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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 (aged)



Deutsche
Akkreditierungsstelle
D-PL-13119-02-00

Test Report No.: V288/18.2

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

Test Report

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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 GmbH
Laboratory for Pipe System Testing
Wilhelmine-Reichard-Ring 4
01109 Dresden
GERMANY

Test Specimen received on: 27 June 2018

Test Period: June 2018 – January 2019

Person in Charge: Dipl.-Ing. Matthias Thölert

Distribution List: 1 x Zakład Produkcyjno Usługowy
Kazimierz Jonca Sp. z o.o.
1 x IMA Dresden

Authorized
Dresden, 21st February 2019
IMA Materialforschung und
Anwendungstechnik GmbH

Dipl.-Ing. Heiko Below
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 (aged condition),
- foam density (aged condition),
- compressive strength (aged condition),
- composition of the gas in the cells of the insulation (aged condition),
- thermal conductivity (aged 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 artificially aged condition | 4.5.7 | 5.4.5 |

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 (aged 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)
Aging condition: 150 d / 90 °C
Test location: FH / A1
Technician: MIL

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

| Test parameter | Actual test values | | | | Requirement EN 253 |
|------------------------------|--------------------|------------|------------|---------------|-----------------------|
| | Specimen 1 | Specimen 2 | Specimen 3 | Average value | |
| Cell size [mm] Pipe end 1 | 0,23 | 0,17 | 0,22 | 0,21 | ≤ 0,5 |
| Cell size [mm] Pipe end 2 | 0,20 | 0,19 | 0,27 | 0,22 | ≤ 0,5 |

4.2 Compressive strength (aged 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)
Aging condition: 150 d / 90 °C
Test location: FH / B1
Technician: PBAE

Table 4–2 Requirements and test results – Compressive strength (aged condition)

| Test parameter | Test individual values | | | | Requirement EN 253 |
|--|------------------------|------------|------------|---------------|-----------------------|
| | Specimen 1 | Specimen 2 | Specimen 3 | Average value | |
| Compressive strength [MPa] Pipe end 1 | 0,43 | 0,43 | 0,43 | 0,43 | ≥ 0,30 |
| Compressive strength [MPa] Pipe end 2 | 0,48 | 0,41 | 0,42 | 0,44 | ≥ 0,30 |

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4.3 Foam density (aged 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) |
| Aging condition: | 150 d / 90 °C |
| Test location: | FH / V1 |
| Technician: | JLE |

Table 4-3 Requirements and test results – Foam density (aged condition)

| Test parameter | Test individual values | | | | Requirement EN 253 |
|---|------------------------|------------|------------|---------------|--------------------|
| | Specimen 1 | Specimen 2 | Specimen 3 | Average value | |
| Foam density [kg/m ³] Pipe end 1 | 71,8 | 70,8 | 70,7 | 71,1 | ≥ 55 |
| Foam density [kg/m ³] Pipe end 2 | 70,6 | 73,2 | 72,5 | 72,1 | ≥ 55 |

4.4 Composition of the gas in the cells of the insulation (aged condition)

The stipulation of the cell gas content was implemented in a sub-order instruction through the BASF Schwarzheide, according to Chalmers-procedure. This test procedure is not included in the scope of accreditation. The result is documented in the test report 905019595786, dated 2019-01-22, which was available to IMA Dresden.

Aging condition: 150 d / 90 °C

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

| Result from test report number: 905019595786 | Pressure [kPa] | Oxygen [Vol%] | Nitrogen [Vol%] | Carbondioxide [Vol%] | n-Pentane [Vol%] | Cyclopentane [Vol%] |
|---|-------------------|------------------|--------------------|-------------------------|---------------------|------------------------|
| Measurement 1 | 89 | 7,1 | 31,8 | 24,9 | 0,5 | 35,7 |
| Measurement 2 | 88 | 8,4 | 34,5 | 20,6 | 0,5 | 36,0 |
| Measurement 3 | 87 | 7,5 | 32,5 | 23,2 | 0,5 | 36,3 |
| Average value | 88 | 7,7 | 32,9 | 22,9 | 0,5 | 36,0 |

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4.5 Thermal conductivity (artificially aged condition)

The determination of thermal conductivity (artificially aged 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 |
| Conditioning: | 26 th November to 3 rd December 2018 |
| Steel service pipe: | $D_{S1} = 54,55 \text{ mm}$, $D_{S2} = 60,55 \text{ mm}$, $T = 3,00 \text{ mm}$ |
| PE- Casing pipe: | $D_{C3} = 118,25 \text{ mm}$, $D_{C4} = 127,25 \text{ mm}$; $e_{PE} = 4,50 \text{ mm}$ |
| Length of test specimen: | 1998 mm |
| Number of measurements: | 3 |
| Aging condition: | 150 d / 90 °C |
| Test location: | FH / V1 |
| Technician: | JLE |

Table 4-5 Test results – Thermal conductivity (aged condition)

| Heat flow - rate ϕ [W] | Temperature | | 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)] |
|---|--|---|---|---|---|
| | hot sample surface $\overline{T_1}$ [°C] | cold sample surface $\overline{T_4}$ [°C] | | | |
| 22,54 | 70,14 | 26,92 | 43,23 | 48,69 | 0,0270 |
| 23,65 | 72,07 | 27,28 | 44,79 | 49,85 | 0,0271 |
| 24,38 | 73,36 | 27,44 | 45,92 | 50,58 | 0,0272 |
| $\lambda_{50} = 0,0271 \text{ W/(m·K)}$ | | | | | |

5 Summary

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

- cell size (aged condition),
- foam density (aged condition),
- compressive strength (aged condition),
- composition of the gas in the cells of the insulation (aged condition),
- thermal conductivity (aged 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. Heiko Below
Laboratory for Pipe Systems

Created

Dipl.-Ing. Matthias Thöler
Person in Charge