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Test Report

**“Test of preinsulated bonded pipe Ø 60,3/125 mm
PUR foam system Daltofoam TE34201 / Suprasec 5005
manufactured by ZPU Jonca Sp. z o.o.”**

Short Title: Daltofoam TE34201 - Thermal conductivity (unaged)



Deutsche
Akkreditierungsstelle
D-PL-13119-02-00

Test Report No.: V288/18.1

Order No.: 402308110

Issued by Department Pipe Systems

Laboratory for Pipe System Testing

Recognised test laboratory of DVGW, DIN CERTCO and DIBt

The recognitions are valid for the test methods stated in the attachments of certificates of approval
DVGW LW-BU0023, DIN CERTCO PL121 and DIBt SAC 08

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Test Specimen:	Preinsulated bonded pipe, Ø 60,3/125 mm
Customer:	Zakład Produkcyjno Usługowy Kazimierz Jonca Sp.z o.o. ul. Przemysłowa 2 66-300 Miedzyrzecz POLAND
Order no. of the Customer:	Email, 25 June 2018
Test Laboratory:	IMA Materialforschung und Anwendungstechnik Laboratory for Pipe System Testing Wilhelmine-Reichard-Ring 4 01109 Dresden GERMANY
Test Specimen received on:	27 June 2018
Test Period:	June 2018 – August 2018
Person in Charge:	Dipl.-Ing. Matthias Thölert
Distribution List:	1 x Zakład Produkcyjno Usługowy 1 x IMA Dresden

Authorized
Dresden, 22 August 2018
IMA Materialforschung und
Anwendungstechnik GmbH

Dipl.-Ing. (BA) Carsten Dietze
Deputy Head of Department Pipe Systems

The test results refer exclusively to the specimen under test.
Rounded measurement or calculation values are based on the rule according to ISO 80000-1 Appendix B, Rule B.
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1 Task Definition

ZPU Jonca Sp. z o.o. commissioned IMA Materialforschung und Anwendungstechnik GmbH with conducting tests on a preinsulated bonded pipe Ø 60,3/125 mm in accordance with DIN EN 253 to the characteristics

- cell size (unaged condition),
- closed cell content,
- foam density (unaged condition),
- compressive strength (unaged condition),
- composition of the gas in the cells of the insulation (unaged condition),
- thermal conductivity (unaged condition).

2 Requirements

DIN EN 253:2015-12

District heating pipes - Preinsulated bonded pipe systems for directly buried hot water networks - Pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene; German version EN 253:2009+A2:2015

Table 2-1 Requirements and tests according to DIN EN 253:2015-12

Characteristics	Requirements acc. to clause	Test methods / remarks
Cell size	4.4.2	5.3.2.1
Closed cell content	4.4.2	5.3.2.2
Compressive strength	4.4.3	5.3.3
Foam density	4.4.4	5.3.4
Composition of the gas in the cells of the insulation	4.5.6	Chalmers method
Thermal conductivity in unaged condition	4.5.6	5.4.4

3 Test Specimen

- Preinsulated bonded pipe, Ø 60,3/125 mm manufactured by ZPU Jonca Sp. z o.o.,
- Service pipe: steel,
- Casing pipe: HDPE,
- Foam system: PUR type Daltofoam TE34201 / Suprasec 5005, cyclopentane-blown rigid polyurethane foam,
- Delivery of the sample material to IMA Dresden: 2018-06-27,
- Storage of the sample material before preparation and test: 72 h at 23 ± 2 °C and 50 ± 10 % R.H.

4 Testing procedure and results

4.1 Cell size (unaged condition)

For determination of the cell size in the radial direction, the PUR foam samples were taken from both ends of the pipe, distributed over the circumference of pipe. According to IMA test specification AA1/11, the sample surfaces were primed and the cell structure, which was examined with the scanning electron microscope, documented. The cell size results from the number of intersections in the range of the gauge length. Three parallel measurements were carried out per test specimen.

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Test equipment: Scanning electron microscope EVO MA10 (IMA 9026810)
Specimen dimensions: 25 mm x 20 mm x 10 mm
Specimen number: 2 x 3 items (taken distributed over the circumference, both ends of pipe)
Test location: FH / A1
Technician: Mr. Illing

Table 4-1 Requirements and test results – Cell size (unaged condition)

Test parameter	Actual test values				Requirement EN 253
	Specimen 1	Specimen 2	Specimen 3	Average value	
Cell size [mm] Pipe end 1	0,22	0,21	0,21	0,21	≤ 0,5
Cell size [mm] Pipe end 2	0,19	0,25	0,23	0,22	≤ 0,5

4.2 Closed cell content

For the determination of the closed cell content (percentage content of open to closed cells) according to ISO 4590, the test specimens were taken from both ends of the pipe, distributed over the circumference.

Test equipment: Pycnometer (Micrometrics IMA 9904521), Slide gauge Mitutoyo S (IMA 08499664), Electronic analytical balance (IMA 9904 286)
Specimen dimensions: 25 mm x 25 mm x 25 mm
Specimen number: 2 x 3 items (taken distributed over the circumference, both ends of pipe)
Test location: FH / V1
Technician: Mr. Lehmann

Table 4-2 Requirements and test results – Closed cell content

Test parameter	Actual test values				Requirement EN 253
	Specimen 1	Specimen 2	Specimen 3	Average value	
Closed cell content [%], Pipe end 1	96,1	96,9	97,8	96,9	≥ 88
Closed cell content [%], Pipe end 2	94,1	98,2	95,7	96,0	≥ 88

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4.3 Compressive Strength (unaged condition)

For the determination of the compressive strength of the foam in the radial direction, the test specimens were taken from both ends of the pipe, distributed over the circumference. The strength test was carried out according to ISO 844.

Test equipment: Material testing machine FPZ 100 (IMA 9023842)
Slide gauge Mitutoyo (IMA 2983001)
Specimen dimensions: 30 mm x 30 mm x 20 mm
Number of specimen: 2 x 3 items (taken distributed over the circumference, both ends of pipe)
Test location: FH / B1
Technician: Mr. Bärwald

Table 4-3 Requirements and test results – Compressive strength (unaged condition)

Test parameter	Test individual values				Requirement EN 253
	Specimen 1	Specimen 2	Specimen 3	Average value	
Compressive strength [MPa] Pipe end 1	0,39	0,41	0,40	0,40	≥ 0,30
Compressive strength [MPa] Pipe end 2	0,42	0,41	0,40	0,41	≥ 0,30

4.4 Foam density (unaged condition)

For the determination of the foam density, the test specimens were taken from both ends of the pipe, distributed over the circumference. The density measurement was carried out according to ISO 845.

Test equipment: Electronic analytical balance (IMA 9904 286)
Slide gauge Mitutoyo (IMA 2983001)
Specimen dimensions: 30 mm x 30 mm x 20 mm
Specimen number: 2 x 3 items (taken distributed over the circumference, both ends of pipe)
Test location: FH / V1
Technician: Mr. Lehmann

Table 4-4 Requirements and test results – Foam density (unaged condition)

Test parameter	Test individual values				Requirement EN 253
	Specimen 1	Specimen 2	Specimen 3	Average value	
Foam density [kg/m³] Pipe end 1	68,5	68,2	66,6	67,8	≥ 55
Foam density [kg/m³] Pipe end 2	73,0	77,4	75,0	75,1	≥ 55

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4.5 Composition of the gas in the cells of the insulation (unaged condition)

The stipulation of the cell gas content was implemented in a sub-order instruction through the BASF Schwarzheide, according to Chalmers-procedure. The result is documented in the test report 905019225581, dated 2016-07-19, which was available to IMA Dresden.

Table 4-5 Test results – Composition of the gas in the cells (unaged condition)

Result from test report number: 905019225581	Pressure [kPa]	Oxygen [Vol%]	Nitrogen [Vol%]	Carbondioxide [Vol%]	n-Pentane [Vol%]	Cyclopentane [Vol%]
Measurement 1	136	0,6	3,0	71,0	0,3	25,1
Measurement 2	137	0,3	1,8	72,4	0,3	25,2
Measurement 3	134	0,6	2,7	69,8	0,3	26,6
Average value	136	0,5	2,5	71,1	0,3	25,6

4.6 Thermal conductivity (unaged condition)

The determination of thermal conductivity (unaged condition) at the preinsulated pipe Ø 60,3/125 mm was carried out based on EN 253:2015 and ISO 8497.

Test equipment:

Test-equipment for determination of thermal conductivity on pre-insulated pipes according to EN 253:2015, Annex F
Manufacturer: IMA Dresden / PMK B98-B2

Temperature measurement:

2 x 6 thermocouples

End apparatus:

calibrated endcaps; correction according to van Rinsum

Steel service pipe:

$D_{S1} = 54,60$ mm, $D_{S2} = 60,59$ mm, $T = 3,00$ mm

PE- Casing pipe:

$D_{C3} = 118,08$ mm, $D_{C4} = 127,15$ mm; $e_{PE} = 3,34$ mm

Length of test specimen:

2000 mm

Number of measurements:

3

Test location:

FH / V1

Technician:

Mr. Lehmann

Table 4-6 Test results – Thermal conductivity (unaged condition)

Heat flow - rate \dot{q} [W]	Temperature hot cold sample surface		Difference in temperature sample surface $\overline{T_1} - \overline{T_4}$ [K]	Mean temperature of sample T_m [°C]	Thermal conductivity of PUR-foam λ_{PUR} [W/(m·K)]
	$\overline{T_1}$ [°C]	$\overline{T_4}$ [°C]			
21,08	70,71	26,61	44,10	48,81	0,0247
22,27	73,13	26,94	46,19	50,20	0,0249
22,91	74,37	27,03	47,34	50,87	0,0250
$\lambda_{50} = 0,0249$ W/(m·K)					

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5 Summary

The test results documented in this test report verify that the tested characteristics

- cell size (unaged condition),
- closed cell content,
- foam density (unaged condition),
- compressive strength (unaged condition),
- composition of the gas in the cells of the insulation (unaged condition),
- thermal conductivity (unaged condition)

of the pre-insulated pipe Ø 60,3/125 mm with PUR rigid foam system Daltofoam TE34201 / Suprasec 5005 meet the requirements of DIN EN 253:2015-12.

Reviewed

Dipl.-Ing. (BA) Carsten Dietze
Head of Building Services

Created

Dipl.-Ing. Matthias Thölert
Person in Charge