

Test certificate No.: 62548/03-I

Customer: aquatherm GmbH
Biggen 5
D-57439 Attendorn

Commission: First test of a warm water floor heating system and radiator connecting system as per DIN 4721 (June 2001), para. 8.1.2, 8.1.4 and 8.1.5:
Pipes of PE-RT with oxygen barrier layer and metal clamp connectors, dimension 14 x 2 mm, and pressurised sleeve connectors made of polyphenylene sulfone (PPSU) or of metal, dimensions 16 x 2 mm and 20 x 2 mm.

Results: See section 6 "Summary"

Letter dated: 24 July 2003 Ref.: Ulrich Höffer

Samples received: see section 3 Sampling:

Test period: 10 November 2003 to 18 March 2004

The test certificate consists of 7 text pages.

Würzburg, 5 July 2004

Klu/we

pp.

/signature/

Dr. Anton Zahn

(round stamp:)
SKZ-TeConA GmbH
Internationally accredited

pp.

/signature/

Dipl.-Ing. Michael Klute

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1. Commission

In the letter dated 24 July 2003, aquatherm GmbH, Biggen 5, D-57439 Attendorn, commissioned SKZ-TeConA GmbH to conduct initial testing of a warm water floor heating system and radiator connecting system according to DIN 4721 (June 2001), para. 8.1.2, 8.1.4 and 8.1.5, on pipes of PE-RT with oxygen barrier layer and metal clamp connectors, dimension 14 x 2 mm, and pressurised sleeve connectors made of polyphenylene sulfone (PPSU) or of metal, dimensions 16 x 2 mm and 20 x 2 mm.

2. Application, structure, pipe connector programme

2.1 Application

The system is intended for use in plastic pipes for warm water floor heating systems and radiator connections. The operating conditions applicable to this system have been classified as follows according to DIN 4721, table 12:

Application classes 4 and 5 in combination with an operating pressure $p_{oper} = 4$ bar.

2.2 Structure

2.2.1 Pipe of PE-RT with oxygen barrier layer

The pipe is produced by aquatherm GmbH, Biggen 5, D-57439 Attendorn. It has a 3-ply concentric wall structure and consists of the following components, as indicated by the manufacturer:

Ply No.	Component	Colour	Material	Form mass/manufacturer
1	Oxygen barrier layer	colourless	EVOH	SOARNOL A 4412 HB / Sojitz Europe plc., Düsseldorf Branch, Am Wehrhahn 33
2	Coupling agent	colourless	PP	ADMER QF 551 E /Mitsui & Co. Deutschland GmbH, Königsallee 63 – 65, 40215 Düsseldorf
3	Basic pipe	natural	PE-RT	Dowlex 2344 E / Dow Europe S.A., Bachtobelstrasse 3, CH-8810 Horgen/Switzerland, alternatively Yuclair DX800 / SK Corporation, 110 Kosadong Nam-gu Ulsan 680-130, Korea

2.2.2 Clamp connectors

The clamp connectors, dimension 14 x 2 mm, are produced by Dumser Metallbau GmbH & Co. KG, 768298 Landau, and consist of the following components or materials, according to the manufacturer:

Component	Material	Material designation
Basic body (double nipple)	brass	MS 58
Support sleeve	brass	CW614N (CuZn39Pb3)
Sealing ring (O-ring) between support sleeve and basic body (in the area of the "Euro cone")	elastomer	EPDM Shore 70
Clamping ring	brass	CW 614N (CuZn39Pb3)
Union nut	brass	CW614N (CuZn39Pb3), nickel-plated

2.2.3 Pressurised sleeve connectors

The pressurised sleeve connectors, dimension 16 x 2 mm and 20 x 2 mm, are produced by aquatherm GmbH, Biggen 5, D-57439 Attendorn, and consist of the following components or materials, according to the manufacturer:

Component	Material	Material designation
Basis metal body	brass	CW614N (CuZn39Pb3)
Basic plastic body	PPSU	Radel R-5100 GY 1037 (colour: grey)
Pressurised sleeve	brass	CW614N (CuZn39Pb3)

3. Test material

SKZ-TeConA GmbH received the following test material on 3 and 9 September and 18 December 2003 and on 21 January 2004:

Sample No.	Designation	Dimension [mm]	Quantity	Marking [FZ = company marking]
1.1	PE-RT pipe (Dowlex 2344) with oxygen barrier	14 x 2	30 m	aquatherm floor heating pipe 14x2 mm Art. No. 90024 PE-RT DIN 4721 class C application class 4/5 6 bar "oxygen-proof" 18 June 2003 03:38 5010-M-14_200 M Made in Germany
1.2	Coupling (brass) (clamp connector)	14 x 2	15	14 14 14 14
2.1	PE-RT pipe (Dowlex 2344) with oxygen barrier	16 x 2	30 m	aquatherm floor heating pipe 16x2 mm Art. No. 90026 PE-RT DIN 4721 class C application class 4/5 6 bar "oxygen-proof" 10:19 6 June 2003 -M-14-5010-029 M Made in Germany
2.1Y	PE-RT pipe (Yuclair DX 800) with oxygen barrier	16 x 2	30 m	aquatherm floor heating pipe 16x2 mm Art. No. 90026 PE-RT DIN 4721 class C application class 4/5 6 bar "oxygen-proof" 07:12 6 June 2003 -M-14-5010-029 M Made in Germany
2.2	Union (brass) with AG (pressurised sleeve connector)	16 x 2 - 1/2 "	25	aquatherm Ø 16
2.3	T-piece (PPSU) (pressurised sleeve connector)	16 x 2	25	aquatherm Ø 16 a Ø 16 2/03
2.4	Angle (PPSU) (pressurised sleeve connector)	16 x 2	5	aquatherm Ø 16 a Ø 16 2/03
3.1	PE-RT pipe (Dowlex 2344) with oxygen barrier	20 x 2	30 m	aquatherm floor heating pipe 20x2mm Art. No. 90028 PE-RT DIN 4721 class C application class 4/5 6 bar "oxygen-proof" 001 M 22 July 2003 08.32 M-14 5016 Made in Germany
3.2	Union (brass) with AG (pressurised sleeve connector)	20 x 2 - 1/2"	40	aquatherm Ø 20
3.3	T-piece (PPSU) (pressurised sleeve connector)	20 x 2	30	aquatherm Ø 20 FZ 8/03
3.4	Angle (PPSU) (pressurised sleeve connector)	20 x 2	5	aquatherm Ø 20 a Ø 20 3/03
3.5	Union angle (brass) with AG (pressurised sleeve connector)	20 x 2 - 1/2 "	10	FZ 20x2 1/2 12 D 03

4. Test method

Our reports are usually based on accredited standards. The list of all accredited standards can be consulted on the internet under www.skz.de.

The test was conducted according to DIN 4721 (June 2001) "Plastic piping systems for warm water floor heating and radiator connecting – Polyethylene of raised temperature resistance PE-RT", para. 8.1.2, 8.1.4 and 8.1.5

The individual tests are listed in the following table:

Test	Requirements according to	Carried out according to
4.1 Burst test	DIN 4721, para. 8.1.2	DIN EN 921
4.2 Pull-out test	DIN 4721, para. 8.1.4	DIN EN 712
4.3 Temperature cycling test	DIN 4721, para. 8.1.5	DIN EN 12293

5. Test results

5.1 Burst test

Sample No.	Test temp [°C]	Test pressure [bar]	Exposure time [h]		Remarks
			act.	nom.	
1.1/1.2	95	7	> 1,000	≥ 1,000	no complaints
2.1/2.2/2.3	95	7	> 1,000	≥ 1,000	no complaints
2.1>/2.2/2.3	95	7	> 1,000	≥ 1,000	no complaints
3.1/3.2/3.3	95	7	> 1,000	≥ 1,000	no complaints

There were no leaks in the pipes, mouldings and pipe connectors. The requirements of DIN 4721, para. 8.1.2, were fulfilled.

5.2 Pull-out test

Sample No.	Test temp [°C]	Pull-out force [N]	Exposure time [h]		Remarks
			act.	nom.	
1.1/1.2	95	62	> 1	≥ 1	no complaints
2.1/2.2/2.3	95	80	> 1	≥ 1	no complaints
2.1>/2.2/2.3	95	80	> 1	≥ 1	no complaints
3.1/3.2/3.3	95	126	> 1	≥ 1	no complaints

The requirements of DIN 4721, para. 8.1.4, were fulfilled.

5.3 Temperature cycle test

Sample No.	Test temp [°C]	Test overpressure [bar]	Exposure time [h]		Remarks
			act.	nom.	
1.1/1.2	20/95 alternating	4	> 5,000	≥ 5,000	no complaints
2.1/2.2/2.3	20/95 alternating	4	> 5,000	≥ 5,000	no complaints
2.1>/2.2/2.3	20/95 alternating	4	> 5,000	≥ 5,000	no complaints
3.1/3.2/3.3	20/95 alternating	4	> 5,000	≥ 5,000	no complaints

There were no leaks in the pipes, mouldings and pipe connectors. The requirements of DIN 4721, para. 8.1.5, were fulfilled

6. Summary

The first test as per DIN 4721 (June 2001), para. 8.1.2, 8.1.4 and 8.1.5: on pipes of PE-RT with oxygen barrier layer and metal clamp connectors, dimension 14 x 2 mm, and pressurised sleeve connectors made of polyphenylene sulfone (PPSU) or of metal, dimensions 16 x 2 mm and 20 x 2 mm was concluded with positive results.