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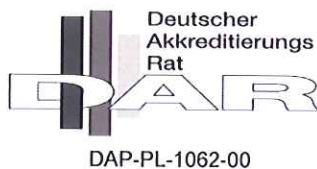
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Registergericht: Amtsgericht Dresden | HRB 5995
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Test report – short version

**District heating pipe system-test
manufactured by Brugg Rohrsystem AG
(Type CALPEX-pipe)**

Summary



Test Report No.: B044/11.2

Order No.: 302131001

Issued by Department of Plastics

Laboratory for Plastics Testing

Test report

Bonded pipe testing, CALPEX-pipe

Test Report No.: B044/11.2



Subject of the test:	Pre-insulated flexible bonded pipe, type CALPEX pipe
Customer:	Brugg Rohrsystem AG Industriestraße 39 CH-5314 Kleindöttingen
Delivery of the test objects:	2011-01-24
Period of tests:	2011-02 to 2011-03
Person in charge:	Dipl.-Ing. Döring
Distribution:	1 x Brugg Rohrsystem AG 2 x IMA Dresden

Reviewed and authorized.

Dresden, 31.03.2011
IMA Materialforschung und
Anwendungstechnik GmbH

A handwritten signature in blue ink, appearing to read 'Ridzewski'.

Prof. Dr.-Ing. Jens Ridzewski
Head of Department Plastics

This is a translation and short version of the German test report B044/11.1 by Klaus-Dieter Döring.

The test results refer exclusively to the specimen under test.

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Test report

Bonded pipe testing, CALPEX-pipe

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1. Task definition

On pre-insulated bonded flexible pipes type CALPEX, manufactured by Brugg Rohrsystem AG, the following selected properties are to be tested. The tests are to be carried out in accordance with EN 15632.

- Compressive creep (1000 h / 78 °C and 300 h / 93 °C)
- Carbon black content
- Thermal stability (OIT)
- Stress crack resistance (EN 60811-4-1:2004)
- Resistance to external actions (4 J, -20 °C)
- Flexibility
- Ring stiffness
- Water absorption (100 °C)
- Axial shear stress (23 °C)
- Linear water tightness

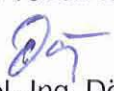
2. Test objects

- Pre-insulated bonded flexible pipe, type CALPEX, manufactured by Brugg Rohrsystem AG
- PUR-rigid-foam system: Cyclopentan blown high pressure PUR-foam
- Service pipe: PEX-a with EVOH-barrier, 63x5,8, SDR 11
- Delivery of the sample material to IMA Dresden: 2011-01-24
- Storage of the sample material before the test: Room climate

3. Test results

Test parameter	Test values (Average value)	Requirement of EN 15632
Compressive creep (1000 h, 78 °C, 12 N)	1,37 %	≤ 10 %
Compressive creep (300 h, 93 °C, 12 N)	0,78 %	≤ 10 %
Carbon black content	3,4 %	≥ 2 %
Thermal stability (OIT)	30,5 min	≥ 20 min
Stress crack resistance (50 °C, 1000 h)	10 specimen, without damages	10 specimen, without dam- ages (EN 60811-4-1)
Resistance to external actions (-20 °C, 4 J)	no damages after 6 impacts	no damages after 6 impacts (EN 744)
Flexibility Bending radius 1000 mm	no breaks in service pipe no breaks in casing pipe Ovality 2,1 % Cracks 2 mm to 3 mm	no breaks in service pipe no breaks in casing pipe Ovality ≤ 30 % Cracks ≤ 5 mm
Flexibility Bending radius 750 mm	no breaks in service pipe no breaks in casing pipe Ovality 2,3 % Cracks 3 mm to 4 mm	no breaks in service pipe no breaks in casing pipe Ovality ≤ 30 % Cracks ≤ 5 mm
Ring stiffness	29,4 kN/m ²	≥ 4k N/m ²
Water absorption (100 °C, 90 min)	8,9 %	≤ 10 %
Axial shear stress (23 °C)	0,20 MPa	≥ 0,09 MPa
Linear water tightness (0,05 bar, 168 h)	0 g / 168 h	≤ 100 g / 168 h

The flexible CALPEX-pre-insulated pipe fulfil the requirements of the EN 15632-1:2009 and EN 15632-2:2009.


Dipl.-Ing. Döring
Person in charge