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***Piping Systems, Inc*.**

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**Part 1 – General**

**1.01 Below Ground EN253 Pre-Insulated Piping System**

**1.02 This Below Ground Piping System** shall comply to EN 253 standard, and consist of steel carrier pipes, polyurethane foam insulation with integral Nordic copper alarm wires and a polyethylene outer casing as provided by **Rovanco Piping Systems** of Joliet, Illinois. The materials shall be bonded together to form a solid unit with shear and axial strength values as specified in the insulation section.

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

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

**1.05 The piping system** shall be manufactured for a service life of 30 years under continuous

operation at 140 deg C.

**1.06 The piping system** shall withstand pressure testing with cold water (20 deg C) at a maximum of 1.5 x operating pressure.

**Part 2 – Steel Pipe**

**2.01 Carrier 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:

* + - * 1. DN300 (12 inch NPS) and smaller: P235GH or P235TR1 or 2
				2. Larger than DN300 (12 inch NPS): P235GH

**2.02 Melt analysis** (max. %): Cmax0,16; Pmax 0,025; Smax 0,020; Mnmax 1,20; Simax 0,35

**2.03 Dimensions and tolerances** shall comply with ISO 4200.

**2.04 Mechanical properties:**

* + - * 1. Tensile strength > 350 N/mm2
				2. Yield stress min. 235 N/mm2
				3. Young's modulus 2.1 x 105 N/mm2
				4. Elongation at break: Min. 23%
				5. Weld factor: V = 1.0
				6. Inspection certificate: EN 10204 - 3.1
				7. Beveling: EN ISO 9692-1

**2.05 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.

**Part 3 – Insulation**

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

**3.02 The foam shall be** homogenous with the following properties (Minimum as required
by EN 253):

a. Average foam cell size ≤ 0.5 mm.

b. Density ≥ 60 kg/m3

c. Closed cells > 88%

d. Water absorption if boiled < 10% (Vol)

e. Compressive strength, At 10 % deformation > 0.3 N/mm2

f. Axial shear strength > 0.12 N/mm2

g. Tangential shear strength > 0.20 N/mm2

h. Calculated continuous operating temperature (CCOT): >140° C for 30 years.

i. Max. short-term operating temperature: 150°C.

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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  |

**Part 4 – Casing**

**4.01 The polyethylene casing** shall be black colored 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.

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

* + - * 1. Thermal stability: Calculated continuous surface temperature ≥ 50°C for 30 years.
				2. Melt from rate (MFR): Parts are fully weldable within the melt flow index: MFR variation ≤ 0.5 g/10 min.
				3. Oxidation induction time (OIT): > 30 min. at 210°C.
				4. 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).

**4.03** 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.

**Part 5 – Additional Specifications**

**5.01 Leak Detection:** The pipes shall be supplied with two (2) copper wires, embedded in the insulation. The piping system will be monitored by an alarm wire circuit with a documented, proven technique. Mapping and field service to be done by pre-insulated pipe manufacture.

**5.02 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.

**5.03 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 crosslinked type.

a. Joints to be installed using piping system manufacturer approved equipment and method.

b. Joints to be RhinoJoint by Rovanco or approved equal.

c. Installation contractor shall be trained by the manufacturer on the proper use of the joint

system.

**5.04 Fill & Bedding Materials:** Type 1 Fill (Granular ‘A’ Base Material) and Type 2 Fill (Granular ‘B’

Sub-base Material): Properties to MTO Special Provision No. 110F13

a. Crushed, screened stone, gravel or sand consisting of hard durable particles free from

 clay lumps, cementation, organic material and other deleterious materials. Pit run

 granular material will not be considered as acceptable.

b. Gradations to be within limits specified when tested to ASTM C136 and ASTM C117,

 as shown in Table 2. Sieve sizes to CAN/CGSB-8.1.

c. Table 2: Type 1 / Type 2 Fill

| **Sieve Designation** | **% Passing** |
| --- | --- |
| **[mm]** | **Type 1** | **Type 2** |
| 75 | - | 100 |
| 50 | - | 0 |
| 37.5 | 0 | 0 |
| 25 | 100 | 0 |
| 19 | 75 – 100 | - |
| 12.5 | - | - |
| 9.5 | 50 – 100 | - |
| 4.75 | 30 – 70 | 22 – 85 |
| 2.00 | 20 – 45 | - |
| 0.425 | 10 – 25 | 5 – 30 |
| 0.180 | - | - |
| 0.075 | 3 – 8 | 0 - 10 |

**5.05 Type 3 Fill:** selected backfill material from excavation or other sources, approved for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse, ice, vegetable matter or other deleterious materials.

**5.06 Type 4 Fill (Sand bedding):**

a. Sand consisting of hard durable particles free from lumps, cementation, organic
 material and other deleterious material.

b. Gradations to be within limits specified in Table 3.

c. Table 3: Sieve Sizes Summary for Sand Backfill Material

| **Sieve Size** | **% Passing (by weight)** |
| --- | --- |
| **Number** | **(mm)** |
| #4 | 4.75 | 100% |
| #10 | 2.0 | 90-96% |
| #20 | 0.85 | 75-94% |
| #40 | 0.425 | 45-82% |
| #60 | 0.25 | 18-40% |
| #100 | 0.15 | 10-17% |
| #200 | 0.075 | 5% |

**5.07 Unshrinkable fill:** proportioned and mixed to provide:

a. Maximum Portland cement content of 25 kg/m3.

b. Minimum strength of 0.07MPa at 24 hours.

c. Concrete aggregates: to CAN/CSA-A23.1.

d. Maximum compressive strength of 0.4MPa at 28 days.

e. Portland cement: Type 10.

f. Slump: 160mm to 200mm.

**5.08 Shear mat:** Honeycomb type biodegradable cardboard 100mm thick, treated to provide

sufficient structural support for poured concrete until concrete cured.

**5.09 Cast-in-place concrete:** Refer to Structural division specifications.

**5.10 Manufacturer’s Assistance:** Rovanco will provide a field service man on-site to properly train the installing personnel in all phases of installation. 10-year warranty included.

**5.11 Approved Vendors:** HDPE Piping Systems by Rovanco, Joliet, Illinois or approved, ISO certified, equal. Any alternate supplier must submit their technical data to the engineer ten days prior to bid date to be approved in writing as an equal.