

Geschäftsführer: Prof. Dr.-Ing. Wilhelm Hanel (Sprecher)
Prof. Dr.-Ing. Thomas Fleischer

Tel.: +49 351 8837-0
Tel.: +49 351 8837-264

Fax: +49 351 8804-313
Fax: +49 351 8837-313

Sitz der Gesellschaft: Dresden · Registergericht: Amtsgericht Dresden · HRB 5995
Hausadresse: Wilhelmine-Reichard-Ring 4 · 01109 Dresden
Postadresse: Postfach 80 01 44 · 01101 Dresden

Test Report

Identification of plastic jacket compound pipe CALPEX 63/126



Test Report No.: B 128/07

Order No.: 4037075

Issued by Division Department Plastics

Laboratory for Plastic Testing

Specimen under Test: flexible, corrugated plastic jacket compound pipe DN 50;
CALPEX 63/126

Ordering customer: Brugg Rohrsystem AG
Industriestrasse 39
CH-5314 Kleindöttingen

Order No. of customer: 4037075

Test items received on: 12.04.2007

Test period: 04/2007

In charge: Dipl.-Ing. Friebel

IMA Materialforschung und
Anwendungstechnik GmbH
Wilhelmine-Reichard-Ring 4
01109 Dresden

Dresden, 23.04.2007
IMA Materialforschung und
Anwendungstechnik GmbH

gez. Dr. Ing. Höninger
Head of Department Plastics

Content

1	Task.....	4
2	Specimen.....	4
3	Test execution and results	5
3.1	Sampling.....	5
3.2	Closed cell ratio	5
3.3	Density of cellular plastic of PUR	5
3.4.	Water absorption.....	6
3.5.	Thermal conductivity	6

1 Task

The following parameters of a plastic jacket compound pipe DN 50 for district heating will be determined:

Properties of cellular plastic

- closed cell ratio
- density of cellular plastic
- water absorption

Properties of compound pipe

- thermal conductivity λ_{50}

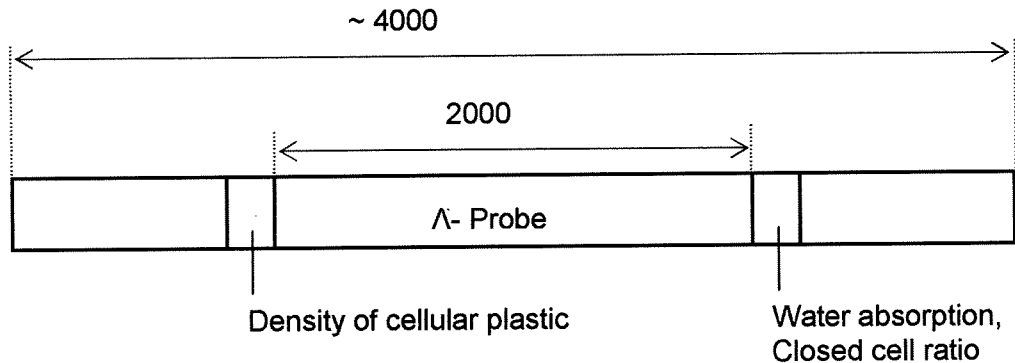
The tests will be performed according to DIN EN 253:2006-02.

2 Specimen

Plastic jacket pipe:	1 piece of plastic jacket compound pipe DN 50 CALPEX 63/126; length = 4,0 m Vendor: Brugg Rohrsystem AG
Thermal insulating material:	PUR-hard foam
Medium pipe:	PEX-pipe, DN 50
Cleading:	HDPE-pipe, corrugated
Date of production:	12.02.2007
Delivery of specimen at IMA GmbH:	05.03.2007
Storage of specimen before testing:	indoor temperature

3 Test execution and results

3.1 Sampling



3.2 Closed cell ratio

For the determination of Closed cell ratio (percentage fraction of closed to open cells) according to ISO 4590, 3 samples were taken regularly distributed at circumference of plastic jacket compound pipe and tested.

Test equipment: Pycnometer (Micrometrics: IMA102 3011)
 Sample dimensions: 25mm x 25mm x 25mm
 Number of samples: 3 pieces
 (taken regularly distributed at circumference)

Testing parameter	Testing single results			mean
Closed cell ratio [%]	98,4	97,5	95,5	97,1

3.3 Density of cellular plastic of PUR

For the determination of density of cellular plastic, 4 samples were taken regularly distributed at circumference of plastic jacket compound pipe and the density was analysed according to ISO 845.

Test equipment: Electronic balance (IMA9904 286)
 Calliper gauge Mitutoyo S (IMA 05660836)
 Sample dimensions: 30mm x 30mm x 30mm
 Number of samples: 4 pieces
 (taken regularly distributed at circumference)

Testing parameter	Testing single results				mean
density of cellular plastic [kg/m ³]	52,1	61,2	51,5	51,7	54,9

3.4. Water absorption

For the determination of water absorption, 3 samples were taken regularly distributed at circumference of plastic jacket compound pipe and drowned in boiling water for 90 minutes. The percentage of water absorption is determined by weighing.

Test equipment: Electronic balance (IMA9904 286)
Calliper gauge Mahr (IMA 102 3011)

Sample dimensions: 25mm x 25mm x 25mm

Number of samples: 3 pieces
(taken regularly distributed at circumference)

Testing parameter	Testing single results				mean
Water absorption [%]	8,79	7,29	7,11		7,73

3.5. Thermal conductivity

The determination of the thermal conductivity at plastic jacket compound pipe DN 50 was done according DIN EN 253:2006-02, Appendix G and ISO 8497.

Test equipment: Test stand for determination of thermal conductivity of tubular samples in steady state by measuring the temperature difference at constant heat flow

Manufacturer of test equipment: IMA GmbH Dresden

Temperature measurement: 2x 6 thermocouples

Pipe end protection: End caps; correction according van Rinsum (x=0,8m)

Sample length: 2000 mm

Medium pipe: PEX-pipe:
D₁= 51,36 mm, D₂=64,20 mm, s_{PEX}=6,42 mm

Thermal insulating layer: PUR foam material,
density of foam material: ρ = 54,9 kg/m³

Jacket pipe: polyethylene, corrugated:
D₃= 116,675 mm, D₄= 125,395mm; s_{PE}= 4,36mm
with D₄ = 0,5(D_{4max}+D_{4min})

Test period of thermal conductivity: 16.04.2007 till 23.04.2007

Heat - flow ϕ [W]	Temperature warm cold sample surface		Temperature difference at Sample $\bar{T}_1 - \bar{T}_4$ [K]	Mean temperature of Sample T_m [°C]	Thermal conductivity of PUR-Isolation λ_{PUR} [W/(m·K)]
	\bar{T}_1 [°C]	\bar{T}_4 [°C]			
22,65	70,56	26,53	44,03	48,20	0,0234
27,55	78,54	26,77	51,77	52,25	0,0240
30,45	84,15	27,23	56,92	55,23	0,0242
32,58	88,75	28,22	60,52	57,99	0,0244
$\lambda_{50} = 0,0237$ W/(m·K)					



Dipl.-Ing. Friebel
Person in charge