alpha = 0.035 \text{ mm/m}^\circ\text{C}$

**$\Delta L = 40 \times 40 \times 0.035 = 56\text{mm}$**



## 9. Compensating expansion and contraction

The expansion and contraction of **PnC** Fiber pipes is limited to an absolute minimum as the above calculation shows. Should special situations require control and absorption of expansion and contraction expansion loops and flexible legs can be installed:

The length (MS) of an expansion loop or flexible leg is calculated by using a specific material constant for **PnC** fiber pipes:

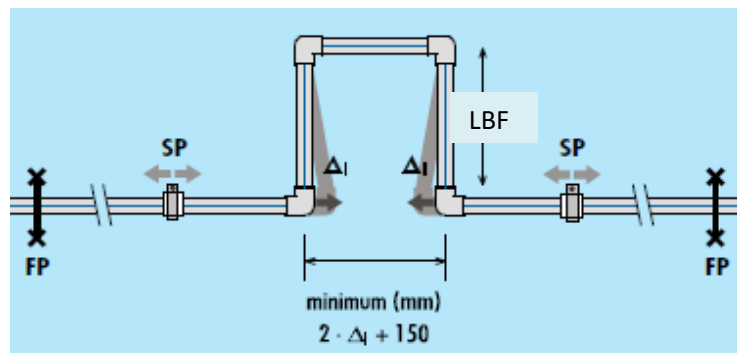
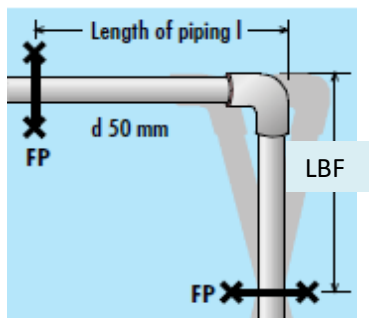
$$L_{BF} = C \times \sqrt{\Delta L \times d_e}$$

LBF: Length of flexible leg  
 C: Material specific constant 15  
 $\Delta L$ : Change of length  
 de: Outer diameter of pipe

**Example :**

C = 15  
 $\Delta L = 56\text{mm}$   
 de = 63mm

$$L_{BF} = 15 \times \sqrt{56 \times 63} = 891\text{mm}$$



FP: Fixed bracket

SP: Sliding bracket

Sliding brackets and fixed brackets are used to guide expansion and contraction of pipes. In a fixed point (fixed bracket) the pipe should be held in position and the bracket should be able to withstand forces created by expanding and contracting pipe. In a sliding point (sliding bracket) the pipe should be able to move freely.

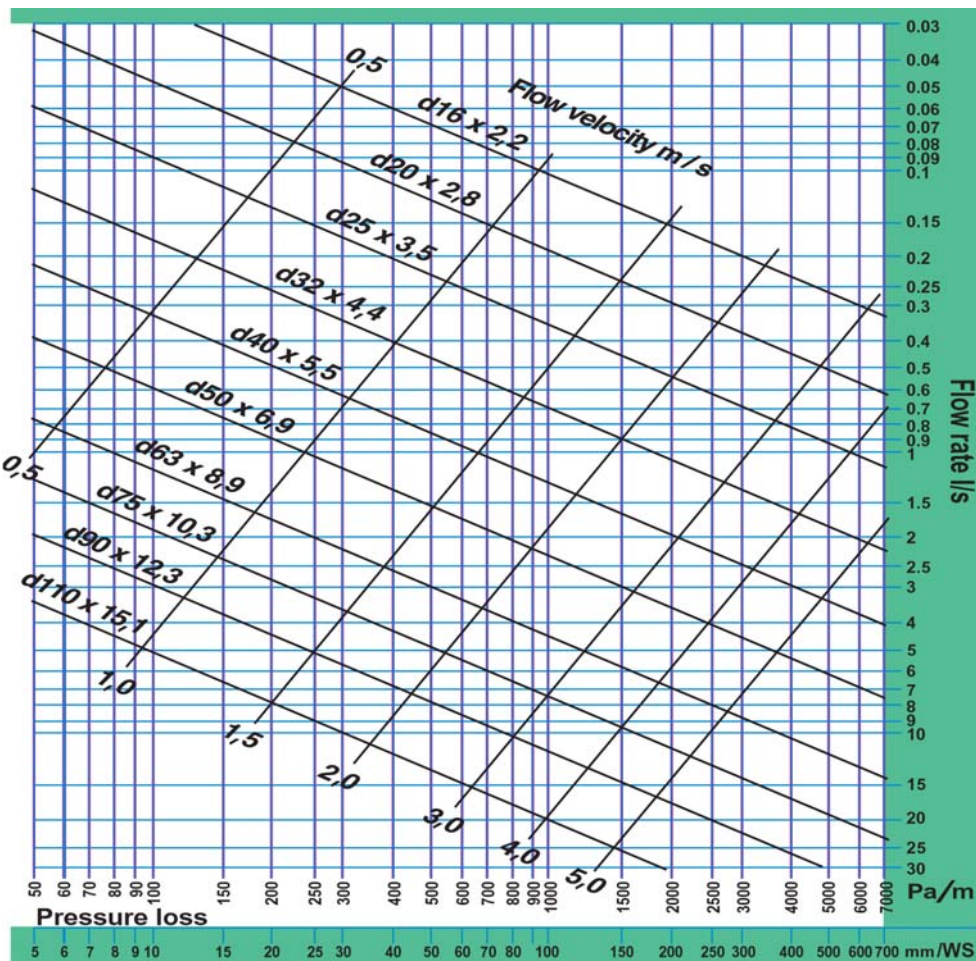
## 10. Bracket Spacing.














Rigidity is one of the advantages of **PnC** fiber pipes. The rigid pipes remain straight even at high temperatures and require fewer brackets than a normal PP-R pipe.

|          | Pipe diameter d (mm)  |     |     |     |     |     |     |     |
|----------|-----------------------|-----|-----|-----|-----|-----|-----|-----|
|          | 20                    | 25  | 32  | 40  | 50  | 63  | 75  | 90  |
|          | Bracket spacing in cm |     |     |     |     |     |     |     |
| Cold     | 90                    | 105 | 120 | 135 | 155 | 175 | 185 | 195 |
| Tempered | 85                    | 95  | 110 | 125 | 145 | 165 | 175 | 185 |
| Hot      | 70                    | 80  | 95  | 110 | 130 | 145 | 155 | 165 |

Temperature ranges: Cold: 20°C; Tempered: 50°C; Hot: 70°C

## 11. Pressure loss in PnC Fiber Pipes & Fittings.



| Description            | Symbol   | Coefficient of Resistance |
|------------------------|--|---------------------------|
| Socket                 |    | 0.25                      |
| Elbow 90°              |    | 2.00                      |
| Elbow 45°              |    | 0.60                      |
| Tee 90°                |    | 1.80                      |
| Reduced Tee 90°        |    | 3.60                      |
| Tee 90°                |    | 1.30                      |
| Reduced Tee 90°        |    | 2.60                      |
| Tee 90°                |    | 4.20                      |
| Reduced Tee 90°        |    | 9.00                      |
| Tee 90°                |    | 2.20                      |
| Reduced Tee 90°        |   | 5.00                      |
| Threaded Fitting, Male |  | 0.40                      |
| Threaded Elbow, Female |  | 2.20                      |

**Example:**

Assume we have a water services system with the following characteristics:

- pipe diameter 25 mm
- total pipe length 10 m
- fittings used:
  - 4 coupling
  - 3 elbows 90°
  - 2 equal tees
  - 1 threaded coupling, male
- velocity 1.5 m/s
- flow rate 0.35 l/s
- T = 20°C

From the table,

- ξ1 (coupling) = 0.25 x 4
- ξ2 (elbow 90°) = 2.00 x 3
- ξ3 (equal tees) = 1.80 x 2
- ξ4 (threaded coupling, male) = 0.40 x 1

Total ξ = 11

$$\text{Total } P = \Delta p + H$$

From graph above,  
 $\Delta p = 1100 \text{ Pa/m}$   
 $= 11 \text{ mbar}$

For 10m length pipe,  
 $\Delta p = 11 \times 10$   
 $= \underline{110 \text{ mbar}}$

$$H = 10 \cdot \frac{\xi \cdot v^2 \cdot \rho}{2g}$$

where:

- H = pressure losses in fittings
- v = water velocity (m/s)
- g = specific gravating of water (kg/m<sup>3</sup>)  
 $= 9.8 \text{ m/s}^2$
- ξ = coefficient of resistance

$$H = \frac{10 \times 11 \times 1.52 \times 1000}{2 \times 9.8}$$

$$= 12630 \text{ Pa}$$

$$= \underline{126 \text{ mbar}}$$

$$\text{Total } P = H + \Delta p$$

$$= 110 + 126$$

$$= \underline{236 \text{ mbar}}$$

## 12. Socket Fusion Jointing – Hand Welding Tool

Socket fusion process

1. Create permissible working conditions, e.g. dry and clean
2. Connection welding device to the mains or generator and check its function
3. Clean the heating bushes with suitable cleaning agent (e.g. industrial alcohol), with unused, absorbent, non-fraying and non-died paper
4. Check welding temperature (250°C - 270°C)
5. Clean all joining faces of pipe and fitting with suitable cleaning agent (e.g. industrial alcohol), with unused, absorbent, non-fraying and non-died paper
6. Cut the pipe at right angle and remove any burrs, bevel if necessary. Mark insertion depth.
7. Simultaneously push the fitting and the pipe on to the heating spigot respectively into the heating bush as far as the stop respectively the mark. Avoid pushing the pipe too deep (bump into the end of the heating bush) or not deep enough.
8. Elapse heating time according to below table
9. Pull fitting and pipe off the heating bush / spigot and immediately push them together as far as the mark or stop (see below table for max. change over time). Do not rotate pipe and fitting after join for more than 15°.
10. Let the joint cool down. Only subject the welded joint to mechanical loads when total cooling time according to below table has elapsed.
11. The outer fusion bead must be inspected. A double bead must be uninterrupted all around the pipe circumference.

| 1                | 2               | 3             | 4             | 5       | 6     |
|------------------|-----------------|---------------|---------------|---------|-------|
| Outside Diameter | Insertion depth | Heating       | Change - over | Cooling |       |
| d                |                 | 250°C - 270°C |               | Fixed   | Total |
| mm               | mm              | s             | s             | s       | min   |
| 20               | 14              | 6             | 4             | 6       | 2     |
| 25               | 16              | 8             | 4             | 10      | 2     |
| 32               | 18              | 10            | 6             | 10      | 4     |
| 40               | 20              | 15            | 6             | 20      | 4     |
| 50               | 23              | 22            | 6             | 20      | 4     |
| 63               | 26              | 30            | 8             | 30      | 6     |
| 75               | 28              | 40            | 8             | 30      | 6     |
| 90               | 31              | 50            | 8             | 40      | 6     |



### 1 Fix heating bushes

Install the heating bushes on the heating plate.  
Maximum two set of bushes can be installed on the plate.



### 2 Set the temperature

After put el. power, set the temperature at side.  
The temperature range must be between 250 °C and 270 °C.  
The temperature can be checked by two thermostatis pencils.



### 3 Clean the heating bushes

After checking the temperature,  
clean the heating bushes with suitable cleaning agent (e.g. industrial alcohol), with unused, absorbent, non-fraying and non-died paper.  
Cleaning must be repeated whenever welding residues accumulate in the heating bushes.



### 4 Cut the pipe

Cut the pipe at right angle.



### 5 Clean pipe & fitting

Clean all joining faces of pipe and fitting with suitable cleaning agent (e.g. industrial alcohol), with unused, absorbent, non-fraying and non-died paper to remove any impurities and especially oil and grease.



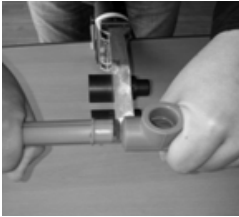
### 6 Mark the insertion depth

Mark the insertion depth on pipe according to recommended table for each dimension.  
The mark should remain visible during heating and joining.



## 7 Heat pipe & fitting

Simultaneously push the fitting and the pipe on to the heating spigot respectively into the heating bush as far as the stop respectively the mark. Avoid pushing the pipe too deep (bump into the end of the heating bush) or not deep enough. Wait till recommended heating time specified in below table elapses and do not let go of pipe and fitting during this time.



## 8 Join pipe and fitting

Pull fitting and pipe off the heating bush/spigot and immediately push them together as far as the mark or stop (see below table for max. change over time). Do not rotate pipe and fitting during joining for more than 15°. During cooling time any rotation and adjustments in alignment shall be avoided.



## 9 Fusion inspection

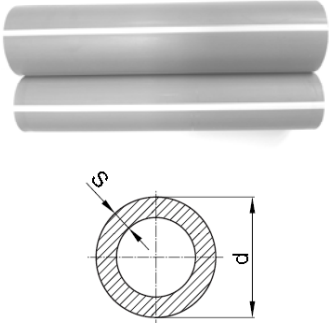
The outer fusion bead must be inspected. A double bead must be uninterrupted all around the pipe circumference.

### 13. Catalogue – PnC Fiber reinforced Pipes

**PnC Fiber reinforced Pipes SDR 7.4 (PN16)**

Material: PP-R and PnC Fiber Reinforced PP-R

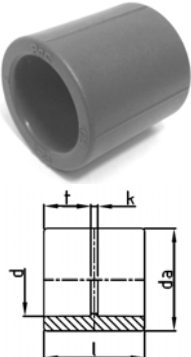
Standards: DIN 8077 / DIN 8078 / ISO15874-2

|  | d x s     | Article No. | Kg / m | Length |
|---|-----------|-------------|--------|--------|
|   | 20 x 2.8  | 20 20 001   | 0.16   | 4m     |
|   | 25 x 3.5  | 20 25 002   | 0.24   | 4m     |
|   | 32 x 4.4  | 20 32 003   | 0.38   | 4m     |
|   | 40 x 5.5  | 20 40 004   | 0.58   | 4m     |
|   | 50 x 6.9  | 20 50 005   | 0.91   | 4m     |
|   | 63 x 8.6  | 20 63 006   | 1.42   | 4m     |
|   | 75 x 10.3 | 20 75 007   | 2.05   | 4m     |
|   | 90 x 12.3 | 20 90 008   | 2.90   | 4m     |

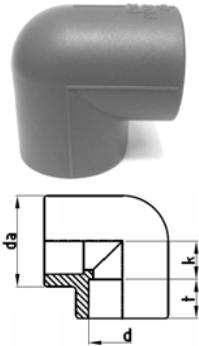


## 14. Catalogue – Fittings

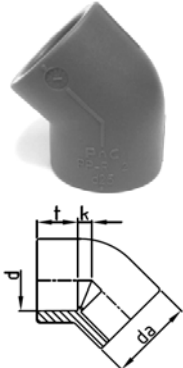
### Sockets

|  | Article No. | d  | da | k   | t    | l    |
|---|-------------|----|----|-----|------|------|
|   | 20 20 021   | 20 | 29 | 3   | 14.5 | 32   |
|   | 20 25 022   | 25 | 34 | 3   | 16   | 35   |
|   | 20 32 023   | 32 | 43 | 4.5 | 18   | 40.5 |
|   | 20 40 024   | 40 | 55 | 7.5 | 20   | 47.5 |
|   | 20 50 025   | 50 | 67 | 6   | 23.5 | 53   |
|   | 20 63 026   | 63 | 88 | 6.5 | 27   | 60.5 |
|   | 20 75 027   | 75 | 98 | 8   | 31   | 70   |

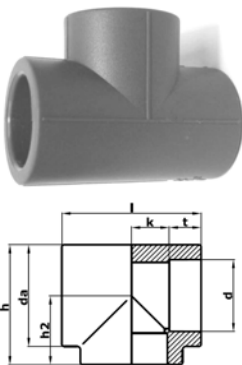
### Elbow 90°

|  | Article No. | d  | da | k    | t    |
|---|-------------|----|----|------|------|
|   | 20 20 041   | 20 | 29 | 11   | 14.5 |
|   | 20 25 042   | 25 | 34 | 13.5 | 16   |
|   | 20 32 043   | 32 | 43 | 18   | 18   |
|   | 20 40 044   | 40 | 55 | 22   | 20   |
|   | 20 50 045   | 50 | 66 | 26.5 | 25.5 |
|   | 20 63 046   | 63 | 88 | 33.5 | 27   |
|   | 20 75 047   | 75 | 98 | 39   | 31   |

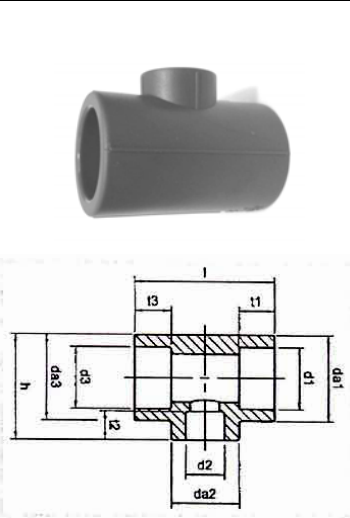
### Elbow 45°

|  | Article No. | d  | da | k    | t    |
|---|-------------|----|----|------|------|
|   | 20 20 061   | 20 | 29 | 5    | 14.5 |
|   | 20 25 062   | 25 | 34 | 6    | 16   |
|   | 20 32 063   | 32 | 43 | 7.5  | 18   |
|   | 20 40 064   | 40 | 55 | 10   | 20   |
|   | 20 50 065   | 50 | 65 | 11.5 | 25   |
|   | 20 63 066   | 63 | 88 | 16   | 27   |
|   | 20 75 067   | 75 | 98 | 18   | 31   |

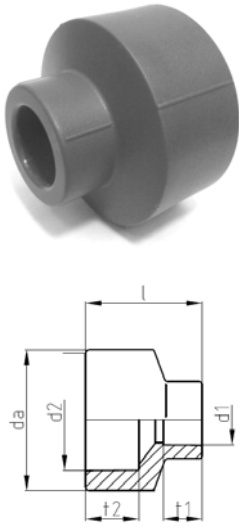
## Tee

|  | Article No. | d  | h     | da | l   | k    | t    | h2    |
|---|-------------|----|-------|----|-----|------|------|-------|
|   | 20 20 081   | 20 | 40.25 | 29 | 51  | 11   | 14.5 | 25.75 |
|   | 20 25 082   | 25 | 47.5  | 34 | 62  | 15   | 16   | 30.5  |
|   | 20 32 083   | 32 | 57    | 43 | 70  | 17   | 18   | 35.5  |
|   | 20 40 084   | 40 | 69    | 55 | 81  | 20.5 | 20   | 41.5  |
|   | 20 50 085   | 50 | 84    | 66 | 102 | 26   | 25   | 51    |
|   | 20 63 086   | 63 | 103   | 88 | 120 | 33   | 27   | 59    |

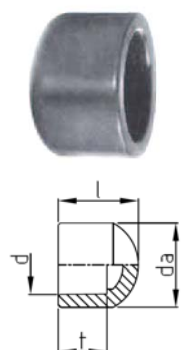
## Reduced Tee

|  | Article No. | d1-d2-d3 | h    | l    | da1 | da2 | t1 | t2   |
|---|-------------|----------|------|------|-----|-----|----|------|
|   | 20 25 101   | 25-20-25 | 47.5 | 62   | 34  | 29  | 16 | 14.5 |
|   | 20 32 102   | 32-20-32 | 52   | 70   | 43  | 29  | 18 | 14.5 |
|   | 20 32 103   | 32-25-32 | 56   | 70   | 43  | 34  | 18 | 16   |
|   | 20 40 104   | 40-20-40 | 62   | 83   | 55  | 29  | 20 | 14.5 |
|   | 20 40 105   | 40-25-40 | 62   | 83   | 55  | 34  | 20 | 16   |
|   | 20 40 106   | 40-32-40 | 66.5 | 83   | 55  | 43  | 20 | 18   |
|   | 20 50 109   | 50-32-50 | 78.5 | 85.5 | 65  | 43  | 25 | 20   |
|   | 20 50 110   | 50-40-50 | 80   | 93   | 65  | 52  | 25 | 22   |
|   | 20 63 111   | 63-20-63 | 90.5 | 120  | 88  | 29  | 27 | 14.5 |
|   | 20 63 112   | 63-25-63 | 90.5 | 120  | 88  | 34  | 27 | 16   |
|   | 20 63 113   | 63-32-63 | 95.5 | 120  | 88  | 43  | 27 | 18   |
|   | 20 63 114   | 63-40-63 | 95.5 | 120  | 88  | 55  | 27 | 20   |
|   | 20 75 118   | 75-40-75 | 110  | 110  | 98  | 52  | 32 | 22   |

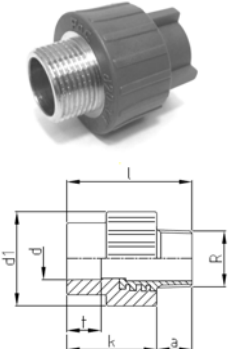
### Reducer

|  | Article No. | d2-d1 | da | t2   | t1   | l    |
|---|-------------|-------|----|------|------|------|
|   | 20 25 151   | 25-20 | 34 | 16   | 14.5 | 38   |
|   | 20 32 152   | 32-20 | 43 | 18   | 14.5 | 36.5 |
|   | 20 32 153   | 32-25 | 43 | 18   | 16   | 38.5 |
|   | 20 40 154   | 40-20 | 55 | 20   | 14.5 | 45   |
|   | 20 40 155   | 40-25 | 55 | 20   | 16   | 50   |
|   | 20 40 156   | 40-32 | 55 | 20   | 18   | 50   |
|   | 20 50 160   | 50-40 | 67 | 23.5 | 20   | 54   |
|   | 20 63 161   | 63-20 | 88 | 27   | 14.5 | 58   |
|   | 20 63 162   | 63-25 | 88 | 27   | 16   | 58   |
|   | 20 63 164   | 63-40 | 88 | 27   | 20   | 65   |
|   | 20 63 165   | 63-50 | 88 | 27   | 23.5 | 65   |
|   | 20 75 166   | 75-63 | 98 | 31   | 27   | 67   |

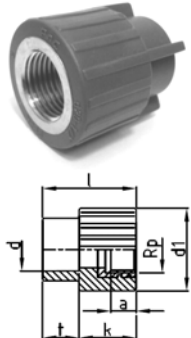
### Cap

|  | Article No. | d  | da | l    | t    |
|---|-------------|----|----|------|------|
|   | 20 20 181   | 20 | 29 | 25.5 | 14.5 |

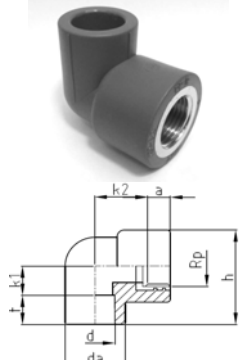
### Male Thread Adaptor

|  | Article No. | d-R       | d1   | l  | t    | k  | a  |
|---|-------------|-----------|------|----|------|----|----|
|   | 20 20 301   | 20-1/2"   | 38.5 | 54 | 14.5 | 41 | 13 |
|   | 20 20 302   | 20-3/4"   | 45   | 56 | 14.5 | 41 | 15 |
|   | 20 25 303   | 25-3/4"   | 45   | 58 | 16   | 43 | 15 |
|   | 20 40 305   | 40-1 1/4" | 74   | 85 | 20   | 66 | 19 |
|   | 20 63 307   | 63-2"     | 94   | 95 | 27   | 74 | 22 |

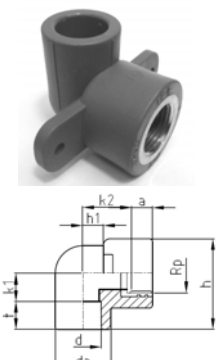
### Female Thread Adaptor

|  | Article No. | d-Rp      | d1   | l    | t    | k    | a  |
|--|-------------|-----------|------|------|------|------|----|
|  | 20 20 321   | 20-1/2"   | 38.5 | 41   | 14.5 | 26.5 | 13 |
|  | 20 25 322   | 25-3/4"   | 45   | 42   | 16   | 26   | 15 |
|  | 20 40 324   | 40-1 1/4" | 72   | 68.5 | 21.9 | 47   | 20 |

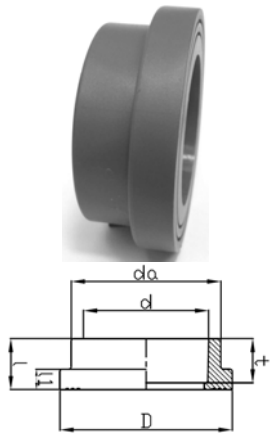
### Female Thread Elbow

|  | Article No. | d-Rp    | h  | da | t    | k1   | k2   | a  |
|---|-------------|---------|----|----|------|------|------|----|
|   | 20 20 361   | 20-1/2" | 48 | 29 | 14.5 | 15.5 | 23.5 | 13 |


**Female Thread Elbow with lug**

|   |             |         |    |    |      |      |      |      |    |
|---|-------------|---------|----|----|------|------|------|------|----|
|  | Article No. | d-Rp    | h  | da | h1   | t    | k1   | k2   | a  |
|   | 20 20 386   | 20-1/2" | 48 | 29 | 10.5 | 14.5 | 15.5 | 23.5 | 13 |

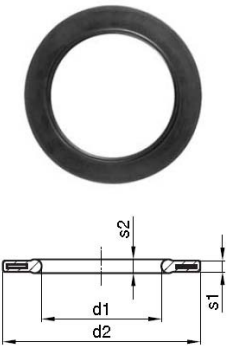
**Flange Adaptor**

|  |             |    |    |    |      |      |    |
|--|-------------|----|----|----|------|------|----|
|  | Article No. | d  | da | t  | l    | l1   | D  |
|  | 20 63 401   | 63 | 76 | 27 | 34.5 | 14.5 | 91 |

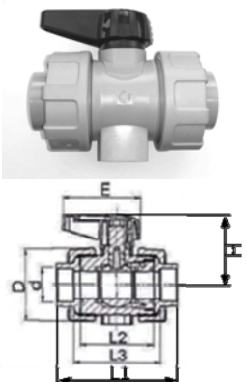
**Backing Flange**

|   |             |    |     |     |    |    |    |    |
|---|-------------|----|-----|-----|----|----|----|----|
|  | Article No. | d  | D   | k   | b  | c  | l  | AL |
|   | 20 63 411   | 63 | 165 | 125 | 18 | 78 | 18 | 4  |

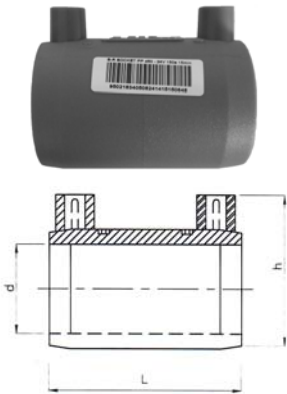
### Flange Seal

|  | Article No. | d  | d1 | d2  | s1 | s2 |
|---|-------------|----|----|-----|----|----|
|   | 20 63 421   | 63 | 63 | 107 | 4  | 5  |

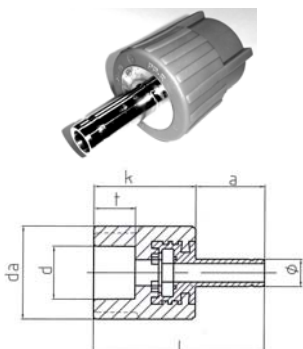
### Ball Valves

|  | Article No. | d  | L1  | L2   | L3   | D     | H   | E    |
|--|-------------|----|-----|------|------|-------|-----|------|
|  | 20 20 501   | 20 | 98  | 57   | 68   | 50.5  | 48  | 67   |
|  | 20 25 502   | 25 | 110 | 65   | 78.5 | 59    | 57  | 81.5 |
|  | 20 32 503   | 32 | 120 | 71.5 | 84.5 | 70.5  | 64  | 81.5 |
|  | 20 40 504   | 40 | 142 | 86   | 100  | 86    | 83  | 95.5 |
|  | 20 50 505   | 50 | 154 | 89.5 | 107  | 100   | 89  | 95.5 |
|  | 20 63 506   | 63 | 174 | 102  | 118  | 125.5 | 115 | 144  |

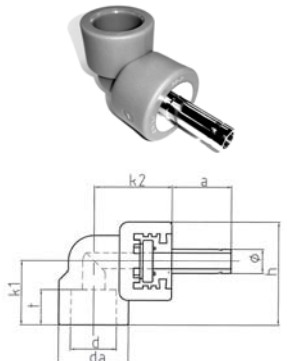
### Electrofusion Sockets

|  | Article No. | d   | h   | L  |
|---|-------------|-----|-----|----|
|   | 20 20 601   | 20  | 52  | 70 |
|   | 20 25 602   | 25  | 58  | 70 |
|   | 20 32 603   | 32  | 65  | 70 |
|   | 20 40 604   | 40  | 75  | 85 |
|   | 20 50 605   | 50  | 87  | 88 |
|   | 20 63 606   | 63  | 100 | 98 |
| 20 75 607   | 75          | 114 | 125 |    |


### Tube Adapter

|  | Article No. | d-Ø     | da | l  | t  | k  | a  |
|---|-------------|---------|----|----|----|----|----|
|   | 20 20 391   | 20-10.0 | 34 | 62 | 15 | 37 | 25 |
|   | 20 20 392   | 20-12.7 | 34 | 62 | 15 | 37 | 25 |

### Tube Elbow

|  | Article No. | d-Ø     | h    | da   | t  | k1 | k2   | a  |
|--|-------------|---------|------|------|----|----|------|----|
|  | 20 20 395   | 20-10.0 | 43.5 | 29.5 | 15 | 27 | 32.8 | 25 |
|  | 20 20 396   | 20-12.7 | 43.5 | 29.5 | 15 | 27 | 32.8 | 25 |


## Hand Welding tools

|  | Article No. | d     | Voltage     | Weight<br>kg |
|---|-------------|-------|-------------|--------------|
|   | 20 00 700   | 20-63 | 230V / 800W | 6            |

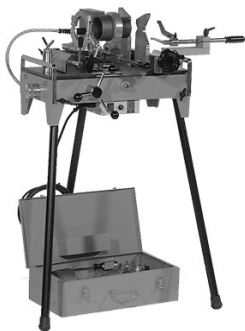
Hand Welding Tool set, including :

1. 800W thermostat controlled heating element
2. Heating bushes d20 – d63
3. Floor and table stand
4. Transport case and accessories

## Heating Bushes

|  | Article No. | d  |
|--|-------------|----|
|  | 20 20 701   | 20 |
|  | 20 25 702   | 25 |
|  | 20 32 703   | 32 |
|  | 20 40 704   | 40 |
|  | 20 50 705   | 50 |
|  | 20 63 706   | 63 |
|  | 20 75 707   | 75 |
|  | 20 90 708   | 90 |

## Bench Type Welding Machine


|  | Article No. | d     | Voltage      | Weight<br>kg |
|---|-------------|-------|--------------|--------------|
|   | 20 00 741   | 20-90 | 230V / 1000W | 54           |

Bench Type Welding Machine set, including:

1. 1000W electronic controlled heating element
2. Heating bushes d20 - d90
3. Clamping elements d20 - d90
4. Floor stand, tripod pipe support
5. Tool box



### Electrofusion Welding Tool

|  | Article No. | d      | Voltage      | Weight<br>kg |
|---|-------------|--------|--------------|--------------|
|   | 20 00 801   | 20-125 | 230V / 2000W | 8            |

Electrofusion Welding Tool set, including:

1. Scan reader / optical pen / printer connector
2. Welding cable
3. Welding connectors
4. Power supply cable
5. Transport bag
6. Scan reader

Weldable materials : PE / PP / PP-R

Dimensions (W x D x H) : 200 x 250 x 210 mm

# 15. Certificates & Approvals

**DNV-GL**

## MANAGEMENT SYSTEM CERTIFICATE

Certificate No: 12489-2012-AQ-KOR-RUK Initial certification date: 08 October, 2012 Valid: 09 October, 2013 - 09 October, 2018

This is to certify that the management system of

**PnC TECH BUSAN CO., LTD.**  
78-20, Sandan 7-ro, Jeongwan-myeon, Gijang-gun, Busan, Korea

has been found to conform to the Quality Management System standard:  
**ISO 9001:2008, KS Q ISO 9001:2009**

This certificate is valid for the following scope:  
**Manufacture of PP-R Pipes & Fittings**

Place and date:  
Seoul 25, September, 2013

For the issuing office:  
DNV GL - Business Assurance  
18F, Kyobo Bldg., 1, Jeong-ro, Jeongno-gu, Seoul, Korea

**In-Kyeon Ahn**  
Management Representative

Lack of fulfillment of conditions set out in the Certification Agreement may render this Certificate invalid.

ISO 9001 : 2008 Certificate

**DNV-GL**

## TYPE APPROVAL CERTIFICATE

Certificate No: K-4203 File No: 332.31 Sub No: 262.1-016268-2

**This is to certify:**  
That the Plastic Pipes, Thermoplastic with type designation(s) **PnC PP-R Fiber layer SDR7.4 / S3.2 (PN16) Pipes and Fittings**

Issued to **PnC TECH BUSAN CO., LTD.**  
Busan, Republic of Korea

is found to comply with **Det Norske Veritas' Rules for Classification of Ships**  
**Det Norske Veritas' Type Approval Programme 1-501.2, 2011, Thermoplastic Pipes**

**Application :**  
For use in systems for water and sea water up to 16 bar. Service temperature 0°C to 70°C (shorter periods up to 85°C). For installation in accordance with DNV Rules and Manufacturer's Specifications. The piping system is not tested w.r.t. Fire Endurance characteristics. The piping system is tested to Low Flame Spread in accordance with ASTM D635.

This Certificate is valid until **2017-12-31**.  
Issued at **Havik** on **2015-01-06**

DNV GL local station: **Pusan**  
Approval Engineer: **Mats Gustafsson**

for DNV GL  
**Martin Strande**  
Head of Section

The Certificate is subject to terms and conditions overall. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Form code: TA 1411a Revision: 2014-11 www.dnvgl.com Page 1 of 3  
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DNV Type Approval Certificate

Certificate Number: 14-BK1180115-PDA 15Q07/2015

**Confirmation of Product Type Approval**

Please refer to the "Service Restrictions" shown below to determine if Unit Certification is required for this product. This certificate reflects the information on the product in the ABS Records as of the date and time the certificate is printed.

Pursuant to the Rules of the American Bureau of Shipping (ABS), the manufacturer of the below listed product held a valid Manufacturing Assessment (MA) with expiration date of 19/AUG/2019. The continued validity of the Manufacturing Assessment is dependent on completion of satisfactory audits as required by the ABS Rules.

And: a Product Design Assessment (PDA) valid until 24/APR/2019 subject to continued compliance with the Rules or standards used in the evaluation of the product.

The above entitle the product to be called Product Type Approved.

The Product Design Assessment is valid for products intended for use on ABS classed vessels, MODUs or facilities which are in existence or under contract for construction on the date of the ABS Rules used to evaluate the Product.

ABS makes no representations regarding Type Approval of the Product for use on vessels, MODUs or facilities built after the date of the ABS Rules used for this evaluation.

Due to wide variety of specifications used in the products ABS has evaluated for Type Approval, it is part of our contract that, whether the standard is an ABS Rule or a non-ABS Rule, the Client has full responsibility for continued compliance with the standard.

**Product Name: Thermoplastic Pipe, Fittings and Joints**  
**Model Name(s): PP-R Pipes and Fittings**

Presented to:  
**PnC TECH BUSAN CO., LTD.**  
78-23, SANDAN 7-RO, JEONGWAN-MYEON GUANG-GUN  
Korea, Republic of

**Intended Service:** Non-essential systems for hot and cold fresh water and seawater

**Description:** G-1: PP-R Fiber Reinforced Pipes G-2: Socket G-3: Elbow 90 G-4: Elbow 45 G-5: Tee G-6: Reduced Tee G-7: Reducer G-8: Cap G-9: Male Thread Adaptor G-10: Female Thread Adaptor G-11: Female Thread Elbow G-12: Female Thread Elbow with Lug G-13: Flange Adaptor G-14: Backing Flange G-15: Flange Seal G-16: Ball Valve Material Specification Pipes and Fittings: Polypropylene Random (PP-R) Valve: Body (PP-R), O-Ring (EPDM), Teflon (PTFE) Flange: PP-S Gasket: NBR PP-R Pipes & Fittings - Sizes 20-25-32-40-50-63-75-90 mm OD PP-R ball valves - Sizes 20-25-32-40-50-63-75 mm OD

**Tier:** 3

**Design pressure - Pipe and Fittings:** 0 to 16 bar Design pressure - Valve: 0 to 10 bar Design temperature: 0 deg. C to 70 deg. C, for shorter intervals up to 95 deg. C

**Service Restrictions:** Unit Certification is not required for this product.

**Comments:** 1. The following tests are not carried out - Load Deformation - Fluid Absorption (Fluid Absorption rate is 0.03% according to the Definitive User's Guide and Datasheet) - Axial strength 2. Load Deformation is not carried out. (applicable only for pipe > 100mm) 3. Usage of Ageing & Fatigue is limited in report of Bodycode Polymer. 4. Usage of Material Compatibility is limited in raw material certificate. (TOPLENE R200P by Hanjin Laboratories Ltd.) 5. Flame spread test is carried out by KCL(Korea Conformity Laboratories), According to ASTM D635 (Ref. Report

10/150015 7:43:31 PM Copyright 2001 American Bureau of Shipping. All rights reserved. Page 1 of 2

ABS Type Approval Certificate

Page 1 / 3

Certificate number: 38307AD BV File number: ADM 1362739/01 Product code: 2065H

**BUREAU VERITAS**  
Marine & Offshore Division

## TYPE APPROVAL CERTIFICATE

This certificate is issued to **PnC TECH BUSAN CO., LTD.**  
BUSAN - KOREA (REPUBLIC OF)

for the type of product  
**THERMOPLASTIC MATERIAL PIPES AND FITTINGS**  
PnC PP-R Fiber layer SDR7.4 / S3.2 Pipes, Fittings & Ball Valve

**Requirements:**  
- BUREAU VERITAS Rules for the Classification of Steel Ships  
- IMO Resolution A.753(18)

This certificate is issued to attest that BUREAU VERITAS did undertake the relevant approval procedures for the product identified above which was found to comply with the relevant requirements mentioned above.

**This certificate will expire on: 24 Jul 2019**

For BUREAU VERITAS,  
At BV PUSAN, on 24 Jul 2014,  
Heon Geuk Choi

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