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## Test Report

### **“Identification at preinsulated bonded pipes DN 50/125 mm disconti manufactured by PLIXXENT Foam system Plixxopol RF 2100P”**

Short Title: Thermal conductivity (unaged) – Plixxopol RF 2100P



**DAkkS**  
Deutsche  
Akkreditierungsstelle  
D-PL-13119-02-00

Test Report No.: V178/20.2

Order No.: 302300018

Issued by Department Pipe Systems

Laboratory for Pipe System Testing

**Recognised test laboratory of EUROHEAT&POWER, DVGW, DIN CERTCO and DIBt**

The recognitions are valid for the test methods stated in the attachments of certificates of approval  
EHP001 – DISTRICT HEATING PRE-INSULATED STRAIGHT PIPES Certification Bodies and Test Institutes,  
DVGW LW-BU0023, DIN CERTCO PL121 and DIBt SAC 08

# Test Report

Thermal conductivity (unaged) – Plixxopol RF 2100P

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Test Specimen: Preinsulated bonded pipe DN 50/125 mm,

Customer: PLIXXENT  
Kronborgvej 24  
5450 Otterup  
DENMARK

Manufacturer: PLIXXENT  
Kronborgvej 24  
5450 Otterup  
DENMARK

Order no. of the Customer: RF 2100P

Test Laboratory: IMA Materialforschung und Anwendungstechnik GmbH  
Laboratory for Pipe System Testing  
Wilhelmine-Reichard-Ring 4  
01109 Dresden  
GERMANY

Test Specimen received on: 2020-05-12

Test Period: May 2020 – July 2020

Person in Charge: Dipl.-Ing. Matthias Thölert

Distribution List: 1 x PLIXXENT  
1 x IMA Dresden

Authorized  
Dresden, 11<sup>th</sup> August 2020  
IMA Materialforschung und  
Anwendungstechnik GmbH

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

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

PLIXXENT commissioned IMA Materialforschung und Anwendungstechnik GmbH with conducting tests on preinsulated bonded pipes DN 50/125 mm, discontinuous proceeding, in accordance with DIN EN 253:2020-03 to the characteristics

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

## 2 Requirements

DIN EN 253:2020-03

District heating pipes - Bonded single pipe systems for directly buried hot water networks - Factory made pipe assembly of steel service pipe, polyurethane thermal insulation and a casing of polyethylene; German version EN 253:2019

**Table 2–1 Requirements and tests according to EN 253:2019**

Characteristics	Requirements acc. to clause	Test methods / remarks
Cell size	4.4.2	5.3.2.1
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	4.5.7	Chalmers method
Thermal conductivity in unaged condition	4.5.7	5.4.3

## 3 Test Specimen

- Preinsulated bonded pipes, DN 50/125 mm, discontinuous proceeding,
- Service pipe: steel, P235GH
- Casing pipe: HDPE,
- Foam system: Plixxopol RF 2100P, cyclopentane-blown rigid polyurethane foam,
- Delivery of the sample material to IMA Dresden: 2020-05-12,
- Storage of the sample material before preparation and test: 72 h at  $23 \pm 2$  °C and  $50 \pm 10$  % 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 004895)  
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: EPA / MIL

**Table 4–1 Requirement 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	0.34	0.36	0.30	0.33	≤ 0,5
Cell size [mm] Pipe end 2	0.23	0.24	0.26	0.24	≤ 0,5

## 4.2 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 Inspekt (IMA 008639)  
Slide gauge Mitutoyo (IMA 004268)  
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: IG / V1  
Technician: MLA

**Table 4–2 Requirement 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	0.31	0.31	0.30	0.31	≥ 0,3
Compressive strength [MPa] Pipe end 2	0.32	0.32	0.31	0.32	≥ 0,3

## 4.3 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.

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Thermal conductivity (unaged) – Plixxopol RF 2100P

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Test equipment: Electronic analytical balance (IMA 004961)  
Slide gauge Mitutoyo (IMA 004268)  
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: PDI

**Table 4–3 Requirement and test results – Foam density (unaged condition)**

Test parameter	Actual test values			Requirement EN 253
	Specimen 1	Specimen 2	Specimen 3	
Foam density [kg/m <sup>3</sup> ] Pipe end 1	60.1	60.7	57.8	≥ 55
Foam density [kg/m <sup>3</sup> ] Pipe end 2	58.9	59.9	57.4	≥ 55

## 4.4 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 Chalmers-procedure. This test procedure is not included in the scope of accreditation. The result is documented in the test report 905020846564, dated 2020-06-24, which was available to IMA Dresden.

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

Result from test report number: 905020846564	Pressure [kPa]	Oxygen [Vol%]	Nitrogen [Vol%]	Carbon- dioxide [Vol%]	iso- Pentane [Vol%]	n- Pentane [Vol%]	Cyclopentane [Vol%]
Measurement 1	116	0.3	3.1	57.9	0.9	0.3	37.5
Measurement 2	109	0.4	4.3	56.2	0.9	0.3	37.5
Measurement 3	110	0.2	3.1	58.4	0.8	0.5	37.0
Average value	112	0.3	3.5	57.5	0.9	0.4	37.5

## 4.5 Thermal conductivity (unaged condition)

The determination of thermal conductivity (unaged condition) at the preinsulated pipe DN 50/125 mm was carried out based on EN 253 and ISO 8497.

Test equipment: Test-equipment for determination of thermal conductivity on pre-insulated pipes IMA Dresden / PMK B98-B2  
Temperature measurement: 2 x 6 thermocouples  
End apparatus: calibrated endcaps; correction according to van Rinsum  
Conditioning: 2020-05-12 – 2020-05-19  
Steel service pipe: D<sub>S1</sub> = 54.40 mm, D<sub>S2</sub> = 60.20 mm, T = 2.90 mm  
PE- Casing pipe: D<sub>C3</sub> = 120.25 mm, D<sub>C4</sub> = 127.00 mm; e<sub>PE</sub> = 3.40 mm  
Length of test specimen: 2001 mm  
Number of measurements: 3

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Test location:

FH / V1

Technician:

JLE

**Table 4–5 Requirement and test results – Thermal conductivity (unaged condition)**

Heat flow - rate $\phi$ [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  $\lambda_{PUR}$ [W/(m·K)]
	hot sample surface  $\overline{T_1}$ [°C]	cold sample surface  $\overline{T_4}$ [°C]			
19.80	70.05	26.57	43.47	48.42	0.0245
25.08	81.37	27.95	53.43	54.79	0.0254
29.12	88.97	28.40	60.57	58.84	0.0259
<b>Actual test value <math>\lambda_{50}</math></b>					<b>0.0247</b>
Requirement EN 253					0.0290

Reviewed

Created

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Person in Charge