

1. GENERAL

Pre-insulated piping system shall comply to EN 253, and consist of steel carrier pipes, pipe polyurethane foam insulation with integral copper alarm wires and outer casing of polyethylene. The materials shall be bonded together to form a solid unit with shear and axial strength values as specified in the insulation (Series one) section.

The pipe ends shall be free of insulation; insulation cut-back: 220 ± 10 mm

The pipe shall be supplied in straight lengths of 12 m.

Continuous operating temperature in a bonded single pipe system is max. 140°C for 30 years.

The pipe system can be pressure tested with cold water approx 20°C at max. 1.5 x operating pressure.

2. STEEL PIPE

Steel pipes shall be supplied longitudinally or spirally welded, P235TR1, P235TR2 according to EN 10217-1 or P235GH according to EN 10217-2 or EN 10217-5. Steel pipe quality according to EN 253:

- Dimension \leq DN 300, P235GH or P235TR1 or 2;
- All other dimensions $>$ DN300, P235GH

Melt analysis (max. %): C_{\max} 0,16; P_{\max} 0,025; S_{\max} 0,020; Mn_{\max} 1,20; Si_{\max} 0,35

Dimensions and Tolerances shall comply with ISO 4200.

Mechanical properties:

- Tensile strength $>$ 350 N/mm²
- Yield stress min. 235 N/mm²
- Young's modulus 2.1×10^5 N/mm²
- Elongation at break: Min. 23%
- Weld factor: $V = 1.0$
- Inspection certificate: EN 10204 - 3.1
- Beveling: EN ISO 9692-1

The outer surface of the pipe shall comply to EN ISO 8501-1:2007 without pitting. Prior to insulation, the outer surface of the pipe shall be cleaned so that it is free from rust, mil scale, oil, grease, dust, paint, moisture and other contaminants.

3. CASING

The polyethylene casing shall be black coloured PE-HD, bimodal classified at least PE 80 in accordance with EN ISO 12162. The casing may be a separately manufactured pipe or be applied directly onto the insulation by extrusion.

Material properties and casing properties minimum as required in EN 253.

- *Thermal stability*: Calculated continuous surface temperature $\geq 50^\circ\text{C}$ for 30 years.
- *Melt from rate (MFR)*: Parts are fully weldable within the melt flow index: MFR variation ≤ 0.5 g/10 min.
- *Oxydation induction time (OIT)*: > 30 min. at 210°C .
- *Resistance against crack formation*: Slow crack formation (notch sensitivity) > 2000 h (notch, 4 MPa, 80° , EN 253).
Rapid crack propagation, RCP (cold sensitivity) > 5 bar (0°C , ISO 13477).

To ensure optimum adhesion between outer casing and insulation, the internal surface of traditionally produced polyethylene casing shall be corona-treated. For the extruded polyethylene, the adhesion takes place automatically during the production process.

4. POLYURETHANE RIGID FOAM INSULATION (PUR)

Polyurethane foam shall be made from polyol and isocyanate with cyclopentane as blowing agent. Hard polyurethane foam (PUR) in accordance to EN 253.

The foam shall be homogenous with properties (Minimum as required in EN 253):

- Average foam cell size ≤ 0.5 mm.
- Density ≥ 60 kg/m³
- Closed cells $> 88\%$
- Water absorption if boiled $< 10\%$ (Vol)
- Compressive strength, At 10 % deformation > 0.3 N/mm²
- Axial shear strength > 0.12 N/mm²
- Tangential shear strength > 0.20 N/mm²
- Calculated continuous operating temperature (CCOT) : $> 140^{\circ}\text{C}$ for 30 years.
- Max. short-term operating temperature: 150°C .

Thermal conductivity: - Traditionally manufactured pipes (50°C): 0.027 W/m K.¹)

Table 1: Pre-insulated pipes of insulation series 1 - Pipe and casing dimensions

Nominal pipe diameter	Pipe outside diameter (OD)	Pipe wall thickness	Jacket OD	Min. Jacket thickness
mm	mm	mm	mm	mm
50 (2")	60.3	2.9	125	3
65 (2½")	76.1	2.9	140	3
80 (3")	88.9	3.2	160	3
100 (4")	114.3	3.6	200	3.2
125 (5")	139.7	3.6	225	3.4
150 (6")	168.3	4	250	3.6
200 (8")	219.1	4.5	315	4.1
250 (10")	273	5	400	4.8
300 (12")	323.9	5.6	450	5.2
350 (14")	355.6	5.6	500	5.6

5. SURVEILLANCE SYSTEM (ALARM WIRES)

The pipes shall be supplied with two (2) copper wires, embedded in the insulation. The district heating pipe will be monitored by an alarm wire circuit with a documented, proven technique.

6. FITTINGS

Pre-insulated fittings shall comply with EN 448, all fittings (elbows, anchors, Tees, etc) shall be pre-insulated and have embedded copper wires for surveillance.

7. DOUBLE JOINT KITS

Joint kit shall comply with EN 489. The joint kit installed shall be power transmitting, double water sealed system with 100% cross linked PE thermally shrinkable material. Joint kits to be of BX type.

¹ These lambda values are based on an average of the continuous measurements.

8. VALVES

Pre-insulated ball valves shall comply with EN 488. They shall be delivered as pre-insulated units and be designed on the basis of a maintenance-free ball valve with an all-welded valve body and a stainless polished valve ball placed in a spring-loaded Teflon seat.

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