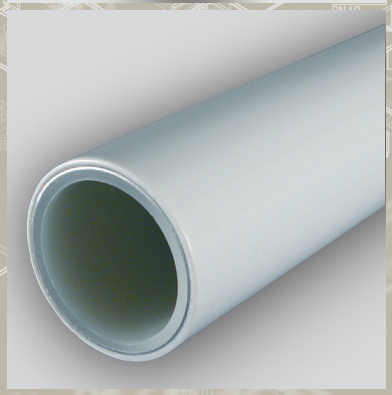
heatwave
multilayer pipe systems

TECHNICAL MANUAL

HOT + COLD WATER SYSTEMS
HEATING SYSTEMS



MANUFACTURED IN **GERMANY**

heatwave
multilayer pipe systems

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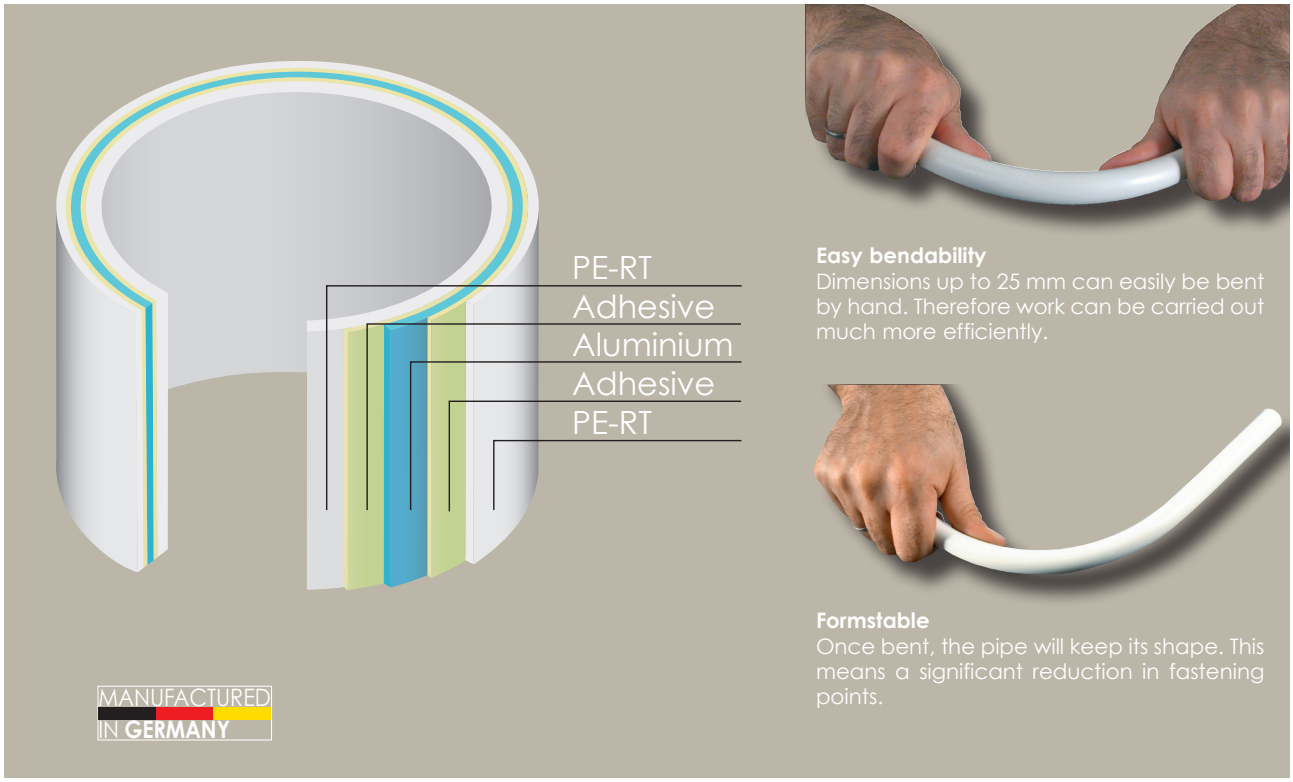
1.1. Heatwave systems – multi-layer pipe

The Heatwave systems multi-layer pipe consists of 5 layers. One polyethylene layer is applied to the inside and one to the outside of the welded aluminium pipe. Both PE layers are permanently bonded to the aluminium pipe by means of an adhesive layer. The polyethylene used is a non-cross-linked polyethylene of raised temperature resistance according to DIN 16833 (PE-RT – polyethylene of raised temperature resistance). The Heatwave systems multi-layer pipe is designed for the specific requirements of drinking water and heating installations. The 5-layer structure combines the advantages of plastics and metal.



Highest material safety
Selected raw materials and a continous experience in production of more than 30 years, guarantee the high quality of a technically perfected product. The high loading capacity of a continous operating temperature* exceeds the requirements of the WRAS approval test procedure of t_{max} 70 °C (tap water) and t_{max} 80 °C (heating) as well as a continous operating pressure* of p_{max} 10 bar as the basis for daily safety.

Simple bendability
The standard diameters up to 25 mm can be easily bent without any tools. The bending spring provides exact rounding at narrow bend radii.

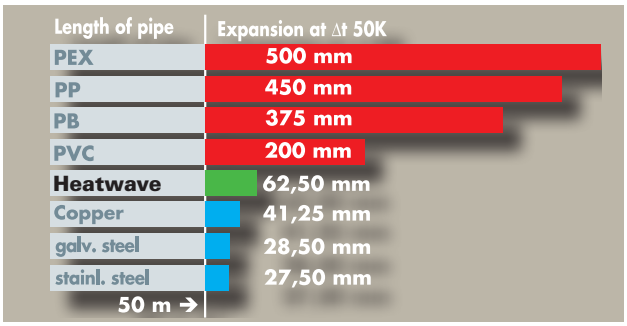
Advantages of a metal pipe
- absolutely oxygen tight because of welded aluminium pipe
- form stable, no spring back forces
- low thermal expansion

Advantages of a plastic pipe
- no deposits because of the smooth inside wall
- no corrosion because of high chemical resistance
- low weight

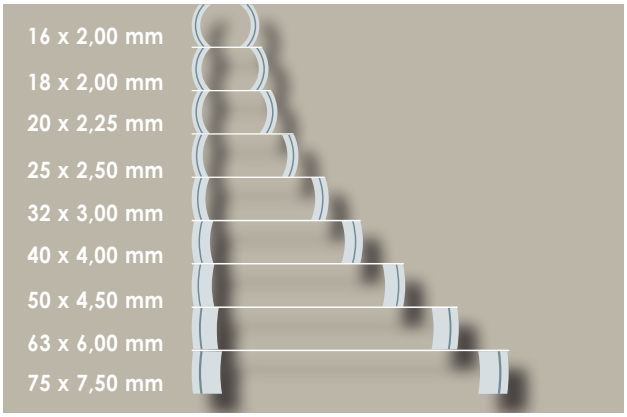
*** Except pipe qualities with special characteristics in performance (e.g. panel heating, red).**
**** The DVGW, the German Technical and Scientific Association for Gas and Water is the german technical standardization organisation.**

1.0. System description

The low thermal expansion
Due to the inner aluminium layer the thermal expansion is similar to those of metal pipes. Thus the fastening with slide points and fixed points corresponds to those of metal pipes.



Range of dimensions



1.1.1. Technical data Heatwave systems multi-layer pipes

Pipe dimension	mm	16 x 2	18 x 2.00	20 x 2.25	25 x 2.5	32 x 3	40 x 4	50 x 4.5	63 x 6	75 x 7.5
Inner diameter	mm	12	14	15.5	20	26	32	41	51	60
Material		PE-RT/AL/PE-RT								
Fire classification		normally inflammable B2 according to DIN 4102 / Euroclass E								
Length, coil (standard)	m	200/500	200	100	50	25	-	-	-	-
Straight length (standard)	m	5	5	5	5	5	5	5	5	5
Weight of pipe	kg/m	0.105	0.120	0.148	0.215	0.323	0.507	0.742	1.223	1.788
Water volume	l/m	0.113	0.154	0.190	0.314	0.531	0.803	1.320	2.042	2.827
Weight of pipe (filled with water)	kg/m	0.218	0.273	0.338	0.529	0.854	1.310	2.062	3.265	4.615
Roughness of surface (inner pipe)	mm	0.0004								
Heat conductivity	W/m x K	0.4								
Expansion coefficient	mm/m x K	0.025								
Min. bending radius (by hand)	mm	80 (5 x d)	90 (5 x d)	100 (5 x d)	125 (5 x d)	160 (5 x d)	-	-	-	-
Min. bending radius (by bending spring)	mm	60 (4 x d)	72 (4 x d)	80 (4 x d)	100 (4 x d)	125 (4 x d)	-	-	-	-
Min. bending radius (by bending tool)	mm	50	60	70	90	110	160	200	-	-

Temperature resistance, Heatwave systems standard pipe:

Application tap water: The daily use of the pipe may not exceed the permanent operating temperature range from 0 °C up to 70 °C and the permanent operating pressure of 10 bar. The maximum short-time accidential temperature is 95 °C and may not occur for longer than 100 operating hours.

Application heating: The daily use of the pipe may not exceed the permanent operating temperature range from 0 °C up to 80 °C and the permanent operating pressure of 10 bar. The maximum short-time accidential temperature is 100 °C and may not occur for longer than 100 operating hours.

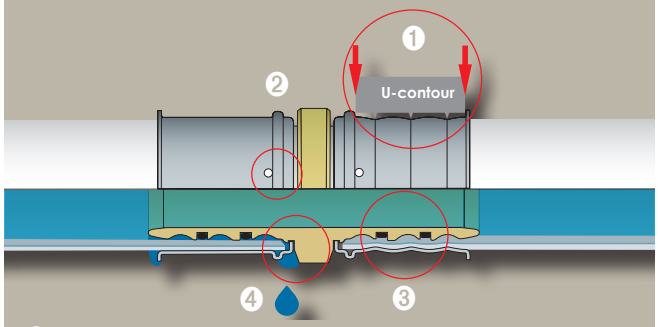
1.2. Heatwave systems – Connection techniques

1.2.1. Metal-Press-Fitting, 16 mm- 32 mm

The pressing-sleeve
- is fixed to the tin-plated brass body and protects the O-rings from being damaged.
- enables an easy check of the correct insertion-depth due to the inspection windows.
- has a double flange press-jaw guide, that makes a proper pressing easier even at poorly accessible positions.
- keeps the pipe permanently fixed to the fitting body after pressing. The pipe still can be turned and adjusted after the pressing.

Additional test safety
- Non-pressed connections can be easily detected during the pressure-test (test pressure 10 bar) by appearance of water.

Metal-Press-Fitting, 16 mm - 32 mm



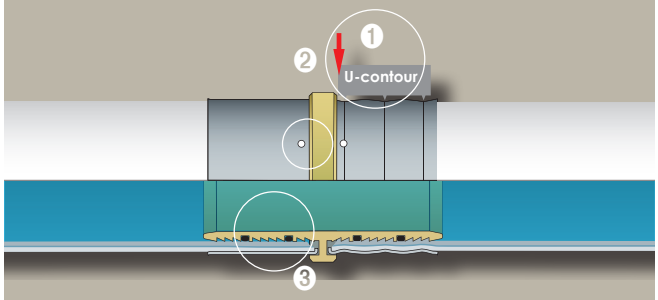
❶ – Double pressing jaw guide 16 mm - 32 mm
❷ – Inspection window for easy check of insertion depth of pipe
❸ – Special profile geometry with O-rings made of EPDM
❹ – Additional test safety

1.2.2. Metal-Press-Fitting, 40 mm - 75 mm

The pressing-sleeve
- protects the O-rings from being damaged.
- enables an easy check of the correct insertion-depth due to the inspection windows.

The fitting
- has a press-jaw guide, that makes a proper pressing easier.
- keeps the pipe permanently fixed to the fitting body after pressing. The pipe still can be turned and adjusted after the pressing.

Metal-Press-Fitting, 40 mm - 75 mm



❶ – Pressing jaw guide 40 mm - 75 mm
❷ – Inspection window for easy check of insertion depth of pipe
❸ – Special profile geometry with O-rings made of EPDM

1.2.3. Technical data Heatwave systems metal and PPSU press systems / Zeta – values and equivalent pipe length

Dimension d_a x s	mm	**16 x 2.00**		**18 x 2.00**		**20 x 2.25**		**25 x 2.50**		**32 x 3.00**		**40 x 4.00**		**50 x 4.50**		**63 x 6.00**		**75 x 7.50**	
Inner-diameter d_i	mm	12		14		15,5		20		26		32		41		51		60	
Zeta-value ζ / equivalent pipe-length L_a	m	ζ	L_a	ζ	L_a	ζ	L_a	ζ	L_a	ζ	L_a	ζ	L_a	ζ	L_a	ζ	L_a	ζ	L_a
Elbow 90°		4.3	2.0	3.6	2.0	2.9	1.9	2.7	2.4	2.3	2.7	2.0	3.1	1.6	3.3	1.4	3.8	1.5	4.6
Elbow 45°		-	-	-	-	-	-	-	-	1.2	1.4	1.2	1.8	0.8	1.7	0.9	2.2	0.9	2.6
Reduction		1.6	0.8	1.4	0.8	1.1	0.8	1.0	0.9	0.9	1.1	0.8	1.2	0.6	1.2	0.7	1.6	0.6	1.6
Branch at disconnection		5.1	2.4	4.2	2.3	3.5	2.3	3.1	2.7	2.6	3.1	2.4	3.7	1.9	3.9	1.7	4.6	1.8	5.6
Branch, pass-way at disconnection		1.1	0.6	1.0	0.6	0.8	0.5	0.8	0.7	0.7	0.8	0.5	0.8	0.4	0.8	0.5	1.1	0.5	1.3
Branch, counter direction at disconnection		4.5	2.1	3.7	2.0	3.1	2.0	2.8	2.5	2.3	2.7	2.1	3.2	1.7	3.5	1.5	4.1	1.6	4.9

Base: Flow rate of 2m/s
All information is compiled to the best of our knowledge. No liability can be assumed for possible faults.

1.0. System description

1.3. Tools

To round up the well engineered system, Heatwave systems offers tools which perfectly match with the components. A detailed overview of the tool range can be found in the latest price list.

2.0. Fields of application

2.0. Fields of application

Applications

Domestic and building technology, industry applications.

Available dimensions

16 x 2.00 mm / 18 x 2.00 / 20 x 2.25 mm / 25 x 2.50 mm / 32 x 3.00 mm / 40 x 4.00 mm / 50 x 4.50 mm / 63 x 6.00 mm / 75 x 7.50 mm

Drinking water installation

In its function as a drinking water pipe for cold and hot water of every drinking water quality (according to TrinkwV) Heatwave systems fulfils all requirements of the sanitary technology.

Heating installation

In its function as a heating pipe within the mentioned load values, Heatwave systems can be used without limitations for radiator connection or for radiant heating/cooling.

Rain water piping

For rain water piping separately laid from drinking water installations within buildings. The ph-value of the water must be > 6.

Compressed air

As piping for compressed air in installations with preceding oil filter (oil-free).

Automotive engineering

Water transport in vehicles and aeroplanes.

Other media

Further media and fields of application on inquiry (e.g. antifreeze and disinfectant).

Installation possibilities

within the building

- applicable for the installation within buildings in form of surface or concealed installations, of main risers and distributing pipework, as well as for the pre-wall installation with prefabricated fastening options or in concrete components.
- Heatwave systems press connections are permanently tight and thus allowed for concealed installations.

in the open-air

- Heatwave systems has to be protected reliably from constant direct UV load (solar radiation).

Building material class

Heatwave systems corresponds to the building material class B2 (normally inflammable) according to DIN 4102 (please see also topic 4.7.).

Comparison of the Heatwave systems pipe dimensions with other pipe materials

The dimensions of Heatwave systems pipes can be roughly compared with other materials like copper and galvanized steel according to the following list. (Only a hydraulic calculation can provide information on the dimensioning of whole installations.)

DN	Heatwave systems	Copper	Steel
DN 12	16 x 2.0	15 x 1	R3/8
DN 15	20 x 2.25	18 x 1	R1/2
DN 20	25 x 2.5	22 x 1	R3/4
DN 25	32 x 3	28 x 1.5	R1
DN 32	40 x 4	35 x 1.5	R1 1/4
DN 40	50 x 4.5	42 x 1.5	R1 1/2
DN 50	63 x 6	54 x 2	R2
DN 65	75 x 7.5	64 x 2	R 2 1/2

3.0. Installation and assembly instructions

3.1. Mounting instructions

Please read the mounting instructions carefully, the components of the system have been stringently tested and only Heatwave tools or tools that are approved by Heatwave are to be used otherwise the warranty will be invalidated.

3.1.1. Preparation of the connection

1. CUT TO LENGTH OF THE PIPE

16 mm – 20 mm (fig. 1)
Cut the Heatwave systems pipe right-angled with the pipe cutter.
25 mm - 75 mm (fig. 2)
Cut the Heatwave systems pipe right-angled with the pipe cutting tool.

2. CENTERING AND BEVELING OF THE PIPES

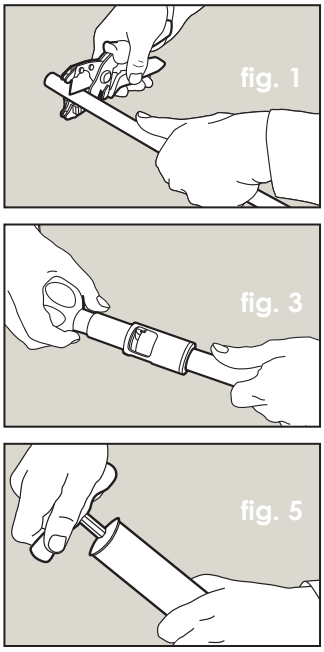
16 mm – 32 mm (fig. 3)
Bevel the Heatwave systems multi-layer pipe by using the beveling insert in combination with the handle until there is a clearly visible edge all over the pipe end.

16 mm – 25 mm (fig. 4)
Use the Combined Beveling Tool for press connections to make a clearly visible edge all over the pipe end.

40 mm – 75 mm (fig. 5)
Use the Beveling Tool until there is a clearly visible edge all over the pipe end.

3. INSPECTION OF THE PIPE AND THE FITTING BEFORE INSERTING THE FITTING

Visual inspection of the beveled pipe end and the fitting to identify damages or impurities **(fig. 6 + fig. 7).**



3.1.2. Connections with press fittings 16 mm - 32 mm

1. ATTACH FITTING TO PIPE

a) Preparation of the Heatwave systems multi-layer pipe as described in point 3.1.1.
b) Push the fitting into the pipe as far as it will go **(fig. 8)**; the correct insertion depth is indicated by the appearance of the pipe in the inspection window of the metal sleeve.

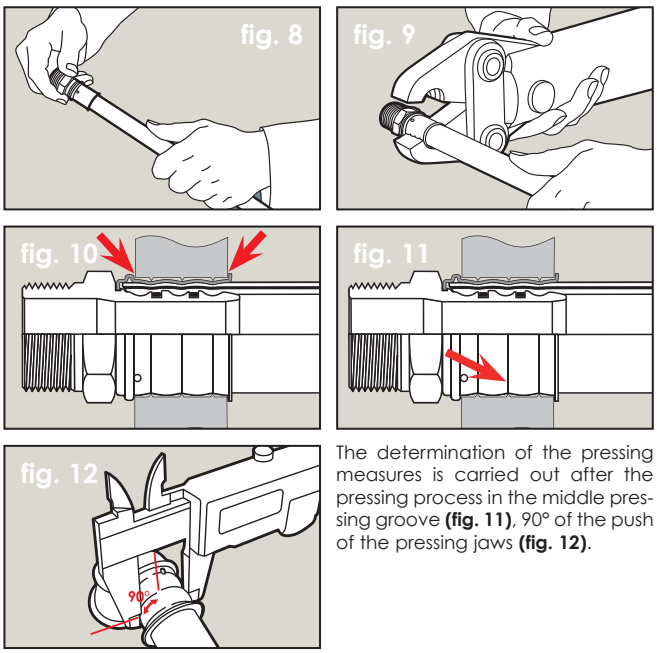
2. PRESSING OF THE FITTING

Open the pressing jaws and position the jaws between the double guides on the press-sleeve **(fig. 9, fig. 10)**. Close pressing jaws and start pressing procedure.

3. Use of the pressing jaws

When using approved pressing jaws with a U-profile that are suitable for the application and have been calibrated in good condition the following pressing measurements should be observed:

Ø 16 pressing measure 16.0 - 16.4 mm
Ø 18 pressing measure 18.0 - 18.4 mm
Ø 20 pressing measure 20.0 - 20.4 mm
Ø 25 pressing measure 25.0 - 25.4 mm
Ø 32 pressing measure 32.0 - 32.4 mm



The determination of the pressing measures is carried out after the pressing process in the middle pressing groove **(fig. 11)**, 90° of the push of the pressing jaws **(fig. 12)**.

3.1.3. Connections with press fittings 40 mm - 75 mm

1. ATTACH FITTING TO PIPE

a) Preparation of the Heatwave systems multi-layer pipe as described in point 3.1.1.
b) Push the metal sleeve over the pipe, push the fitting into the pipe as far as it will go **(fig. 13)**. When the fitting lies against the metal sleeve and the pipe can be seen in the inspection window the connection is ready for pressing.

2. PRESSING OF THE FITTING

Open the pressing jaws (75 mm: pressing chain!) and position the jaws on the end-stop of the fitting. Close pressing jaws/pressing chain and start pressing procedure **(fig. 14, fig. 15)**.
(Please refer to the instructions supplied with the pressing tool).

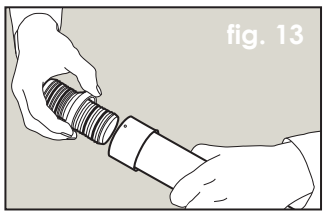


fig. 13

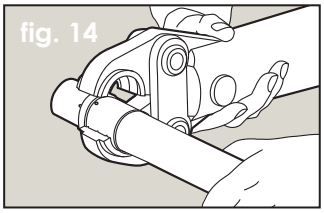


fig. 14

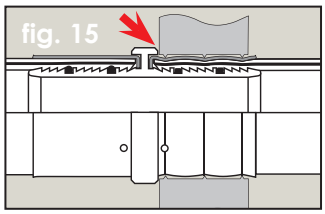


fig. 15

3.1.4. Connections with screw fittings 16 mm - 20 mm

1. ASSEMBLY OF SCREW FITTINGS

a) Preparation of the Heatwave systems multi-layer pipe as described in point 3.1.1.
b) Push the nut onto the pipe.
c) Push the clamping ring onto the pipe.
d) Push the fitting as far as it will go into the pipe **(fig. 16, fig. 18)**.
e) Tighten the nut with a torque of 40 Nm **(fig. 17, fig. 19)**.

IMPORTANT: PLEASE MIND THAT THE FITTING IS NOT BEING PULLED OUT OF THE PIPE DURING TIGHTENING.

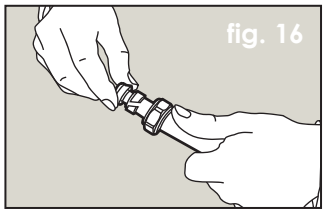


fig. 16

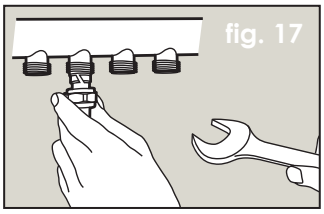


fig. 17

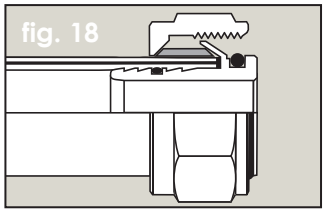


fig. 18

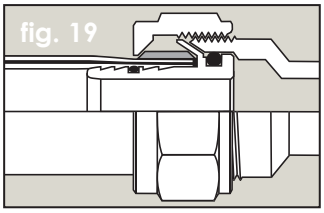
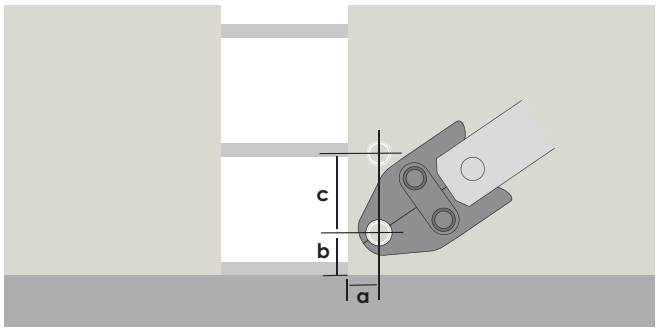


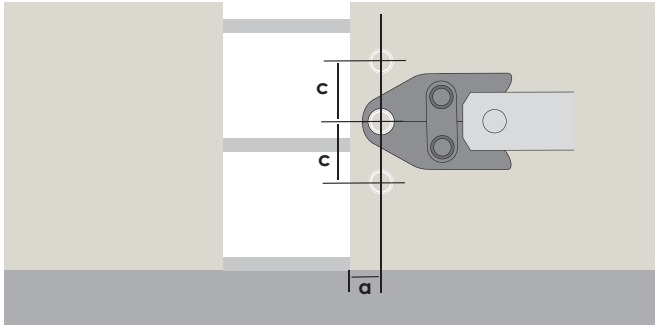
fig. 19

3.2. Installation measures

Pipe dimension (mm)	a (mm)	b (mm)	c (mm)
16 x 2.00	30	30	90
18 x 2.00	31	31	90
20 x 2.25	32	32	90
25 x 2.50	50	50	105
32 x 3.00	50	50	110
40 x 4.00	55	60	115
50 x 4.50	60	60	120
63 x 6.00	80	75	125
75 x 7.50	82	82	125

Pipe dimension (mm)	a (mm)	c (mm)
16 x 2.00	15	45
18 x 2.00	0	0
20 x 2.25	18	48
25 x 2.50	27	71
32 x 3.00	27	75
40 x 4.00	45	105
50 x 4.50	50	105
63 x 6.00	80	120
75 x 7.50	82	125



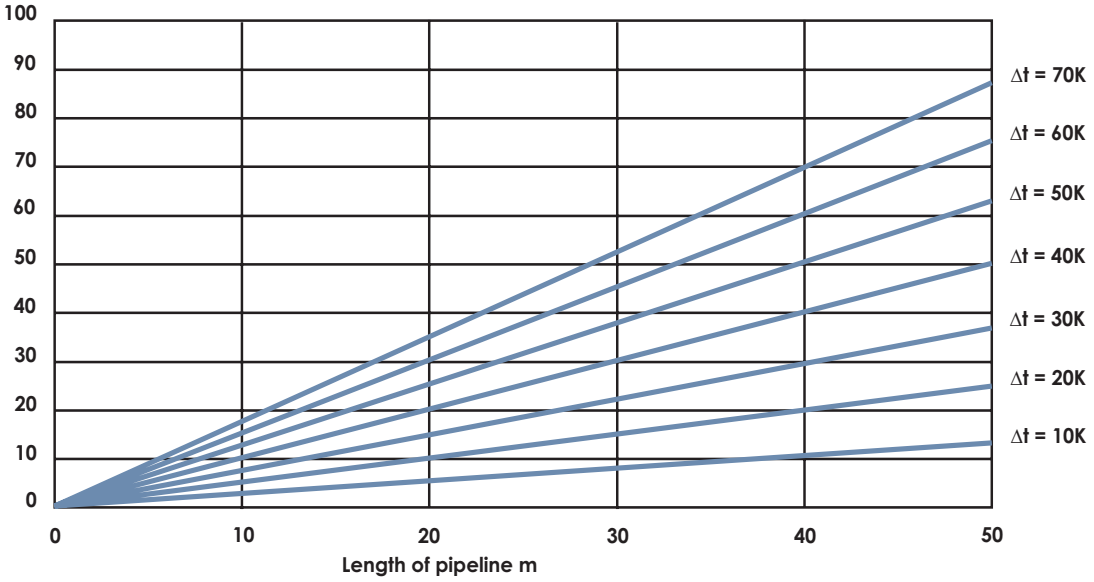


3.3. Thermal expansion

It is important to consider the thermal expansion that occurs when the pipe heats up and is taken into consideration during the design and installation phase of the project. The thermal expansion can be calculated by means of the following formula, and it is shown in the graph:

$\Delta l = \alpha \times L \times \Delta t$
Legend:
Δl: Expansion (mm)
α: Coefficient of expansion (0,025 mm/(m x K))
L: Length of pipeline (m)
Δt: Difference of temperature (K)

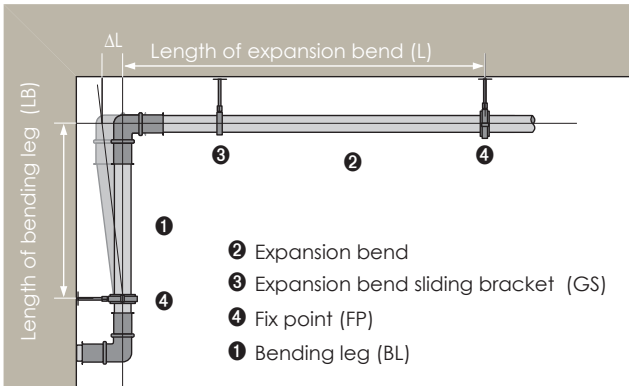
Thermal expansion Heatwave systems multi-layer pipes



3.4. Thermal expansion of distribution lines and risers

4.) When designing and installing Heatwave multilayer pipes in distribution and risers systems and additionally to the structural expansion of the pipe the thermal related length expansion must also be considered. The thermal length expansion must be absorbed and the pipe work must have the ability to expand in the direction of the bending leg, space for this expansion must be designed in to the installation. The diagram opposite describes who this can be achieved with two fixed points and an expansion sliding bracket.

Scheme for length compensation at thermal length expansion



3.5. Bending leg length

All pipes have to be arranged in such a way that the thermal expansion (warming and cooling) is not hindered. As a rule, the thermal expansion is regulated by a suitable arrangement of the piping. A pipe installation with bending leg is inevitable at changes of direction or at right-angled connections using the correct placing of slide and fixed points.

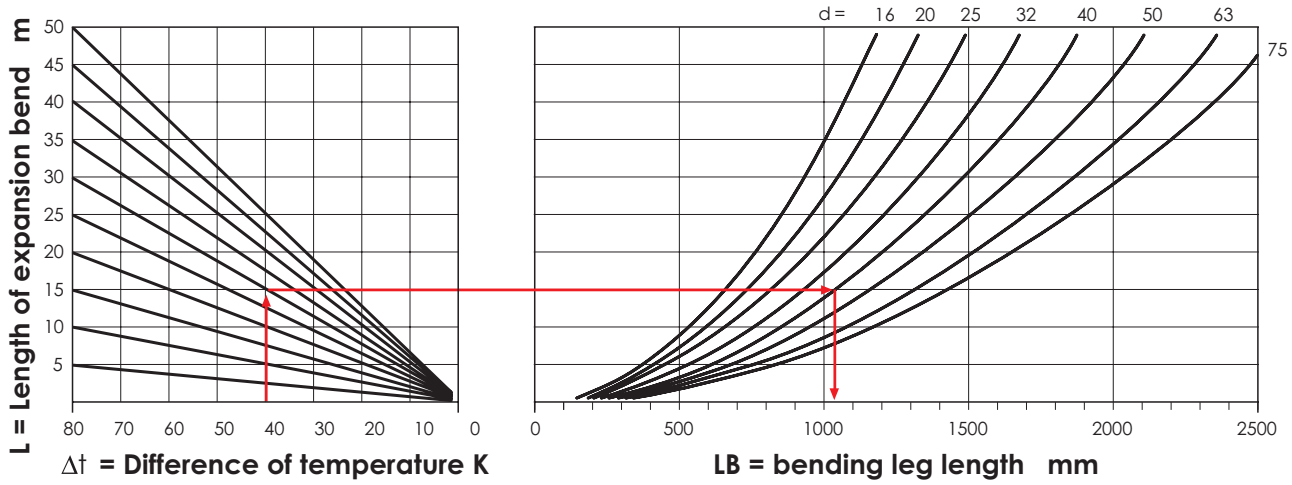
Determination of the bending leg length:

$$LB = C\sqrt{d \cdot \Delta L}$$

Legend:
LB = Length of bending leg [mm]
d = Outer diameter of pipe [mm]
ΔL = Expansion [mm]
C = Material-specific constant for Heatwave systems (= 30)

Determination of the bending leg length

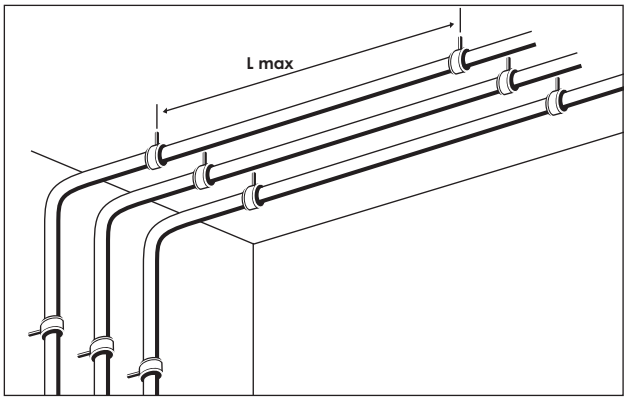
Graphical determination of the bending leg length required



3.6. Fastening technique

3.6.1. Pipe fastening on the ceiling

If Heatwave systems multi-layer pipes are openly installed on the ceiling, additional pipe supports are not necessary. The following chart shows the maximal fastening distances between the individual pipe clamps for the different pipe dimensions.

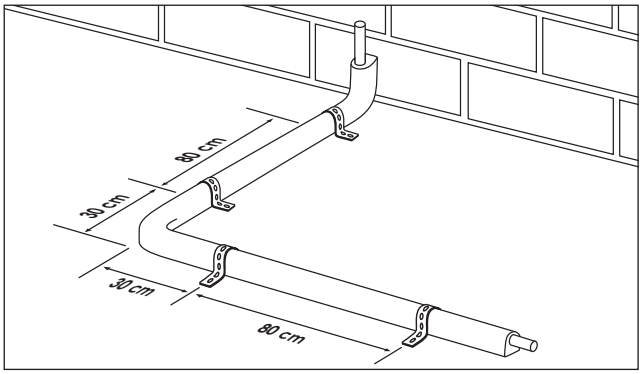


The type and the distance of the pipe fixing devices are depending on the pressure, the temperature and the medium. The dimensioning of the pipe clamps has to be carried out expertly taking into consideration the overall mass (weight of pipe + weight of the water inside + weight of insulation), observing the approved technical rules.

Dimension	Maximum distance between pipe clamps L		Weight of pipe filled with water of 10 °C/without insulation	
da x s (mm)	**horizontal (m)**	**vertical (m)**	**Coil (kg/m)**	**Straight length kg/m)**
16 x 2.00	1.20	1.55	0.218	0.218
18 x 2.00	1.20	1.60	0.273	0.273
20 x 2.25	1.30	1.70	0.338	0.338
25 x 2.50	1.50	1.95	0.529	0.529
32 x 3.00	1.60	2.10	0.854	0.854
40 x 4.00	1.70	2.20	-	1.310
50 x 4.50	2.00	2.60	-	2.062
63 x 6.00	2.20	2.85	-	3.265
75 x 7.50	2.40	3.10	-	4.615

3.6.2. Pipe fastening on the bare floor

If Heatwave systems multi-layer pipes are installed on the floor or in the supporting floor, a fastening distance of 80 cm has to be observed. The distance between each bend and the fixing device before and after it must be 30 cm.



3.7. Pipe bending

Heatwave systems multi-layer pipes in dimensions 16 – 25 mm can be bent easily by hand, with or without a bending spring, larger dimensions can be bent using a suitable bending tool.

Minimal bending radii:

Pipe dimension	bending radius by hand	bending radius with bending spring	bending radius with adequate bending tool
mm	**mm**	**mm**	**mm**
16 x 2.00	5 x OD ≈ 80	4 x OD ≈ 60	50
18 x 2.00	5 x OD ≈ 90	4 x OD ≈ 70	60
20 x 2.25	5 x OD ≈ 100	4 x OD ≈ 80	70
25 x 2.50	5 x OD ≈ 125	4 x OD ≈ 100	90
32 x 3.00	5 x OD ≈ 160	4 x OD ≈ 125	110
40 x 4.00	-	-	160
50 x 4.50	-	-	200

4.1. Potential equalisation

The regulations BS 7671 require earthing between protective conductors, "conductive" water and heating pipes. As Heatwave systems multi-layer pipes are not conductive pipe installations, they cannot be used for potential equalisation and thus they need not be earthed.
An approved electrician has to check whether the Heatwave systems installation impairs the existing electrical protective and earthing arrangements.

4.2. Use of rainwater

The Heatwave systems system can be used for the installation in a rainwater utilisation installation. Regulations concerning the marking of the tapping locations as well as the drinking water feeding can be found in DIN 1988 part 4.

4.3. Installation in the mastic asphalt

A direct connection between Heatwave systems and the tar screed is not allowed. It has to be guaranteed by a suitable floor construction that the maximal allowed temperatures of the pipe system of 95 °C is not exceeded.

4.4. Connection to water heaters

A direct connection of the Heatwave systems multi-layer pipe without metal intermediary is always possible if the water heaters (flow heater, small and large water storage tanks) do not create higher temperatures than 95 °C in line with the standard regulations.

4.5. Trace heating

Heatwave systems multi-layer pipes are suitable for the use of trace heating. The pipe's aluminium core guarantees an even heat transfer around the pipe. The choice and the fastening are carried out in line with the manufacturer's instructions; here the Heatwave systems multi-layer pipe is classified as a plastic pipe.

4.6. Antifreeze

Heatwave systems multi-layer pipes in areas where frost can occur have to be protected from freezing.

4.7. Fire-protection

The structurally engineered requirements for fire-protection varies from area to area and thus the local requirements must be considered.

Upfront, the designer and installer must check the actual valid local fire protection guidelines and laws before installation.

4.7.1. Fire classification

To conform to the required fire protection guidelines, it is important to classify the used materials according to their fire-behaviour. For this all materials are classified into a fire classification according to a fire test (DIN 4102). Here all materials are tested on inflammability, flammability and gas release. The actual valid fire classification according to DIN 4102 will be replaced by a European classification in the future.
The Heatwave systems multi-layer pipes are in Fire classification class B2, "normal combustible", according to the new European classification they are in Fire classification class E (combustible, dripping off).

4.7.2. Fire Classification according to DIN 4102-1 and Euro classification

Requirement	DIN 4102 old	Euro classification new
non-combustible	A1	A1
	A2	A2
combustible	B1	B
		C
normal combustible	B2	D
		E
easy combustible	B3	F

4.8. Legionella

Measures to avoid legionella growth are stipulated in the work sheet L8 approved code of practice "The control of legionella bacteria in water systems".

Measures are, for example:
- potable water storage temperature of min. 60°C
- Avoidance of aerosol formation at tap fittings
- Avoidance of non-circulating installations without trace heating
- The cooling in the hot-water pipes and the circulation pipes must not be higher than 5 K

Existing studies show that it is not the material that favours the growth of legionella but the incrustation in the material.

4.10. Pipe installation in concrete, screed and in-wall

The Heatwave systems multi-layer pipe is protected by the outer PE layer. Considering the surface corrosion prevention, the installation of fittings in concrete, screed and in-wall is possible, though it must be insured that there is no permanent moisture penetration and no pH-values higher than 12.5.

For such installations it is recommended to protect the connection with adequate coatings (e.g. duct tape, insulation tape, shrink-tape / -socket or something similar) against destructive influences. All regulations and standards referring thermal and acoustic insulation are unaffected and must be considered. The tightness test (pressure test) always has to be done before protection and / or insulation activities.

4.11. Installation in the soil, outdoor

The Heatwave systems multi-layer pipe is protected by the outer PE layer. An installation in the soil is possible, if following issues are considered:

- Pay attention to freeze protection, an adequate installation depth must be chosen.
- During installation or operating state no mechanical loads are allowed on the pipe (e.g. traffic-load)
- Covering the system must be done with fine-grained materials. Coarse-grained and sharp-edged materials cause damage to the pipe.
- The fittings must be protected with corrosion protection tape against the soil.
- For outdoor application in the open air, the pipes must be protected against UV-radiation and mechanical impact.
- For this, multi-layer pipes in a protective tube can be used.

4.12. Application in compressed air systems

The Heatwave systems multi-layer pipe in connection with the press fittings is also suitable for compressed air installations. For the permanently tight connection the following parameters have to be observed:

Nominal pressure:	16 bar
Allowed excess working pressure:	12 bar
Maximal working temperature:	60°C
Minimum durability:	50 years
Safety factor:	1.3

In oil-free compressed air installations, for example as used in medicine technology, the Heatwave systems system can be used. In case of compressed air installations that are not oil-free, the Heatwave systems system is only suitable if only oils on silicon basis are used.

Note:
Due to the regulations it is not allowed to transport combustible and fire-promoting media (such as for example pure oxygen, acetylene, butane, etc.) through combustible pipe installations.

4.13. Mounting instructions of screw connections

When installing press thread connections the mechanical impact must be kept as low as possible to avoid damage to the pipe.

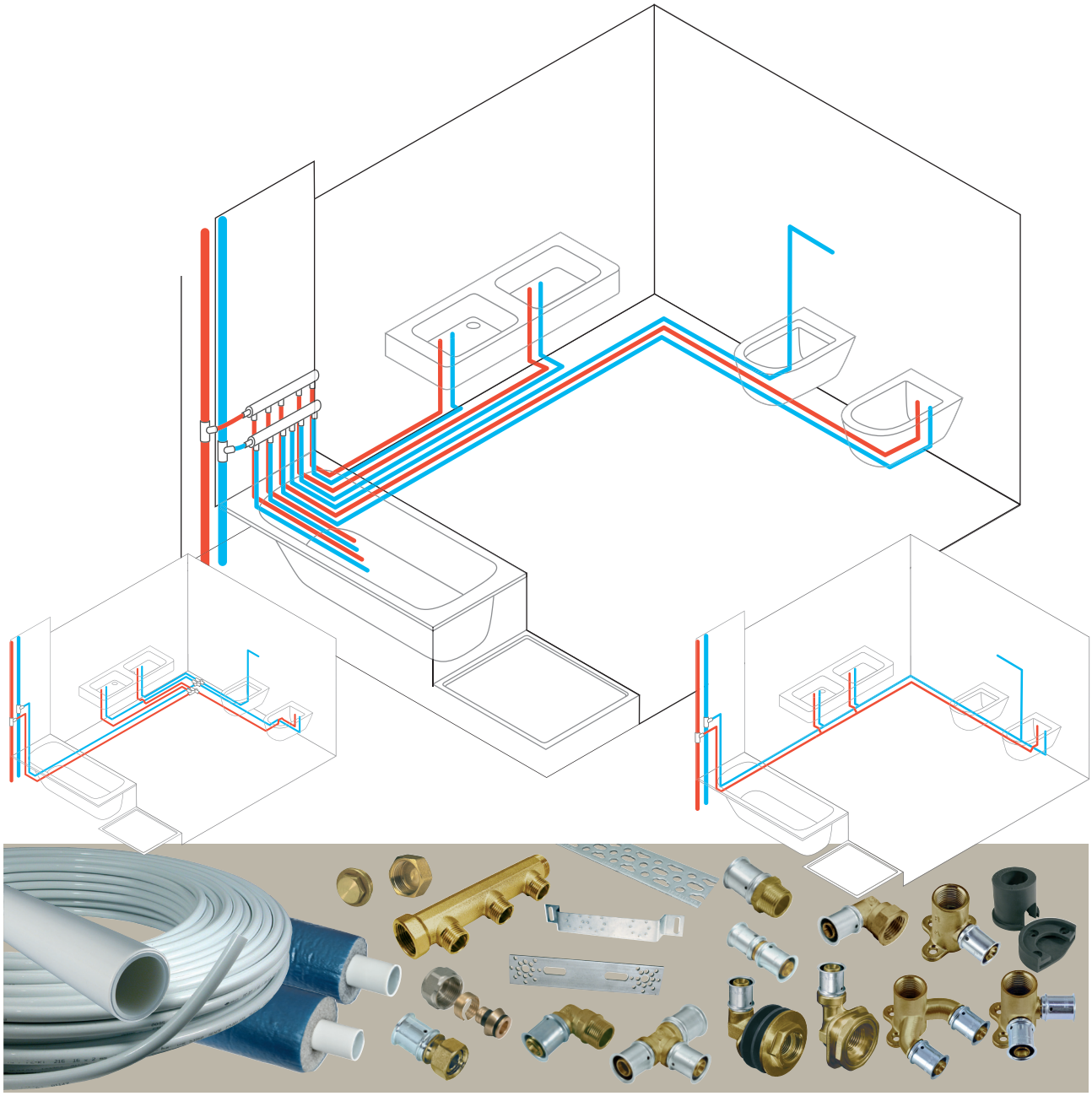
- Thus, the screw connections should be done – if possible – before connecting the pipework to minimise the stress of the press connection.
- Suitable and approved sealing tape should be used on the thread connection and manufacturers guidance followed.
- Consideration of the Heatwave mounting instructions must be considered.
- Excessive brute force must be avoided, for example the increased effort that is needed when too much sealing tape is applied to the thread. Over screwing or extensions on tooling to generate an increased leverage must be avoided.
- The use of fitting aids, tightening agents or cleaning agents must be suitable for the application. They must not contain substances or compounds that cause stress-cracking corrosion (like ammoniac or chloride containing compounds).

4.14. Storage and assembly requirements

Apart from the assembly instructions of all devices and components, for the storage and assembly of Heatwave systems multi-layer pipes the following requirements have to be fulfilled (this is also valid for finished installation parts):

The assembly temperature for the pipe system should not be below – 10°C. The working temperature of pressing tools must not be below 0°C and must not exceed 40°C. The optimal working temperature range for Heatwave systems system components is between 5°C and 25°C.

If the Heatwave systems multi-layer pipes are stored below –10°C, the pipes should be protected from mechanical damage. The pipes and fittings are optimally protected in the original packaging.
The pipes should be protected from direct intensive solar radiation and load by UV radiation. This is both true for the storage and the installation of the pipes. Finished installation parts have to be correspondingly covered or protected from UV radiation by other suitable measures (for example insulation or installation in a protective pipe).



5.1. General information

Heatwave systems is a complete system for the entire sanitary installation from the house connection and the plant room piping, risers and distributing mains to the outlet point. The installation is possible in all sanitary rooms, for example for commercial and public buildings, for residential buildings and for communal washing troughs. It is perfectly suitable for drinking water installations for cold and hot water and circulation installations respectively. In the field of renovation, the clean and quick processing of Heatwave systems using the press technique, without complicated welding, thread cutting, soldering or gluing, turns out to be an additional advantage.
All installations have to be carried out in line with the currently valid regulations and standards, inter alia concerning thermal insulation, sound insulation and fire protection.

5.2. Basis of design

5.2.1. Dimensioning

The dimensioning and design of the Heatwave systems system is carried out on the basis of BS 6700.

5.2.2. Determination of the pipe friction resistance (Water 10 °C)

	16 x 2.00 DN 12 V/l = 0.11 l/m		18 x 2.00 DN 14 V/l = 0.15 l/m		20 x 2.25 DN 15 V/l = 0.19 l/m		25 x 2.50 DN 20 V/l = 0.31 l/m	
V_S l/s	v m/s	R hPa/m	v m/s	R hPa/m	v m/s	R hPa/m	v m/s	R hPa/m
0.01	0.09	0.22	0.06	0.11	0.05	0.07	0.03	0.02
0.02	0.18	0.69	0.13	0.34	0.11	0.21	0.06	0.06
0.03	0.27	1.36	0.19	0.66	0.16	0.41	0.10	0.13
0.04	0.35	2.21	0.26	1.07	0.21	0.66	0.13	0.20
0.05	0.44	3.23	0.32	1.56	0.26	0.97	0.16	0.30
0.06	0.53	4.41	0.39	2.13	0.32	1.32	0.19	0.40
0.07	0.62	5.75	0.45	2.78	0.37	1.72	0.22	0.52
0.08	0.71	7.23	0.52	3.49	0.42	2.16	0.25	0.66
0.09	0.80	8.86	0.58	4.28	0.48	2.68	0.29	0.80
0.10	0.88	10.63	0.65	5.13	0.53	3.17	0.32	0.96
0.15	1.33	21.49	0.97	10.35	0.79	6.39	0.48	1.94
0.20	1.77	35.52	1.30	17.08	1.06	10.54	0.64	3.20
0.25	2.21	52.55	1.62	25.24	1.32	15.56	0.80	4.73
0.30	2.65	72.43	1.95	34.76	1.59	21.41	0.95	6.51
0.35	3.09	95.07	2.27	45.59	1.85	28.07	1.11	8.55
0.40	3.54	120.39	2.60	57.70	2.12	35.52	1.27	10.84
0.45	3.98	148.33	2.92	71.05	2.38	43.72	1.43	13.36
0.50	4.42	178.83	3.25	85.62	2.65	52.67	1.59	16.12
0.55	4.86	211.85	3.57	101.38	2.91	62.35	1.75	19.11
0.60	5.31	247.33	3.90	118.31	3.18	72.74	1.91	22.33
0.65	5.75	285.24	4.22	136.40	3.44	83.84	2.07	25.78
0.70	6.19	325.56	4.55	155.63	3.71	95.64	2.23	29.45
0.75	6.63	368.25	4.87	175.98	3.97	10.13	2.39	33.35
0.80	7.07	413.27	5.20	197.44	4.24	121.29	2.55	37.47
0.85			5.52	219.99	4.50	135.12	2.71	41.80
0.90			5.85	243.63	4.77	149.62	2.86	46.36
0.95			6.17	268.35	5.03	164.77	3.02	51.13
1.00			6.50	294.13	5.30	180.57	3.18	56.12
1.05			6.82	320.97	5.56	197.02	3.34	61.32
1.10			7.15	348.86	5.83	214.11	3.50	66.74
1.15					6.09	231.84	3.66	72.36
1.20					6.36	250.19	3.82	78.21
1.25					6.62	269.17	3.98	84.26
1.30					6.89	288.77	4.14	90.52
1.35							4.30	96.99
1.40							4.46	103.67
1.45							4.62	110.56
1.50							4.77	117.65
1.60							4.93	124.96
1.70							5.41	148.11
1.80							5.73	164.57
1.90							6.05	181.86

Vs = Peak flow of water [l/s], v = Flow rate [m/s],
R = Pipe friction-pressure loss [hPa/m]

5.2.2. Determination of the pipe friction resistance (Water 10 °C)

	32 x 3.00 DN 25 V/l = 0.53 l/m		40 x 4.00 DN 32 V/l = 0.80 l/m		50 x 5.00 DN 40 V/l = 1.32 l/m	
Vs l/s	v m/s	R hPa/m	v m/s	R hPa/m	v m/s	R hPa/m
0.10	0.19	0.28	0.12	0.10	0.08	0.03
0.20	0.38	0.91	0.25	0.34	0.15	0.11
0.30	0.57	1.84	0.37	0.69	0.23	0.21
0.40	0.75	3.03	0.50	1.13	0.30	0.35
0.50	0.94	4.48	0.62	1.67	0.38	0.52
0.60	1.13	6.17	0.75	2.30	0.45	0.72
0.70	1.32	8.10	0.87	3.01	0.53	0.94
0.80	1.51	10.25	0.99	3.81	0.61	1.19
0.90	1.70	12.63	1.12	4.69	0.68	1.46
1.00	1.88	15.22	1.24	5.65	0.76	1.76
1.10	2.07	18.02	1.37	6.69	0.83	2.09
1.20	2.26	21.03	1.49	7.80	0.91	2.43
1.30	2.45	24.24	1.62	8.99	0.98	2.81
1.40	2.64	27.66	1.74	10.25	1.06	3.20
1.50	2.83	31.28	1.87	11.59	1.14	3.62
1.60	3.01	35.09	1.99	13.00	1.21	4.07
1.70	3.20	39.10	2.11	14.48	1.29	4.53
1.80	3.39	43.30	2.24	16.03	1.36	5.02
1.90	3.58	47.69	2.36	17.65	1.44	5.53
2.00	3.77	52.27	2.49	19.34	1.51	6.07
2.10	3.96	57.04	2.61	21.10	1.59	6.62
2.20	4.14	61.99	2.74	22.92	1.67	7.20
2.30	4.33	67.13	2.86	24.82	1.74	7.80
2.40	4.52	72.45	2.98	26.78	1.82	8.42
2.50	4.71	77.96	3.11	28.81	1.89	9.07
2.60	4.90	83.64	3.23	30.90	1.97	9.73
2.70	5.09	89.50	3.36	33.06	2.05	10.42
2.80	5.27	102.43	3.48	35.28	2.12	11.13
2.90	5.46	109.28	3.61	37.57	2.20	11.86
3.00	5.65	116.35	3.73	39.93	2.27	12.31
3.10	5.84	123.62	3.85	44.68	2.35	13.38
3.20	6.03	131.09	3.98	47.36	2.42	14.17
3.30	6.22	138.78	4.10	50.11	2.50	14.99
3.40	6.40	146.68	4.23	52.93	2.58	15.82
3.50	6.59	154.78	4.35	55.82	2.65	16.68
3.60	6.78	163.09	4.48	58.79	2.73	17.55
3.70			4.60	61.83	2.80	18.45
3.80			4.72	64.94	2.88	19.37
3.90			4.85	68.12	2.95	20.31
4.00			4.97	71.37	3.03	21.27
4.50			5.60	88.71	3.41	26.37
5.00			6.22	107.83	3.79	31.99
5.50					4.17	38.10
6.00					4.54	44.72
6.50					4.92	51.83
7.00					5.30	59.44
7.50					5.68	67.54
8.00					6.06	76.12
8.50						

Vs = Peak flow of water [l/s], v = Flow rate [m/s],
R = Pipe friction-pressure loss [hPa/m]

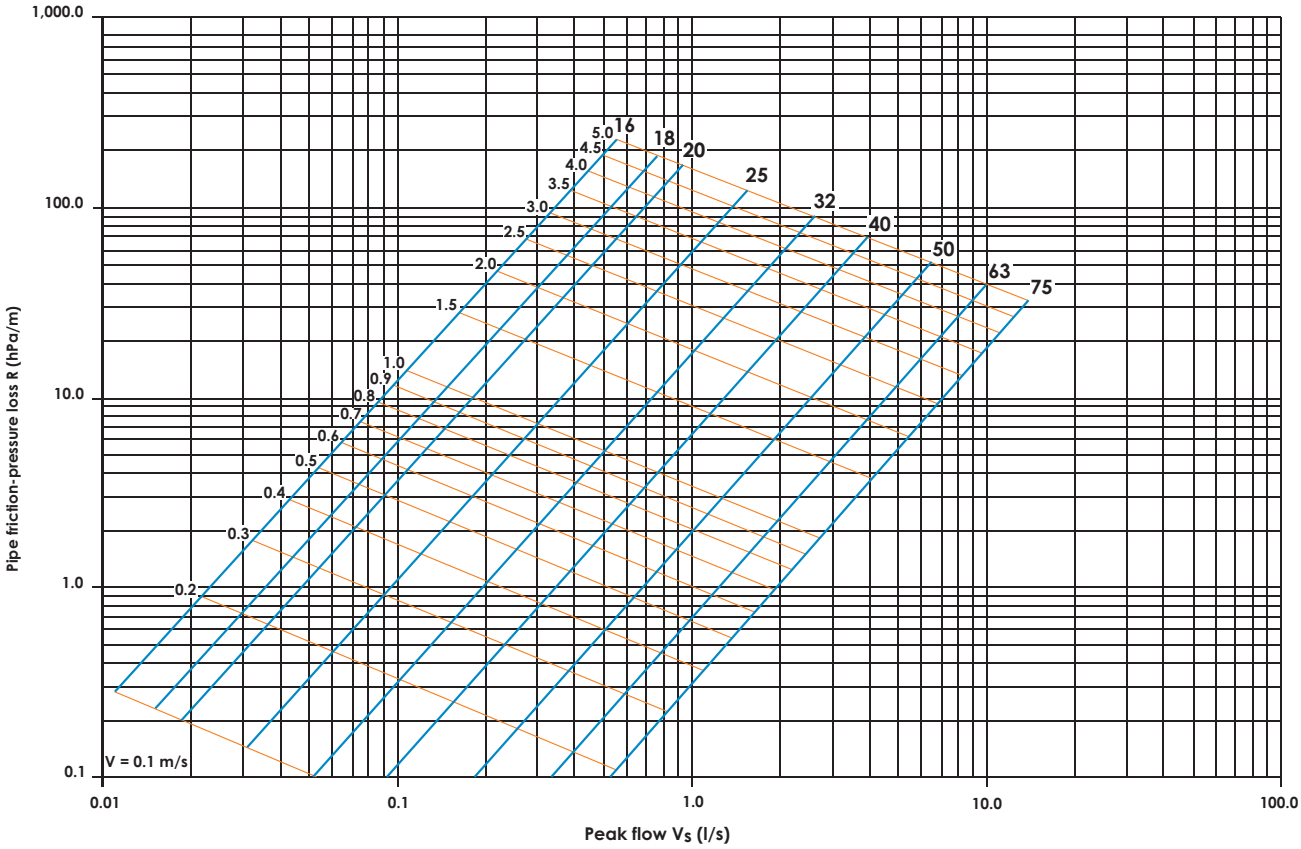
	63 x 6.00 DN 51 V/l = 2.04 l/m		75 x 7.50 DN 60 V/l = 2.83 l/m	
Vs l/s	v m/s	R hPa/m	v m/s	R hPa/m
1.00	0.49	0.61	0.35	0.28
1.25	0.61	0.91	0.44	0.42
1.50	0.73	1.25	0.53	0.58
1.75	0.86	1.65	0.62	0.76
2.00	0.98	2.08	0.71	0.96
2.25	1.10	2.57	0.80	1.18
2.50	1.22	3.10	0.88	1.43
2.75	1.35	3.67	0.97	1.69
3.00	1.47	4.28	1.06	1.97
3.25	1.59	4.94	1.15	2.27
3.50	1.71	5.64	1.24	2.59
3.75	1.84	6.38	1.33	2.93
4.00	1.96	7.16	1.41	3.29
4.25	2.08	7.98	1.50	3.66
4.50	2.20	8.84	1.59	4.06
4.75	2.33	9.73	1.68	4.47
5.00	2.45	10.67	1.77	4.90
6.00	2.94	14.80	2.12	6.79
7.00	3.43	19.53	2.48	8.95
8.00	3.92	24.84	2.83	11.38
9.00	4.41	30.71	3.18	14.07
10.00	4.90	37.15	3.54	17.01
11.00	5.38	44.13	3.89	20.20
12.00			4.24	23.63
13.00			4.60	27.31
14.00			4.95	31.23
15.00			5.31	35.38
16.00			5.66	39.77
17.00			6.01	44.39
18.00				
19.00				
20.00				
21.00				
22.00				
23.00				
24.00				
25.00				

Vs = Peak flow of water [l/s], v = Flow rate [m/s],
R = Pipe friction-pressure loss [hPa/m]

5.2.3. Pressure loss graph

The pressure loss graph includes the piping characteristic curve with the different dimensions for Heatwave systems multi-layer pipes well as the limit lines of the flow rates. By means of the graph, at a given volume flow or flowing-through respectively, the pipe friction resistance per metre in the pipe dimension and the flow rate can be determined in a simple graphic way.

Pipe friction-pressure loss of Heatwave systems multi-layer pipes (Water 10 °C)



5.3. Pressure test

5.3.1. Pressure test with water

According to BS 806, for Heatwave systems a pressure test has to be carried out in an uncovered state after the installation of pipe work is complete.
At first each connection has to be checked visually for the correct pressing. Only pressure gauges are suitable for the test that allows a clear reading of a pressure change of 0.1 bar.
The pressure gauge has to be installed at the lowest point of the installation to be tested.

Preliminary test:
The working pressure x 1.5 has to be applied as test pressure during the preliminary test. This test pressure has to be brought to the initial test pressure twice within 30 minutes at an interval of 10 minutes each. Afterwards the test pressure must not fall by more than 0.6 bar (0.1 bar per 5 minutes) after 30 minutes and leakages must not occur.

Main test:
The main test is carried out directly after the preliminary test. The test pressure read after the preliminary test must not have been fallen by more than 0.2 bar after two hours. Leakages must not be detected at any point of the tested installation.

5.3.1. Pressure test with water

Additional test safety (Metal-Press fittings and PPSU-Press fittings, 16 mm - 32 mm)

The press - fittings from dim 16 to 32 mm of the Heatwave systems plumbing system have an additional test safety feature. That means that the installer - when original Heatwave systems tools were used - is able to detect the position of non-pressed connections during the pressure test and thus able to fix this immediately. For the pressure test 10 bar are required.

5.3.2. Pressure test with air or inert gases

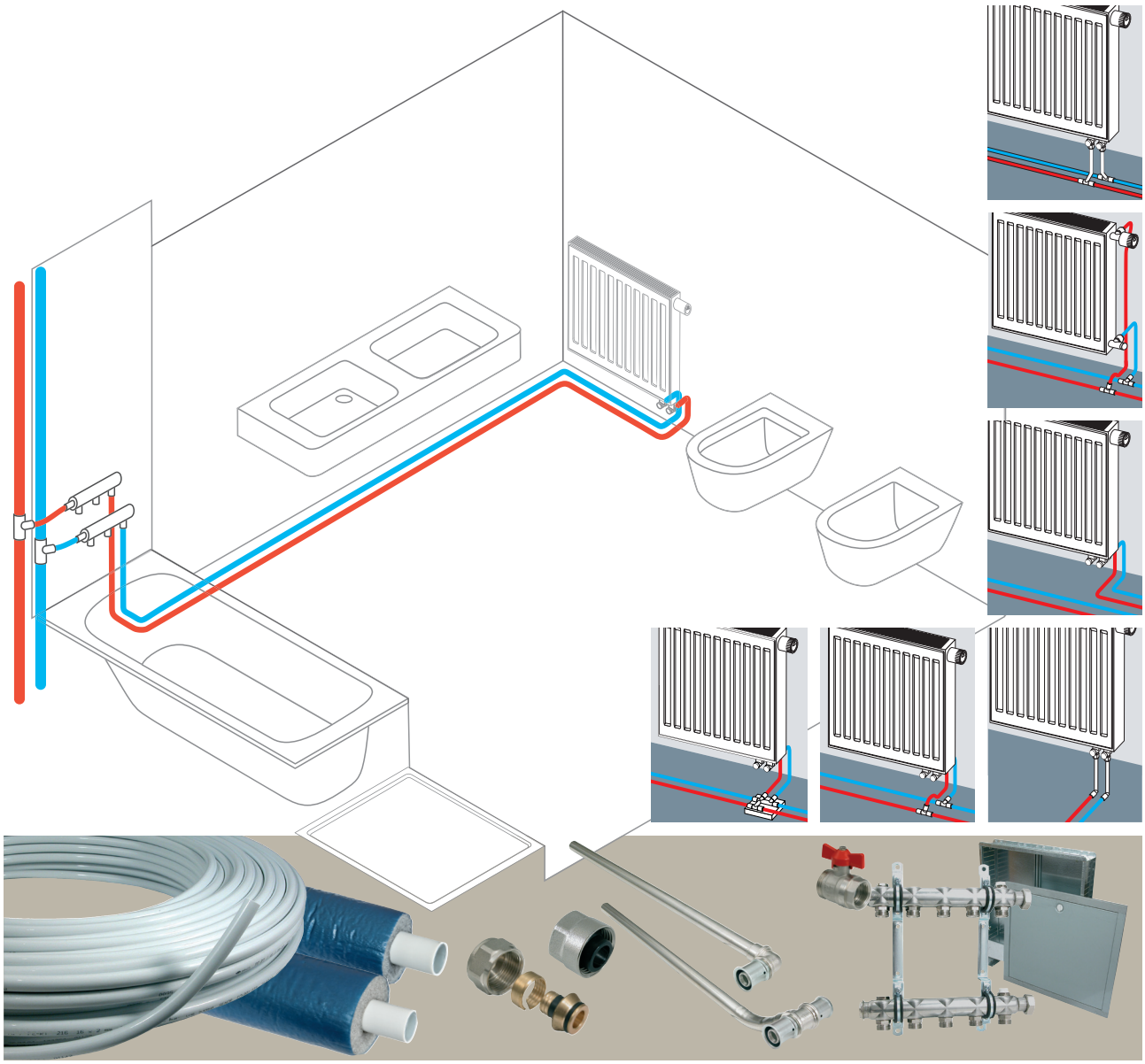
Alternatively to the pressure test with water, the pressure test for the Heatwave systems installation system can also be carried out using compressed air or inert gases. This is particularly recommended in the freezing period. When using compressed air the HSE "Safety requirements for pressure testing" good practice guide should be considered.

5.3.3. Pipe flushing

After the pressure test, the complete installation has to be flushed thoroughly. The procedure for the pipe flushing is described in BS 7593.

5.3.4. Pressure test protocol for sanitary applications

For the presssure test protocols according to german stan-dards (DVGW), please see at our website or contact us.



6.1. Technical information radiator connection

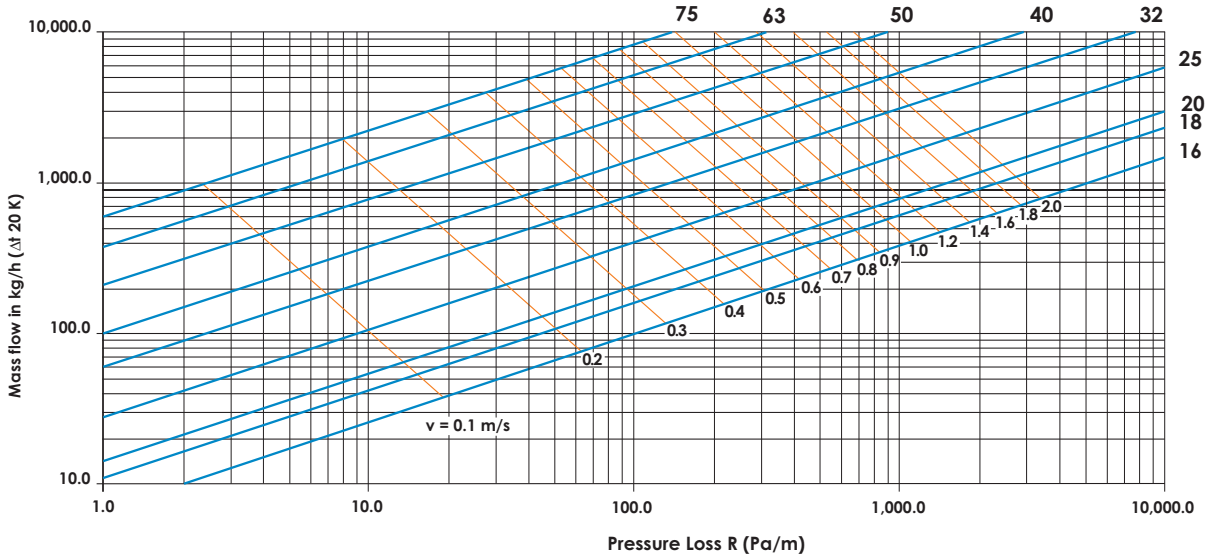
Heatwave systems allow the complete installation of heating facilities from the heat generator to the radiator. Both single pipe connections and two-pipe connections are possible without any problems.
Not only in a new building, but also in the field of the reconstruction of old buildings the press connection technique, which allows an installation without soldering and welding, shows its clear advantages.
All installations must be carried out in line with the currently valid regulations and standards, including thermal insulation, sound protection and fire protection.

Important information: Installations such as solar or long-distance energy installations, which are operated with working temperatures exceeding 95 °C, must not be connected directly to Heatwave systems! It has to be guaranteed in every working situation that the operating limits of Heatwave systems multi-layer pipes are not exceeded.

6.2. Pressure loss graph

The pressure loss graph includes the piping characteristic curve for Heatwave systems with the different dimensions as well as the limit lines of the flow rates. By means of the graph, for the spread T = 20 K at an average water temperature of 60 °C and at a given flow (volume flow), the pipe friction resistance per metre in dependence of the pipe dimension and the flow rate can be determined in a simple graphic way.

Pressure-loss, depending on the mass flow (Water 60 °C)



6.3. Heat capacity of Heatwave systems multi-layer pipes

Heat capacity of Heatwave systems multi-layer pipes

Radiator connection pipeline:	≤ 0.3 m/s					
Pipe dimension	16 x 2.00	18 x 2.00	20 x 2.25	25 x 2.50	32 x 3.00	
Mass flow (kg/h)	122	166	204	339	573	
Heat capacity (W) at ΔT = 20K	2,840	3,865	4,738	7,889	13,332	
Heat capacity (W) at ΔT = 15K	2,130	2,899	3,554	5,916	9,999	
Heat capacity (W) at ΔT = 10K	1,420	1,933	2,369	3,944	6,666	
Heat capacity (W) at ΔT = 5K	710	966	1,185	1,972	3,333	

Heating distribution pipeline:	≤ 0.5 m/s					
Pipe dimension	16 x 2.00	18 x 2.00	20 x 2.25	25 x 2.50	32 x 3.00	40 x 4.00
Mass flow (kg/h)	204	277	340	565	956	1,448
Heat capacity (W) at ΔT = 20K	4,733	6,442	7,897	13,148	22,119	33,658
Heat capacity (W) at ΔT = 15K	3,550	4,832	5,923	9,861	16,665	25,243
Heat capacity (W) at ΔT = 10K	2,367	3,221	3,948	6,574	11,110	16,829
Heat capacity (W) at ΔT = 5K	1,183	1,611	1,974	3,287	5,555	8,414

Risers and basement distribution pipeline: ≤ 1.0 m/s						
Pipe dimension	16 x 2.00	18 x 2.00	20 x 2.25	25 x 2.50	32 x 3.00	40 x 4.00
Mass flow (kg/h)	407	554	679	1,131	1,911	2,895
Heat capacity (W) at ΔT = 20K	9,466	2,885	15,794	26,295	44,439	67,316
Heat capacity (W) at ΔT = 15K	7,100	9,663	11,845	19,721	33,329	50,487
Heat capacity (W) at ΔT = 10K	4,733	6,442	7,897	13,148	22,219	33,698
Heat capacity (W) at ΔT = 5K	2,367	3,221	3,948	6,574	11,110	16,829

6.4. Pressure test

For Heatwave systems, a leak test has to be carried out according to BS 806. This test has to be executed after the installation and before the wall slots and cut-throughs of walls and ceilings are closed
At first, a visual check of each connection point for proper pressing has to be carried out.
Hot water heating systems must be tested with a pressure of the 1.5 x of the total pressure at all points of the installation, but at least with 1 bar excess pressure. Immediately after the cold water test, the impermeability at the maximum temperature must be tested by means of heating up to the highest heating water temperature that was the basis for the calculation.

Additional test safety (Metal-Press-Fittings and PPSU-Press-Fittings, 16 mm - 32 mm)

The press - fittings from dim 16 to 32 mm of Heatwave systems have an additional test safety feature. That means that the installer - when original Heatwave systems tools were used - is able to detect the position of non-pressed connections during the pressure test and thus able to fix this immediately. For the pressure test 10 bar are required.

If radiators are already connected during the pressure test, the maximum pressure requirements of the radiator supplier must be considered.

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hw-tec-08/16