

JRG Sanipex MT

Technical documentation

System description

Laying methods / Guidelines

Calculation principles

Installation procedures





Georg Fischer JRG Ltd.

Hauptstrasse 130
CH-4450 Sissach
Switzerland
Phone +41 (0)61 975 23 23
info.jrg.ps@georgfischer.com
www.gfps.com

Georg Fischer GmbH

Nördliche Grünauerstr. 65
DE-86633 Neuburg/Donau
Germany
Phone +49 (0)8431 5817-0
info.jrg.ps@georgfischer.com
www.gfps.com

Georg Fischer GmbH

Daimlerstrasse 6
DE-73095 Albershausen
Germany
Phone +49 (0)7161 302-0
info.de.ps@georgfischer.com
www.gfps.com

Georg Fischer Rohrleitungssysteme GmbH

Sandgasse 16
A-3130 Herzogenburg
Austria
Phone +43 (0)2782 85643-0
jrg.at.ps@georgfischer.com
www.gfps.com

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JRG Sanipex MT® technology

Please read carefully the following JRG Sanipex MT® technology before planning and applying the systems. The symbols used denote:

**Danger**

This system warns of a high risk of injury to the person. Pay attention to the safety instructions.

**Warning**

This symbol points to information that, if ignored, may result in considerable material damage. Pay attention to the safety instructions.

**NB**

This symbol refers to important information for using the system. If the instructions are not followed malfunctions can result.

Abbreviations and symbols

- M: Metric thread according to DIN ISO 261
Rp: Cylindrical inner thread for inside thread sealed connections, accord. ISO 7 / 1 and DIN 2999 / 1
R: Conical outer thread for sealed thread connections accord. ISO 7 / 1 and DIN 2999 / 1
G: Cylindrical inner- and outer thread not for sealing inside thread accord. DIN ISO 228 / 1
GN: Grandeur Nominal – Nominal size (thread size)
DN: Diameter Nominal – Nominal width (inside diameter)
PN: Pressure Nominal – Nominal pressure

 Wrench width 6 kt.

 Wrench width 4 kt.

 Packing unit

Surfaces - names:

R: Raw

C: Chromed

JRG Sanipex MT®

The brand name JRG Sanipex MT® represents the development of an innovative installation system which, together with the complete JRG Sanipex® programme and JRG fittings, offers a system for the whole building. The abbreviation MT stands for Multi-Technology and denotes peak quality by means of an innovative combination of high quality materials.

Pipes and fittings	The JRG Sanipex MT® installations system consists of high quality composite pipes (PE-X / Al / PE-X) and a new type of fitting technology. The composite metal pipes consist of an aluminium support pipe the inner lining of which is of white cross-linked polyethylene and the outer layer of black cross-linked polyethylene.
d16 – d40	The fitting is a two layered construction. In a special plastic-injection process the inner layer of hot water resistant PPSU is combined with the outer layer which is highly resistant to strain and reinforced with glass fibre PA-plastic. The resulting „ Fitting-in- Fitting“ is connected to the composite pipe by means of a special glass-reinforced PA-plastic cap nut which can withstand high mechanical loads. The sections d16 and d20 can also be connected to JRG Sanipex® pipes made of cross-linked polyethylene.
d50 + d63	The fitting is made of bronze according to DIN EN 1982 and shows high resistance to corrosion. The pipe connection to the fitting is made using the hot water resistant PPSU-plastic adaptor, pre-mounted by the factory and with the aid of a highly load resistant cap nut made of glass-reinforced PA-plastic. The revolutionary installation system JRG Sanipex MT® of the dimensions d16 to d63 is suitable for sanitation-, heating and compressed air installations. It can be used for cold water PN 10, hot water PN 10 and 95° C as well as compressed air PN 15 and 40° C (dry and oil free).
Connection technology	When developing and making the JRG Sanipex MT® connection technology, JRG Gunzenhauser Ltd incorporated the experience gained a million fold from the highly reliable cone grip union technology. Consequently it is only natural that we retain the full pipe cross sections up to the size d63. Using the same connection technique's high quality JRG bronze fittings (in accordance to DIN EN 1982) can be built into the pipe system. The JRG Sanipex MT® connection system is free of death traps and offers an extremely versatile connection.
Simple Tools	The special tools developed for installing JRG Sanipex MT® installations systems offers the plumber a high degree of safety.
Rapid and simple installation	The simple use of the tools enables a rapid and safe installation. The connection can be loosened and re-connected. Please take note of the servicing, maintenance and installing instructions for the tools. The versatile system components facilitate the rational pre-fabrication and mounting of components.
Ecology	Obviously, the whole range of JRG Sanipex MT® products is made of environmentally friendly recyclable materials. This underlines the consideration JRG Gunzenhauser Ltd pays to the environment and the care taken when handling resources during the development of new products.

Services	For all planning and operating questions please contact our fully-trained technical sales advisors or our technical customer service.
Scope of use	The drinking water-installation system JRG Sanipex MT® may only be employed for drinking water that fulfils the appropriate public standards and for heating, rain water and compressed air installations. Medium tolerance ↔ The suitability of the raw materials and the medium to be transported must always be ascertained. Ask for information concerning other mediums and their constituents.
Installing JRG Sanipex MT® systems	The installation must be carried out according to valid standards and to the instructions contained in this technical document. Furthermore, attention must be paid to local water suppliers regulations. Only JRG Sanipex MT® fitting tools can be used for installing JRG Sanipex MT® systems. Only JRG Sanipex® cone grip unions can be employed for JRG Sanipex MT® pipes, together with JRG Sanipex® tools.



Warning

Tools

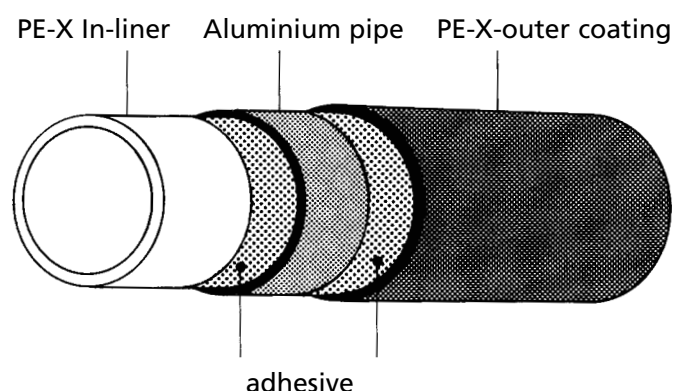
Take note of the servicing, maintenance and installing instructions for the tools.

Layout procedures	On and under the outer wall installation In shafts and trunking In outer walls, element, wood and lightweight constructions. Extended distribution or in single tap station systems
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JRG Sanipex MT® pipe labelling	JRG Sanipex MT® PE-X / Al / PE-X 16 x 2.25 Drinking water 70° C / 10 bar Heating max. 95° C DVGW DW-8501 BM0013 ÖVGW W1.390 ÖNORM B5157 tested Typ 1-A-B-C TW  HO 34531 WA B01634 73 3N	Product name Composite metal pipe Outer diameter x wall thickness Sustained load drinking water Max. temperature of heating DVGW-approval number ÖVGW-approval number RAL-mark of approval for GKR Place and date of manufacture Commission-No. Internal works code
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JRG Sanipex MT® pipe structure



JRG Sanipex MT® pipes Technical Data

Term	Unit	JRG Sanipex MT® PE-X / AI / PE-X						
Pipe dimensions	DN	12	15	20	25	32	40	50
Outer diameter	mm	16	20	26	32	40	50	63
Wall thickness	mm	2.25	2.5	3	3	3.5	4	4.5
Inner diameter	mm	11.5	15	20	26	33	42	54
Inner volume	l / m	0.104	0.177	0.314	0.531	0.855	1.350	2.230
Pipe weight	g / m	134	185	285	393	605	886	1265
Pipe weight with water 10° C	g / m	238	362	603	928	1460	2236	3495
Oper. temp., cont. operation	° C	70 (50 years)						
Max. operating temperature	° C	95 (short term)						
Max. operating pressure	bar	10						
Air pressure (dry and oil free)	bar / ° C	15 bar up to 40° C / 10 bar 41° up to 70° C						
Surface roughness, inner pipe	µm	7.0						
Linear expansion coefficient	α	0.024						
Heat conductivity	W / mK	0.43						
Oxygen density		after DIN 4726						
Fire indenty number		CH: IV.2 / D: B2 (normally inflammable)						
Fire load	MJ / m	3.36	4.54	7.42	8.23	12.14	16.83	21.18
Bending radius	mm	≥ 3.5 x d (with template) / 5 x d (without template)						
Properties		High corrosion resistance, low limescale deposits High durability, neutral taste and smell						

Operating conditions according to SVGW and DVGW (DIN 1988/Part 2)

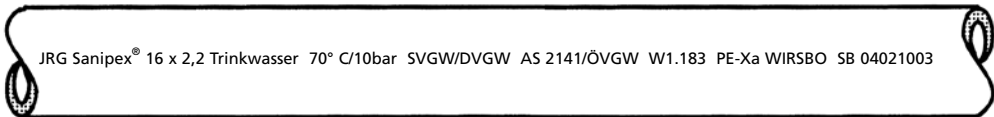
	Working over- pressure bar	Temperature ° C	yearly duration h/a
Cold water ¹⁾	0 to 10 (variable)	until 25	8760
Hot water ²⁾	0 to 10 (variable)	until 60 until 85	8710 50

¹⁾ Reference temperature for durability: 20° C

²⁾ Reference temperature for durability: 70° C

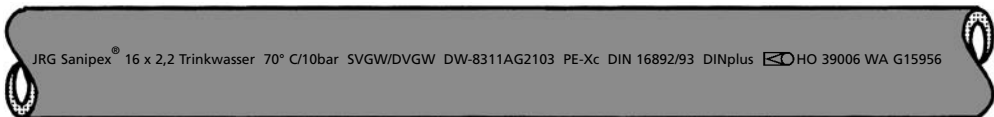
For the measurement of plastic pipes in domestic drinking water installations (cold and hot water pipes) please use the 50-year old value for the comparison stress of the appropriate time-to-rupture curve reduced by applying the basic safety factor of ≥ 1.5.

Pipe labelling
pipe PE-Xa, white



JRG Sanipex®	Product name
16 x 2, 2	Outer diameter x Wall strength
Drinking water 70° C/10 bar	Medium/Operating temperature/max. Operating pressures
SVGW	Swiss approval
DVGW AS 2141	German approval and number
ÖVGW W 1.183	Austrian approval and number
PE-Xa	Polyethylene sheeting according to Engel's process
DIN 16892 / 93	Standards for quality assurance and masses for PE-X-pipes
WIRSBO	Pipe manufacturer
SB 04021003	Date of manufacture

Pipe labelling
pipe PE-Xc, blue



JRG Sanipex®	Product name
16 x 2,2	Outer diameter x Wall strength
Drinking water 70° C/10bar	Medium/Operating temperature/ Max.operating pressure
SVGW	Swiss approval
DVGW DW-8311AG2103	German approval and number
PE-Xc	Polyethylene sheets electron radiated
DIN 16892 / 93	Standards for quality assurance and masses for PE-X-pipes
DINplus	RAL-Certification mark
HO 39006	Pipe manufacturer, Place and date of production
WA G15956	Job number

JRG Sanipex® pipes Technical Data

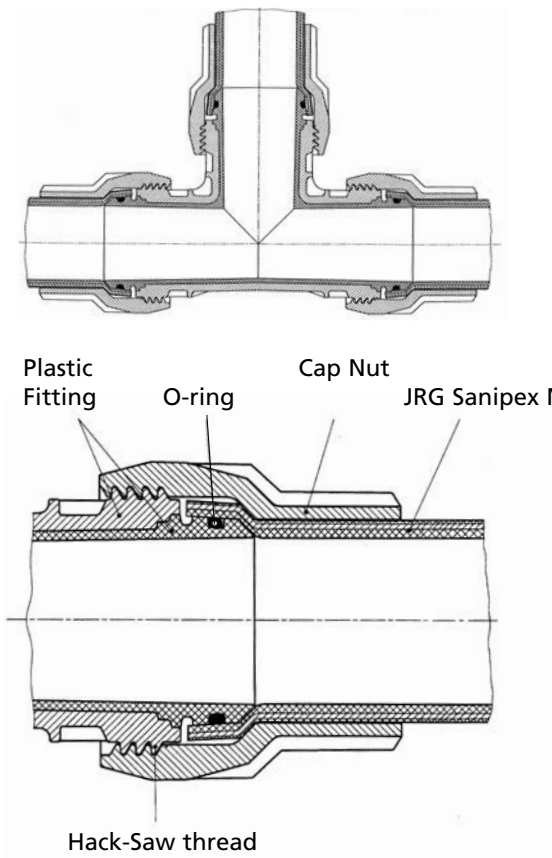
Term	Unit	JRG Sanipex® PE-Xa und PE-Xc	
Pipe dimensions	DN	12	15
Outer diameter	d mm	16	20
Wall thickness	s mm	2.2	2.8
Inner diameter	mm	11.6	14.4
Inner volume	l / m	0.10	0.16
Pipe weight	g / m	86	120
Pipe weight with water 10° C	g / m	186	280
Operating temperature	° C	70 (50 Years)	
Max. operating temperature	° C	95 (short term)	
Max. operating pressure	bar	10	
Air pressure (dry and oil free)	bar / ° C	10 bar up to 40° C / 7 bar 41° up to 70°C	
Surface roughness, inner pipe	µm	7.0	
Expansion coefficient	mm/mK	bei 20° C: $1,4 \times 10^{-4}$ (1/K) / at 100° C: $2,0 \times 10^{-4}$ (1/K)	
Heat conductivity	W / mK	0.38	
Fire identity number		CH: IV.2 / D: B2 (normally inflammable)	
Bending radius	mm	$\geq 8,5 \times d$	
Properties		High corrosion resistance, low limescale deposit High durability, neutral taste and smell	

Protection conduit 5730.xxx

Material	Low pressure polyethylene
Density	0.950 g/cm ³
Melting index	MFI 190/5:0,4 g/10 min
Tear strength	25 N/mm ²
Tear stretch	600%
Temperature durability	100° C

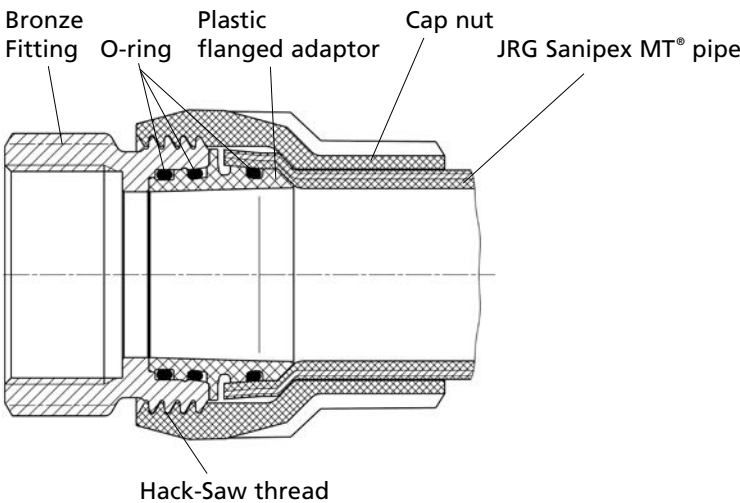
JRG Sanipex MT® fittings
of plastic d16 - d40

Outer fitting PA GF 30% / Inner fitting PPSU

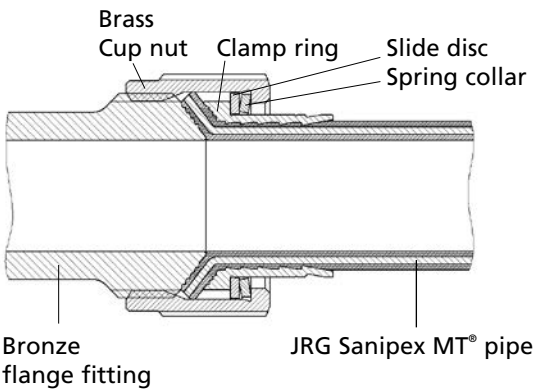


JRG Sanipex MT®, patented
cone grip union made of plastic
for multilayer pipes

JRG Sanipex MT®, patented
cone grip union with
pre-mounted plastic flanged
adaptor



JRG Sanipex MT®, patented
cone grip union made of Bronze/
Brass for JRG Sanipex MT® pipes



Tools

The installation tools are intended for installing Sanipex MT® installations systems. The tools should not be used for any other task.



NB

Operating and maintenance

When using and maintaining JRG Sanipex MT® installation tools, pay attention to the appropriate instructions.

Quality assurance and approval

JRG Sanipex®- and JRG Sanipex MT® pipes are continually checked electronically during production. All short and long term checks are performed by the manufacturer in their own laboratories according to the DVGW working sheet guidelines. The checks are supervised by the state Material Testing Institute (MPA) Darmstadt. Similarly, the pipe connections are also subjected to a yearly quality control by the MPA in Darmstadt.

Hygiene No problems

That JRG Sanipex MT® systems are hygienically sound is proven. The test certificate issued by the DVGW-Technology Centre Water (TZW) attests that the plastic components comply with the KTW-recommendations of the Government Health Institute in Germany as well as the basic requirements of the Government Institute for Foodstuffs Development and Research, according to ÖNORM B 5014, Part 1.
JRG Sanipex MT® plastic components are continually tested according to KTW recommendations.
JRG Sanipex® and JRG Sanipex MT® fulfil the requirements of the DVGW Work sheet W 270.

Chemical stability

JRG Sanipex®- und JRG Sanipex MT® pipes and system components as well as JRG fittings fulfil the requirements of the Drinking Water Decree (TrinkwV 2001) and possess a high degree of stability compared to:

- all natural drinking water solutes, accord. DIN 2000
- Disinfectants, detergents and anti-corrosion chemicals accord. § 11 of the Drinking Water Decree.



Warning

Disinfection process

The measures and disinfection procedures of the Drinking Water Decree, § 11 (TrinkwV 2001) must be followed.



Warning

Disinfection

The following maximum concentration of chlorine shall be used when disinfecting drinking water installations with JRG Sanipex® - and JRG Sanipex MT® pipes, JRG Sanipex® - and JRG Sanipex MT® system components and only with JRG fittings.

Continual disinfection:

For JRG Sanipex® - and JRG Sanipex MT® pipes, JRG Sanipex® - and JRG Sanipex MT® system components and JRG fittings, a continual use of chlorinated drinking water may be used with a chlorine content up to 0,3 mg/l (Limit accord. TrinkwV 2001).

Dis-continuous disinfection:

With JRG Sanipex® - and JRG Sanipex MT® pipes, JRG Sanipex® - and JRG Sanipex MT® system components and JRG fittings, discontinuous disinfection up to twice a year with water containing chlorine 50 mg/l over 24 h or a chlorine content of 100 mg/l over 16 hours.



The water quality (pH-value), suspended solids in the water and the operating condition, particularly when chlorinated water is used, can directly influence the life of the installation.



Warning

Water quality

In areas with harsh waters we recommend:

- that JRG Sanipex MT® installations be easily accessible
- the distribution pipes with JRG Sanipex® classic should be installed as single tap stations and assembled to allow replacement of components possible at all times without damaging the system.



Warning

Building materials

JRG Sanipex® and JRG Sanipex MT® system components should be protected against direct contact with oil, grease, solvents, solvent containing adhesives and adhesive band, foam, bitumen and other building material.



Warning

Environmental factors

For installations made in a hostile environment and /or in spaces with uncontrollable environmental effects, JRG Sanipex® - and JRG Sanipex MT® system components need to be protected.

In case of doubt we are pleased to offer advice.

Handling temperatures

The JRG Sanipex MT® system may be worked with from -15° C to 50° C.

Length change



Warning

Thermally induced length changes

The thermally induced changes in length have to be compensated for according to the ambient installing conditions.

For layouts of JRG Sanipex® and JRG Sanipex MT® pipes the thermally-induced length changes are to be compensated according to the example given in pages 23 to 26 /basic calculations s. pages 50 to 53

Insulation

JRG Sanipex® - and JRG Sanipex MT® installations are to be insulated against noise conduction.

JRG Sanipex® - and JRG Sanipex MT® installations should be insulated against sweating, warming, heat emission and heat loss.

Refer to the basic calculations and instructions on pages 47 to 49.

Heat loss

Heat loss can be reduced by installing a JRGUMAT® Thermo-mixer in the hot water supply. Running the installation is economical and convenient.

Ask for our detailed documentation.



Warning

Electro-accessory heating

JRG Sanipex MT® installations may be used with accessory electro-heating units. The surface temperature must not exceed 95° at any time. Should adhesive tape have been used to secure the pipes then one must ensure it does not contain solvents. Take note of the band manufacturer's instructions.

Water heater

The maximum temperature for continual operation of the system is given for the operating conditions. The use of water flow heaters in connection with JRG Sanipex MT® pipes is recommended.

To protect the pipe material and connections water flow heaters should be fitted with temperature regulators or safety temperature limiters which are guaranteed not to exceed water temperatures of 95° C at time or place, not even by ancillary heating.

With hydraulically controlled apparatus the automatic switching off mechanism must ensure that additional ancillary heating will not increase the system pressure above 10 bar.



NB

Fire extinguisher installations

In the case of installing fire extinguisher pipeline and sprinklers with JRG Sanipex MT® system components, the local regulations and fire protection requirements are to be consulted.

Fire protection

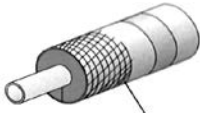
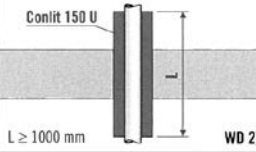
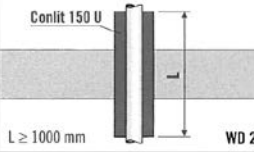
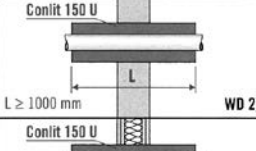
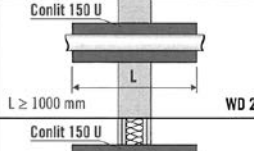
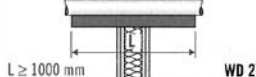
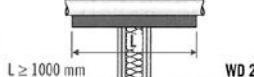
JRG Sanipex MT® pipes and fittings correspond to the following fire identity codes:

CH: IV.2

D: B2 (normally inflammable)

In fire areas the pipes are to be fitted with appropriate fire protective grommets in compliance with local regulations.

Layout variant corresponding to building supervisory test certificate of Rockwool Conlit-Shells: ABP-Nr. P-3726/4140-MPA BS

Component F 30 to F 90	R 30	R 60 to R 90	 Fire proofing insulation Rockwool 800 minimum thickness 30 mm
Solid ceiling Thickness minimum 150 mm			
Solid wall Thickness minimum 100 mm			
Light separating wall Thickness minimum 100 mm			

Pipe dimension	Conlit 150 U			Rockwool 800 1) 2) 3)		
Outer Ø Da (mm)	Type 3)	Insulating thickness 4) s [mm]	Core bore hole Dk [mm]	EnEV 100 % Warm, Type	EnEV 50 % Warm, Type	DIN 1988 Cold Type 3)
16,0	16/22	22,0	60	18/20	18/20	18/20
20,0	20/20	20,0	60	22/20	22/20	22/20
26,0	26/17	17,0	60	28/20	28/20	28/20
32,0	32/24	24,0	80	35/30	35/20	35/20
40,0	40/20	20,0	80	42/40	42/20	42/20
50,0	50/25	25,0	100	54/40	54/30	54/30

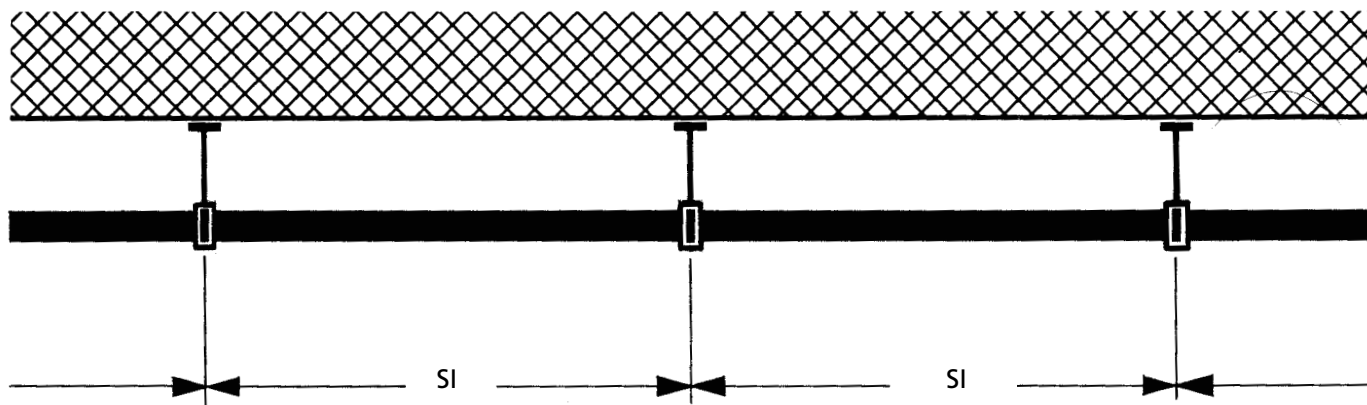
NB/ Special installation conditions

- 1) In some cases the minimum – insulating thickness deliverable is given
- 2) For further insulation choices Rockwool insulation RS800 can be used.
- 3) For pipes that cool down, according to DIN 1988-2, a steam brake must be available, therefore, use only Conli Shell 150 U / Rockwool insulating shells
- 4) Insulation thickness accord. to EnEV 50 % and, according to DIN 1988 also fitting to core bore hole diameter Dk
- 5) Insulating envelope of protection pipe or insulation fitted by factory must be removed from insertion.

All conditions of the declared general building supervisory test certificate (ABP) must be observed.

Source: Rockwool –Planungs- und Montagehelfer für Leitungsanlagen, edition: 2/2007

Noise protection	JRG Sanipex® - and JRG Sanipex MT® installations systems and JRG Fittings fulfil the requirements accord. to DIN 4109 and SIA I81 (6.2006), as long as the installation is carried out according to recognised technical rules and the JRG construction instructions and regulations. Depending upon the requirements and /or layout type, JRG Sanipex® - and JRG Sanipex MT® system components are to be additionally insulated against noise transmission.
UV-Radiation	The PE-X-outer sleeve of JRG Sanipex MT® pipes intended for the free layout in buildings is sufficiently stabilised against UV. Nevertheless, JRG Sanipex® and JRG Sanipex MT® system components should not be left exposed to the sunlight for long periods.
 Warning Frost protection In case of impending frost, JRG Sanipex MT® installations should be fully emptied or protected from freezing before the onset of frost.	
Grounding of electro-Installations	JRG Sanipex MT® installations cannot be used as a grounding conductor.
Pressure tests	JRG Sanipex MT® installations should undergo a pressure test. This should be carried out in accordance with local regulations. Every single cone grip union is to be checked visually. In the case of JRG Sanipex MT® installations combined with JRG Sanipex® pipe-in-pipe distributor pipes, the pressure tests should be done separately. If this is not possible then the pressure test should follow that employed for PE-X. (System description JRG Sanipex®) For reasons of hygiene the installation is to be fully emptied after completing the pressure test with water. For pressure and sealing tests with compressed air or inert gas the specifications in the comments-sheet «sealing tests of drinking-water installations with compressed air, inert gas or water» of the ZVSHK, are to be strictly followed.
Test protocol	The pressure test must be documented and the test-protocol signed by the body requesting the test and the person performing the test. See pages 86 and 87 for the forms for the pressure testing procedure.
Starting operation	Before starting operations the drinking water system must be thoroughly flushed through with water.
Fastening of pipes	JRG Sanipex MT® installations can be secured with JRG Sanipex® / JRG Sanipex MT® fastening components or any accepted means of fastening. In principle, freely laid JRG Sanipex MT® pipes require no carrying shell, support pipes or such like. They must, however, be secured at the following intervals (SI). In installation zones which are liable to bear high mechanical loads or strain or where the stipulated fastening intervals cannot be met, we recommend JRG Sanipex MT® pipes to be additionally stabilised. For this normal carrier shells, support pipes, etc can be used.



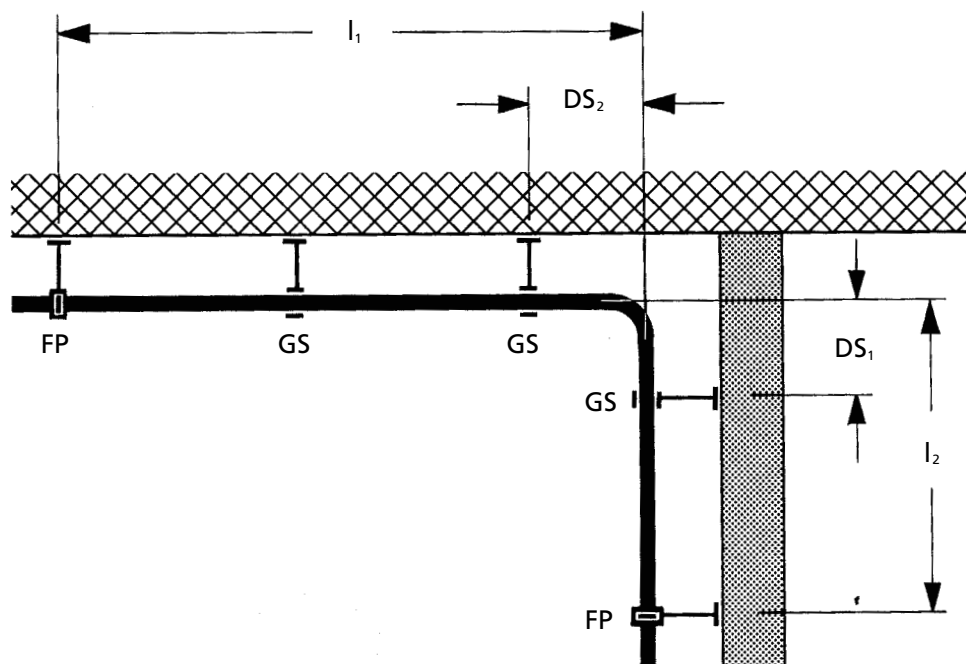
Securing intervals SI

d	DN	SI in cm without add. stabilisation	SI in cm with add. stabilisation	SI in cm with increased mech. strain and with add. stabilisation
16	12	100	200	100
20	15	100	200	100
26	20	150	200	150
32	25	200	300	200
40	32	200	300	200
50	40	250	350	250
63	50	250	350	250

Length changes

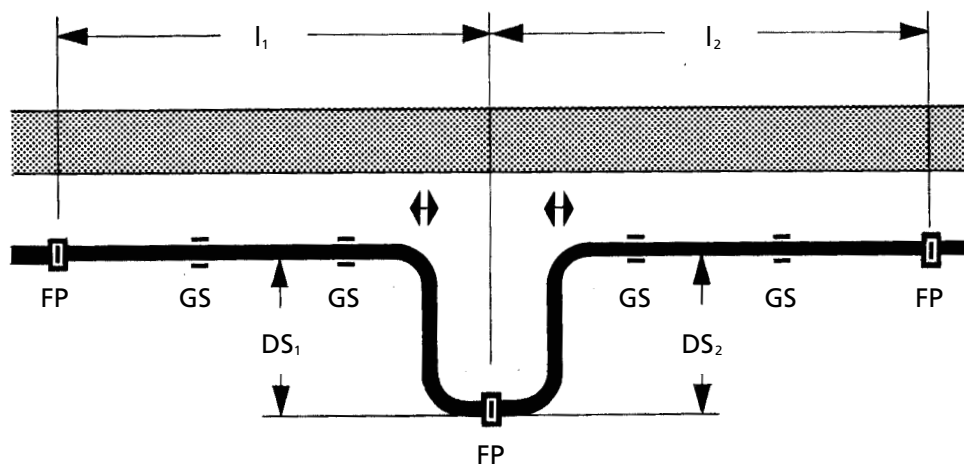
Compensation via expansion bend

The pipe's change in direction takes up the thermally-induced change in pipe length.



Compensation via U-expansion bend

The U-shaped expansion bend takes up the thermally-induced change in pipe length.



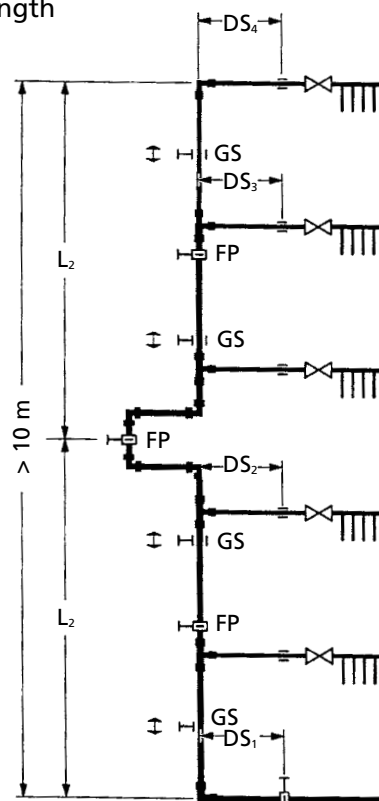
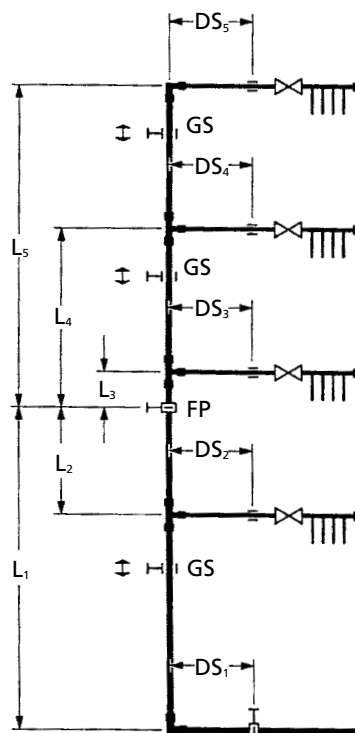
See pages 50 and 51 for basic calculations for expansion bend.

- l_1 / l_2 = Pipe length between fastening point and bend
- FP = Fastening point
- DS_1 / DS_2 = expansion bend length
- GS = Commercial pipe clamping collar with slide insert (JRG Nr. 4751.xxx) or slide collar

Fastening point for riser pipes

Array of fastening points and slide clamping collars for riser pipes

$L_1, \dots, L_5$ = Pipe length between fastening point and bend
 FP = Fastening point
 $DS_1, \dots, DS_5$ = Change in length
 GS = slide collar



Neither a U-expansion bend nor a fastening point need be used for the riser pipes up to 5m riser height.

A U-expansion bend is not required up to 10 m height of riser pipe. However, a fastening point (FP) is needed in the middle of the riser pipe

Above 10 m riser pipe height, a U-expansion bend with appropriate fastening points (FP) at every 10 m interval is required.



Attention

Expansion bend
Note the expansion bend lengths in all cases.

JRG Sanipex MT® fastening point

Expansion bend and U-expansion bends compensate for the thermally-induced changes in length. In order to ensure the function of the expansion bend, fastening points and pipe slide clamping collars are to be installed.

Fastening points-details d16 - d40

Fastening points can be brought onto the pipe at any suitable position by means of a fastening point clamp (JRG Art.Nr. 4752.xxx) in combination with a fastening point pipe clamping collar. The fastening point clamp claws into the outer coat of the JRG Sanipex MT® pipe.

d50 + d63

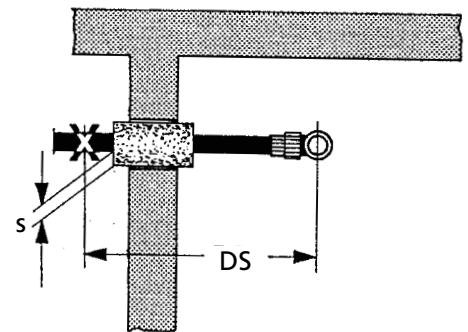
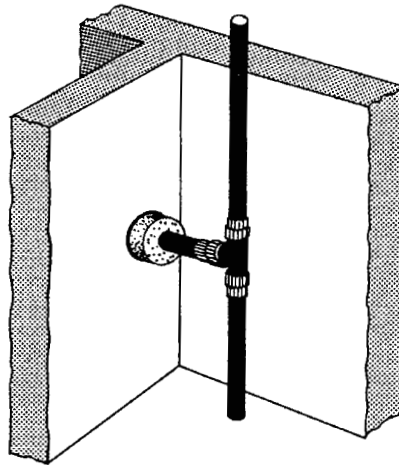
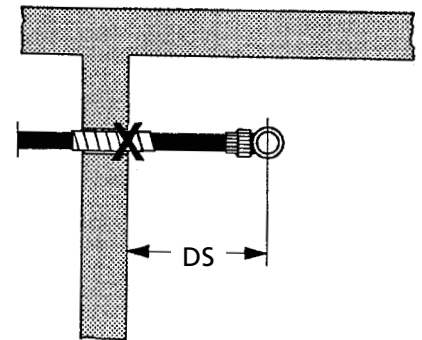
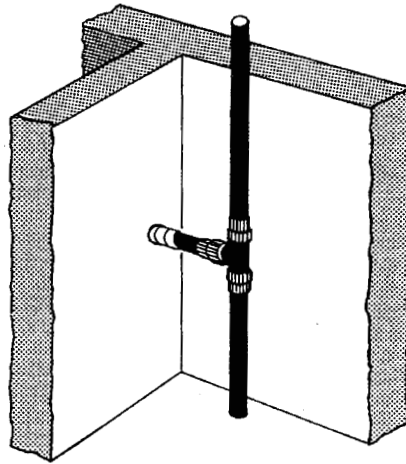
Fastening points can be made at any suitable position of the pipe using any commercially available, correctly fitting fastening point pipe clamping collar. The pipe clamping collar must be pipe-round and when tightened must not constrict the pipe diameter by more as 0,5 mm.

Layout in pipe shaft

JRG Sanipex MT® riser pipe tail is to be padded with a soft material such that the thermally-induced changes in pipe length can be accommodated.

Placement example of expansion bends DS in pipe shaft.

- s = $1.5 \cdot \Delta l$ = minimal insulation strength
- Δl = Length changes (Calculation see pages 50 and 51)
- X = Fastening point



Concealed wall pipes

Built-in and walled up JRG Sanipex MT® installations must

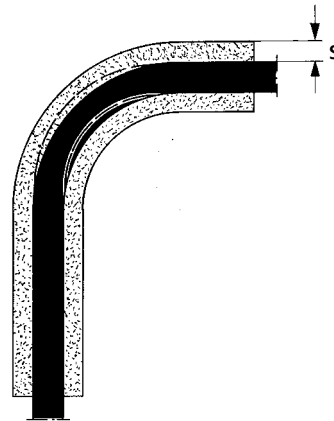
- for taking up thermally-induced changes in pipe length
- for combating sound transmission
- for combating sweating
- for combating heat emission / heat loss or warming the medium
- for combating effects of construction materials

Be insulated with a suitable material and/or separated from the building structure.

The minimal insulation thickness (s) for the thermally induced changes in pipe length (Δl) is sufficient when:

$$s = 1.5 \times \Delta l$$

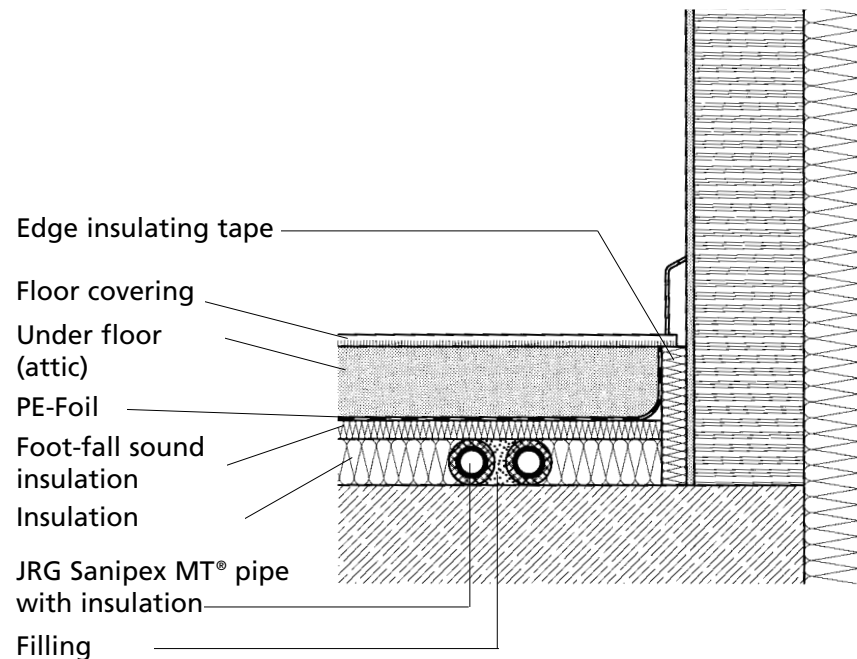
Determination of thermally induced changes in pipe length (see pages 50 and 51)



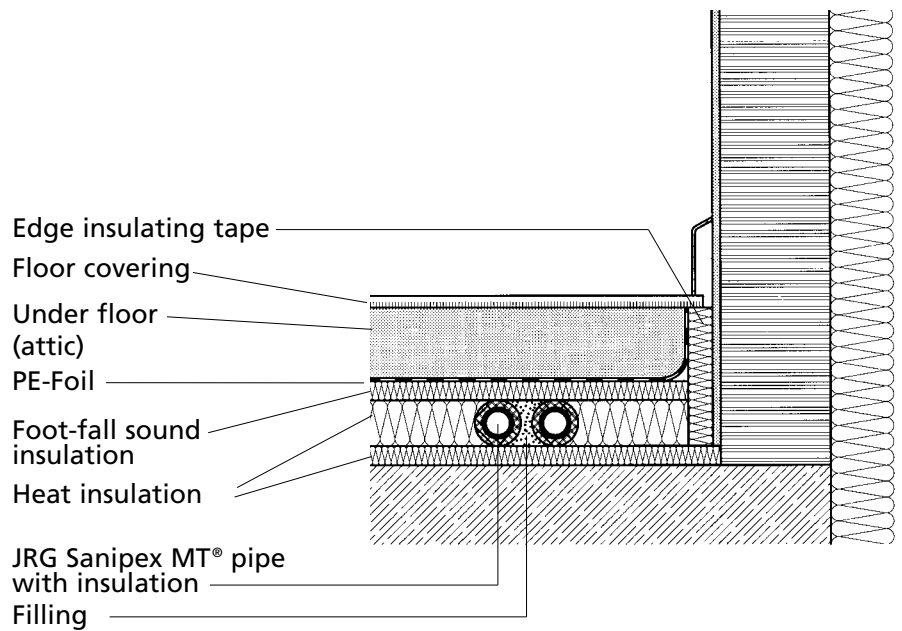
Warning Cementing in

The cementing in of JRG Sanipex MT® composite metal pipes in solid wall and ceiling constructions is not allowed.

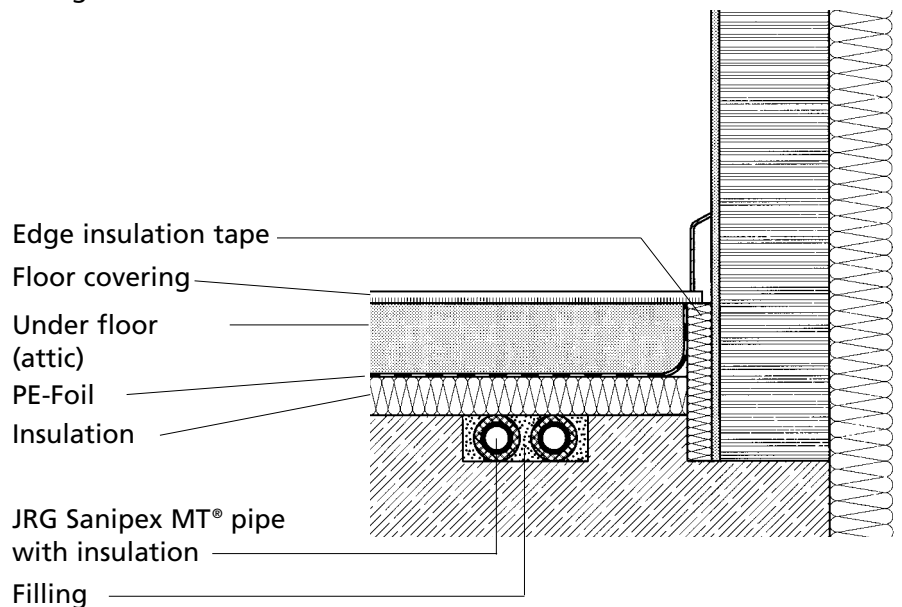
Laying of pipes on a concrete ceiling in the heat insulation



Laying pipes on the heat insulating layer over a cooling room within the heat insulation



Laying pipes in ceiling groove under the insulation

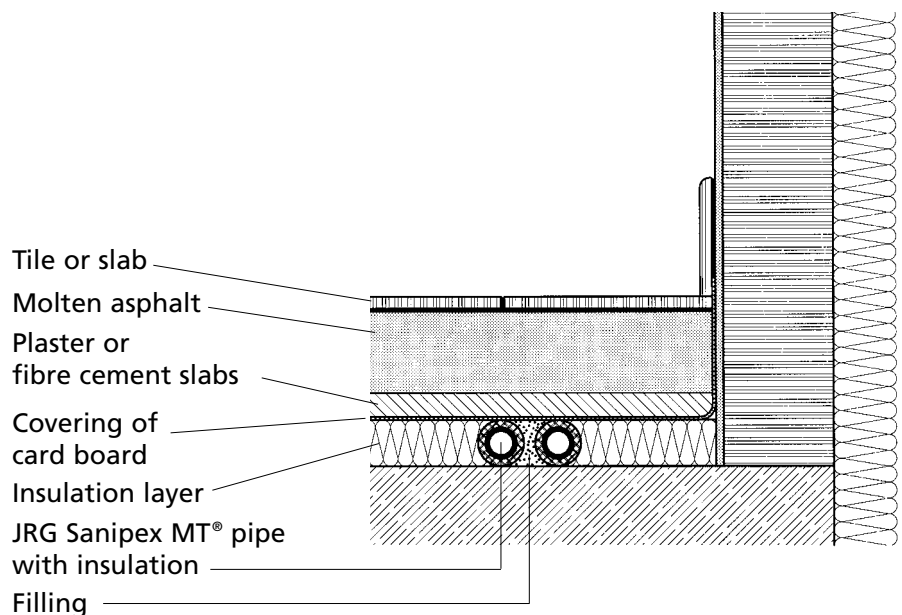


Laying pipes in the insulation using molten asphalt



Warning Molten asphalt

In order to prevent heat build up, the pipes should be permanently cooled with running cold water until totally cold.



Fastening intervals

When lying out JRG Sanipex® pipes d16 – d20 and JRG Sanipex MT® pipes d16 – d26, in outer wall elements, flush-constructions or onto raw cement ceilings, the fastening interval should be 80 cm. Appropriate attention must be paid to the changes in length.

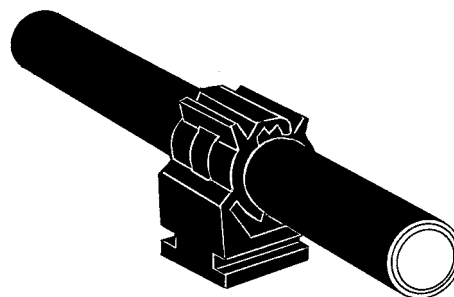
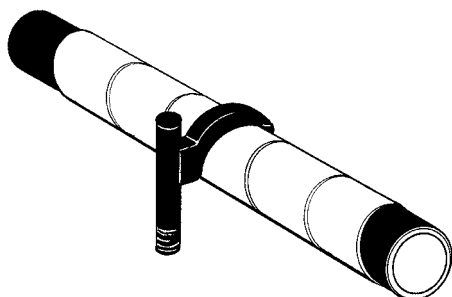
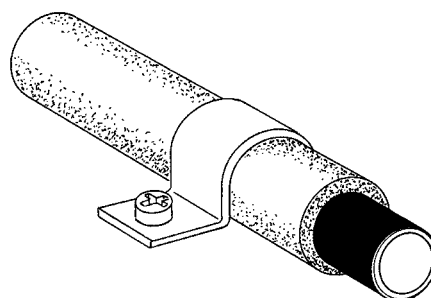
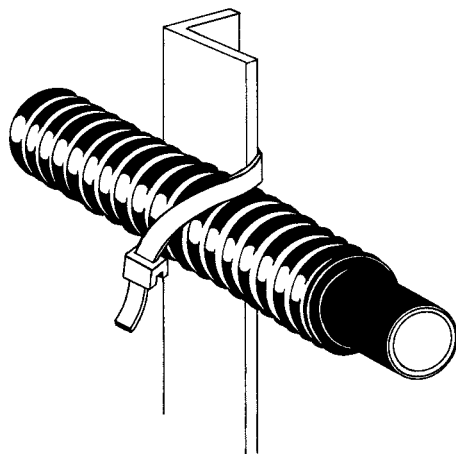
Fastening of pipes

The JRG Sanipex® pipes d16 – d20 and JRG Sanipex MT® pipes d16 – d26, can by choice be fastened with pipe ties (JRG Nr. 5743.xxx), pipe clips (JRG Nr. 5744.xxx / 5745.016), dowel hooks (JRG Nr. 5744.xxx) or pipe bracket (JRG Nr. 4755.xxx).



Warning Thumping

In order to reduce the noise emission caused by the thumping of fast closing fittings, appropriate precautions are to be taken when lying pipe-in-pipe JRG Sanipex®- and JRG Sanipex MT® pipes.



Open installation

4610.xxx Fittings connector, single (2)



4613.xxx Fittings connector, double (2)

4695.xxx Cap



Box 90° on wood

4630.xxx Box 90°

For use in wood construction we recommend mounting the box-extension JRG Nr. 5409.060 as well as the sealing gasket 5409.020.



Box 90° behind wood

4630.xxx Box 90°

5409-01 Aid ring wood construction

For use in wood construction we recommend mounting the box-extension JRG Nr. 5409.060 as well as the sealing gasket 5409.020.



Box 90° behind plaster carton (light construction)

4630.xxx Box 90°

5409-02 Sealing gasket

For use in light weight construction we recommend mounting the box-extension JRG Nr. 5409.060 as well as the sealing gasket 5409.020.



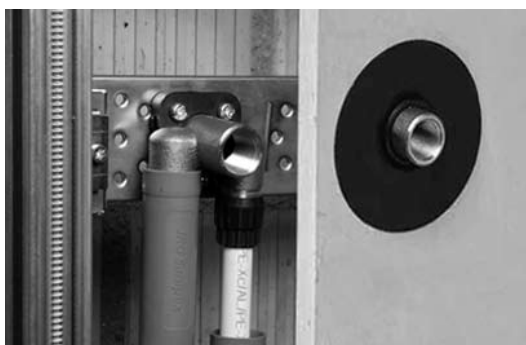
Fitting connections in wood constructions on mounting rails, double

- 4610.xxx Fitting connector, single (2)
- 5741.032 Shapet bracket, double
- 5409.010 Noise protection element (2)
- 5409.012 Sealing gasket (2)



Fitting connections in outer wall system on fitting plate, double

- 4611.xxx Fitting connector, double (2)
- 5458.000 Fitting plate, double
- 5409.011 Noise protection element (2)
- 5409.012 Sealing gasket (2)



Fitting connections in wood constructions behind wooden plate

- 4620.xxx Wall penetration, single
- 4621.xxx Wall penetration, double
- 5539.003 Fixing accessories (2)



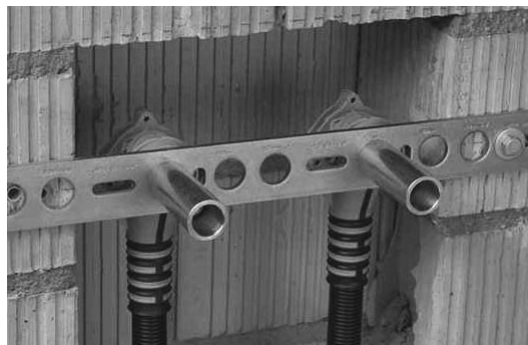
Cistern connection

- 4615.116 Elbow with push fit nipple



Box mounting in the block out

- 4630.xxx Box 90° (2)
- 5741.090 Bar gauge
- 5741.092 Pressure-pin (2)
- 5741.093 Protection and fixing sleeve (2)



- 4634.xxx Box 2-way 90°
- 4635.xxx Box 3-way 90°
- 5409.xxx Protection and fixing sleeve (2)
- 5741.xxx Box bracket, double



- 4630.xxx Box 90° (2)
- 5409.xxx Protection and fixing sleeve (2)
- 5741.xxx Box bracket, double
- 5742.000 Support for sewage pipe



Box mounting front wall

- 4630.xxx Box 90° (2)
- 5409.005 Fixing accessories (2)
- 5749.001 Thread bar (2)
- 5755.001 Base plate (2)
- 5755.005 Spacing gauge



Compact unit for GIS-profile

- 5458.070 Compact unit for GIS-Profile
- 5456.005 Counter unit KOAX



JRG Sanipex MT® distributor

Connected with JRG Sanipex® Pipe-in-Pipe

4771.010 Distributor shut-off valve

JRG LegioStop® (2)

4640.516 Distributor 5-way (2)

4640.116 Distributor 1-way

5430.000 Cap for distributor (2)

5734.030 Marking sleeve, blue (6)

5734.031 Marking sleeve, red (5)

5740.000 Bracket for distributor (2)



JRG Sanipex MT® flush distributor

5800.320 Concealed valve

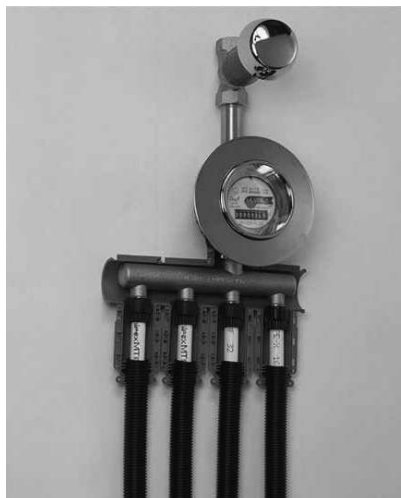
5456.010 Threaded nipple

5456.325 Pipe connection casing KOAX UPZ

5456.005 Counter unit KOAX + m UPZ

4645.100 Concealed distributor 4-way

5758.004 Protection cover set 4-way



Pipe width determination

Connecting values for fittings and instrument

Source: SVGW-Guidelines W3 Edition 2000

Application use, connection 1/2"	Volume flow per connection		Number of load units per connection (LU)
	l/s	l/min	
Washing basin, sluice, wash stand, bidet, cistern, drinking water vendor	0,1	6	1
Sink, drainage sink, drainage fitting for balcony and terrace, hairdresser hand sprinkler, dish washing machine, washing sink	0,2	12	2
Shower	0,3	18	3
Sink for business, floor and wall sink with drain, bathtub, washing machine up to 6 kg, automatic urinal-flushing, dish sprinkler	0,4	24	4
Drainage fitting for garden and garage	0,5	30	5
Application use connection 3/4"			
Sink for business, bathtub, shower, drainage fitting for garden and garage	0,8	48	8

LU: weight limit value (LU) Loading Unit

1 LU = 0,1 l/s

Heating filling valve need not be considered for pipe width determinations.

Pipe width determinations for JRG Sanipex MT® pipes

Guidelines SVGW W3, Edition 2000

Weight limit value (LU) and pipe width for JRG Sanipex MT® pipes

Source: Extract from Table 2h: PE-X/AL/PE-X

Total weight limit value LU	3	4	5	10	20	55	180	540	1300
Largest single value LU	-	-	4	5	8	-	-	-	-
d _a x s (mm)	16 x 2,25			20 x 2,5	26 x 3	32 x 3	40 x 3,5	50 x 4	63 x 4,5
di mm	11.5			15	20	26	33	42	56
Recommended pipe length m	9	5	4	-	-	-	-	-	-
Fittings	1/2			1/2	3/4	1	1 1/4	1 1/2	2

Pipe width determinations
JRG Sanipex® pipes

Weight limit values (LU) and pipe widths for JRG Sanipex® pipes
Source: Extract from Table 2d: PE-X pipes DIN 16893 PN 20

Total Weight limit values LU	3	4	5	8
Largest single value LU	-	-	4	5
d _a x s (mm)	16 x 2,2			20 x 2,8
d _i mm	11.6			14,4
Recommended pipe length m	9	5	4	-
Fittings	1/2			1/2



NB

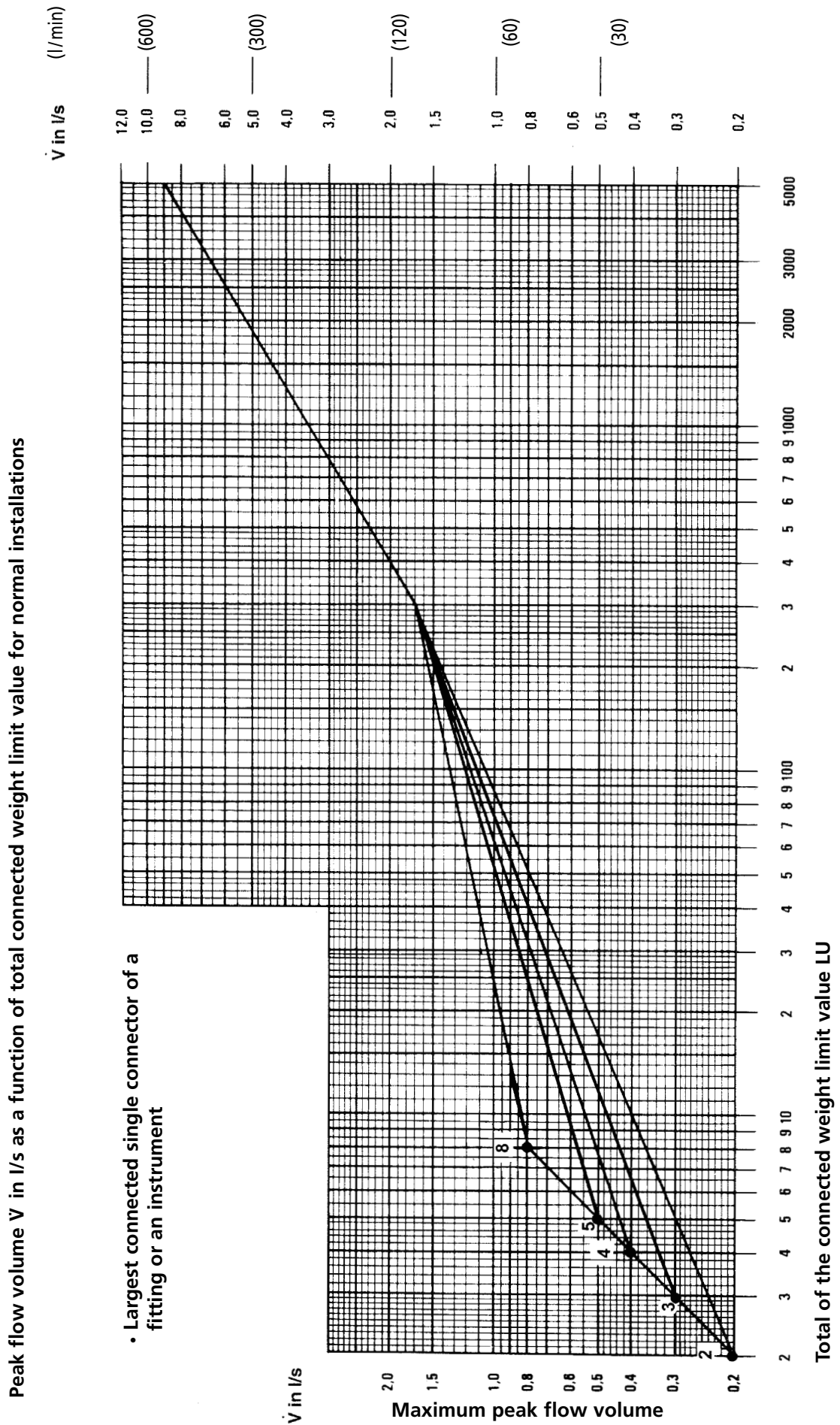
Pressure loss/discharge time

For T-piece installations calculate the voiding times as well as the pressure loss.

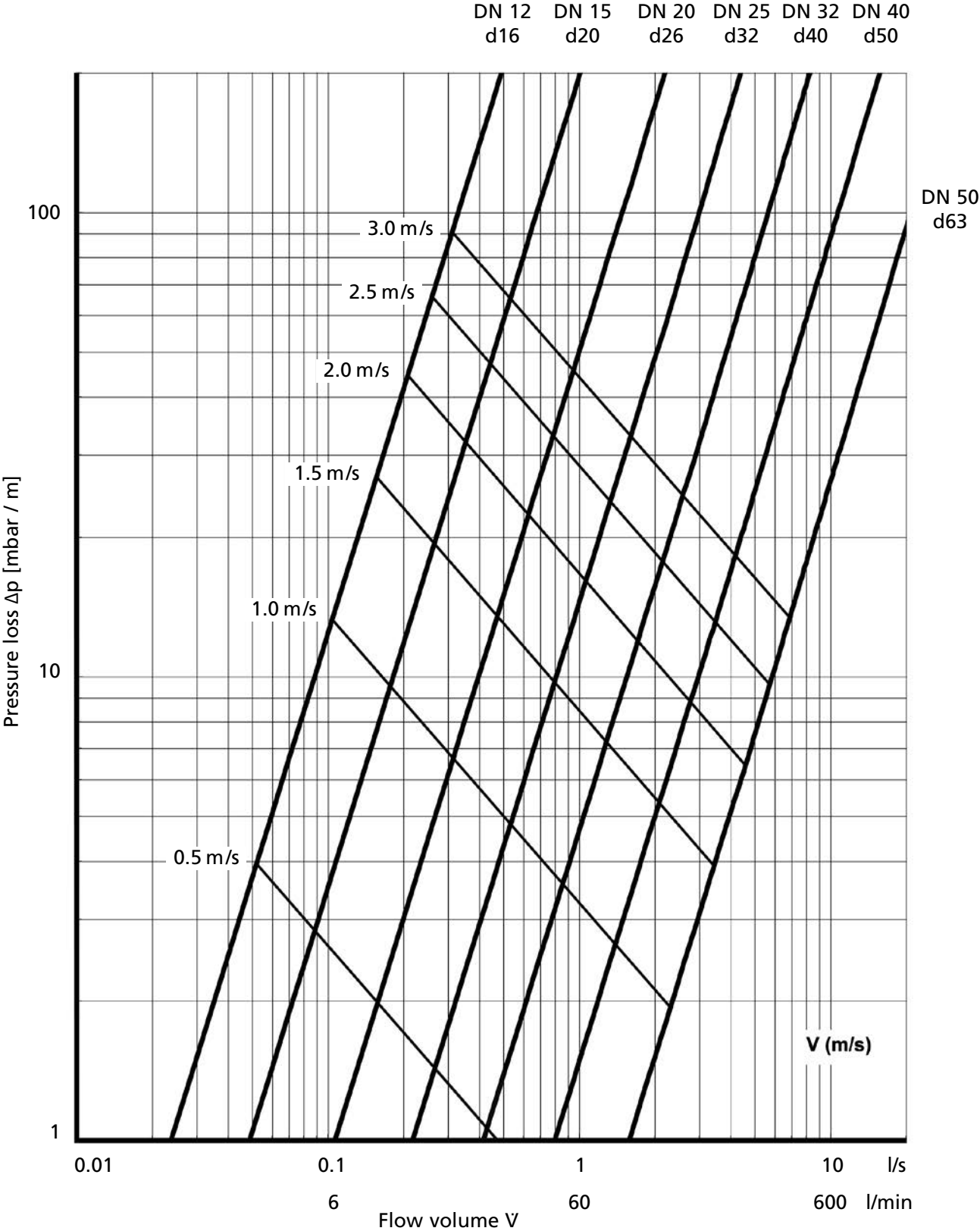
On no account must the maximum pipe length exceed 12 m for single tap station systems.

Basic calculations according to guidelines SVGW W3

Source SVGW Guidelien W3 Edition 2000



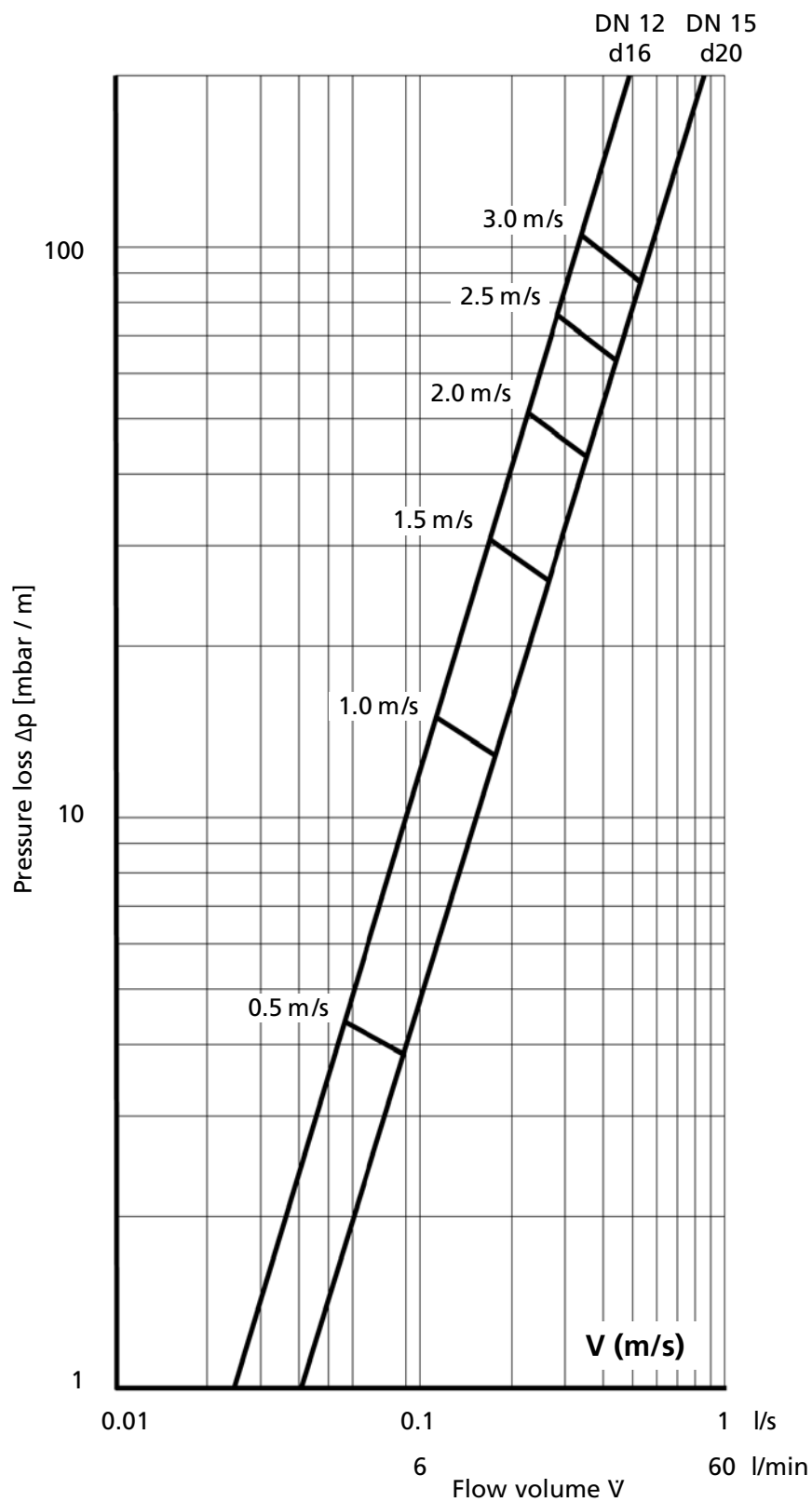
Nomogramm
Pressure loss for JRG Sanipex MT[®] pipes d16 to d63 / DN 12 to DN 50



Water density: 0,998 kg/l
Water temperature 20° C
Surface roughness inner pipe: 7,0 mm

Nomogramm

Pressure loss for JRG Sanipex MT® pipes d16 and d20 / DN 12 and DN 15



Water density: 0,998 kg/l
 Water temperature: 20° C
 Surface roughness inner pipe: 7,0 mm

Basic calculations according to DIN 1988

Standard values for minimum flow pressure and calculated flow rate of usable drinking water sites

Source: DIN 1988 Part 3

Minimum-flow pressure $P_{\min FI}$ bar	Type of drinking water site	Calculated flow rate when tapping off Mixed water*)			Only cold or warmed drinking water
		V_R cold l/s	V_R warm l/s	V_R l/s	
0,5	Emptying valve without aerator**) DN 15	–	–	0,30	
0,5	 DN 20	–	–	0,50	
0,5	 DN 25	–	–	1,00	
1,0	with aerator DN 10	–	–	0,15	
1,0	 DN 15	–	–	0,15	
1,0	Sprinkler head for cleaning sprinklers DN 15	0,10	0,10	0,20	
1,2	Pressure rinser accord. DIN 3265 Part 1 DN 15	–	–	0,70	
1,2	Pressure rinser accord. DIN 3265 Part 1 DN 20	–	–	1,00	
0,4	Pressure rinser accord. DIN 3265 Part 1 DN 25	–	–	1,00	
1,0	Pressure rinser for urinal basin DN 15	–	–	0,30	
1,0	Dish washing machine DN 15	–	–	0,15	
1,0	Household washing machine DN 15	–	–	0,25	
1,0	Mixed battery for Sprinkler bath DN 15	0,15	0,15	–	
1,0	Bath tub DN 15	0,15	0,15	–	
1,0	Kitchen riser DN 15	0,07	0,07	–	
1,0	Wash stand DN 15	0,07	0,07	–	
1,0	Sitting wash basin DN 15	0,07	0,07	–	
1,0	Mixed battery DN 20	0,30	0,30		
0,5	Cistern accord. DIN 19 542 DN 15	–	–	0,13	
1,0	Electro-Hot water apparatus DN 15	–	–	0,10 ***)	

*) The calculated flow rate for mixed water withdrawal is based on 15° C for cold water and 60° C for hot drinking water.

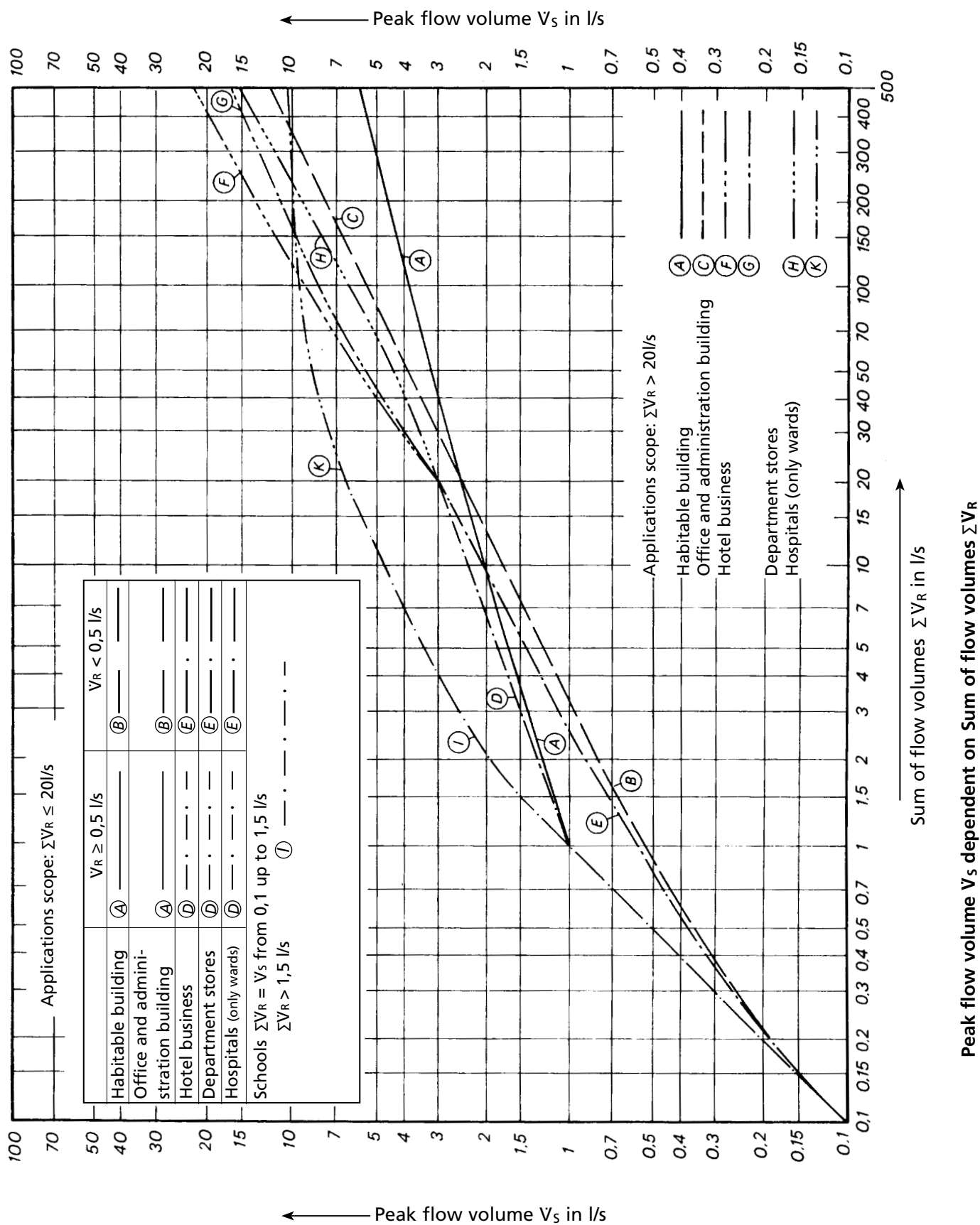
**) For emptying valves without aerator and with plastic tube thread the pressure loss in the tube (up to 10 m length) and in the connected apparatus (e.g. lawn sprinkler) should be considered overall over the minimum flow pressure. In this case the minimum flow pressure increases by 1,0 bar to 1,5 bar.

***) For a fully opened throttle screw.

Remarks: For water withdrawal sites not shown in the table, apparatus of the same type and for flow rates of fittings or minimum flow pressure larger than indicated, take note of the manufacturer's instructions when determining the pipe diameter.

Basic calculations according to DIN 1988

Source: DIN 1988 Part. 3



Pressure loss in JRG Sanipex MT® pipes

Source: DIN 1988 Part 3

Pipe friction pressure gradient R and calculated flow speed v, is dependent on peak volume flow rate $\dot{V}_s$

Pipe dimensions d	16		20		26		32		40		50		63	
Nominal width DN	12		15		20		25		32		40		50	
$\dot{V}_s$	R	v	R	v	R	v	R	v	R	v	R	v	R	v
l/s	mbar/m	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m	m/s
0.01	0.3	0.1	0.1	0.1										
0.02	0.8	0.2	0.2	0.1	0.1	0.1								
0.03	1.7	0.3	0.5	0.2	0.1	0.1								
0.04	2.7	0.4	0.8	0.2	0.2	0.1								
0.05	4.0	0.5	1.1	0.3	0.3	0.2								
0.06	5.5	0.6	1.6	0.3	0.4	0.2								
0.07	7.2	0.7	2.0	0.4	0.5	0.2								
0.08	9.1	0.8	2.6	0.5	0.7	0.3								
0.09	11.1	0.9	3.1	0.5	0.8	0.3								
0.10	13.4	1.0	3.8	0.6	1.0	0.3	0.3	0.2	0.1	0.1				
0.15	27.3	1.4	7.6	0.8	1.9	0.5	0.6	0.3	0.2	0.2				
0.20	45.4	1.9	12.7	1.1	3.2	0.6	0.9	0.4	0.3	0.2				
0.25	67.6	2.4	18.8	1.4	4.7	0.8	1.4	0.5	0.4	0.3				
0.30	93.9	2.9	26.0	1.7	6.5	1.0	1.9	0.6	0.6	0.4				
0.35			34.2	2.0	8.6	1.1	2.4	0.7	0.8	0.4				
0.40			43.4	2.3	10.9	1.3	3.1	0.8	1.0	0.5				
0.45			53.7	2.5	13.4	1.4	3.8	0.8	1.2	0.5				
0.50			64.9	2.8	16.2	1.6	4.6	0.9	1.5	0.6	0.5	0.4		
0.55					19.2	1.8	5.4	1.0	1.7	0.6	0.5	0.4		
0.60					22.4	1.9	6.3	1.1	2.0	0.7	0.6	0.4		
0.65					25.8	2.1	7.3	1.2	2.3	0.8	0.7	0.5		
0.70					29.5	2.2	8.3	1.3	2.7	0.8	0.8	0.5		
0.75					33.4	2.4	9.4	1.4	3.0	0.9	0.9	0.5		
0.80					37.6	2.5	10.6	1.5	3.4	0.9	1.1	0.6		
0.85					41.9	2.7	11.8	1.6	3.7	1.0	1.2	0.6		
0.90					46.5	2.9	13.1	1.7	4.1	1.1	1.3	0.6		
0.95					51.2	3.0	14.4	1.8	4.6	1.1	1.4	0.7		
1.00							15.8	1.9	5.0	1.2	1.6	0.7	0.5	0.44
1.05							17.2	2.0	5.0	1.2	1.7	0.8	0.5	0.46
1.10							18.7	2.1	5.9	1.3	1.9	0.8	0.6	0.48
1.15							20.3	2.2	6.4	1.3	2.0	0.8	0.6	0.30
1.20							21.9	2.3	6.9	1.4	2.2	0.9	0.7	0.52
1.25							23.6	2.4	7.5	1.5	2.3	0.9	0.7	0.55
1.30							25.3	2.4	8.0	1.5	2.5	0.9	0.8	0.57
1.40							28.9	2.6	9.1	1.6	2.9	1.0	0.9	0.61
1.50							32.8	2.8	10.3	1.8	3.2	1.1	1.0	0.65
1.60							36.9	3.0	11.6	1.9	3.6	1.2	1.1	0.70
1.70									12.9	2.0	4.0	1.2	1.2	0.74
1.80									14.4	2.1	4.5	1.3	1.4	0.79
1.90									15.8	2.2	4.9	1.4	1.5	0.83
2.00									17.4	2.3	5.4	1.4	1.6	0.87
2.10									19.0	2.5	5.9	1.5	1.8	0.92
2.20									20.6	2.6	6.4	1.6	1.9	0.96
2.30									22.4	2.7	7.0	1.7	2.1	1.00
2.40									24.2	2.8	7.5	1.7	2.3	1.05
2.50									26.0	2.9	8.1	1.8	2.4	1.09
2.60									28.0	3.0	8.7	1.9	2.6	1.14
2.70											9.3	1.9	2.8	1.18
2.80											9.9	2.0	3.0	1.22
2.90											10.6	2.1	3.1	1.27
3.00											11.2	2.2	3.3	1.31
3.10											11.9	2.2	3.5	1.35
3.20											12.6	2.3	3.7	1.40
3.30											13.4	2.4	3.9	1.44
3.40											14.1	2.5	4.2	1.48
3.50											14.9	2.5	4.4	1.53
3.60											15.6	2.6	4.6	1.57
3.70											16.4	2.7	4.8	1.62
3.80											17.3	2.7	5.1	1.66
3.90											18.1	2.8	5.3	1.70
4.00											19.0	2.9	5.5	1.75
4.10											19.8	3.0	5.8	1.79
4.20											20.7	3.0	6.0	1.83

Pressure loss in
JRG Sanipex MT® pipes
from ζ -values

Source: DIN 1988 Part 3

Loss coefficient $\zeta = 1$; for water ($\vartheta = 10^\circ \text{C}$ and $\rho = 999.7 \text{ kg/m}^3$)
Dependent on the calculated flow rate v

$$\Delta PEW = 5v^2 \cdot \sum \zeta$$

Flow rate v m/s	Pressure loss for $\zeta = 1$ $5v^2$ mbar	Flow rate v m/s	Pressure loss for $\zeta = 1$ $5v^2$ mbar
0.1	0.1	2.6	33.8
0.2	0.2	2.7	36.5
0.3	0.5	2.8	39.2
0.4	0.8	2.9	42.1
0.5	1.3	3.0	45.0
0.6	1.8	3.1	48.0
0.7	2.5	3.2	51.0
0.8	3.2	3.3	55.0
0.9	4.1	3.4	58.0
1.0	5.0	3.5	61.0
1.1	6.1	3.6	65.0
1.2	7.2	3.7	68.0
1.3	8.5	3.8	72.0
1.4	9.8	3.9	76.0
1.5	11.3	4.0	80.0
1.6	12.8	4.1	84.0
1.7	14.5	4.2	88.0
1.8	16.2	4.3	92.0
1.9	18.1	4.4	97.0
2.0	20.0	4.5	101.0
2.1	22.1	4.6	106.0
2.2	24.2	4.7	110.0
2.3	26.5	4.8	115.0
2.4	28.8	4.9	120.0
2.5	31.3	5.0	125.0

Pressure loss in JRG Sanipex MT® system components

Pressure loss in JRG Sanipex MT® system components																			
Art. N°	Terms	Symbol	DN/d	ζ-Valu	Equivalent pipe length in metres														
					1 LU 0.1 l/s	2 LU 0.2 l/s	3 LU 0.3 l/s	4 LU 0.4 l/s	8 LU 0.5 l/s	30 LU 0.8 l/s	60 LU 1.0 l/s	Volume flow accord. W3 Diag. 1 / gr. LU = 4							
4630 4632	Sanipex MT-Box simple 90°		1/2"-d16	1.42	0.50	0.55	0.60	0.60	---	---	---	---	---	---	---	---			
			1/2"-d20	1.46	0.60	0.70	0.75	0.80	0.85	---	---	---	---	---	---	---			
			3/4"-d20	1.77	0.75	0.85	0.90	0.95	0.95	---	---	---	---	---	---	---			
4634	Sanipex MT-Box 2-way 90°		1/2"-d16-d16	4.70	1.65	1.80	1.85	1.85	---	---	---	---	---	---	---	---			
			1/2"-d20-d16	3.90	1.65	1.75	1.85	2.10	2.15	---	---	---	---	---	---	---			
			1/2"-d16-d16	1.55	0.55	0.60	0.65	0.70	---	---	---	---	---	---	---	---			
			1/2"-d20-d16	0.80	0.30	0.30	0.35	0.35	0.35	---	---	---	---	---	---	---			
			1/2"-d16-35mm	3.30	1.15	1.35	1.40	1.45	---	---	---	---	---	---	---	---			
			1/2"-d20-35mm	3.50	1.40	1.65	1.90	1.95	2.00	---	---	---	---	---	---	---			
4610	Fitting connection simple		1/2"-d20-50mm	2.25	0.90	1.05	1.25	1.25	1.35	---	---	---	---	---	---	---			
			3/4"-d26-50mm	1.70	1.00	1.00	1.10	1.15	1.30	1.35	---	---	---	---	---	---			
4611	Fitting connection double		1/2"-d16-d16-50mm	3.01	1.05	1.20	1.30	1.35	---	---	---	---	---	---	---	---			
			1/2"-d16-d16-50mm	2.46	0.80	0.90	1.05	1.05	---	---	---	---	---	---	---	---			
4640 4645	Distributor incl. junction		3/4"-d16	0.40	0.15	0.15	0.15	0.15	---	---	---	---	---	---	---	---			
			3/4"-d20	0.54	0.20	0.25	0.30	0.30	---	---	---	---	---	---	---	---			
			3/4"	0.47	--	--	0.35	0.35	0.35	0.40	0.40	---	---	---	---	---			
5458	Shut off unit		3/4"-DN20	24.80	--	--	17.50	19.00	19.50	21.50	---	---	---	---	---	---			
			3/4"-DN20	25.50	--	--	17.50	19.50	20.00	22.50	---	---	---	---	---	---	---		
4670 4671 4672	Elbow 90°		d16	2.42	0.85	0.95	1.00	1.05	---	---	---	---	---	---	---	---			
			d20	2.28	0.95	1.00	1.20	1.20	1.30	1.35	---	---	---	---	---	---			
			d26	1.80	--	--	--	1.30	1.40	1.55	1.60	---	---	---	---	---	---		
			d32	--	--	--	--	--	--	--	--	---	---	---	---	---	---		
			d40	1.60	--	--	--	--	--	2.00	2.20	2.30	2.60	2.80	---	---	---		
			d50	1.00	--	--	--	--	--	--	--	--	1.80	1.85	1.90	1.90	---		
4676	Elbow 45°		d63	1.14	--	--	--	--	--	---	---	---	---	---	2.70	2.75	2.80	2.85	2.90
			d20	0.84	0.35	0.40	0.45	0.45	0.45	0.50	---	---	---	---	---	---	---	---	---
			d26	0.60	--	--	--	0.45	0.45	0.50	0.55	---	---	---	---	---	---	---	---
			d32	--	--	--	--	--	--	--	--	---	---	---	---	---	---	---	---
			d40	0.60	--	--	--	--	--	0.70	0.80	0.90	0.95	1.05	---	---	---	---	---
			d50	0.51	--	--	--	--	--	--	--	1.80	1.85	1.90	1.90	1.90	---	---	---
			d63	0.55	--	--	--	--	--	--	--	--	--	2.70	2.75	2.80	2.85	2.90	

Pressure loss in JRG Sanipex MT® system components

Pressure loss in JRG Sanipex MT® system components																		
Art. N°	Terms	Symbol	DN/d	ζ-Valu	Equivalent pipe length in metres													
					1 LU 0.1 l/s	2 LU 0.2 l/s	3 LU 0.3 l/s	4 LU 0.4 l/s	8 LU 0.5 l/s	30 LU 0.8 l/s	60 LU 1.0 l/s	Flow volume according W3 Diagram 1 / gr. LU = 4						
	Pipe bend 90° with (Hand) bending template		d16	0.17	0.05	0.05	0.05	0.05	--	--	--	--	--	--	--	--	--	
			d20	0.36	0.15	0.15	0.20	0.20	0.20	0.25	--	--	--	--	--	--	--	
			d26	0.34	--	--	--	0.25	0.25	0.30	0.30	--	--	--	--	--	--	--
			d32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			d40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4607	Pipe bend 90°		d50	--	--	--	--	--	--	--	0.45	0.50	0.55	0.60	0.60	--	--	
			d63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Pipe bend 45° with (Hand) bending template		d16	0.11	0.05	0.05	0.05	0.05	--	--	--	--	--	--	--	--	--	
			d20	0.26	0.10	0.10	0.15	0.15	0.15	0.15	--	--	--	--	--	--	--	
			d26	0.16	--	--	--	0.10	0.15	0.15	0.15	--	--	--	--	--	--	--
			d32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			d40	0.25	--	--	--	--	--	--	0.30	0.35	0.35	0.40	0.45	--	--	--
4608	Pipe bend 45°		d50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
			d63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	T-Pieces Flow rate		d16	0.50	0.20	0.20	0.25	0.25	--	--	--	--	--	--	--	--	--	
4650			d20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
4652			d26	0.35	--	--	--	0.25	0.30	0.30	0.35	--	--	--	--	--	--	
4654			d32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
4655			d40	0.40	--	--	--	--	--	0.50	0.55	0.60	0.65	0.70	--	--	--	--
			d50	0.23	--	--	--	--	--	--	--	0.40	0.40	0.45	0.50	--	--	--
			d63	0.31	--	--	--	--	--	--	--	--	0.70	0.70	0.75	0.75	0.75	0.75
	T-Pieces Branch		d16	1.95	0.65	0.75	0.9	0.95	--	--	--	--	--	--	--	--	--	
4650			d20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
4652			d26	--	--	--	--	1.20	1.25	1.40	1.50	--	--	--	--	--	--	
4654			d32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4655			d40	1.50	--	--	--	--	--	1.95	2.05	2.25	2.45	2.60	--	--	--	--
			d50	1.18	--	--	--	--	--	--	--	2.15	2.20	2.30	2.45	--	--	--
			d63	1.33	--	--	--	--	--	--	--	--	3.10	3.25	3.30	3.40	3.45	3.45

Pressure loss in JRG Sanipex MT® pipes														
Art. N°	Terms	Symbol	DN/d	Pressure loss in mbar per meter pipe										
				1 LU 0.1 l/s	2 LU 0.2 l/s	3 LU 0.3 l/s	4 LU 0.4 l/s	8 LU 0.5 l/s	30 LU 0.8 l/s	60 LU 1.0 l/s	Flow volume according W3 Diag. 1 / gr. LU = 4			
			d16	13.5	44.5	91.0	150.5	---	---	---	---	---	---	---
4600	JRG Sanipex MT® pipe	—	d20	4.0	12.5	26.0	42.5	63.0	---	---	---	---	---	---
4602			d26	---	---	---	11.0	16.0	36.5	54.0	---	---	---	---
4604			d32	---	---	---	---	---	10.5	15.5	31.5	52.0	---	---
4606			d40	---	---	---	---	---	3.5	5.0	10.0	17.0	25.0	---
			d50	---	---	---	---	---	---	---	3.0	5.5	8.0	11.0
			d63	---	---	---	---	---	---	---	---	1.5	2.5	3.5

Discharge times

For JRG Sanipex MT® pipes calculate the discharge times as follows:

$$\Delta t = \frac{V \cdot l}{\dot{V}}$$

Δt	= Discharge time in seconds	[s]
V	= Volume per meter pipe (Table)	[l/m]
l	= Pipe length in meter	[m]
$\dot{V}$	= Flow volume in litres per second	[l/s]

LU				1		2 (1)		2		3		4		6	8
Flow volume l/s		0.07		0.1		0.15		0.2		0.3		0.4		0.6	0.8
Pipe dimension d		16	20	16	20	16	20	16	20	16	20	16	20	20	20
Nominal width DN		12	15	12	15	12	15	12	15	12	15	12	15	15	15
Pipe-inner size		11.5	15.0	11.5	15.0	11.5	15.0	11.5	15.0	11.5	15.0	11.5	15.0	15.0	15.0
Pipe length in m	1	1.5	2.5	1.0	1.8	0.7	1.2	0.5	0.9	0.3	0.6	0.3	0.4	0.3	0.2
	2	3.0	5	2.1	3.5	1.4	2.4	1.0	1.8	0.7	1.2	0.5	0.9	0.6	0.4
	3	4.5	7.6	3.1	5.3	2.1	3.5	1.6	2.6	1.0	1.8	0.8	1.3	0.9	0.7
	4	5.9	10.1	4.2	7.0	2.8	4.7	2.1	3.5	1.4	2.4	1.0	1.8	1.2	0.9
	5	7.4	12.6	5.2	8.8	3.5	5.9	2.6	4.4	1.7	2.9	1.3	2.2	1.5	1.1
	6	8.9	15.2	6.2	10.6	4.2	7.1	3.1	5.3	2.1	3.5	1.6	2.7	1.8	1.3
	7	10.4	17.7	7.3	12.4	4.8	8.3	3.6	6.2	2.4	4.1	1.8	3.1	2.1	1.5
	8	11.9	20.2	8.3	14.2	5.5	9.4	4.2	7.1	2.8	4.7	2.1	3.5	2.4	1.8
	9	13.4	22.7	9.4	15.9	6.2	10.6	4.7	8.0	3.1	5.3	2.3	4.0	2.7	2.0
	10	14.8	25.3	10.4	17.7	6.9	11.8	5.2	8.8	3.5	5.9	2.6	4.4	3.0	2.2
	11	16.3	27.8	11.4	19.5	7.6	13.0	5.7	9.7	3.8	6.5	2.9	4.9	3.2	2.4
	12	17.8	30.3	12.5	21.2	8.3	14.2	6.2	10.6	4.2	7.1	3.1	5.3	3.5	2.7

Water contents of JRG Sanipex MT® pipes

Pipe dimensions		Pipe sections	Content in Litres
d	DN	in mm	per m
16	12	16 x 2.25	0.104
20	15	20 x 2.5	0.177
26	20	26 x 3.0	0.314
32	25	32 x 3.0	0.531
40	32	40 x 3.5	0.855
50	40	50 x 4.0	1.350
63	50	63 x 4.5	2.230

Pressure loss in JRG Sanipex® system components

Pressure loss in JRG Sanipex® system components																		
Art. N°	Terms	Symbol	DN/d	ζ-Valu	Equivalent pipe length in metres													
					1 LU	2 LU	3 LU	4 LU	8 LU	30 LU	60 LU	1.0 l/s	1.5 l/s	2.0 l/s	2.5 l/s	3.0 l/s	3.5 l/s	4.0 l/s
					0.1 l/s	0.2 l/s	0.3 l/s	0.4 l/s	0.5 l/s	0.8 l/s	1.0 l/s							
5400	Sanipex Box simple 90°		1/2"-d16	1.42	0.50	0.55	0.60	0.60	--									
5401			1/2"-d20	1.46	0.60	0.70	0.75	0.80	0.85									
5402			3/4"-d20	1.77	0.75	0.85	0.90	0.95	0.95									
5404	Sanipex Box 2-way 90°		1/2"-d16-d16	4.70	1.65	1.80	1.85	1.85	--									
			1/2"-d20-d16	3.90	1.65	1.75	1.85	2.10	2.15									
			1/2"-d16-d16	1.55	0.55	0.60	0.65	0.70	--									
5415	Fitting connection simple		1/2"-d20-d16	0.80	0.30	0.30	0.35	0.35	0.35									
			1/2"-d16-35mm	3.30	1.15	1.35	1.40	1.45	--									
			1/2"-d20-35mm	3.50	1.40	1.65	1.90	1.95	2.00									
5416	Fitting connection double		1/2"-d20-50mm	2.25	0.90	1.05	1.25	1.25	1.35									
			1/2"-d16-d16-50mm	3.01	1.05	1.20	1.30	1.35	--									
			1/2"-d16-d16-50mm	2.46	0.80	0.90	1.05	1.05										
5421-5427	Distributor incl. Junction		3/4"-d16	0.40	0.15	0.15	0.15	0.15	--									
			3/4"-d20	0.54	0.20	0.25	0.30	0.30	--									
			3/4"	0.47	--	--	0.35	0.35	0.35	0.40	0.40							
5458	Shut off unit with counter 5456 KOAX with blind-flange		3/4"-DN20	24.80	--	--	17.50	19.00	19.50	21.50	--							
			3/4"-DN20	25.50	--	--	17.50	19.50	20.00	22.50	--							
5520-5525	Bend 90°		d16	0.90	0.30	0.35	0.40	0.45	--									
			d20	0.80	0.35	0.40	0.45	0.45	0.50	0.55								
5527	Bend 45°		d16	0.40	0.15	0.15	0.20	0.20										
5463-5471	T-Pieces		d16	0.50	0.20	0.20	0.25	0.25	--									
			d20															
5463-5471	T-Pieces		d16	1.95	0.65	0.75	0.9	0.95	--									
			d20															
Pressure loss in JRG Sanipex® pipes																		
Art. N°	Terms	Symbol	DN/d	Pressure loss in mbar per metre pipe														
					1 LU	2 LU	3 LU	4 LU	8 LU	30 LU	60 LU	1.0 l/s	1.5 l/s	2.0 l/s	2.5 l/s	3.0 l/s	3.5 l/s	4.0 l/s
					0.1 l/s	0.2 l/s	0.3 l/s	0.4 l/s	0.5 l/s	0.8 l/s	1.0 l/s							
5706-5708	JRG Sanipex® Pipe		d16		13.0	43.0	87.0	144.5	--	--	--	--	--	--	--	--	--	--
5716+5717			d20		4.5	15.5	31.0	51.5	76.5	--	--	--	--	--	--	--	--	--

Discharge times

For JRG Sanipex® pipes calculate the discharge times as follows:

$$\Delta t = \frac{V \cdot l}{\dot{V}}$$

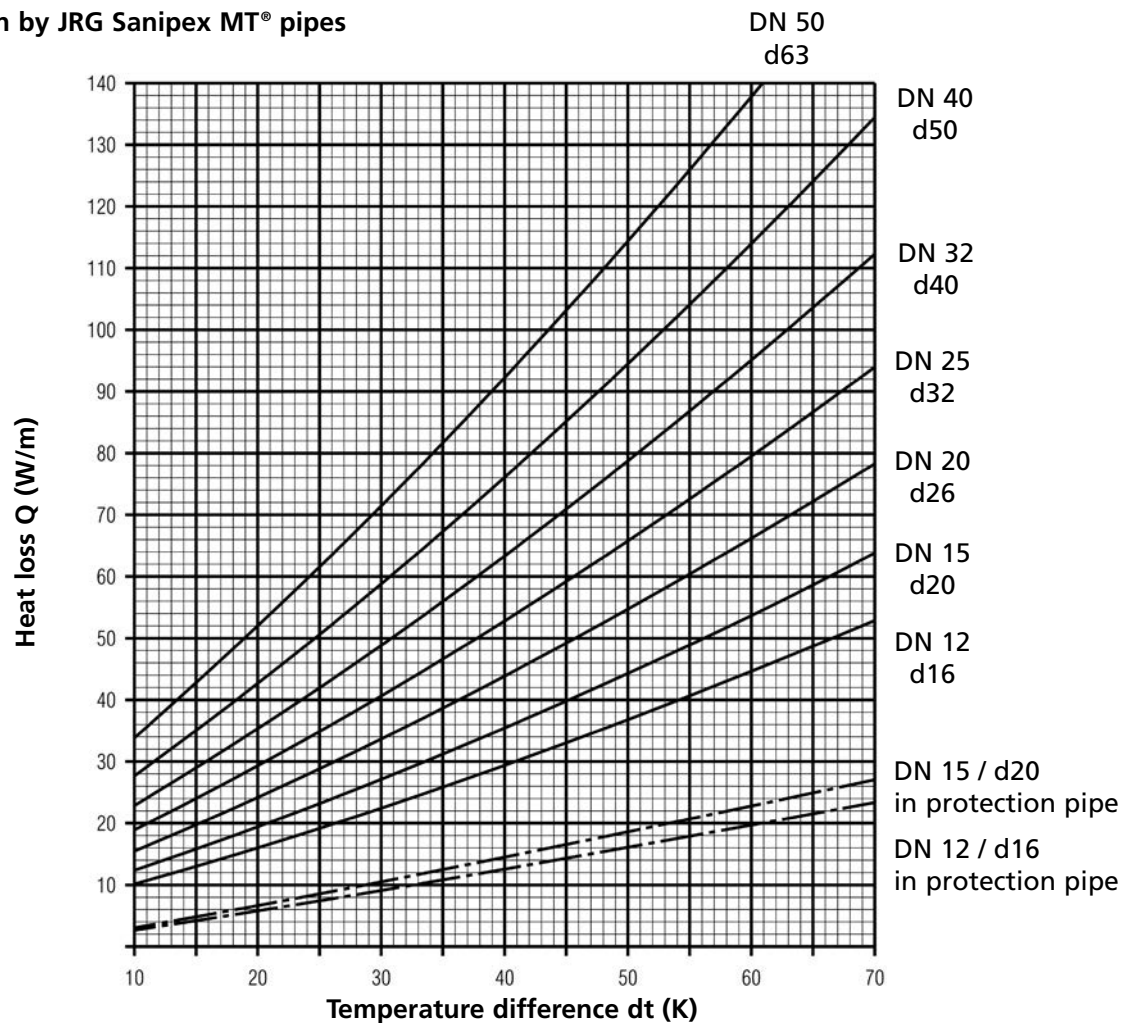
Δt	= Discharge time in seconds	[s]
V	= Volume per meter pipe (Table)	[l/m]
l	= Pipe length in meter	[m]
$\dot{V}$	= Flow volume in litres per second	[l/s]

LU				1		2 (1)		2		3		4		6	8
Flow volume l/s		0.07		0.1		0.15		0.2		0.3		0.4		0.6	0.8
Pipe dimensions d		16	20	16	20	16	20	16	20	16	20	16	20	20	20
Nominal width DN		12	15	12	15	12	15	12	15	12	15	12	15	15	15
Pipe inner size		11.6	14.4	11.6	14.4	11.6	14.4	11.6	14.4	11.6	14.4	11.6	14.4	14.4	14.4
Pipe length in m	1	1.5	2.3	1.1	1.6	0.7	1.1	0.5	0.8	0.4	0.5	0.3	0.4	0.3	0.2
	2	3.0	4.7	2.1	3.3	1.4	2.2	1.1	1.6	0.7	1.1	0.5	0.8	0.5	0.4
	3	4.5	7.0	3.2	4.9	2.1	3.3	1.6	2.4	1.1	1.6	0.8	1.2	0.8	0.6
	4	6.0	9.3	4.2	6.5	2.8	4.3	2.1	3.3	1.4	2.2	1.1	1.6	1.1	0.8
	5	7.5	11.6	5.3	8.1	3.5	5.4	2.6	4.1	1.8	2.7	1.3	2.0	1.4	1.0
	6	9.1	14.0	6.3	9.8	4.2	6.5	3.2	4.9	2.1	3.3	1.6	2.4	1.6	1.2
	7	10.6	16.3	7.4	11.4	4.9	7.6	3.7	5.7	2.5	3.8	1.8	2.9	1.9	1.4
	8	12.1	18.6	8.5	13.0	5.6	8.7	4.2	6.5	2.8	4.3	2.1	3.3	2.2	1.6
	9	13.6	20.9	9.5	14.7	6.3	9.8	4.8	7.3	3.2	4.9	2.4	3.7	2.4	1.8
	10	15.1	23.3	10.6	16.3	7.0	10.9	5.3	8.1	3.5	5.4	2.6	4.1	2.7	2.0
	11	16.6	25.6	11.6	17.9	7.8	11.9	5.8	9.0	3.9	6.0	2.9	4.5	3.0	2.2
	12	18.1	27.9	12.7	19.5	8.5	13.0	6.3	9.8	4.2	6.5	3.2	4.9	3.3	2.4

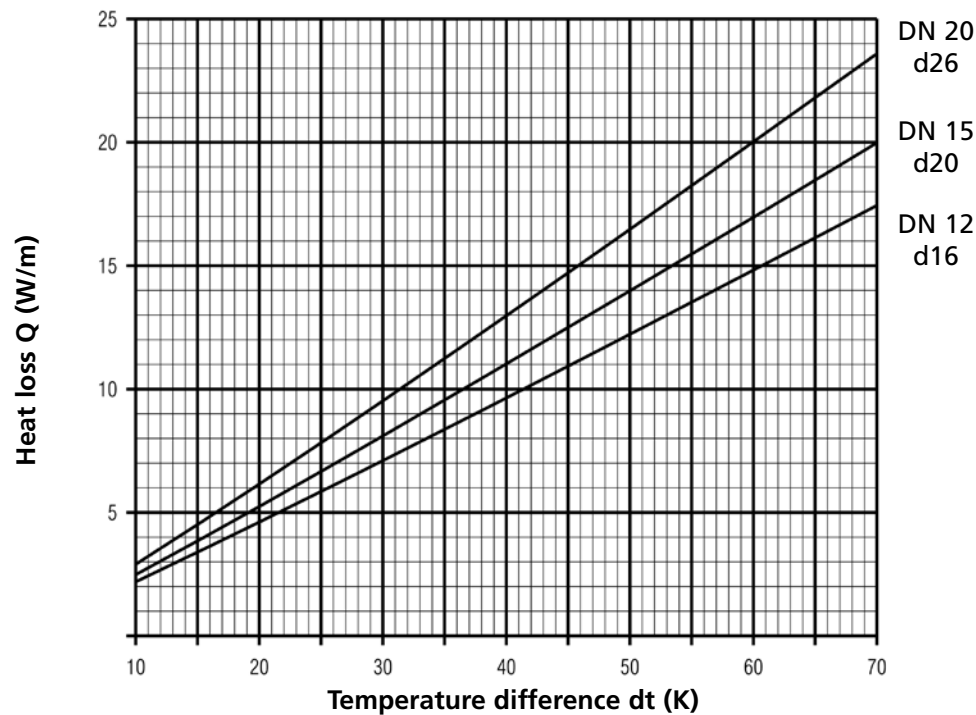
Water contents of JRG Sanipex® pipes

Pipe dimensions		Pipe sections in mm	Contents in litres per m
d	DN		
16	12	16 x 2.25	0.104
20	15	20 x 2.5	0.177

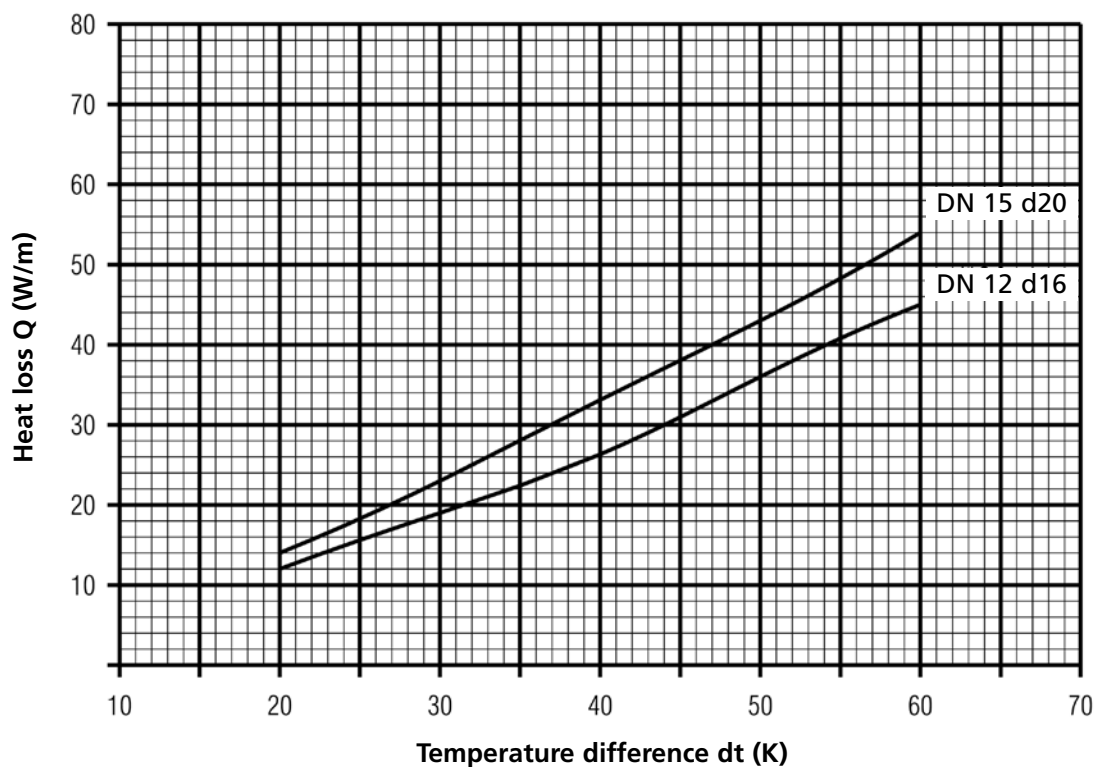
Heat emission by JRG Sanipex MT® pipes



Heat emission of pre-insulated JRG Sanipex MT® pipes
with 9mm PE foam and diffusion resistant PE layer - heat conductivity 0.04 W/mK



Heat emission by JRG Sanipex[®] pipes



Cold water pipes

Protection against condensed water and inadmissible warming

Dew point temperature for room temperatures of 10 to 30° C and a relative humidity of 30% to 90%.

Air temperature	Dew point temperature of air (° C) at a relative humidity of:						
° C	30 %	40 %	50 %	60 %	70 %	80 %	90 %
10	-6,8	-3,0	0,1	2,6	4,8	6,7	8,4
14	-3,3	0,6	3,7	6,3	8,6	10,6	12,4
20	1,9	6,0	9,2	12,0	14,3	16,5	18,3
24	5,3	9,5	12,9	15,8	18,1	20,3	22,3
30	10,5	14,9	18,4	21,3	23,9	26,1	28,2

The minimum insulation thickness for insulating cold drinking water pipes against warming and water condensation at a heat conductance of the insulating material of $\lambda = 0.040 \text{ W/mK}$:

Layout site and type	Insul. thickness
- pipe freely laid, not in a heated room - pipes on cement ceiling - pipes in trunking, without warming pipes - pipes in wall slit, riser pipes	4 mm
- pipes freely laid, in heated room	9 mm
- pipes in trunking, next to warming pipes - pipes in wall blockouts, next to warming pipes	13 mm

Source: DIN 1988, Part. 2 Para. 10.2.2

With a heat conductivity $\lambda = 0.040 \text{ W/mK}$ the insulation strength can be reduced appropriately. It is not necessary to insulate pipe-in-pipe against water condensation.

Hot water pipes

Pipes for hot water are to be insulated against warmth emission and heat loss.

Local regulations apply:

CH: Cantonal energy laws

D: Energy saving decree EnEV 2002, Addendum 5

Thermally induced changes in length of JRG Sanipex MT® pipes

Thermal induced changes of JRG Sanipex MT® pipes dependant upon the water temperature and the pipe length for resistance-free laying.

Linear expansion coefficient $\alpha = 0,024 \text{ mm/mK}$

The thermal induced changes in length of JRG Sanipex MT® pipes can be determined as follows:

$$\Delta l = \alpha \cdot l \cdot \Delta \vartheta$$

α = Linear expansion coefficient (mm/K)

l = Installed pipe length (m)

$\Delta \vartheta$ = Temperature difference (K)

Δl = Length change (mm)

Expansion bend length (Length compensation)

Calculation formula for finding the length of an expansion bend:

$$DS = C \cdot \sqrt{d \cdot \Delta l}$$

DS = Length of expansion bend

d = Outer diameter of JRG Sanipex MT® pipe in mm

Δl = Length change in mm

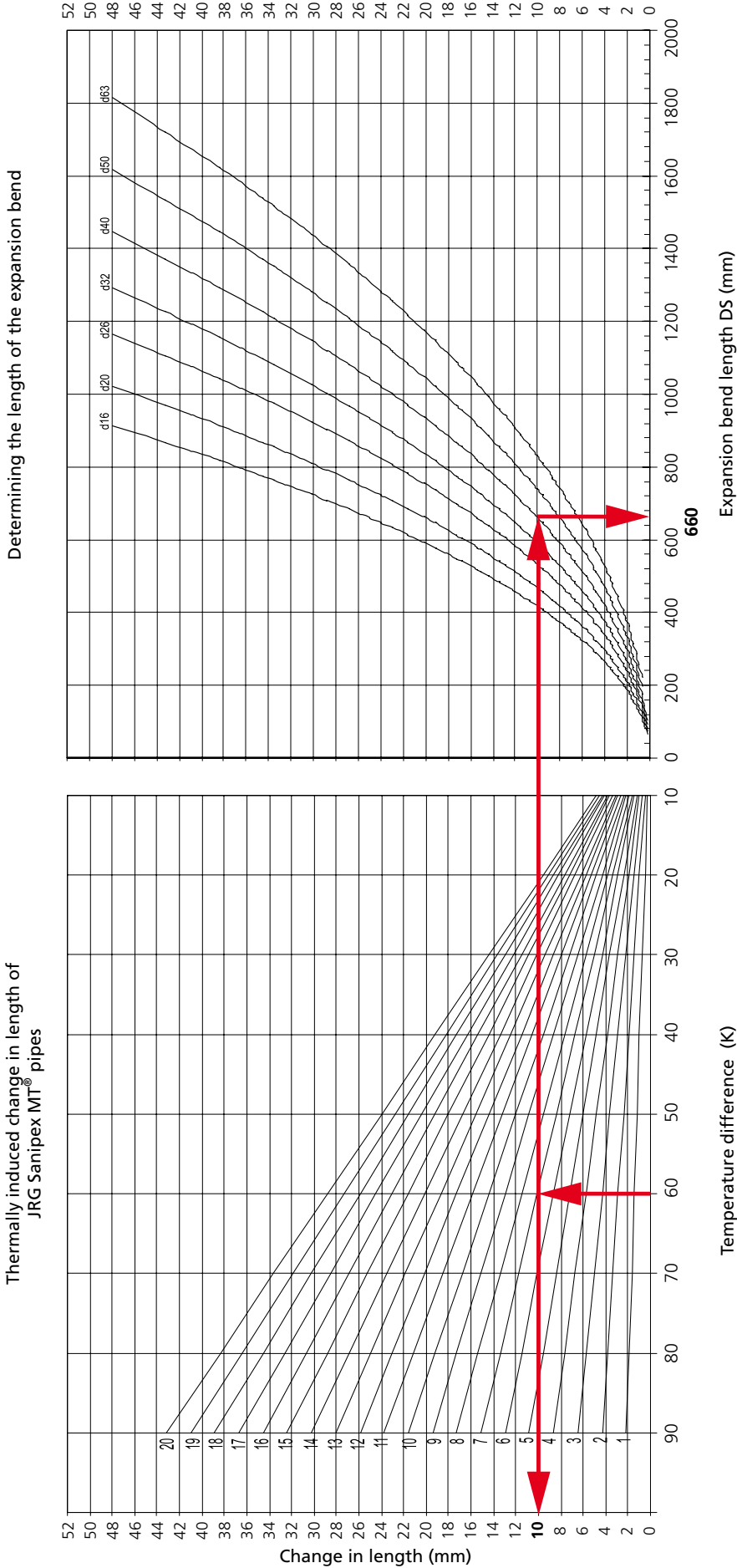
C = Raw material-dependent constant
($C = 33$ for JRG Sanipex MT® pipes)

Nomogram for determining the length of an expansion bend/length change

- Determining the length of an expansion bend using the diagrams
- Thermally induced length changes of JRG Sanipex MT® pipes
 - Determining the length of the expansion bend

Example

Pipe length: 7,0 m
Temperature difference: 60 K (10° C bis 70° C)
=> Length change: ≈ 10 mm
Pipe dimensions: d40
=> Expansion bend: ≈ 660 mm



Thermally induced changes in length of JRG Sanipex® pipes

For resistance free laying, thermally-induced changes in length of JRG Sanipex® pipes are dependent upon the water temperature and the pipe length.

Linear expansion coefficient at 20° C: $1,4 \times 10^{-4}$ (1/K)
at 100° C: $2,0 \times 10^{-4}$ (1/K)

The thermally-induced change in length of JRG Sanipex MT® pipes can be determined as follows:

$$\Delta l = \alpha \times l \times \Delta \theta$$

α = Linear expansion coefficient (1/K)

l = Installed pipe length

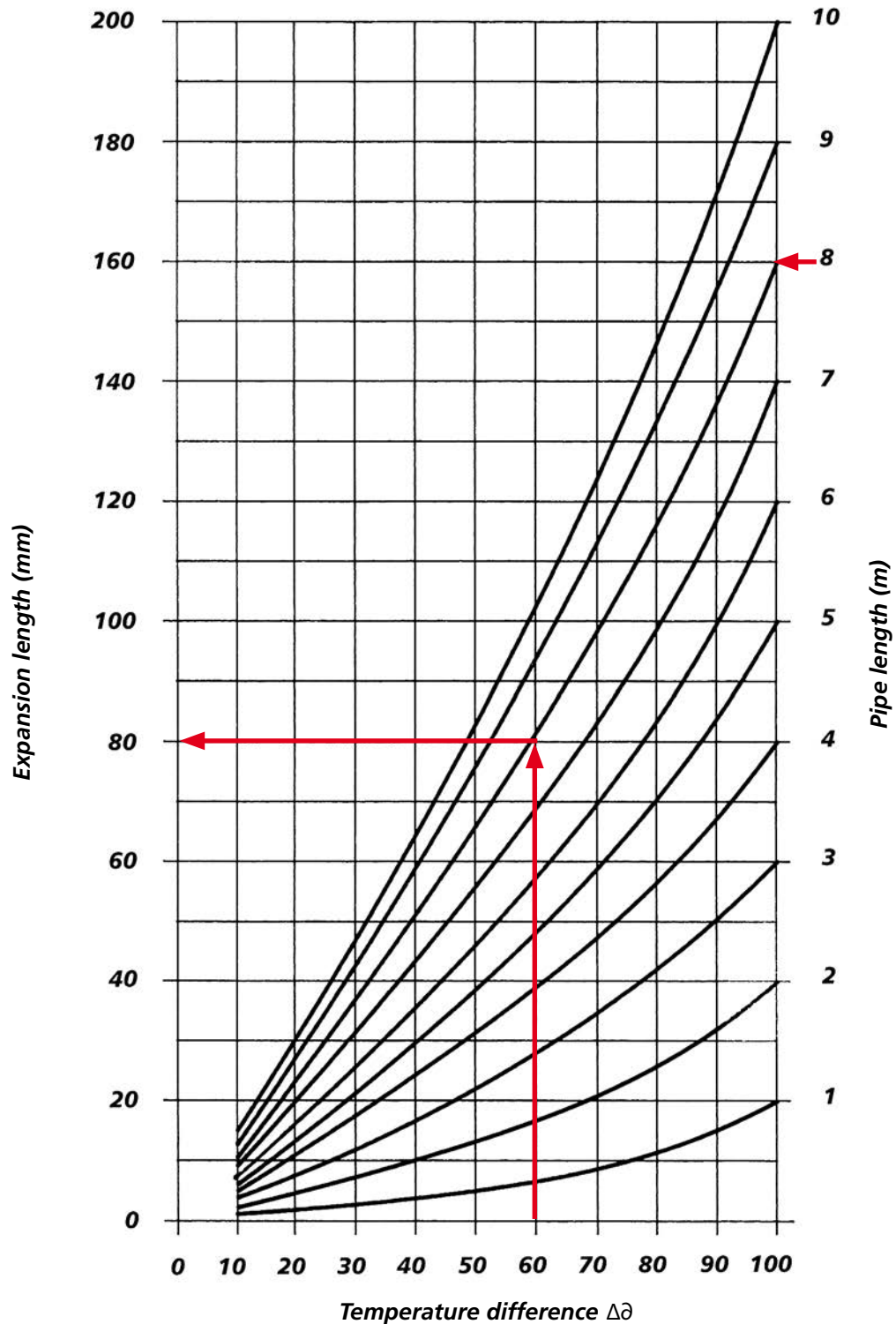
$\Delta \theta$ = Temperature difference (K)

Δl = Length change

Nomogram for determining the expansion length of JRG Sanipex® pipes

For resistance free laying, expansion lengths of JRG Sanipex® pipes are dependant on pipe temperature and length.

Linear expansion coefficient at 20° C: $1,4 \times 10^{-4}$ (1/K)
at 100° C: $2,0 \times 10^{-4}$ (1/K)



Example:

Pipe length: 8,0 m
Temperature difference: 60 K (10° C bis 70° C)
=> Expansion length: 80 mm

JRG Sanipex MT® installing procedure d16 - d40 (with hydraulic expansion tool)



Shorten the JRG Sanipex MT® pipe with the pipe cutter (JRG Nr. 4836.xxx) to the required length.



Screw cap nut onto the JRG Sanipex MT® pipe.



Guide the end of the JRG Sanipex MT® pipe fully home into the expansion tool, close clamping lever. Initiate the expansion process by pressing the start button on the hydraulic unit.



Open clamping lever and remove the flared JRG Sanipex MT® pipe from the expansion tool.



NB

Interruption of expansion procedure

A repeated pressing of the start button interrupts the expansion process. After an interruption of the hydraulic unit, the mains switch must be turned off and then turned on again.



NB

Change of tools

The expansion tool must not be disconnected during the expansion process. The expansion process is finished only when the expansion spike is fully withdrawn.



NB

Ratchet torque wrench

The JRG Sanipex MT® ratchet torque wrench is used exclusively for tightening the JRG Sanipex MT® flanged clamp connection. The appropriate torque is preset and if used in the specified manner requires no further servicing.

Correct clamping joint



Wrong clamping joint



Checking the expansion process

The O-ring on the fitting must be fully covered by the flanged pipe.



Warning
Incorrectly formed pipe flange
Incorrect pipe flanges may not be re-flanged!



Guide flanged JRG Sanipex MT® pipe onto the JRG Sanipex MT® fitting. Tighten the cap nut by hand.



Tighten cap nut with the ratchet torque wrench (JRG Nr. 4832.xxx) until an audible "click". To hold steady, apply counter purchase using the counter key (JRG Nr. 4834.xxx) on the JRG Sanipex MT® fitting.



NB
Finished connection
We advise marking the finished connection with the marking pen JRG Nr. 4838.000.



NB
Changing the bending tool
When changing from the bending to the expansion tool, the hydraulic unit must be switched off.



Warning
Malfunction of the ratchet torque wrench
In the case of eventual malfunction or damage we advise you to replace the defect tool in exchange for a new JRG Sanipex MT® ratchet torque wrench.



Warning

Repairs to the ratchet torque wrench

No repairs need to be made to JRG Sanipex MT® ratchet torque wrenches.



NB

Checking out the tools

A good functioning tool is a precondition for a durable, tight connection. Consequently, we recommend that the tool be maintained and tested regularly for its functionality once a year. Contact our technical sales advisor.

JRG Sanipex MT® adjusting the expansion tools d50 + d63



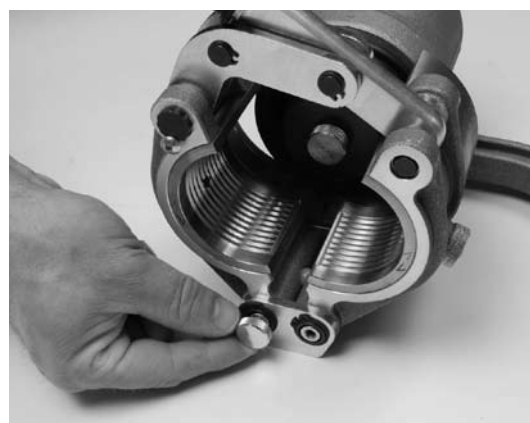
Slip the expansion spur over the piston rod.



Tighten the knurled thumbscrews by hand.



The expansion unit is pushed over the guiding rod (Nut of the clamping jaws against the clawed ring of the working cylinder).



Tighten front knurled thumbscrews by hand. The expansion tool is now ready for the expansion process.



NB

Dimension Expansion spur.

Ensure that the expansion spur and the clamping cheeks have the same dimensions (see identifying colour codes).

JRG Sanipex MT® installing procedure d50 + d63 (with hydraulic expansion tool)



Push the pipe end fully home into the expansion tool.



Press the pipe fully home onto the expansion spur and close the tension unit. Start expansion process.



The expansion tool can also be held in a vice as illustrated.



Warning **Correct flange**

The pipe must not be touched or de-burred otherwise the flange will be too long.

Exception:

If the pipe cannot be shortened with a cutter for plastic pipes, then the pipe can be lightly freed from shavings **after the expansion process**.



NB **Fitting the pipe into the expansion tool**

Take care that the pipe is inserted parallel into the expansion tool before closing the clamping lever.



NB **Ending the expansion process**

The expansion unit can only be opened once the ready lamp of the hydraulic unit is on.



NB **For putting on the connection and checking the expansion process see page 55**



NB **Visual check of connection:**



Locking ring visible
= Connection **not fully on**



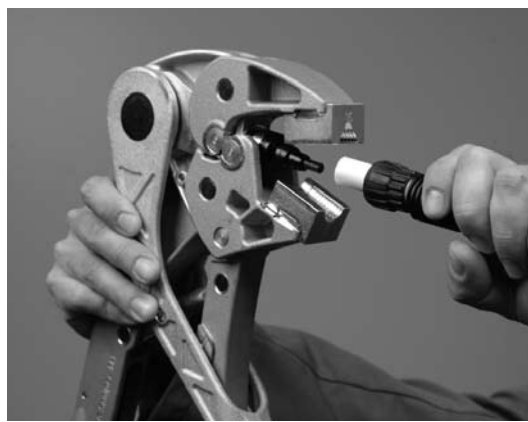
Locking ring not visible
= Connection **fully fitted**

JRG Sanipex MT® installation procedure (with expansion pliers)

The installation procedure applies in principle also to JRG Sanipex® PE-X pipes.



Use the multi-purpose cutter (JRG Nr. 4837.xxx) to cut the JRG Sanipex MT® pipe d16 or 20 to the required length.



After pushing back the cap nut guide the JRG Sanipex MT® pipe fully home over the expansion spur into the expansion pliers and close the working lever. Please ensure that the expansion spur corresponding to the pipe and the appropriate clamping jaws are used.



Initiate expanding process by closing the operating lever.



By opening the operating lever the newly flanged pipe end is released.



NB

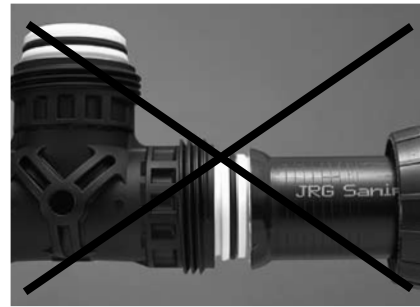
Expanding of JRG Sanipex® pipes (PE-X)

For flexible JRG Sanipex® pipes (PE-X) the connection must be immediately fitted after the expansion process.

Correct clamping joint



Wrong clamping joint



Checking out the expansion process

The O-Ring on the fitting must be fully covered by the flanged pipe.



Warning

Incorrectly formed pipe flange

Incorrect pipe flanges may **not** be re-flanged!



Guide flanged JRG Sanipex MT® pipe onto the JRG Sanipex MT® fitting. Tighten the cap nut by hand.



Tighten cap nut with the ratchet torque wrench (JRG Nr. 4832.xxx). To hold steady, use guide cap(JRG Nr. 5777.xxx) or counter wrench (JRG Nr. 4834.xxx).



NB

Finished connection

We advise marking the finished connection with the marking pen JRG Nr. 4838.000.



NB

JRG Sanipex MT® pipe d16 and d20 can also be connected with JRG Sanipex® system component, flange clamp connections.

- installation s. page 60
- system components s. From page 184
- tools s. page 210

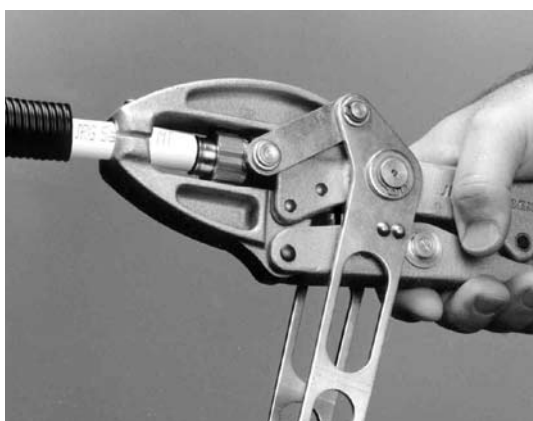
JRG Sanipex MT®
installation procedure cone grip union connection bronze/brass
with assembly pliers d16 + d20



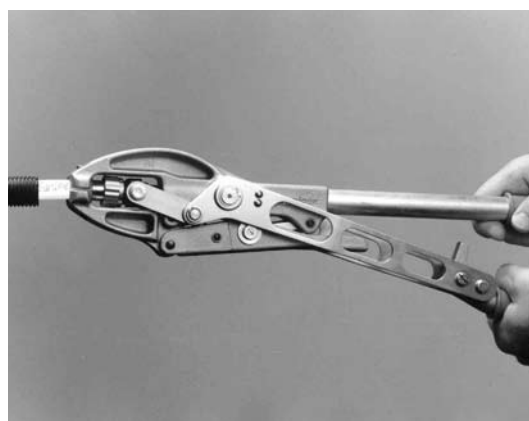
Shorten protective pipe and inner pipe
with multi-purpose cutter 4837.xxx.



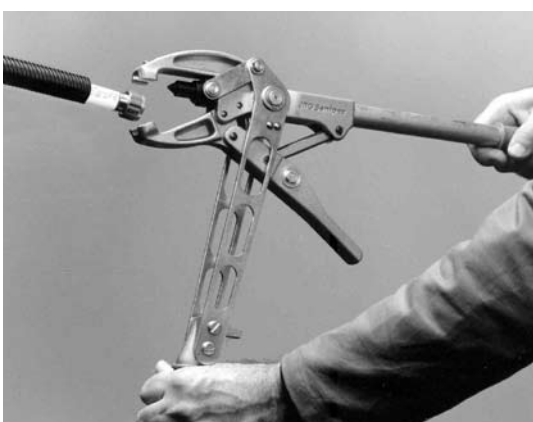
Slide the cone grip union over the spur
of the pliers 5790.002 / 5792.002.



Guide the JRG Sanipex® pipe right on
to the spur of the pliers and close the
clamping lever.



Close operating lever



Opening the operating lever will release
the connected cone grip union.



Tighten the cone grip union connection
with the ratchet torque wrench
5790.003 / 5792.003 until an audible
„Click“

The following JRG Sanipex® - and JRG Sanipex MT® pipes can be expanded with the expansion pliers and connected to JRG Sanipex MT® fittings.

4600.016 / .020 / .026	JRG Sanipex MT® pipe	d16 / d20 / d26	black in bars (5 m)
4600.316 / .320 / .326	JRG Sanipex MT® pipe	d16 / d20 / d26	black in bars (3 m)
4602.016 / .020	JRG Sanipex MT® pipe	d16 / d20	white in coils, with protective pipe
4604.016 / .020 / .026	JRG Sanipex MT® pipe	d16 / d20 / d26	white in coils
4606.016 / .020 / .026	JRG Sanipex MT® pipe	d16 / d20 / d26	white in coils with heat insulation
5706.016 / .020	JRG Sanipex® pipe	d16 / d20	white in coils, with protective pipe
5707.016 / .020	JRG Sanipex® pipe	d16 / d20	white in coils
5716.016 / .020	JRG Sanipex® pipe	d16 / d20	blue, in coils, with protective pipe
5717.016 / .020	JRG Sanipex® pipe	d16 / d20	blue, in coils

The following JRG Sanipex MT® pipes can be flanged with the JRG Sanipex® assembly pliers and connected to JRG Sanipex® system components (d16 und d20)

4600.016 / .020	JRG Sanipex MT® pipe	d16 / d20	black in bars (5 m)
4600.316 / .320	JRG Sanipex MT® pipe	d16 / d20	black in bars (3 m)
4602.016 / .020	JRG Sanipex MT® pipe	d16 / d20	white in coils, with protective pipe
4604.016 / .020	JRG Sanipex MT® pipe	d16 / d20	white in coils
4606.016 / .020	JRG Sanipex MT® pipe	d16 / d20	white in coils with heat insulation



NB

JRG Sanipex® drinking water installation systems

Ask for our detailed technical documentation JRG Sanipex®

**NB****Ratchet torque wrench JRG Sanipex MT®**

The JRG Sanipex MT® ratchet torque wrench is used exclusively for tightening JRG Sanipex MT® cone grip union. The appropriate torque is pre-set from the factory and if employed for the use specified, requires no further servicing.

**NB****Ratchet torque wrench JRG Sanipex®**

Die JRG Sanipex® ratchet torque wrench is used exclusively for tightening JRG Sanipex® cone grip union. The appropriate torque is pre-set from the factory and if employed for the use specified, requires no further servicing.

**Warning****Malfunction of ratchet torque wrenches**

In case of malfunctions or damage we recommend you to replace faulty tools in exchange for JRG Sanipex® / JRG Sanipex MT® ratchet torque wrenches.

**Warning****Repairs to ratchet torque wrenches**

No repairs should be performed on JRG Sanipex® and JRG Sanipex MT® ratchet torque wrenches.

**NB****Checking out of tools**

A good functioning tool is a pre-condition for a durable, tight connection. Consequently, we recommend that the tool be maintained and tested regularly for its functionality once a year. Contact our technical sales advisor.

JRG Sanipex MT® bending process



Mark the appropriate measure of the bending mass



Determine the bending angle and adjust the slider to the corresponding dimensions and tighten with the positioning screw.



Lay the pipe in the bending callipers (note bending mid point).

Attention: before bending, point the rotating bolt prism in the direction of the bending callipers.



Press start and hold down the button on bending tool. The bending instrument ends the bending process automatically when the desired bending angle is achieved. Releasing the button immediately interrupts the bending process. This can be restarted and ended by pressing or releasing the button.



NB

Changing the bending tools

The hydraulic unit must be turned off before changing from the bending-to the expanding function.



Danger

Extending piston

Limbs can be injured!

The bending instrument can only be operated through the closed control cable via the start button



NB

Bending radius

When bending pay attention to the bending radius of the pipe bend!

JRG Sanipex MT® bending technique

Free bending by hand

The JRG Sanipex MT® pipe having the dimensions d16 + d20 + d26 can be bent by hand. Care must be given to ensure that the **bending radius is at least 5 x d** and that the pipe does not become oval shaped.

Commercially available bending tools or bending springs

Commercially available bending tools can be used whereby the bending radius must not be less than **3.5 x d**. The bend form with its outer diameter must fit exactly to the JRG Sanipex MT® pipes.

JRG Sanipex MT® bending tools

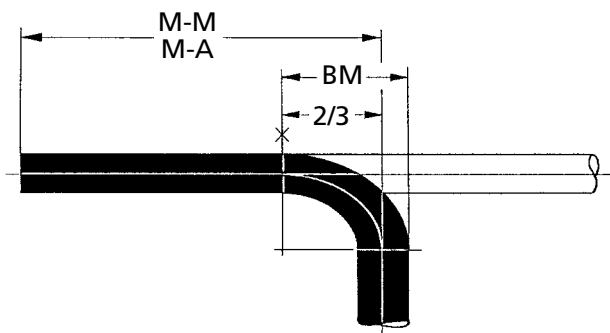
All JRG Sanipex MT® bending tools have a **bending radius of 3.5 x d**. For dimensions d16 – d40 the hydraulic bending can be employed. The JRG hand bending template can be used to bend dimensions d16 + d20 + d26.

Table for pipe bends of
30°, 45°, 60°, 90°
bending radius 3.5 x d

Dimension	DN	Bend radius	Bend section 90°	Hydr.- Bending tool	Hand bending template			
				1/6 Bend section (90°)	2/3 Bend section (90°)	1/3 Bend section (60°)	1/4 Bend section (45°)	1/6 Bend section (30°)
mm		mm	mm	mm	mm	mm	mm	mm
16	12	56	88	15	56	32	23	15
20	15	70	110	18	70	40	29	19
26	20	91	143	24	91	53	38	24
32	25	112	176	25				
40	32	140	220	33				

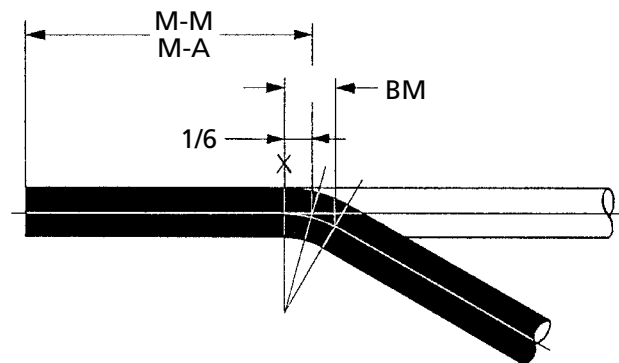
Section deviations due to technical construction have been taken into account.

Bending with hand bending template (bending begins at start of pipe arc)



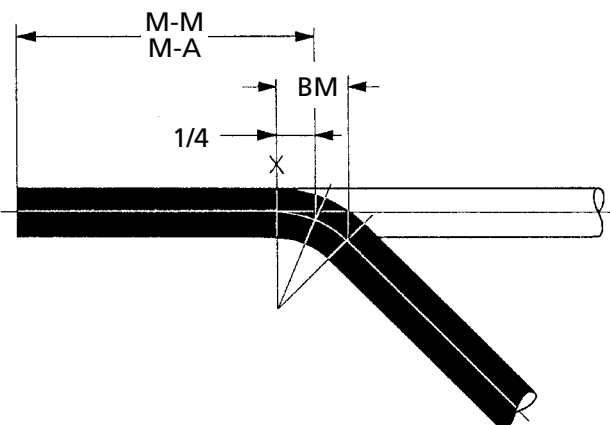
90° Bend

Mark middle-middle (or middle-outer) length on the pipe.
Mark 2/3 bend section* in direction of bend start. You get the start of the bend.



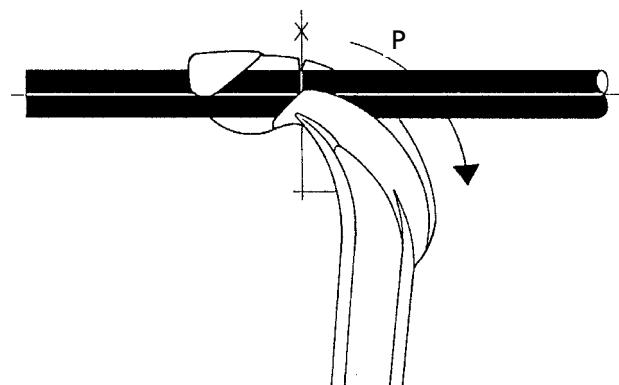
30° Bend

Same procedure as above but 1/6 bend section* in the direction of bend start, return measure and mark.



45° Bend

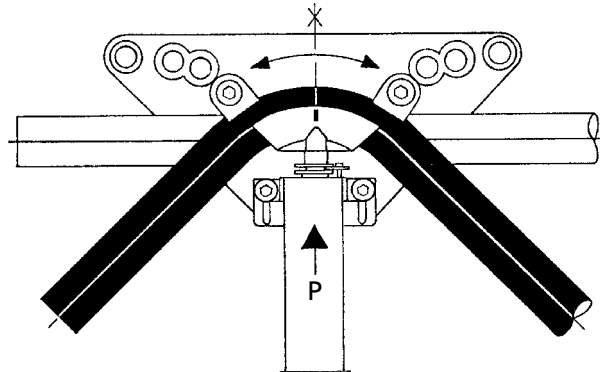
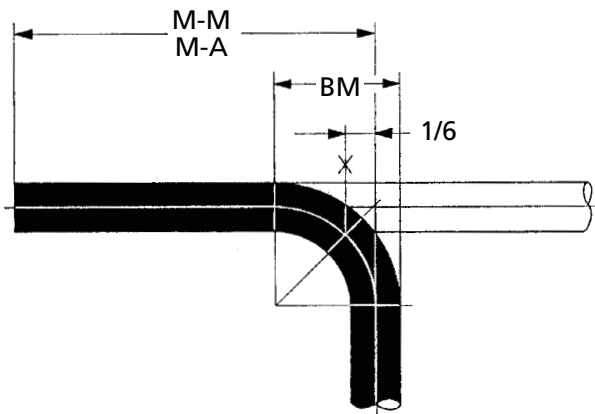
Same procedure as above but 1/4 bend section* in direction of bend start, return measure and mark.



Set pipe in the hand bending template. Note the start of the bend. In order to obtain a smooth bend, the pipe has to be gripped as close to the template as possible.

* See table for pipe bending Page 64

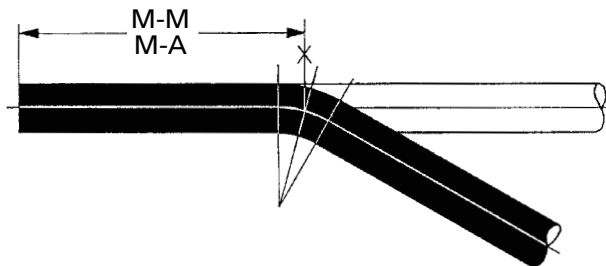
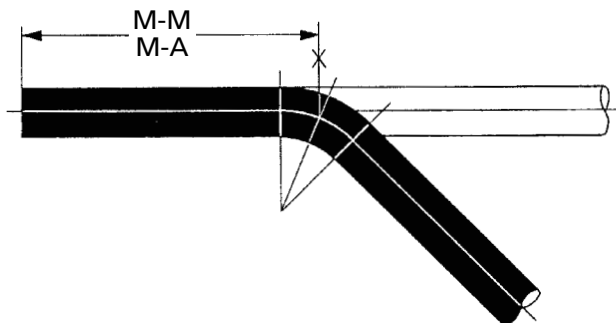
Bending with the hydraulic bending tool (begin bend at middle of pipe arc)



90° Bend

Middle (or middle-outer) section minus 1/6 bend section*, mark on pipe piece. You get the start of the bend.

Lay pipe in the bend holder. Orient bend middle to the mark. Bend the pipe arc.



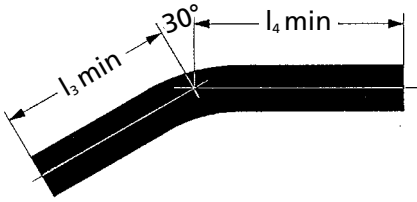
45 Bend, 30° Bend

When bending from the middle of the bend geometrical changes in length can be disregarded.

* See Page 64, table for pipe bending.

Combination minimum bend section (without form pieces)

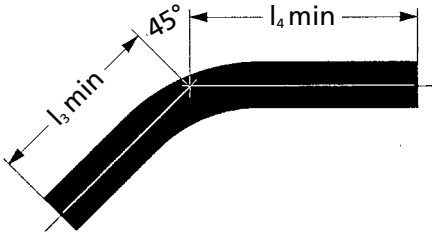
Bend 30° of composite pipe, bend radius = 3.5 x d (with hydraulic bending tool)



Elbow α	Dim	16	16*	20	20*	26	26*	32	40
	DN	12	12	15	15	20	20	25	32
30°		mm	mm	mm	mm	mm	mm	mm	mm
	l _{3min}	60	71	65	74	80	105	102	115
	l _{4min}	60	71	65	74	80	105	102	115

* with expander pliers 4804

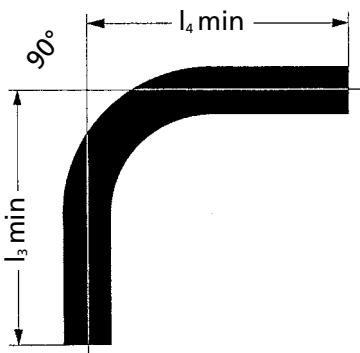
Bend 45° of composite pipe, 4608 bend radius = 3.5 x d (with hydraulic bending tool)



Elbow α	Dim	16	16*	20	20*	26	26*	32	40
	DN	12	12	15	15	20	20	25	32
45°		mm	mm	mm	mm	mm	mm	mm	mm
	l _{3min}	63	72	63	74	90	95	98	139
	l _{4min}	63	72	63	74	90	95	98	139

* with expander pliers 4804

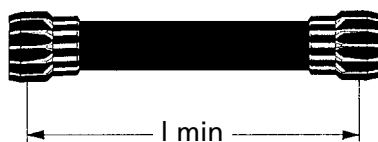
Bend 90° of composite pipe, bend radius = 3.5 x d (with hydraulic bending tool)



Elbow α	Dim	16	16*	20	20*	26	26*	32	40
	DN	12	12	15	15	20	20	25	32
90°		mm	mm	mm	mm	mm	mm	mm	mm
	l _{3min}	91	102	108	117	136	160	165	215
	l _{4min}	91	102	108	117	136	160	165	215

* with expander pliers 4804

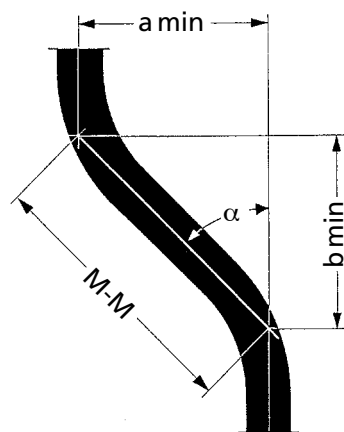
Minimal section straight pipe piece with MT-Nuts



Dim	16	16*	20	20*	26	26*	32	40	50	63
DN	12	12	15	15	20	20	25	32	40	50
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
l _{min}	71	87	88	104	114	120	137	164	201	243

* with expander pliers 4804

Bend combination of composite bend radius = 3.5 x d (with hydraulic bending tool)



Elbow α	Dim	16	16*	20	20*	26	26*	32	40
	DN	12	12	15	15	20	20	25	32
30°		mm	mm	mm	mm	mm	mm	mm	mm
	a _{min}	65	40	65	45	87	63	112	130
	b _{min}	113	69	113	78	151	108	194	225
	M-M	130	80	130	90	174	125	224	260
45°		mm	mm	mm	mm	mm	mm	mm	mm
	a _{min}	103	63	111	80	141	100	163	215
	b _{min}	103	63	111	80	141	100	163	215
	M-M	146	89	159	113	199	142	230	304
60°		mm	mm	mm	mm	mm	mm	mm	mm
	a _{min}	130	80	138	106	176	149	220	287
	b _{min}	75	46	80	61	102	86	127	166
	M-M	150	92	160	122	203	172	254	331
90°	a _{min}	195	145	200	185	245	225	320	410
	M-M	195	145	200	185	245	225	320	410

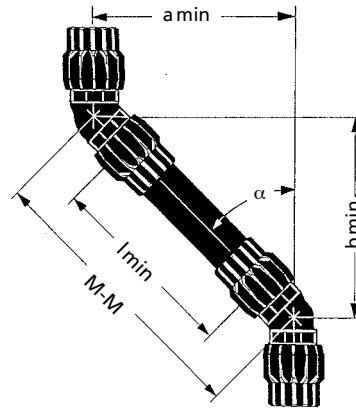
* with hand bending template 4806

Combination minimal bend section (with form pieces)

Form pieces combination elbow 45° and elbow 45° (4676/4676)

Elbow α	Dim	20	20*	26	26*	32	40	50	63
	DN	15	15	20	20	25	32	40	50
		mm	mm	mm	mm	mm	mm	mm	mm
z-Value	mm	44	44	54	54	64	74	94	112
45° 4676	a _{min}	93	102	119	123	142	168	209	251
	b _{min}	93	102	119	123	142	168	209	251
	l _{min}	88	100	114	120	137	164	201	243
	M-M	132	144	168	174	201	238	295	355

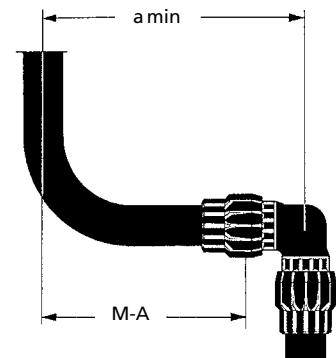
* with expander pliers 4804



Combination pipe bend 90° with elbow 90° (4607) with T-piece (4650)

Elbow α	Dim	16	16*	20	20*	26	26*	32	40	50	63
	DN	12	12	15	15	20	20	25	32	40	50
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
z-Value	mm	28	28	32	32	39	39	45	55	63	79
90° 4607/4670	a _{min}	119	131	140	150	175	199	210	270	292	308
	M-A	91	103	108	118	136	160	165	215	229	273

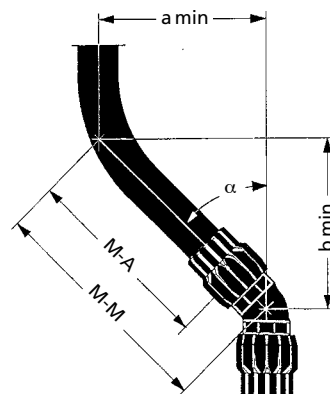
* with expander pliers 4804



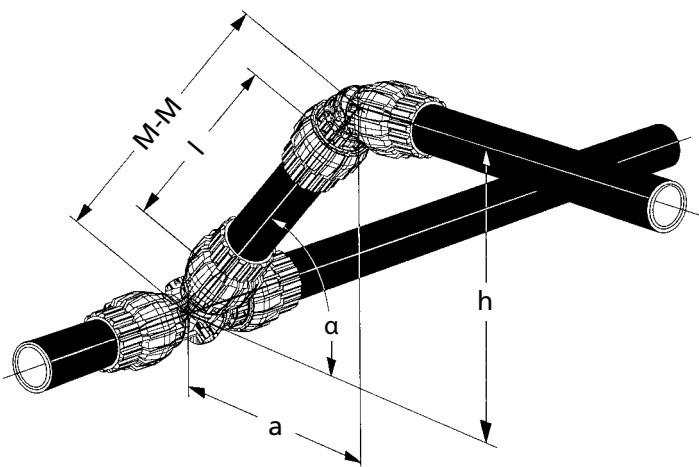
Combination pipe bend 45° with elbow 45° (4676)

Elbow α	Dim	20	20*	26	26*	32	40	50	63
	DN	15	15	20	20	25	32	40	50
		mm	mm	mm	mm	mm	mm	mm	mm
z-Value	mm	22	22	27	27	32	37	47	56
45° 4608/4676	a _{min}	60	67	83	88	92	124	145	165
	b _{min}	60	67	83	88	92	124	156	182
	M-M	85	95	117	124	130	176	205	234
	M-A	63	73	90	97	98	139	158	178

* with expander pliers 4804



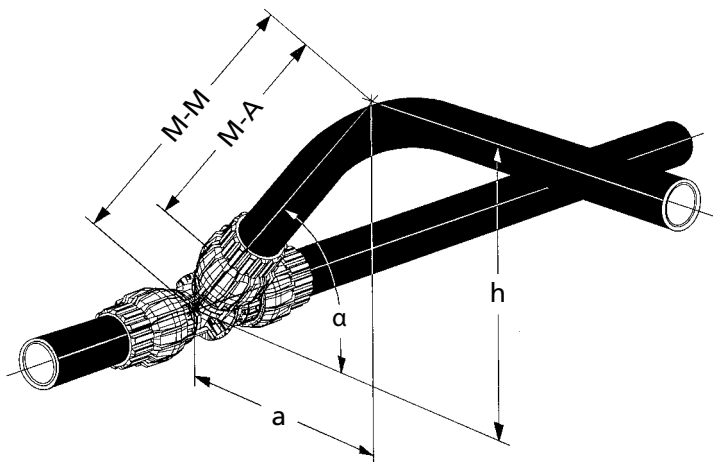
- Angle joint: - T-piece and elbow 45° (4650/4676)
- Elbow 90° and elbow 45° (4670/4676)



Angle joint	Dim	20	26	32	40	50	63
	DN	15	20	25	32	40	50
z-Value	mm	55	66	77	92	110	135
h _{min}	mm	99	127	151	181	217	264
h	M-M	Pipe section I					
mm	mm	mm	mm	mm	mm	mm	mm
100	141	89					
110	156	104					
120	170	118					
130	184	132	118				
140	198	146	132				
150	212	160	146				
160	226	174	160	149			
170	240	188	174	163			
180	255	203	189	178			
190	269	217	203	192	177		
200	283	231	217	206	191		
210	297	245	231	220	205		
220	311	259	245	234	219	201	
230	325	273	259	248	233	215	
240	339	287	273	262	247	229	
250	354	302	288	277	262	244	
260	368	316	302	291	276	258	
270	382	330	316	305	290	272	247
280	396	344	330	319	304	286	261
290	410	358	344	333	318	300	275
300	424	372	358	347	332	314	289
310	438	386	372	361	346	328	303
320	453	401	387	376	361	343	318
330	467	415	401	390	375	357	332
340	481	429	415	404	389	371	346
350	495	443	429	418	403	385	360
360	509	457	443	432	417	399	374
370	523	471	457	446	431	413	388
380	537	485	471	460	445	427	402

Minimal pipe piece falls short

Angle joint: - T-piece and bend 45° (4650/4608)
- Elbow 90° and bend 45° (4670/4608)

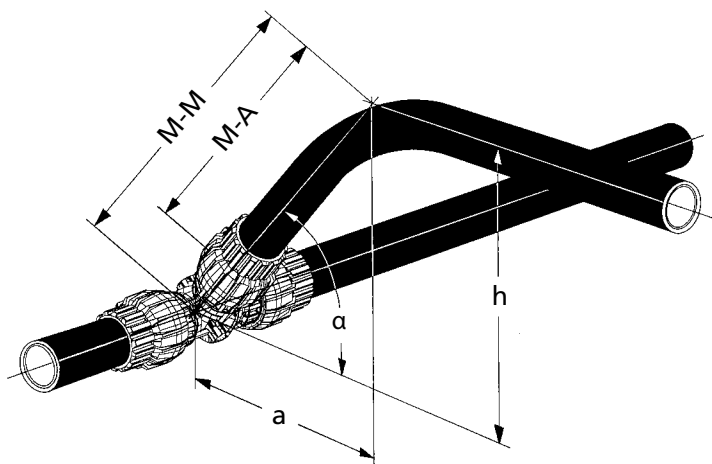


Angle joint	Dim	16	20	26	32	40	50	63
z-Value	m	27	31	39	45	55	63	79
h_{min}	mm	64	66	91	101	137	158	182
h	M-M	Arm length l (M-A)						
mm	mm	mm	mm	mm	mm	mm	mm	mm
80	113	86	82					
90	127	100	96					
100	141	114	110	102				
110	156	129	125	117	111			
120	170	143	139	131	125			
130	184	157	153	145	139			
140	198	171	167	159	153	143		
150	212	185	181	173	167	157		
160	226	199	195	187	181	171	163	
170	240	213	209	201	195	185	177	
180	255	228	224	216	210	200	192	
190	269	242	238	230	224	214	206	190
200	283	256	252	244	238	228	220	204
210	297	270	266	258	252	242	234	218
220	311	284	280	272	266	256	248	232
230	325	298	294	286	280	270	262	246
240	339	312	308	300	294	284	276	260
250	354	327	323	315	309	299	291	275
260	368	341	337	329	323	313	305	289
270	382	355	351	343	337	327	319	303
280	396	369	365	357	351	341	333	317
290	410	383	379	371	365	355	347	331
300	424	397	393	385	379	369	361	345
310	438	411	407	399	393	383	375	359
320	453	426	422	414	408	398	390	374
330	467	440	436	428	422	412	404	388
340	481	454	450	442	436	426	418	402
350	495	468	464	456	450	440	432	416
360	509	482	478	470	464	454	446	430
370	523	496	492	484	478	468	460	444
380	537	510	506	498	492	482	474	458

Minimal pipe piece falls short

Minimal size arm length with bending tool 4852 without need to shortening again

- Angle joint: - T-piece and bend 30° (4650/4609)
- Elbow 90° and bend 30° (4670/4609)



Angle joint	Dim	16	20	26	32	40	50	63
	DN	12	15	20	25	32	40	50
z-Value	mm	27	31	39	45	55	63	79
h _{min}	mm	44	48	60	74	85	109	119
h	M-M	Arm length l (M-A)						
mm	mm	mm	mm	mm	mm	mm	mm	mm
80	160	133	129	121	115			
90	180	153	149	141	135	125		
100	200	173	169	161	155	145		
110	220	193	189	181	175	165	157	
120	240	213	209	201	195	185	177	161
130	260	233	229	221	215	205	197	181
140	280	253	249	241	235	225	217	201
150	300	273	269	261	255	245	237	221
160	320	293	289	281	275	265	257	241
170	340	313	309	301	295	285	277	261
180	360	333	329	321	315	305	297	281
190	380	353	349	341	335	325	317	301
200	400	373	369	361	355	345	337	321
210	420	393	389	381	375	365	357	341
220	440	413	409	401	395	385	377	361
230	460	433	429	421	415	405	397	381
240	480	453	449	441	435	425	417	401
250	500	473	469	461	455	445	437	421
260	520	493	489	481	475	465	457	441
270	540	513	509	501	495	485	477	461
280	560	533	529	521	515	505	497	481
290	580	553	549	541	535	525	517	501
300	600	573	569	561	555	545	537	521
310	620	593	589	581	575	565	557	541
320	640	613	609	601	595	585	577	561
330	660	633	629	621	615	605	597	581
340	680	653	649	641	635	625	617	601
350	700	673	669	661	655	645	637	621
360	720	693	689	681	675	665	657	641
370	740	713	709	701	695	685	677	661
380	760	733	729	721	715	705	697	681

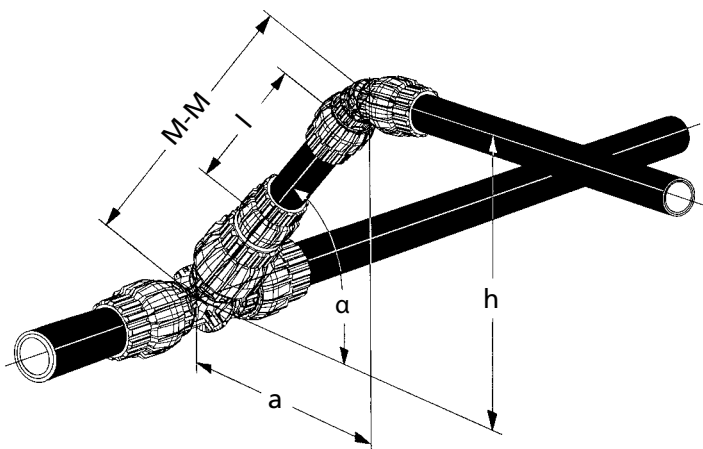
Minimal pipe piece falls short

Minimal size arm length with bending tool 4852 without need to shortening again

Pipe bend 30° must be made with the bending tool.

$$a = h \times 1.732$$

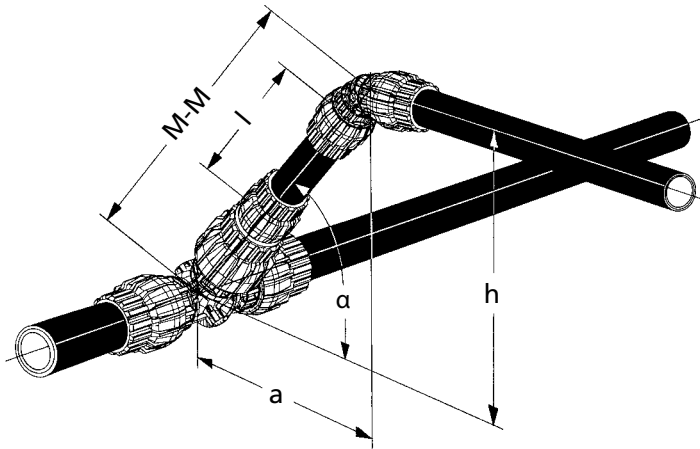
- Angle joint: - T-piece, reduction and elbow 45° (4650/4730/4676)
 - Elbow 90°, reduction and elbow 45° (4670/4730/4676)



Angle joint	Dim	26-20	32-20	32-26	40-20	40-26	40-32
	DN	20-15	25-20	25-20	32-15	32-20	32-25
z-Value	mm	99	118	122	137	143	145
h_{min}	mm	133	146	167	159	182	199
h	M-M	Pipe section I					
mm	mm	mm	mm	mm	mm	mm	mm
100	141						
110	156						
120	170						
130	184						
140	198	99					
150	212	113	94				
160	226	127	108		89		
170	240	141	122	118	103		
180	255	156	137	133	118		
190	269	170	151	147	132	126	
200	283	184	165	161	146	140	138
210	297	198	179	175	160	154	152
220	311	212	193	189	174	168	166
230	325	226	207	203	188	182	180
240	339	240	221	217	202	196	194
250	354	255	236	232	217	211	209
260	368	269	250	246	231	225	223
270	382	283	264	260	245	239	237
280	396	297	278	274	259	253	251
290	410	311	292	288	273	267	265
300	424	325	306	302	287	281	279
310	438	339	320	316	301	295	293
320	453	354	335	331	316	310	308
330	467	368	349	345	330	324	322
340	481	382	363	359	344	338	336
350	495	396	377	373	358	352	350
360	509	410	391	387	372	366	364
370	523	424	405	401	386	380	378
380	537	438	419	415	400	394	392

Minimal pipe piece falls short

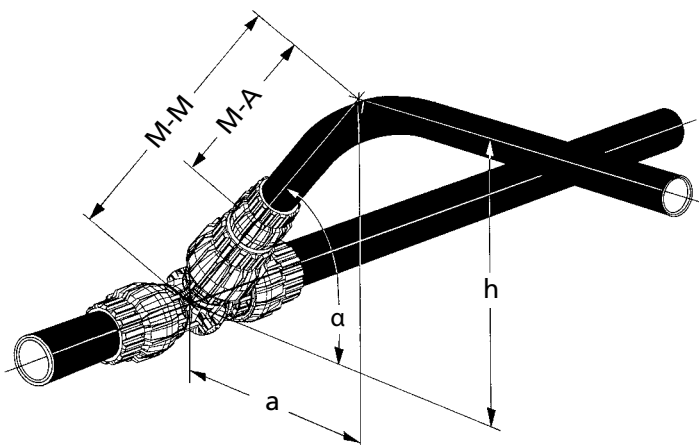
- Angle joint: - T-Piece, reduction and elbow 45° (4650/4730/4676)
 - Elbow 90°, reduction and elbow 45° (4670/4730/4676)



Angle joint	Dim	50-26	50-32	50-40	63-26	63-32	63-40	63-50
	DN	40-20	40-25	40-32	50-20	50-25	50-32	50-40
z-Value	mm	160	165	175	189	196	205	227
h _{min}	mm	193	214	240	214	235	261	302
h	M-M	Pipe section I						
mm	mm	mm	mm	mm	mm	mm	mm	mm
100	141							
110	156							
120	170							
130	184							
140	198							
150	212							
160	226							
170	240							
180	255							
190	269							
200	283	123						
210	297	137						
220	311	152	146		123			
230	325	166	160		137			
240	339	180	174	165	151	144		
250	354	194	189	179	165	158		
260	368	208	203	193	179	172	163	
270	382	222	217	207	193	186	177	
280	396	236	231	221	207	200	191	
290	410	251	245	235	222	214	205	
300	424	265	259	249	236	228	220	
310	438	279	273	264	250	243	234	212
320	453	293	288	278	264	257	248	226
330	467	307	302	292	278	271	262	240
340	481	321	316	306	292	285	276	254
350	495	335	330	320	306	299	290	268
360	509	350	344	334	321	313	304	283
370	523	364	358	348	335	327	319	297
380	537	378	372	363	349	342	333	311

Minimal pipe piece falls short

- Angle joint: - T-Piece, reduction and bend 45° (4650/4730/4608)
 - Elbow 90°, reduction and bend 45° (4670/4730/4608)

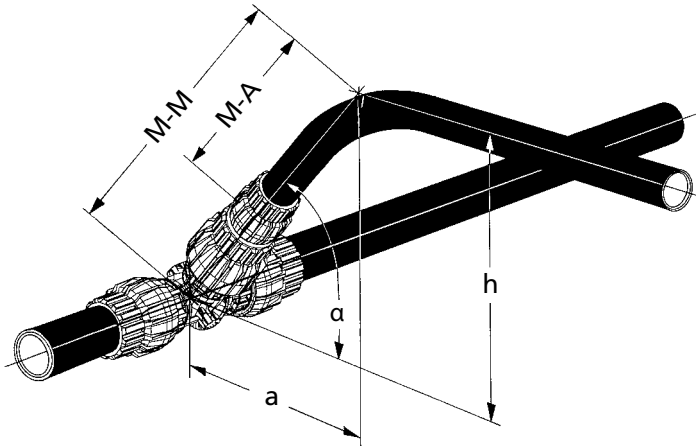


Angle joint	Dim	20-16	26-16	26-20	32-16	32-20	32-26	40-16	40-20	40-26	40-32
z-Value	mm	62	81	78	97	95	95	116	116	116	113
h _{min}	mm	88	101	100	113	112	131	127	127	146	149
h	M-M	Bend length l (M-A)									
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
100	141	79		63							
110	156	94	75	78							
120	170	108	89	92	73	75					
130	184	122	103	106	87	89		68	68		
140	198	136	117	120	101	103	103	82	82		
150	212	150	131	134	115	117	117	96	96	96	99
160	226	164	145	148	129	131	131	110	110	110	113
170	240	178	159	162	143	145	145	124	124	124	127
180	255	193	174	177	158	160	160	139	139	139	142
190	269	207	188	191	172	174	174	153	153	153	156
200	283	221	202	205	186	188	188	167	167	167	170
210	297	235	216	219	200	202	202	181	181	181	184
220	311	249	230	233	214	216	216	195	195	195	198
230	325	263	244	247	228	230	230	209	209	209	212
240	339	277	258	261	242	244	244	223	223	223	226
250	354	292	273	276	257	259	259	238	238	238	241
260	368	306	287	290	271	273	273	252	252	252	255
270	382	320	301	304	285	287	287	266	266	266	269
280	396	334	315	318	299	301	301	280	280	280	283
290	410	348	329	332	313	315	315	294	294	294	297
300	424	362	343	346	327	329	329	308	308	308	311
310	438	376	357	360	341	343	343	322	322	322	325
320	453	391	372	375	356	358	358	337	337	337	340
330	467	405	386	389	370	372	372	351	351	351	354
340	481	419	400	403	384	386	386	365	365	365	368
350	495	433	414	417	398	400	400	379	379	379	382
360	509	447	428	431	412	414	414	393	393	393	396
370	523	461	442	445	426	428	428	407	407	407	410
380	537	475	456	459	440	442	442	421	421	421	424

Minimal pipe piece falls short

Minimal size arm length with bending tool 4852 without need to shortening again

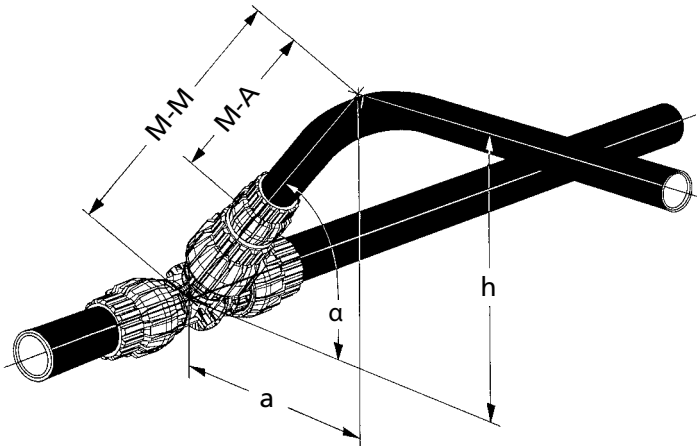
- Angle joint: - T-Piece, reduction and bend 45° (4650/4730/4608)
 - Elbow 90°, reduction und bend 45° (4670/4730/4608)



Angle joint	Dim	50-26	50-32	50-40	63-26	63-32	63-40	63-50
	DN	40-20	40-25	40-32	50-20	50-25	50-32	50-40
z-Value	mm	133	133	138	162	164	168	180
h_{min}	mm	157	163	196	178	185	217	239
h	M-M	Bend length l (M-A)						
mm	mm	mm	mm	mm	mm	mm	mm	mm
100	141							
110	156							
120	170							
130	184							
140	198							
150	212							
160	226	93						
170	240	107	107					
180	255	122	122		93			
190	269	136	136		107	105		
200	283	150	150	145	121	119		
210	297	164	164	159	135	133		
220	311	178	178	173	150	147	143	
230	325	192	192	187	164	161	158	
240	339	206	206	202	178	176	172	160
250	354	221	221	216	192	190	186	174
260	368	235	235	230	206	204	200	188
270	382	249	249	244	220	218	214	202
280	396	263	263	258	234	232	228	216
290	410	277	277	272	249	246	242	231
300	424	291	291	286	263	260	257	245
310	438	305	305	301	277	275	271	259
320	453	320	320	315	291	289	285	273
330	467	334	334	329	305	303	299	287
340	481	348	348	343	319	317	313	301
350	495	362	362	357	333	331	327	315
360	509	376	376	371	348	345	341	330
370	523	390	390	385	362	359	356	344
380	537	404	404	400	376	374	370	358

Minimal pipe piece falls short

- Angle joint: - T-Piece, reduction and bend 30° (4650/4730/4609)
 - Elbow 90°, reduction and bend 30° (4670/4730/4609)



Angle joint	Dim	20-16	26-16	26-20	32-16	32-20	32-26	40-16	40-20	40-26	40-32
z-Value	mm	62	80	78	97	95	95	116	116	116	113
h _{min}	mm	61	70	72	79	80	88	88	91	98	108
h	M-M	Bend length l (M-A)									
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
80	160	98	80	82	63	65					
90	180	118	100	102	83	85	85	64			
100	200	138	120	122	103	105	105	84	84	84	
110	220	158	140	142	123	125	125	104	104	104	107
120	240	178	160	162	143	145	145	124	124	124	127
130	260	198	180	182	163	165	165	144	144	144	147
140	280	218	200	202	183	185	185	164	164	164	167
150	300	238	220	222	203	205	205	184	184	184	187
160	320	258	240	242	223	225	225	204	204	204	207
170	340	278	260	262	243	245	245	224	224	224	227
180	360	298	280	282	263	265	265	244	244	244	247
190	380	318	300	302	283	285	285	264	264	264	267
200	400	338	320	322	303	305	305	284	284	284	287
210	420	358	340	342	323	325	325	304	304	304	307
220	440	378	360	362	343	345	345	324	324	324	327
230	460	398	380	382	363	365	365	344	344	344	347
240	480	418	400	402	383	385	385	364	364	364	367
250	500	438	420	422	403	405	405	384	384	384	387
260	520	458	440	442	423	425	425	404	404	404	407
270	540	478	460	462	443	445	445	424	424	424	427
280	560	498	480	482	463	465	465	444	444	444	447
290	580	518	500	502	483	485	485	464	464	464	467
300	600	538	520	522	503	505	505	484	484	484	487
310	620	558	540	542	523	525	525	504	504	504	507
320	640	578	560	562	543	545	545	524	524	524	527
330	660	598	580	582	563	565	565	544	544	544	547
340	680	618	600	602	583	585	585	564	564	564	567
350	700	638	620	622	603	605	605	584	584	584	587
360	720	658	640	642	623	625	625	604	604	604	607
370	740	678	660	662	643	645	645	624	624	624	627
380	760	698	680	682	663	665	665	644	644	644	647

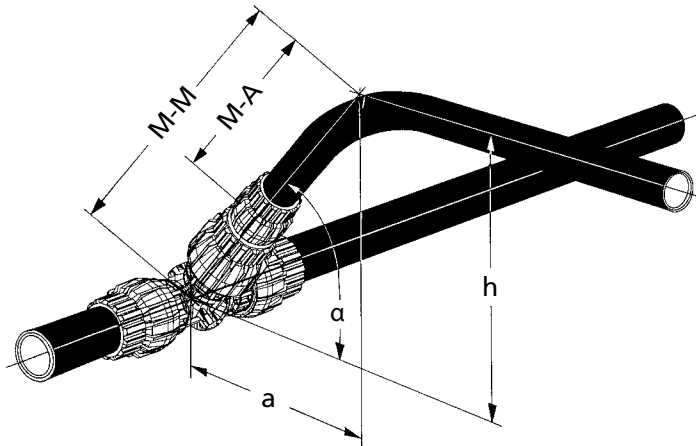
Minimal pipe piece falls short

Minimal size arm length with bending tool 4852 without need to shortening again

Pipe bend 30° must be made with the bending tool.

$$a = h \times 1.732$$

- Angle joint: - T-Piece, reduction and bend 30° (4650/4730/4609)
 - Elbow 90°, reduction und bend 30° (4670/4730/4609)



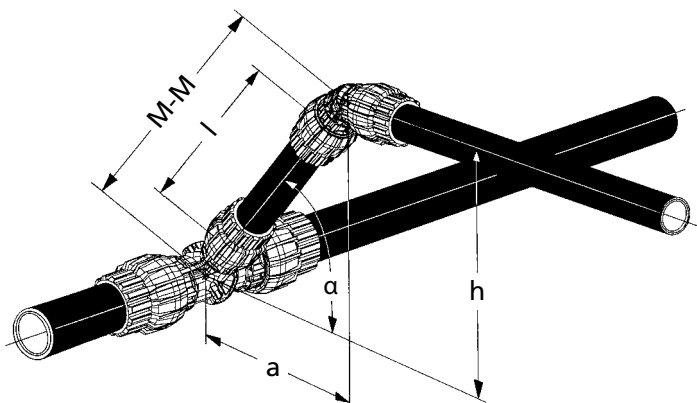
Angle joint	Dim	50-26	50-32	50-40	63-26	63-32	63-40	63-50
	DN	40-20	40-25	40-32	50-20	50-25	50-32	50-40
z-Value	mm	133	133	138	162	164	168	180
h _{min}	mm	106	118	126	121	133	141	166
h	M-M	Bend length l (M-A)						
mm	mm	mm	mm	mm	mm	mm	mm	mm
80	160							
90	180							
100	200							
110	220	87						
120	240	107	107					
130	260	127	127	122	99			
140	280	147	147	142	119	116		
150	300	167	167	162	139	136	132	
160	320	187	187	182	159	156	152	
170	340	207	207	202	179	176	172	
180	360	227	227	222	199	196	192	181
190	380	247	247	242	219	216	212	201
200	400	267	267	262	239	236	232	221
210	420	287	287	282	259	256	252	241
220	440	307	307	302	279	276	272	261
230	460	327	327	322	299	296	292	281
240	480	347	347	342	319	316	312	301
250	500	367	367	362	339	336	332	321
260	520	387	387	382	359	356	352	341
270	540	407	407	402	379	376	372	361
280	560	427	427	422	399	396	392	381
290	580	447	447	442	419	416	412	401
300	600	467	467	462	439	436	432	421
310	620	487	487	482	459	456	452	441
320	640	507	507	502	479	476	472	461
330	660	527	527	522	499	496	492	481
340	680	547	547	542	519	516	512	501
350	700	567	567	562	539	536	532	521
360	720	587	587	582	559	556	552	541
370	740	607	607	602	579	576	572	561
380	760	627	627	622	599	596	592	581

Minimal pipe piece falls short

Pipe bend 30° must be made with the bending tool.

$$a = h \times 1.732$$

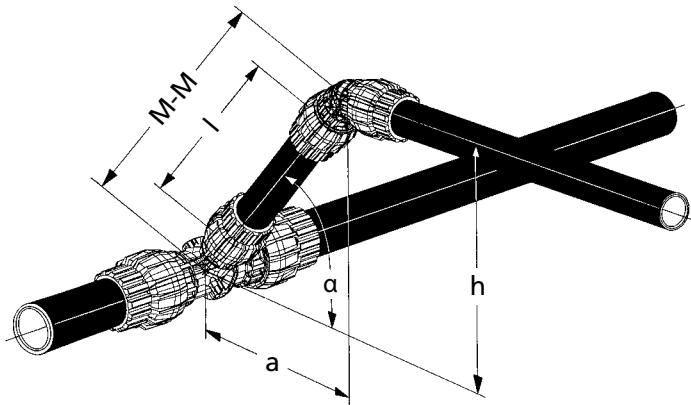
Angle joint: - T-Piece reduced and elbow 45° (4652/4676)
- Elbow 90° and elbow 45° (4670/4676)



Angle joint	Dim	20-20-16	26-20-20	26-20-26	26-26-20	32-20-32	32-26-26	32-26-32	40-26-40	40-32-32	40-32-40
	DN	15-15-12	20-15-15	20-15-20	20-20-15	25-15-25	25-20-20	25-20-25	32-20-32	32-25-25	32-25-32
z-Value	mm	52	57	56	66	61	71	71	77	84	84
h _{min}	mm	99	103	102	127	106	131	131	135	156	156
h	M-M	Pipe size l									
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
100	141	89								57	
110	156	104	99	100		95				72	
120	170	118	113	114		109				86	
130	184	132	127	128	118	123				100	
140	198	146	141	142	132	137	127	127	121	114	
150	212	160	155	156	146	151	141	141	135	128	
160	226	174	169	170	160	165	155	155	149	142	142
170	240	188	183	184	174	179	169	169	163	156	156
180	255	203	198	199	189	194	184	184	178	171	171
190	269	217	212	213	203	208	198	198	192	185	185
200	283	231	226	227	217	222	212	212	206	199	199
210	297	245	240	241	231	236	226	226	220	213	213
220	311	259	254	255	245	250	240	240	234	227	227
230	325	273	268	269	259	264	254	254	248	241	241
240	339	287	282	283	273	278	268	268	262	255	255
250	354	302	297	298	288	293	283	283	277	270	270
260	368	316	311	312	302	307	297	297	291	284	284
270	382	330	325	326	316	321	311	311	305	298	298
280	396	344	339	340	330	335	325	325	319	312	312
290	410	358	353	354	344	349	339	339	333	326	326
300	424	372	367	368	358	363	353	353	347	340	340
310	438	386	381	382	372	377	367	367	361	354	354
320	453	401	396	397	387	392	382	382	376	369	369
330	467	415	410	411	401	406	396	396	390	383	383
340	481	429	424	425	415	420	410	410	404	397	397
350	495	443	438	439	429	434	424	424	418	411	411
360	509	457	452	453	443	448	438	438	432	425	425
370	523	471	466	467	457	462	452	452	446	439	439
380	537	485	480	481	471	476	466	466	460	453	453

Minimal pipe piece falls short

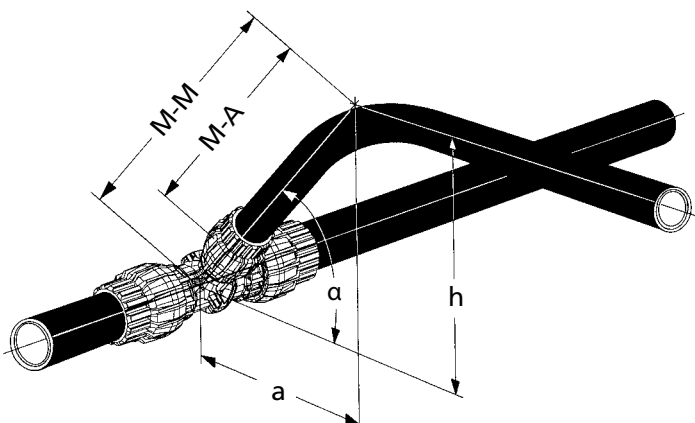
- Angle joint: - T-Piece reduced and elbow 45° (4652/4676)
- Elbow 90° and elbow 45° (4670/4676)



Angle joint	Dim	50-26-50	50-32-50	50-40-50	63-26-63	63-32-63	63-40-63	63-50-63
	DN	40-20-40	40-25-40	40-32-40	50-20-50	50-25-50	50-32-50	50-40-50
z-Value	mm	73	80	89	82	89	97	116
h _{min}	mm	135	157	183	141	164	188	226
h	M-M	Pipe size I						
mm	mm	mm	mm	mm	mm	mm	mm	mm
100	141							
110	156							
120	170							
130	184							
140	198	125						
150	212	139			130			
160	226	153	146		144			
170	240	167	160		158	151		
180	255	182	175		173	166		
190	269	196	189	180	187	180	172	
200	283	210	203	194	201	194	186	
210	297	224	217	208	215	208	200	
220	311	238	231	222	229	222	214	
230	325	252	245	236	243	236	228	209
240	339	266	259	250	257	250	242	223
250	354	281	274	265	272	265	257	238
260	368	295	288	279	286	279	271	252
270	382	309	302	293	300	293	285	266
280	396	323	316	307	314	307	299	280
290	410	337	330	321	328	321	313	294
300	424	351	344	335	342	335	327	308
310	438	365	358	349	356	349	341	322
320	453	380	373	364	371	364	356	337
330	467	394	387	378	385	378	370	351
340	481	408	401	392	399	392	384	365
350	495	422	415	406	413	406	398	379
360	509	436	429	420	427	420	412	393
370	523	450	443	434	441	434	426	407
380	537	464	457	448	455	448	440	421

Minimal pipe piece falls short

Angle joint: - T-Piece reduced and bend 45° (4652/4608)
- Elbow 90° and bend 45° (4670/4608)

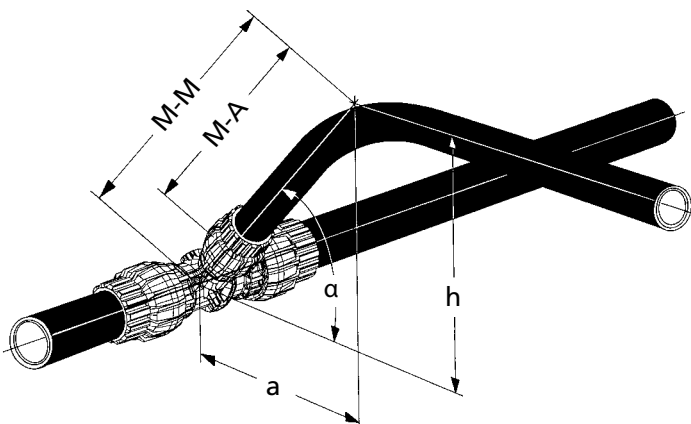


Angle joint	Dim	20-16-16	20-16-20	20-20-16	26-16-26	26-20-20	26-20-26	26-26-20	32-16-32	32-20-32	32-26-26	32-26-32
	DN	15-12-12	15-12-15	15-15-12	20-12-20	20-15-15	20-15-20	20-20-15	25-12-25	25-15-25	25-20-20	25-20-25
z-Value	mm	29	29	31	34	35	35	39	38	40	44	44
h _{min}	mm	65	65	66	69	69	69	91	71	73	95	95
h	M-M	Bend length l (M-A)										
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
80	113	84	84	82	79	78	78		75	73		
90	127	98	98	96	93	92	92		89	87		
100	141	112	112	110	107	106	106	102	103	101	97	97
110	156	127	127	125	122	121	121	117	118	116	112	112
120	170	141	141	139	136	135	135	131	132	130	126	126
130	184	155	155	153	150	149	149	145	146	144	140	140
140	198	169	169	167	164	163	163	159	160	158	154	154
150	212	183	183	181	178	177	177	173	174	172	168	168
160	226	197	197	195	192	191	191	187	188	186	182	182
170	240	211	211	209	206	205	205	201	202	200	196	196
180	255	226	226	224	221	220	220	216	217	215	211	211
190	269	240	240	238	235	234	234	230	231	229	225	225
200	283	254	254	252	249	248	248	244	245	243	239	239
210	297	268	268	266	263	262	262	258	259	257	253	253
220	311	282	282	280	277	276	276	272	273	271	267	267
230	325	296	296	294	291	290	290	286	287	285	281	281
240	339	310	310	308	305	304	304	300	301	299	295	295
250	354	325	325	323	320	319	319	315	316	314	310	310
260	368	339	339	337	334	333	333	329	330	328	324	324
270	382	353	353	351	348	347	347	343	344	342	338	338
280	396	367	367	365	362	361	361	357	358	356	352	352
290	410	381	381	379	376	375	375	371	372	370	366	366
300	424	395	395	393	390	389	389	385	386	384	380	380
310	438	409	409	407	404	403	403	399	400	398	394	394
320	453	424	424	422	419	418	418	414	415	413	409	409
330	467	438	438	436	433	432	432	428	429	427	423	423
340	481	452	452	450	447	446	446	442	443	441	437	437
350	495	466	466	464	461	460	460	456	457	455	451	451
360	509	480	480	478	475	474	474	470	471	469	465	465
370	523	494	494	492	489	488	488	484	485	483	479	479
380	537	508	508	506	503	502	502	498	499	497	493	493

Minimal pipe piece falls short

Minimal size arm length with bending tool 4852 without need to shortening again

- Angle joint: - T-Piece reduced and bend 45° (4652/4608)
- Elbow 90° and bend 45° (4670/4608)

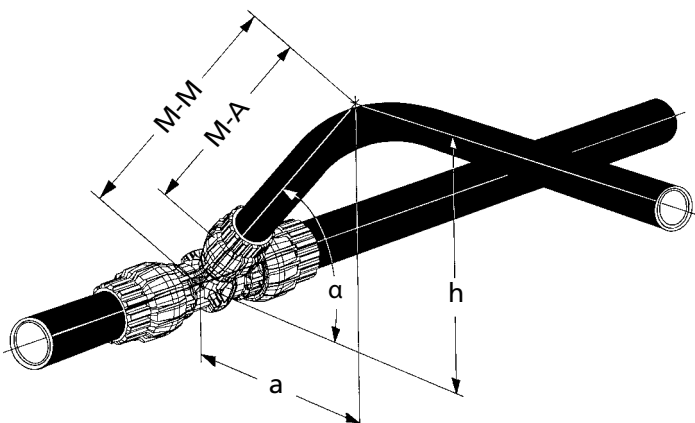


Angle joint	Dim	40-26-40	40-32-32	40-32-40	50-26-50	50-32-50	50-40-50	63-26-63	63-32-63	63-40-63	63-50-63
	DN	32-20-32	32-25-25	32-25-32	40-20-40	40-25-40	40-32-40	50-20-50	50-25-50	50-32-50	50-40-50
z-Value	mm	50	52	52	46	48	52	55	57	60	69
h _{min}	mm	99	106	106	146	147	150	164	166	168	175
h	M-M	Bend length l (M-A)									
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
80	113										
90	127										
100	141	91	89								
110	156	106	104	104							
120	170	120	118	118							
130	184	134	132	132							
140	198	148	146	146							
150	212	162	160	160	166	164	160				
160	226	176	174	174	180	178	174				
170	240	190	188	188	194	192	188	185	183	180	
180	255	205	203	203	209	207	203	200	198	195	186
190	269	219	217	217	223	221	217	214	212	209	200
200	283	233	231	231	237	235	231	228	226	223	214
210	297	247	245	245	251	249	245	242	240	237	228
220	311	261	259	259	265	263	259	256	254	251	242
230	325	275	273	273	279	277	273	270	268	265	256
240	339	289	287	287	293	291	287	284	282	279	270
250	354	304	302	302	308	306	302	299	297	294	285
260	368	318	316	316	322	320	316	313	311	308	299
270	382	332	330	330	336	334	330	327	325	322	313
280	396	346	344	344	350	348	344	341	339	336	327
290	410	360	358	358	364	362	358	355	353	350	341
300	424	374	372	372	378	376	372	369	367	364	355
310	438	388	386	386	392	390	386	383	381	378	369
320	453	403	401	401	407	405	401	398	396	393	384
330	467	417	415	415	421	419	415	412	410	407	398
340	481	431	429	429	435	433	429	426	424	421	412
350	495	445	443	443	449	447	443	440	438	435	426
360	509	459	457	457	463	461	457	454	452	449	440
370	523	473	471	471	477	475	471	468	466	463	454
380	537	487	485	485	491	489	485	482	480	477	468

Minimal pipe piece falls short

Minimal size arm length with bending tool 4852 without need to shortening again

Angle joint: - T-Piece reduced and bend 30° (4652/4609)
- Elbow 90° and bend 30° (4670/4609)



Angle joint	Dim	20-16-20	20-16-20	20-20-16	26-16-26	26-20-20	26-20-26	26-26-20	32-16-32	32-20-32	32-26-26	32-26-32
	DN	15-12-12	15-12-15	15-15-12	20-12-20	20-15-15	20-15-20	20-20-15	25-12-25	25-15-25	25-20-20	25-20-25
z-Value	mm	29	29	31	33	35	35	39	38	40	44	44
h _{min}	mm	45	45	48	47	50	50	60	49	53	62	62
h	M-M	Bend length l (M-A)										
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
50	100	71	71	69	67	65	65		62			
60	120	91	91	89	87	85	85	81	82	80		
70	140	111	111	109	107	105	105	101	102	100	96	96
80	160	131	131	129	127	125	125	121	122	120	116	116
90	180	151	151	149	147	145	145	141	142	140	136	136
100	200	171	171	169	167	165	165	161	162	160	156	156
110	220	191	191	189	187	185	185	181	182	180	176	176
120	240	211	211	209	207	205	205	201	202	200	196	196
130	260	231	231	229	227	225	225	221	222	220	216	216
140	280	251	251	249	247	245	245	241	242	240	236	236
150	300	271	271	269	267	265	265	261	262	260	256	256
160	320	291	291	289	287	285	285	281	282	280	276	276
170	340	311	311	309	307	305	305	301	302	300	296	296
180	360	331	331	329	327	325	325	321	322	320	316	316
190	380	351	351	349	347	345	345	341	342	340	336	336
200	400	371	371	369	367	365	365	361	362	360	356	356
210	420	391	391	389	387	385	385	381	382	380	376	376
220	440	411	411	409	407	405	405	401	402	400	396	396
230	460	431	431	429	427	425	425	421	422	420	416	416
240	480	451	451	449	447	445	445	441	442	440	436	436
250	500	471	471	469	467	465	465	461	462	460	456	456
260	520	491	491	489	487	485	485	481	482	480	476	476
270	540	511	511	509	507	505	505	501	502	500	496	496
280	560	531	531	529	527	525	525	521	522	520	516	516
290	580	551	551	549	547	545	545	541	542	540	536	536
300	600	571	571	569	567	565	565	561	562	560	556	556
310	620	591	591	589	587	585	585	581	582	580	576	576
320	640	611	611	609	607	605	605	601	602	600	596	596
330	660	631	631	629	627	625	625	621	622	620	616	616
340	680	651	651	649	647	645	645	641	642	640	636	636
350	700	671	671	669	667	665	665	661	662	660	656	656
360	720	691	691	689	687	685	685	681	682	680	676	676
370	740	711	711	709	707	705	705	701	702	700	696	696
380	760	731	731	729	727	725	725	721	722	720	716	716

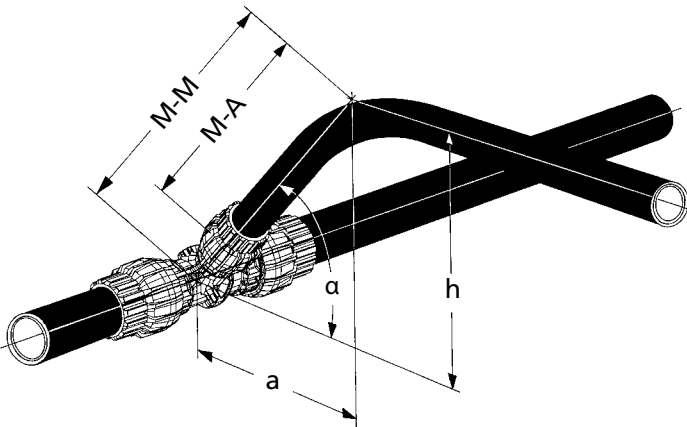
Minimal pipe piece falls short

Minimal size arm length with bending tool 4852 without need to shortening again

Pipe bend 30° must be made with the bending tool.

$a = h \times 1.732$

- Angle joint: - T-Piece reduced and bend 30° (4652/4609)
- Elbow 90° and bend 30° (4670/4609)



Angle joint	Dim	40-26-40	40-32-32	40-32-40	50-26-50	50-32-50	50-40-50	63-26-63	63-32-63	63-40-63	63-50-63
	DN	32-20-32	32-25-25	32-25-32	40-20-40	40-25-40	40-32-40	50-20-50	50-25-50	50-32-50	50-40-50
z-Value	mm	50	52	52	46	48	52	55	57	60	69
h_{min}	mm	65	77	77	63	75	84	68	80	88	111
h	M-M	Bend length l (M-A)									
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
50	100										
60	120										
70	140	90	88		94			85			
80	160	110	108	108	114	112		105	103		
90	180	130	128	128	134	132	128	125	123	120	
100	200	150	148	148	154	152	148	145	143	140	
110	220	170	168	168	174	172	168	165	163	160	151
120	240	190	188	188	194	192	188	185	183	180	171
130	260	210	208	208	214	212	208	205	203	200	191
140	280	230	228	228	234	232	228	225	223	220	211
150	300	250	248	248	254	252	248	245	243	240	231
160	320	270	268	268	274	272	268	265	263	260	251
170	340	290	288	288	294	292	288	285	283	280	271
180	360	310	308	308	314	312	308	305	303	300	291
190	380	330	328	328	334	332	328	325	323	320	311
200	400	350	348	348	354	352	348	345	343	340	331
210	420	370	368	368	374	372	368	365	363	360	351
220	440	390	388	388	394	392	388	385	383	380	371
230	460	410	408	408	414	412	408	405	403	400	391
240	480	430	428	428	434	432	428	425	423	420	411
250	500	450	448	448	454	452	448	445	443	440	431
260	520	470	468	468	474	472	468	465	463	460	451
270	540	490	488	488	494	492	488	485	483	480	471
280	560	510	508	508	514	512	508	505	503	500	491
290	580	530	528	528	534	532	528	525	523	520	511
300	600	550	548	548	554	552	548	545	543	540	531
310	620	570	568	568	574	572	568	565	563	560	551
320	640	590	588	588	594	592	588	585	583	580	571
330	660	610	608	608	614	612	608	605	603	600	591
340	680	630	628	628	634	632	628	625	623	620	611
350	700	650	648	648	654	652	648	645	643	640	
360	720	670	668	668	674	672	668	665	663	660	
370	740	690	688	688	694	692	688	685	683	680	
380	760	710	708	708	714	712	708	705	703	700	

Minimal pipe piece falls short

Minimal size arm length with bending tool 4852 without need to shortening again

Pipe bend 30° must be made with the bending tool.

$$a = h \times 1.732$$

JRG Sanipex MT® Bauobjekt: Bâtiment: Edificio: Building site:	Firma: Firme: Ditta: Company:	Dat.: Blatt Nr.: Feuille no.: Foglio no.: Sheet no.: Anzahl der Blätter: Nombre de feuilles: Numero dei fogli: Number of sheets:	Bezeichnung Designation Numerazione Marking Mass M-M Distance d'axe M-M Distanza d'asse M-M Axis measure M-M – cm Z-Mass – cm distanza Z – cm distanza Z – cm Z-measure Rohrlänge cm Longueur du tube en cm Lunghezza del tubo in cm Pipe length cm Ø Bemerkungen Remarques Observazioni Remarks									
	Draft copy											

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General

JRG Sanipex MT® installations are, if still visible, to be pressure checked **with water** in accordance with local regulations

Every connection is to be checked visually.

Installation firm

Examiner

Objekt

Checked installation part

JRG Sanipex MT® pipe material

Test pressure _____ bar (1.5 x operating pressure, min. 15 bar)

Pressure loss after 60 min. _____ bar (max. 0.1 bar)

Combined installation JRG Sanipex MT® und JRG Sanipex® (PE-X)

Pre-test

Test pressure _____ bar (1.5 x operating pressure, min. 15 bar)

Pressure loss after 30 min. _____ bar (test begin)

Pressure loss after 5 min. _____ bar (below 0.1 bar)

Pressure loss after 60 min. _____ bar (max. 0.1 bar)

Results of pre-test:

Main test

Test pressure **13 bar** (don't reduce pressure after pre-test)

Pressure loss after 60 min. _____ bar (max. 0.1 bar)

All connections subjected to checks.

The pressure test was successfully accomplished.

The pressure test could **not** be locked.
They must be repeated.

Results of main tests:

Building Managers' signature

Examiner's signature

Place, date, time

General

JRG Sanipex® installations are, if still visible, to be pressure checked **with water** in accordance with local regulations

Every connection is to be checked visually.

Installation firm**Examiner****Objekt****Checked installation part****Description of installation**

Pipe length 20: _____ m 16: _____ m

Pipe threading 20: _____ pce. 16: _____ pce.

Highest tap point lies: _____ m over pressure gauge

Pre-test

Test pressure _____ bar (1.5 x operating pressure, min. 15 bar)

Pressure loss after 30 min. _____ bar (test begin)

Pressure loss after 5 min. _____ bar (below 0.1 bar)

Pressure loss after 60 min. _____ bar (max. 0.1 bar)

Results of pre-test:

Main test

Test pressure **13 bar** (don't reduce pressure after pre-test)

Pressure loss after 60 min. _____ bar (test begin)

Pressure loss after 120 min. _____ bar

Pressure loss after 60 min. _____ bar (max. 0,1 bar)

All connections subjected to checks.

The pressure test was succesfully accomplished.

The pressure test could **not** be locked.
They must be repeated.

Results of main tests:

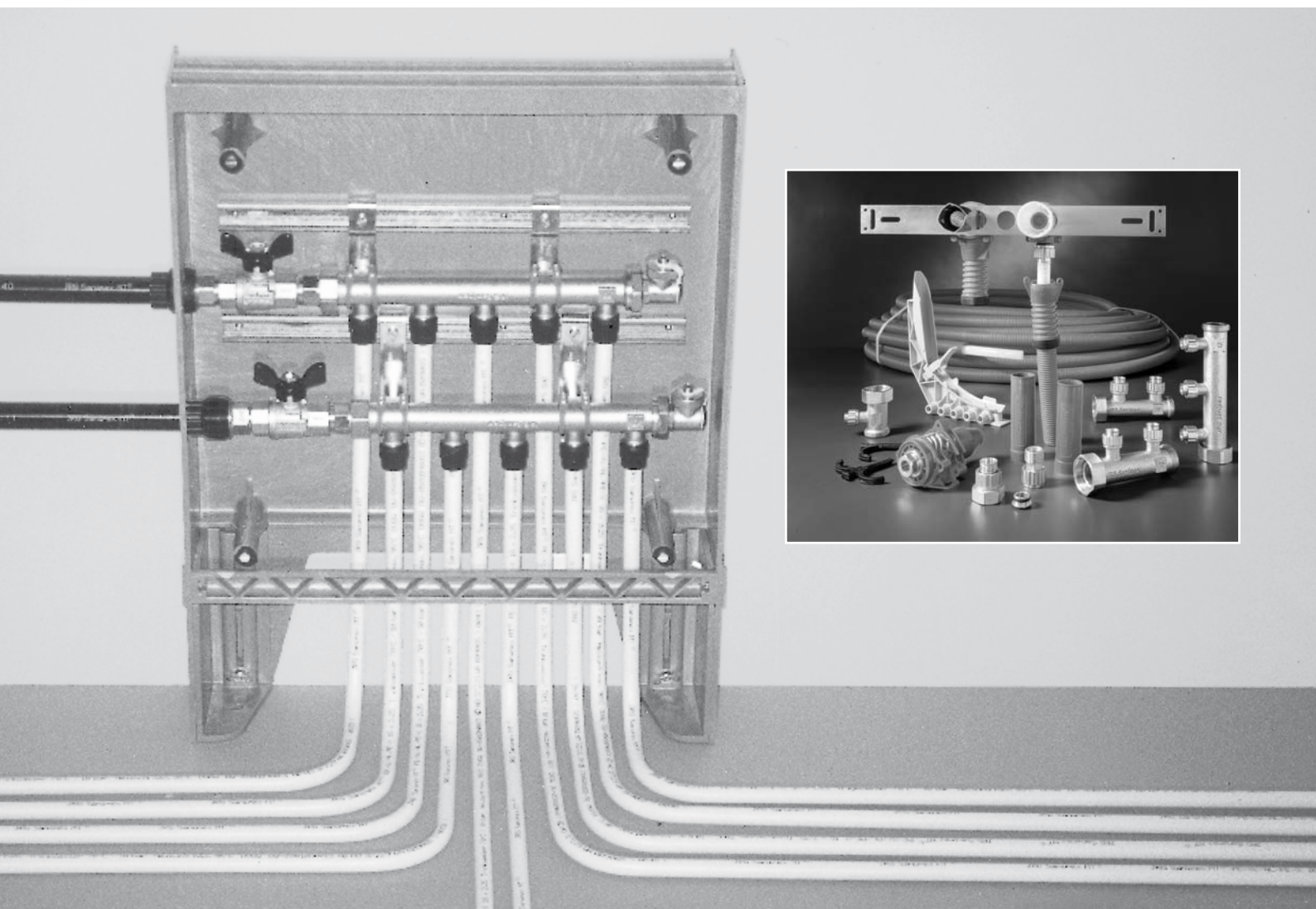
Building Managers' signature

Examiner's signature

Place, date, time

This image shows a full page of blank graph paper. The grid consists of small, uniform squares formed by thin, light gray lines. There are no margins, text, or other markings on the page.

JRG Sanipex MT® Calor



Usage JRG Sanipex MT® Calor

Please read carefully the following chapter JRG Sanipex MT® Calor before using the system.

The chapter JRG Sanipex MT® Calor contains the layout and use of **formstable** pipe systems for the **central heating installation with heating element connections**.

The symbols and abbreviations used signify:



Danger

This symbol denotes high risk of injury to the person. The safety instructions must be consulted.



Warning

This symbol points to information that, if ignored, can lead to extensive system malfunctions. The safety instructions must be consulted.



NB

This symbol points to important information regarding the usage. If ignored, system disturbances may occur.

- M: Metric thread accord. DIN ISO 261
- Rp: Cylindrical inside thread for sealing connections with inside threads accord. ISO 7 / 1 and DIN 2999 / 1
- R: Conical outer thread for sealing connections with inside threads accord. ISO 7 / 1 and DIN 2999 / 1
- G: Cylindrical inside and outer thread for sealing connections not with thread, accord. DIN ISO 228 / 1
- GN: Grandeur Nominal – Nominal size (thread size)
- DN: Diameter Nominal – Nominal diameter (inner diameter)
- PN: Pressure Nominal – Nominal pressure

 Wrench width 6 kt.

 Wrench width 4 kt.

 Packaging unit

Surface-terminology:

- R: Raw
- C: Chromed

General Requirements

Because of the inter-related aspect respecting the building framework, installation techniques and energy carrying media, the standards for established pipe systems are constantly being re-defined. The life of a building, not only demands the application of ecological and economical materials but also places high demands upon the quality of the materials employed. This are the factors we take into consideration when designing and manufacturing our products.

Ancillary systems description for **JRG Sanipex MT® Calor**. Please take note of the systems description of JRG Sanipex MT® on pages 10 to 18.

Scope of use

The installation system JRG Sanipex MT® covering dimensions d16 to d63 allows the complete construction of water-pump hot water heating from the heat source to the radiators.

With the formstable, fully plastic installation system JRG Sanipex MT®, a gap in the JRG supplier assortment is closed – **thereby offering common advantages** – for heating and sanitation:

- **reliable for food stuffs**
- **formstable yet bendable by hand** (d16, d20 and d26**)
- **smaller bending radius with JRG Sanipex MT® bending tool*****
- **removable joints**, pipes and fittings re-usable
- **low noise conduction than pure metal pipe**
- **no limescale build-up deposits** (typical feature of JRG Sanipex MT®)
- **low axial expansion**
- **rapidly and simply installed** using lightweight tools
- **no outside energy necessary** for the dimensions d16, d20 and d26
- **Solder- and welding-free installation**
- **high durability**

During the planning phase, attention must be paid to the following system-specific physical operating parameters:

- max. 95° C
- max. 10 bar

Possible temperature- and pressure combinations:

- 70° C for an approved operating pressure of 10 bar*
- 95° C for an approved operating pressure of 6 bar*

*at a safety factor SF = 1.5; theoretical service-life of 50 years



NB

Operating temperature

JRG Sanipex MT® pipes are not to be used at an operating temperature > 95° C. Through the use of a suitable controlling circuit the operation of the water heating system under the above mentioned limit is guaranteed.

For sections of the plant with higher operating temperatures, even when short lived, suitable steel pipes can be employed.

**With bending tool Art.-Nr. 4852; bending radius 3.5d; d16 to d40

***With bending spring for bending tool; bending radius max. 1.5d; d16



NB

General-instructions

Whenever central heating plants are being planned or constructed the local laws, regulations and standards are to be observed!



NB

Heat measuring, Switzerland

New Centrally heated buildings having at least five heating consumers should be equipped with the necessary instruments for registering heat consumption.

(Accord. Energy usage regulations ENV Art. 8)



NB

Heating insulation, Switzerland

For technical equipment of buildings

New plant requirement

The following installations including fittings and pumps either newly constructed or as part of a renovations project, are to be insulated against heat loss with the following insulation capabilities:

- a) Distributor pipes for heating in unheated rooms,
- b) Hot water pipes in unheated rooms, except stub lines without accompanying trace heating to single tap points,
- c) Hot water pipes from circulation systems or hot water pipes with accompanying trace heating in heated rooms,
- d) Hot water pipes from storage up to and including distributor.

In justified cases, e.g. crossings, wall and ceiling penetration, for maximum flow temperatures of 30° C and for fittings, pumps, etc. the insulation capability can be reduced. The given insulation capabilities apply to operating temperatures of 90° C but for temperatures higher than this the insulating thicknesses are to be increased accordingly.

Nominal pipe width DN	Inches	Insulating capabilities at $\lambda > 0.03$ bis ≤ 0.05 W/m·K	Insulating capabilities at $\lambda \leq 0.03$ W/m·K
10 – 15	$\frac{3}{8}$ " – $\frac{1}{2}$ "	40 mm	30 mm
20 – 32	$\frac{3}{4}$ " – $1 \frac{1}{4}$ "	50 mm	40 mm
40 – 50	$1 \frac{1}{2}$ " – 2"	60 mm	50 mm
65 – 80	$2 \frac{1}{2}$ " – 3"	80 mm	60 mm
100 – 150	4" – 6"	100 mm	80 mm
175 – 200	7" – 8"	120 mm	80 mm

Table 6. Minimal insulation capability for heating and hot water pipes.

(Accord. hot water insulation regulations Building Authorities, Canton Zürich, Edition 2002)



NB

Heat measurement, Germany

Buildings with more than two apartments where one is used by the owner, must be equipped with instruments that record the heating consumption.

(Accord. Heating costs regulations – Heating Costs V)



NB

Heating insulation Germany

For all heating distribution systems as well as for all other hot water distributing pipes up to an operating temperature of 90°C.

**Regulation for energy saving heating insulation and energy saving installation techniques for buildings (Energy saving regulations - EnEV)
From 24 July 2007**

Add 5 (zu §14 Abs. 5)

Requirements for limiting the heat emission of heat distributors and hot water pipes as well as fittings.

1. The heat emission of heat distributors and hot water pipes and associated fittings is to be limited by means of heat insulation according to the values given in Table 1.

Table 1

Heating insulation of heat distributors and hot water pipes and fittings.

Line	Type of Pipe/Fitting	Minimal thickness of insulating layer, calculated for a heat conduction of 0,035 W/m·K
1	Inner diameter to 22 mm	20 mm
2	Inner diameter over 22 mm bis 35 mm	30 mm
3	Inner diameter over 35 mm bis 100 mm	same inner diameter
4	Inner diameter over 100 mm	100 mm
5	Pipes and fittings from Lines 1 to 4 in wall and ceiling penetration, in crossed areas of pipes, on pipe relay areas, and in central pipe network distributors	1/2 of the requirements Lines 1 to 4
6	Pipes of central heaters from Lines 1 to 4, that after 31. January 2002 will be laid for different users in building parts between heated rooms.	1/2 of the requirements Lines 1 to 4
7	Pipes from Line 6 for in-built floors	6 mm

Central heating pipes (Lines 1 to 4) located in heated rooms or in building areas between heated rooms of users, and where their heat emissions through freely laid blocking devices can be influenced, then no requirements regarding the minimal thickness of the insulating layer will be made. Hot water pipes up to an inside diameter of 22 mm that are neither in the circulation system nor equipped with additional electric heating, are exempted from the minimal insulation thickness requirements.

2. For materials with a heat conductivity other than 0,035 W/m·K the minimum insulating layer thickness must be calculated. For the calculation and the heat conductivity of the insulating materials one should consult the calculation procedures and critical values contained in recognized technical specifications
3. The minimum thickness of the insulation layer for heat distributing- and hot water pipes given in table 1 may possibly be reduced since equivalent heat loss limitation, also exist for other types of insulation and varying pipe wall thickness.

Modifying layouts and guidelines for **JRG Sanipex MT® Calor – form stable** –. Please take note of the layout type and guidelines of JRG Sanipex MT® on pages 19 to 32.

Heat distribution system

The heating element connections with JRG Sanipex MT® can be used in many ways. One can install heater connections for one and two pipe systems as well both systems combined or single rooms combined with floor heating (Childs bedroom/Bathroom/Shower).

- One pipe system for one pipe systems all radiator-one pipe valve to be linked in series. Several heating elements linked in series form a heat loop or ringed pipe system

 - Two pipe system for two pipe systems all heating elements (radiator valves, two pipe valves) should be linked in parallel. In multi-storey buildings attic or storey distributors and T-pieces are an alternative.

 - Two pipe system, "Tichelmann" The Tichelmann-System is a special form of a two pipe system. The first radiator in the flow line is the last in the return line. By this means all radiators have about the same pressure loss and warm up at the same rate.

 - Two pipe system, combined On the radiator return flow line a down stream heating panel can be connected. The return pipeline must be laid in undulations or loops. The radiator return line flow temperature must be limited to the temperature of the panel heating.

 - Laying as floor heating Single rooms can be fitted with a floor heating as an alternative to radiator heating without incurring extra costs for an additional heat source (infant's bedroom/bath/shower).
- When choosing the matching of temperatures between flow line and return flow, the maximum allowed floor heating surface temperature must be taken into consideration.

Radiator connection

Heating radiator connections for all standard or valve heaters (compact radiators) can be made right/left, above/below, from the wall and from the skirting boards.

The radiator valves are connected as wished at centre intervals of 35, 40, 45 and 50 mm. The Euro-tap block has hereby a central interval of 50 mm.

Connection types with JRG Sanipex MT® Calor

- Junction with cone (G ¾" Eurocone - d16/20)
- Flanged-Adapter (M22x1.5 - d16)
- Box 90°, Box 2fold 90° (R ½"-d16/20 or R ¾"-d20)
- Junction with outer thread, nickel (R ½"- d16)
- Radiator connecting bend, nickel (CU 15 mm - d16)
- Connecting pipe, nickel (R ½"x CU 15 mm, R ½"x CU 12 mm)
- Connection A11 (soft sealing G ¾" Euro cone)
- Via Radiator UP-connecting element (d16)
- Via Crosspiece (d16-16-16, d20-20-20, d20-16-20 and d20-16-16)
- Via MT-Baseboard -set (R ½"x CU 15 mm)

Heating elements connections (HKA) from the storey perspective

HKA in two pipe system from below

- 4707 Bend for radiator connection, nickel plated
- + 4660 Connection A11, nickel plated
- Alternative:
 - 4662/5490* Flared-adapter, nickel plated
 - 4663/5494* Adapter with cone, nickel plated
 - 4711 Connecting piece with external thread, nickel plated
 - 5400/5412* JRG Sanipex® box 90°
 - + 5496 Pipe for connections, nickel plated
 - + 4660 Connection A11, nickel plated

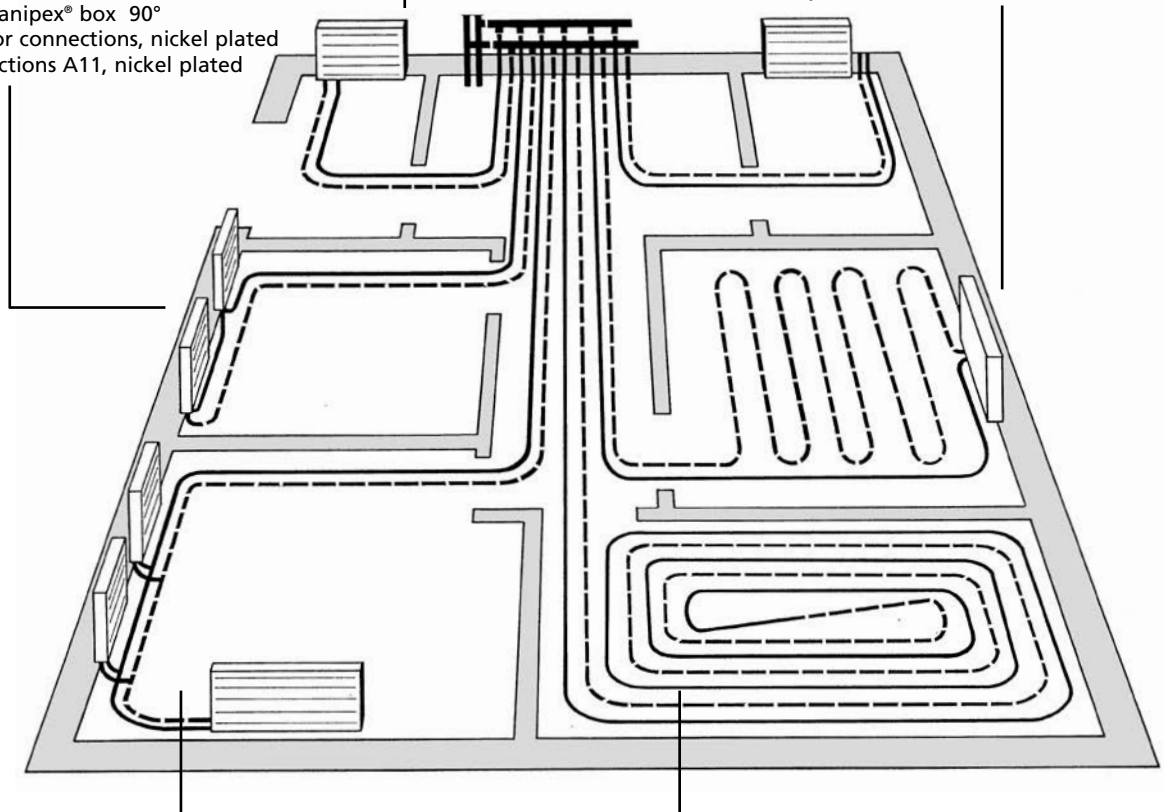
HKA in one pipe system

- 4707 Bend for radiator connection, nickel plated
- + 4660 Connection A11, nickel plated
- Alternative:
 - 4666 MT-Baseboard-set
 - 4662/5490* Flared-adapter, nickel plated
 - 4663/5494* Adapter with cone, nickel plated
 - 4711 Connecting piece with external thread, nickel plated
 - 5412* JRG Sanipex® box 90°
 - + 5496 Pipe for connections, nickel plated
 - + 4660 Connections A11, nickel plated

HKA in two pipe system out of the wall

- 4663/5494* Adapter with cone, nickel plated
- Eventually with:
 - + 4665 Concealed connection unit for radiator
 - + 4690 Coupling
- Alternative:
 - 4662/5490* Flared-adapter, nickel plated
 - 4707 Bend for radiator connection, nickel plated
 - 4711/5480* Connecting piece with external thread, nickel plated
 - 5412* JRG Sanipex® box 90°
 - + 5496 Pipe for connections, nickel plated
 - + 4660 Connection A11, nickel plated

The floor heating temperature can be adjusted by any commercially available return flow regulator



HKA in two pipe system with crosspiece or T-piece installation

- 4664 Cross-piece
- + 4707 Bend for radiator connection, nickel plated
- + 4660 Connections A11, nickel plated
- Alternative:
 - 4650/4652 T-piece installation
 - 4613/5434* Fitting connector, double
 - + 5409-10 Noise protection element
 - + 5496 Pipe for connections, nickel plated
 - + 4660 Connections A11, nickel plated

Comfort-floor heating

- 4604 JRG Sanipex MT® pipe in coils to 50 m, d16x2.25

* System part JRG Sanipex®, mounting pliers 5791

Pipe layout types

JRG Sanipex MT® pipes are intended for the following types of channelling:

- Channelling for raw floors (e.g. SFH)
- Channelling in the levelling layer (insulation)
- Channelling in the insulation
- Channelling in the ceiling

Pipe layout on cement ceiling in protective pipe adjacent to heated and same heat user

The heat emission of the heating element connector is influenced by blocking devices.

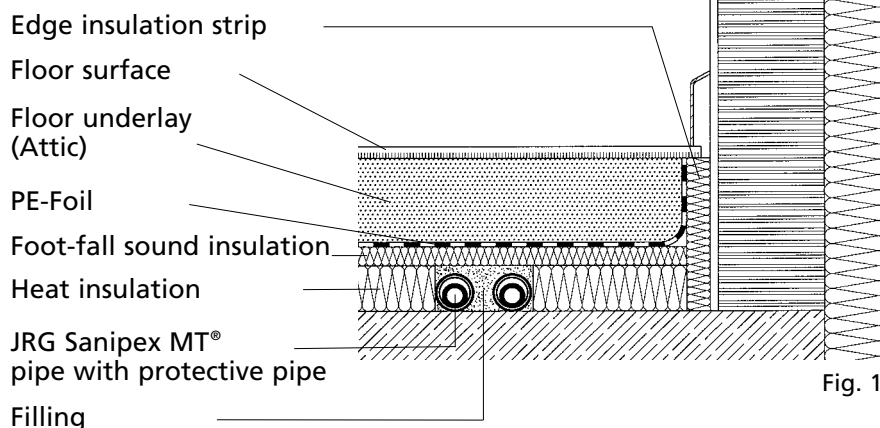


Fig. 1

Pipe layout on cement ceiling in the same equalizing layer (insulation) adjacent to the unheated and foreign heat user

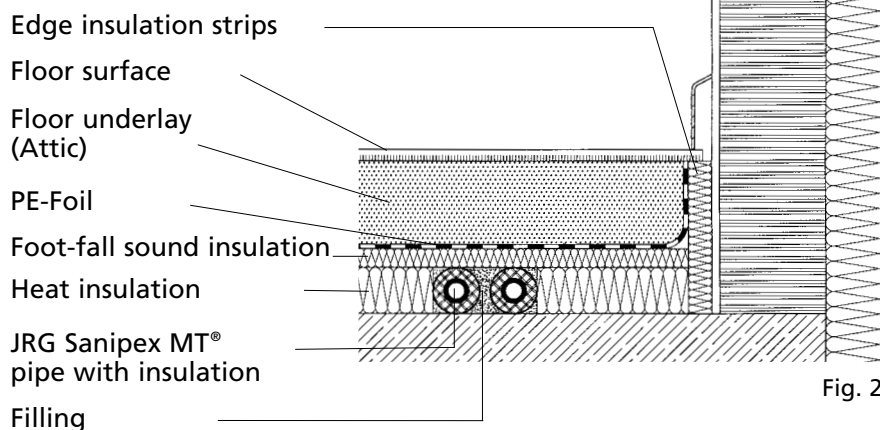


Fig. 2

Pipe layout on heat insulation in the same equalizing layer (insulation) adjacent to the unheated user

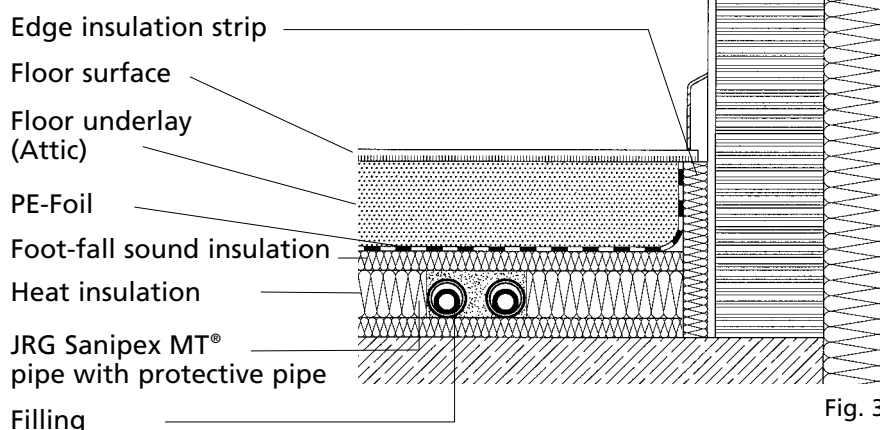
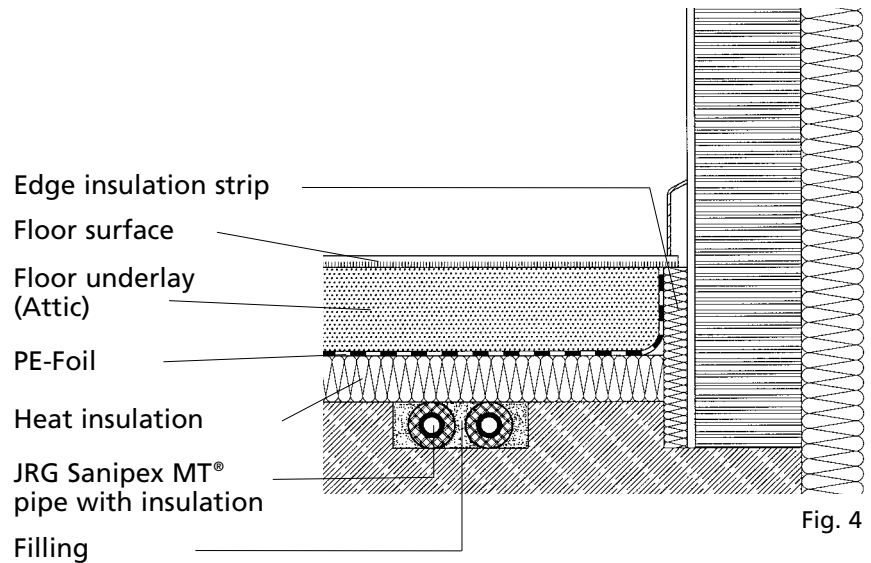
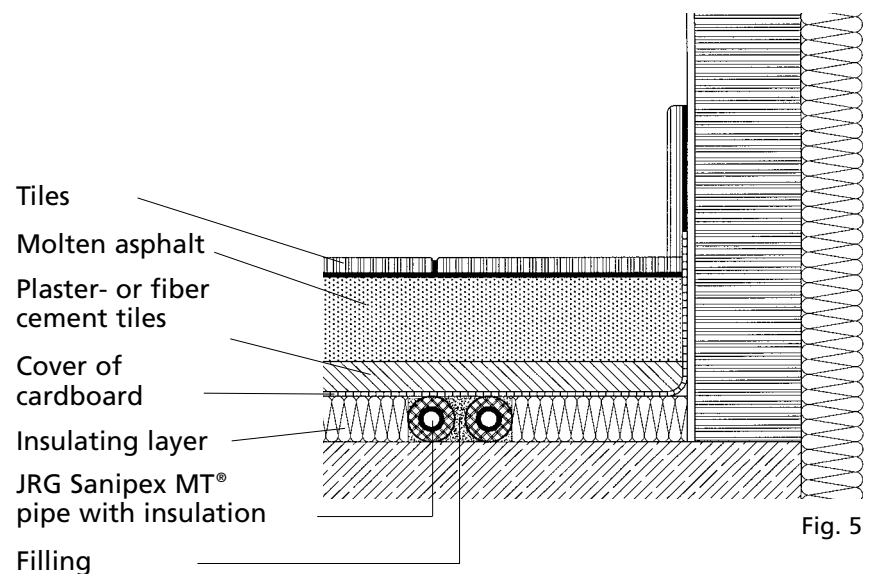


Fig. 3

Pipe layout on ceiling channel under the insulation adjacent to the unheated or incidental heat user



Pipe layout on heat insulation and covered with molten asphalt adjacent to the unheated or incidental heat user



Warning

Molten asphalt

In order to prevent heat damage the pipes must be constantly flushed with cold running water until the asphalt is completely cold.



NB

Securing the pipes

If the pipes are laid directly on raw cement ceilings then they must be secured according to the pertinent standards. A flat surface for absorbing the heat and insulation against footstep noise should be installed. Any hollow spaces which occur when laying should be filled out with a suitable bonding material. The pipe should be laid as straight as possible and run parallel to axis and walls.

Examples of radiator connections

Noise insulation

The sound of flow at radiator connections can be eliminated by using flanged connections from JRG Sanipex MT®. Full pipe cross section is guaranteed with all of JRG Sanipex MT® system components. This guarantees reduced water flow noise.

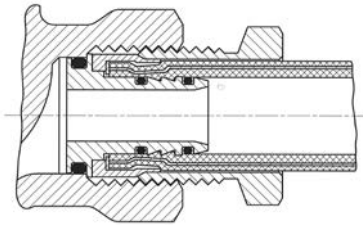


Fig.1 Standard

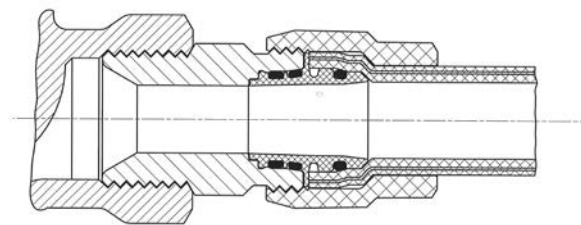


Fig. 2 JRG Sanipex MT® Calor



NB Illustrations

All radiator connections are illustrated without heating insulation. The insulation must be carried out in accordance with the local energy saving regulations (see chapter notes).

Connecting piece with external thread, nickel plated 4711/5480*

Connection for standard-radiator with standard-radiator valve, corner- or straight through type, connection from the wall.

Alternative:
Adapter with cone, nickel plated
G ¾"-Eurocone
4663/5494*

If radiator connections with added mechanical strength are desired. (e.g. for thick, heavy radiator we recommend):

Bend for radiator connection
4707
Connection A11, nickel plated
4660



Fig. 3

* System component JRG Sanipex®,
assembly pliers 5791

**Bend for radiator connection,
nickel plated
d16, CU 15x1
4707**

Connection of compact radiator
(valve radiator) with tap block from
underneath with:

**Connection A11, nickel plated
4660**



Fig. 4

**Adapter with cone, nickel plated
G ¾"-Eurocone
4663/5494.116***

Connection to radiator from under-
neath

If additional mechanical strength is
desired, we recommend:

**Bend for radiator connection,
nickel plated
4707**

**Connection A11, nickel plated
4660**



Fig. 5

* System component JRG Sanipex®,
assembly pliers 5791

Pipe guide bend-set 5736.051

Connection of radiator with
TKM-valve from underneath with:

Flared-adaptor, nickel plated
M22x1.5
4662/5490.016*
Pipe clamp
5744

* System component JRG Sanipex®,
assembly pliers 5791



Fig. 6

Junction with cone, nickel plated G 3/4"-Eurocone **4663/5494.116***

Connection from compact radiator
(valve radiator) with tap block out
of the wall

for TKM-valve:
Flanged-adaptor, nickel plated
by M22x1.5
4662/5490.016*

If radiator connections with added
mechanical strength are required
we recommend:

Bend for radiator connection,
nickel plated
4707
Connection A11, nickel plated
4660

* System component JRG Sanipex®,
assembly pliers 5791

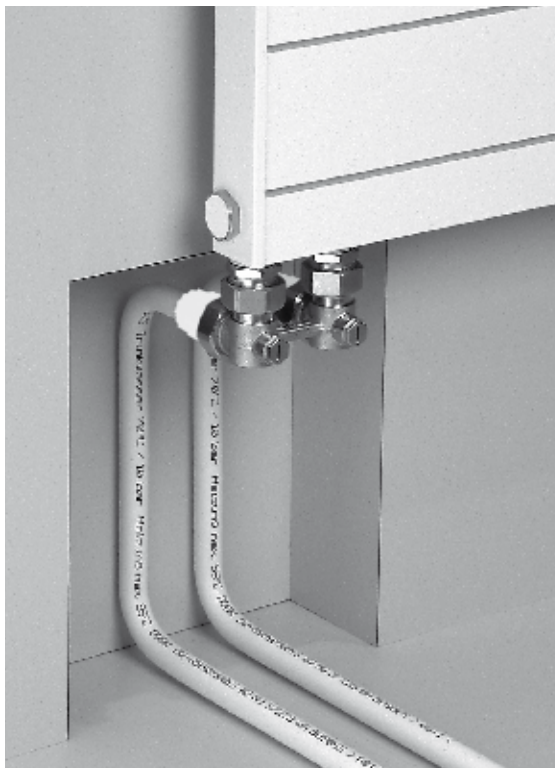


Fig. 7

Fitting connector, double 4613/5534*

Connection of compact radiator
(valve radiator) with tap block from
underneath with:

Noise protection element
5409-10
Pipe for connections, nickel plated
5496
Connection A11, nickel plated
4660

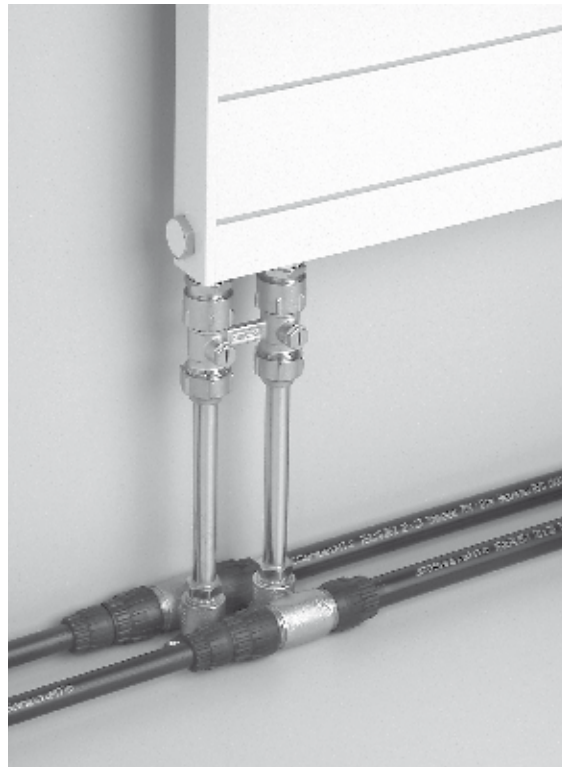


Fig. 8

* System component JRG Sanipex®,
assembly pliers 5791

Concealed connection unit for radiator 4665

Connection of compact radiator
(valve radiator) out of the wall.

With tap block:
Adapter with cone, nickel plated
G ¾"-Eurocone
4663/5494*

Connection height:
OK FFB min. 90 mm



Fig. 9

* System component JRG Sanipex®,
assembly pliers 5791, connection from
45 mm possible!



NB radiator connection

Using an expansion tool it is possible to make a radiator connection 50 mm out of the wall (Art.-Nr. 4830). Alternatively use clamped threaded coupling d16 x 2.25 mm.

MT baseboard-set 4666

Connection of compact radiator (valve radiator) with HZ-cut-off set from underneath, optional left or right under the radiator, mountable e.g. in the HZ-skirting board.

Connection thread GN 1/2" fits to HZ-clamp rings and HZ-clamp threaded coupling

Axis distance 50 mm

Connection dimensions:

d16 - 1/2" - 16, optional

d20 - 1/2" - 20, optional

d20 - 1/2" - 16, reduced

d16 - 1/2" - 20, reduced



Fig. 10

Cross-piece 4664

Cross piece for the cross-free parallel storey distributors.

High insulating shell 50 mm

Connection dimensions:

d16 - 16 - 16, optional

d20 - 20 - 20, optional

d20 - 16 - 20, reduced

d20 - 16 - 16, reduced



Fig. 11

Guidelines for piping high and low points

Inserts of bronze with male thread adapter or with female thread adapter
4696/4697

For the operation-and maintenance of the installation, always take into consideration air venting and draining.

Drain ball valve
6010/6012



Fig. 12



NB

Recommendation for heat measurement

From the heating sub-distributor – **each living unit** – we recommend connecting the radiator according to the star pipe principle. This allows individual heating costs to be estimated.

The self saturating regulation of room temperature is specified by law and also applies to area heating. For small enclosed rooms – **bathroom and toilets** – where the adjacent rooms profit from the higher temperature, the automatic regulator can be dispensed with (see local regulations).

JRG Sanipex MT® distributor

Connected with JRG Sanipex MT® pipe-in-pipe.

6023 Ball cock
5566 Junction
4640 Distributor 1-5 way
5431 Distribution-Set
5734 Marking sleeve
5740 Holder for distributor

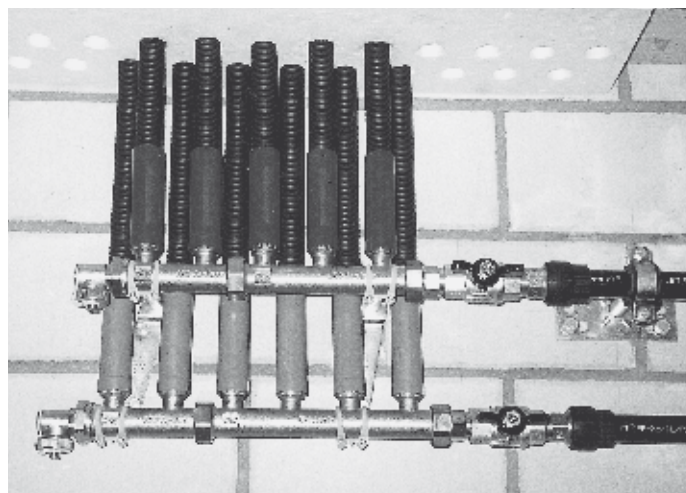


Fig. 13

JRG Sanipex MT® concealed distributor

Connected with JRG Sanipex MT®
pipe.

- 6023 Ball valve
- 5566 Adapter for distributor
- 4641 Distributor 1-5 way
- 5432 Distributor-Set
- 5734 Marking sleeve
- 5754 Bracket for distributor
- 5765 Built-in box for distributor

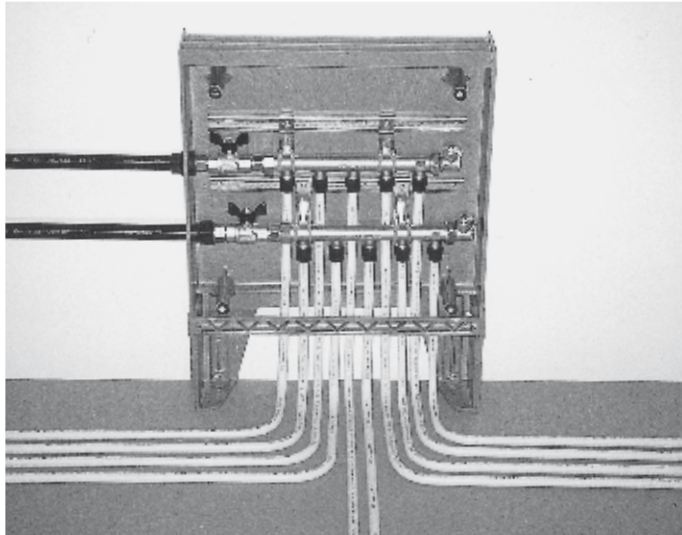


Fig. 14

Pipe laying in distributor area

Centre distances of parallel laid pipes
including the pipe insulation should
not exceed 30 cm.
Otherwise plan for a broader pipe
bundle with an interval of 20 cm.

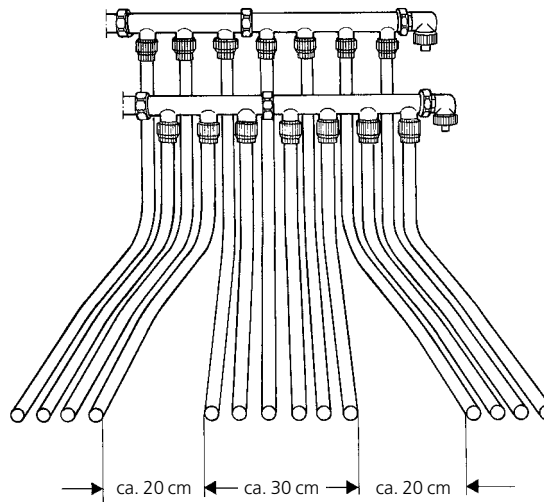


Fig. 15



NB

Floor underlay

On no account exceed the minimum covering thickness for heating pipes in
cement floors under lays of 45 mm and liquid floor under lays of 25 mm.
See local regulations.

Start of operation

Before starting to use the hot water heating system, all seals and all functional tests of the regulatory circuit should be checked. The start should be made in consultation with the construction managers and the future installation owner. These must verify the start of operations.



NB

Pressure tests of hot water heating system

We recommend testing the installation at a minimum of 4 bar and a maximum of 6 bar over 24 hours. Protect pressure sensitive parts of the installation with appropriate limiters.

The pressure checks should be made on the finished but not yet covered pipe system.

Extract from the VOB / DIN 18380: "Immediately before cold water pressure testing, the hot water system should be heated up to the highest calculation-based hot water temperature so as to test for the absence of leaks at the highest temperature".



NB

Heater water contents

In heating installations, poor water quality leads to damage through sedimentation, limescale formation and corrosion. To prevent damage, the reliability of the hot water chemical additives must be confirmed by the manufacturer. The requirements for heater water contents are given in the VDI-guidelines 2035 and SWKI 97-1.

Dimensioning of central heating pipes

The choice of JRG Sanipex MT® Calor pipes should be according to the required Mass flow [ṁ] for the respective pipe section. Depending upon the pipe dimensions $d_a \times s$ the water flow rate [v] and the pipe friction pressure gradient [R] both vary.



NB

Water flow rate/pressure gradient

We recommend the following flow rates [v] when laying the pipe network:

- Heating element-connecting pipe [v] $\leq 0.3 \text{ m/s}$
- Heating-distributor pipe [v] $\leq 0.5 \text{ m/s}$
- Heating-riser and cellar pipes [v] $\leq 0.8 \text{ m/s}$

- Take notice of economical pressure gradient [R]

(Pressure fall of : 100-150 Pa/m)!

Rough dimensioning

The planning of the pipe network should be done such that the water flow rate [v] from the heater to the most distant heating element declines uniformly. The following table gives the maximal heat production [$\dot{Q}_N$] and Mass flow [$\dot{m}_{\max}$] taking into account the maximum water flow rate which itself is dependent upon the pipe dimension and temperature difference (in Kelvin).

Heating element-connecting pipe [v] $\leq 0.3 \text{ m/s}$

MT-pipe $d_a \times s$ [mm]	16 x 2,25	20 x 2,5	26 x 3,0	32 x 3,0	40 x 3,5	50 x 4,0	63 x 4,5
Mass flow [kg/h]	115	193	344	-	-	-	-
Heat production $\dot{Q}_N$ [W] bei Δt :							
5K	669	1'122	2'000	-	-	-	-
10K	1'337	2'245	4'001	-	-	-	-
15K	2'006	3'367	6'001	-	-	-	-
20K	2'675	4'489	8'001	-	-	-	-

Heating-distributor pipe [v] $\leq 0.5 \text{ m/s}$

MT-pipe $d_a \times s$ [mm]	16 x 2,25	20 x 2,5	26 x 3,0	32 x 3,0	40 x 3,5	50 x 4,0	63 x 4,5
Mass flow [kg/h]	190	315	570	975	1'550	2'470	-
Heat production $\dot{Q}_N$ [W] bei Δt :							
5K	1'105	1'832	3'315	5'670	9'013	14'363	-
10K	2'210	3'663	6'629	11'339	18'027	28'726	-
15K	3'315	5'495	9'944	17'009	27'040	43'089	-
20K	4'419	7'327	13'258	22'679	36'053	57'452	-

Heating-riser- and basement pipes [v] $\leq 0.8 \text{ m/s}$

MT-pipe $d_a \times s$ [mm]	16 x 2,25	20 x 2,5	26 x 3,0	32 x 3,0	40 x 3,5	50 x 4,0	63 x 4,5
Mass flow [kg/h]	300	515	900	1'540	2'490	3'980	6'660
Heat production $\dot{Q}_N$ [W] bei Δt :							
5K	1'745	2'995	5'234	8'955	14'479	23'144	38'728
10K	3'489	5'989	10'467	17'910	28'959	46'287	77'456
15K	5'234	8'984	15'701	26'865	43'438	69'431	116'184
20K	6'978	11'979	20'934	35'820	57'917	92'575	154'912

Example

Calculating the mass-flow [ṁ] in kg/h (Flow mass)

Formula: $\dot{Q}_N = \dot{m} \cdot c \cdot \Delta t$

$$\text{Flow mass } [\dot{m}] = \frac{\dot{Q}_N}{c \cdot \Delta t} = \frac{500 \text{ W}}{1.163 \frac{\text{Wh}}{\text{kg K}} \cdot 20 \text{ K}} = 21.5 \text{ kg/h}$$

Remarks

In the case of system bound heating loops (single pipe heating) the whole loop flow mass of all heating elements must be considered!

Conversion

100.000 Pascal (Pa) = 1.000 mbar = 1 bar

Nomogram-pipe friction pressure decline

The pressure fall diagram contains the pipe system characteristic curves for **JRG Sanipex MT® Calor**-pipes with the various dimensions as well as the limits for the water flow rates.

For a given flow rate (mass flow) the pipe system resistance, (which is dependent upon the pipe dimension and on the flow rate), can be determined in a simple graphical manner that is valid for a mean water temperature of 50° C.

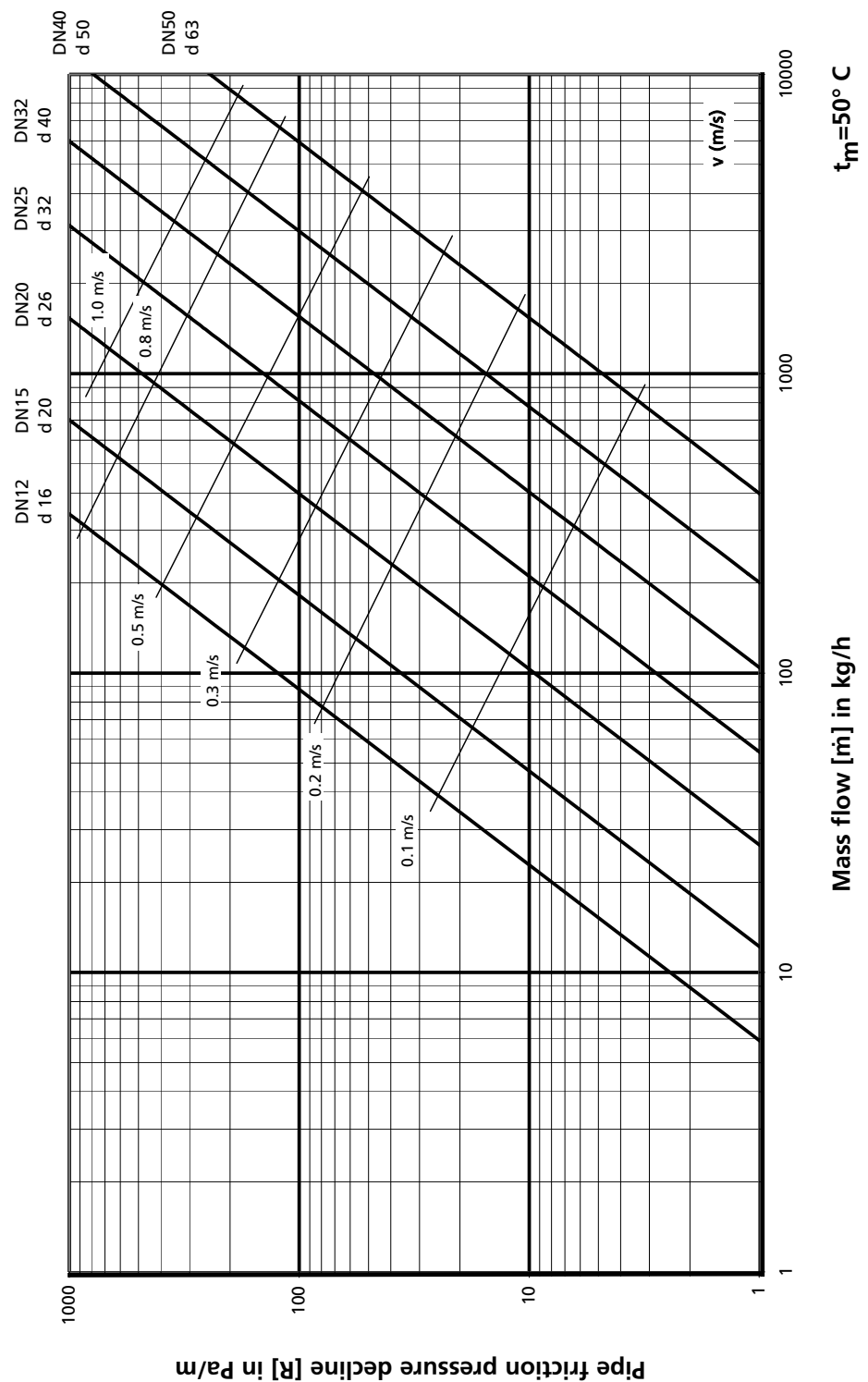
Calculation example:

Given: mass flow $\dot{m}$ = 90 kg/h

Wanted: Pressure decline [R]

Result: Flow rate (d16 x 2.25) $[v] = 0.24$ m/s, pressure decline $[R] = 103$ Pa/m

Pipe friction pressure decline dependent upon mass flow
at a middle temperature of t_m 50° C



Pipe friction pressure decline for water is dependent upon the heat resp. mass flow [m] at medium water temperature [t_m] of 40° C.



NB
Layout table

Recommendation:
Heating element-connecting pipe [v] ≤ 0.3 m/s
Heating-distributor pipe [v] ≤ 0.5 m/s
Heating riser- and Cellar pipes [v] ≤ 0.8 m/s

Layout table: 45/35° C

Spread = 10 K

Pipe dimension	d	16		20		26		32		40		50		63	
Nominal width	DN	12		15		20		25		32		40		50	
		v	R	v	R	v	R	v	R	v	R	v	R	v	R
Q [W]	[kg/h]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]
150	13	0.03	4												
300	26	0.07	13												
400	34	0.09	21	0.05	6										
500	43	0.11	31	0.07	9										
600	52	0.14	42	0.08	12										
700	60	0.16	54	0.09	16										
800	69	0.18	68	0.11	20	0.06	5								
900	77	0.21	83	0.12	24	0.07	6								
1'000	86	0.23	100	0.14	29	0.08	8								
1'100	95	0.25	117	0.15	34	0.08	9								
1'200	103	0.28	136	0.16	40	0.09	10								
1'300	112	0.30	156	0.18	45	0.10	12								
1'400	120	0.32	177	0.19	52	0.11	14								
1'500	129	0.34	199	0.20	58	0.11	15								
1'600	138	0.37	222	0.22	65	0.12	17	0.07	5						
1'700	146	0.39	247	0.23	72	0.13	19	0.08	6						
1'800	155	0.41	272	0.24	79	0.14	21	0.08	6						
1'900	163	0.44	298	0.26	87	0.14	23	0.09	7						
2'000	172	0.46	325	0.27	95	0.15	25	0.09	7						
2'500	215	0.57	476	0.34	139	0.19	36	0.11	11						
3'000	258	0.69	650	0.41	189	0.23	50	0.13	15	0.08	5				
3'500	301	0.80	846	0.47	246	0.27	65	0.16	19	0.10	6				
4'000	344			0.54	309	0.30	81	0.18	24	0.11	8				
4'500	387			0.61	378	0.34	99	0.20	29	0.13	10				
5'000	430			0.68	453	0.38	119	0.22	35	0.14	12				
5'500	473			0.74	533	0.42	140	0.25	41	0.15	14				
6'000	516			0.81	618	0.46	163	0.27	48	0.17	16	0.10	5		
6'500	559					0.49	186	0.29	55	0.18	18	0.11	6		
7'000	602					0.53	211	0.31	63	0.20	21	0.12	7		
7'500	645					0.57	238	0.34	70	0.21	23	0.13	8		
8'000	688					0.61	266	0.36	79	0.22	26	0.14	8		
8'500	731					0.65	295	0.38	87	0.24	29	0.15	9		
9'000	774					0.68	325	0.40	96	0.25	32	0.16	10		
9'500	817					0.72	356	0.43	105	0.27	35	0.16	11		
10'000	860					0.76	389	0.45	115	0.28	38	0.17	12		
10'500	903					0.80	422	0.47	125	0.29	41	0.18	13		
11'000	946					0.84	457	0.49	135	0.31	45	0.19	15		
11'500	989					0.87	493	0.52	146	0.32	48	0.20	16		
12'000	1'032					0.91	531	0.54	157	0.34	52	0.21	17	0.13	5
12'500	1'075					0.95	569	0.56	168	0.35	56	0.22	18	0.13	6
13'000	1'118					0.99	608	0.58	180	0.36	59	0.22	19	0.14	6
13'500	1'161					1.03	649	0.61	192	0.38	63	0.23	21	0.14	6
14'000	1'204							0.63	204	0.39	67	0.24	22	0.15	7
14'500	1'247							0.65	217	0.40	72	0.25	23	0.15	7
15'000	1'290							0.67	230	0.42	76	0.26	25	0.16	8
15'500	1'333							0.70	243	0.43	80	0.27	26	0.16	8
16'000	1'376							0.72	256	0.45	85	0.28	28	0.17	9
16'500	1'419							0.74	270	0.46	89	0.28	29	0.17	9
17'000	1'462							0.76	284	0.47	94	0.29	31	0.18	10

Layout table: 45/35° C

Spread = 10 K

Pipe dimension	d	16		20		26		32		40		50		63	
Nominal width	DN	12		15		20		25		32		40		50	
		v	R	v	R	v	R	v	R	v	R	v	R	v	R
Q [W]	[kg/h]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]
17'500	1'505							0.79	299	0.49	99	0.30	32	0.18	10
18'000	1'548							0.81	313	0.50	104	0.31	34	0.19	11
18'500	1'591							0.83	328	0.52	109	0.32	35	0.19	11
19'000	1'634							0.85	344	0.53	114	0.33	37	0.20	12
19'500	1'677							0.88	359	0.54	119	0.34	39	0.20	12
20'000	1'720							0.90	375	0.56	124	0.34	40	0.21	13
20'500	1'763							0.92	391	0.57	129	0.35	42	0.21	13
21'000	1'806							0.94	408	0.59	135	0.36	44	0.22	14
21'500	1'849							0.97	425	0.60	140	0.37	46	0.22	14
22'000	1'892							0.99	442	0.61	146	0.38	48	0.23	15
22'500	1'935							1.01	459	0.63	152	0.39	50	0.23	15
23'000	1'978									0.64	157	0.40	51	0.24	16
23'500	2'021									0.66	163	0.41	53	0.25	17
24'000	2'064									0.67	169	0.41	55	0.25	17
24'500	2'107									0.68	175	0.42	57	0.26	18
25'000	2'150									0.70	182	0.43	59	0.26	18
25'500	2'193									0.71	188	0.44	61	0.27	19
26'000	2'236									0.73	194	0.45	63	0.27	20
26'500	2'279									0.74	201	0.46	65	0.28	20
27'000	2'322									0.75	207	0.47	68	0.28	21
27'500	2'365									0.77	214	0.47	70	0.29	22
28'000	2'408									0.78	220	0.48	72	0.29	22
28'500	2'451									0.80	227	0.49	74	0.30	23
29'000	2'494									0.81	234	0.50	76	0.30	24
29'500	2'537									0.82	241	0.51	79	0.31	24
30'000	2'580									0.84	248	0.52	81	0.31	25
31'000	2'666									0.87	262	0.53	86	0.32	27
32'000	2'752									0.89	277	0.55	90	0.33	28
33'000	2'837									0.92	292	0.57	95	0.34	30
34'000	2'923									0.95	307	0.59	100	0.35	31
35'000	3'009									0.98	322	0.60	105	0.37	33
36'000	3'095									1.01	338	0.62	110	0.38	34
37'000	3'181									1.03	354	0.64	116	0.39	36
38'000	3'267									1.06	371	0.66	121	0.40	38
39'000	3'353									1.09	388	0.67	127	0.41	39
40'000	3'439											0.69	132	0.42	41
41'000	3'525											0.71	138	0.43	43
42'000	3'611											0.72	144	0.44	45
43'000	3'697											0.74	150	0.45	47
44'000	3'783											0.76	156	0.46	48
45'000	3'869											0.78	162	0.47	50
46'000	3'955											0.79	168	0.48	52
47'000	4'041											0.81	174	0.49	54
48'000	4'127											0.83	180	0.50	56
49'000	4'213											0.84	187	0.51	58
50'000	4'299											0.86	193	0.52	60
52'500	4'514											0.91	210	0.55	65
55'000	4'729											0.95	228	0.57	71
57'500	4'944											0.99	246	0.60	76
60'000	5'159											1.03	264	0.63	82
62'500	5'374											1.08	283	0.65	88
65'000	5'589											1.12	303	0.68	94
67'500	5'804											1.16	323	0.70	101
70'000	6'019											1.21	343	0.73	107

Layout table: 45/35° C

Spread = 10 K

Pipe dimension	d	16		20		26		32		40		50		63	
Nominal width	DN	12		15		20		25		32		40		50	
		v	R	v	R	v	R	v	R	v	R	v	R	v	R
Q [W]	[kg/h]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]
72'500	6'234											1.25	365	0.76	114
75'000	6'449											1.29	386	0.78	120
77'500	6'664													0.81	127
80'000	6'879													0.83	134
82'500	7'094													0.86	142
85'000	7'309													0.89	149
87'500	7'524													0.91	157
90'000	7'739													0.94	164
92'500	7'954													0.96	172
95'000	8'169													0.99	180
97'500	8'383													1.02	188
100'000	8'598													1.04	197
105'000	9'028													1.10	214
110'000	9'458													1.15	231
115'000	9'888													1.20	250
120'000	10'318													1.25	268

Pipe friction pressure decline for water is dependent upon the heat resp. mass flow [m] at medium water temperature [t_m] of 50° C.



NB
Layout table

Recommendation:

Heating element-connecting pipe [v] ≤ 0.3 m/s
Heating-distributor pipe [v] ≤ 0.5 m/s
Heating riser- and Cellar pipes [v] ≤ 0.8 m/s

Layout table: 55/45° C

Spread = 10 K

Pipe dimension	d	16		20		26		32		40		50		63	
Nominal width	DN	12		15		20		25		32		40		50	
		v	R	v	R	v	R	v	R	v	R	v	R	v	R
Q [W]	[kg/h]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]
150	13	0.03	4												
300	26	0.07	12												
400	34	0.09	20	0.05	6										
500	43	0.11	29	0.07	9										
600	52	0.14	40	0.08	12										
700	60	0.16	52	0.09	15										
800	69	0.18	65	0.11	19	0.06	5								
900	77	0.21	80	0.12	23	0.07	6								
1'000	86	0.23	96	0.14	28	0.08	7								
1'100	95	0.25	113	0.15	33	0.08	9								
1'200	103	0.28	131	0.16	38	0.09	10								
1'300	112	0.30	150	0.18	44	0.10	11								
1'400	120	0.32	170	0.19	49	0.11	13								
1'500	129	0.34	191	0.20	56	0.11	15								
1'600	138	0.37	213	0.22	62	0.12	16								
1'700	146	0.39	237	0.23	69	0.13	18	0.08	5						
1'800	155	0.41	261	0.24	76	0.14	20	0.08	6						
1'900	163	0.44	286	0.26	83	0.14	22	0.09	6						
2'000	172	0.46	312	0.27	91	0.15	24	0.09	7						
2'500	215	0.57	457	0.34	133	0.19	35	0.11	10						
3'000	258	0.69	624	0.41	182	0.23	48	0.13	14	0.08	5				
3'500	301	0.80	812	0.47	236	0.27	62	0.16	18	0.10	6				
4'000	344			0.54	297	0.30	78	0.18	23	0.11	8				
4'500	387			0.61	363	0.34	95	0.20	28	0.13	9				
5'000	430			0.68	435	0.38	114	0.22	34	0.14	11				
5'500	473			0.74	511	0.42	134	0.25	40	0.15	13				
6'000	516			0.81	593	0.46	156	0.27	46	0.17	15	0.10	5		
6'500	559					0.49	179	0.29	53	0.18	17	0.11	6		
7'000	602					0.53	203	0.31	60	0.20	20	0.12	6		
7'500	645					0.57	228	0.34	68	0.21	22	0.13	7		
8'000	688					0.61	255	0.36	75	0.22	25	0.14	8		
8'500	731					0.65	283	0.38	84	0.24	28	0.15	9		
9'000	774					0.68	312	0.40	92	0.25	30	0.16	10		
9'500	817					0.72	342	0.43	101	0.27	33	0.16	11		
10'000	860					0.76	373	0.45	110	0.28	36	0.17	12		
10'500	903					0.80	405	0.47	120	0.29	40	0.18	13		
11'000	946					0.84	439	0.49	130	0.31	43	0.19	14		
11'500	989					0.87	473	0.52	140	0.32	46	0.20	15		
12'000	1'032					0.91	509	0.54	151	0.34	50	0.21	16	0.13	5
12'500	1'075					0.95	546	0.56	161	0.35	53	0.22	17	0.13	5
13'000	1'118					0.99	584	0.58	173	0.36	57	0.22	19	0.14	6
13'500	1'161					1.03	623	0.61	184	0.38	61	0.23	20	0.14	6
14'000	1'204							0.63	196	0.39	65	0.24	21	0.15	7
14'500	1'247							0.65	208	0.40	69	0.25	22	0.15	7
15'000	1'290							0.67	220	0.42	73	0.26	24	0.16	7
15'500	1'333							0.70	233	0.43	77	0.27	25	0.16	8
16'000	1'376							0.72	246	0.45	81	0.28	27	0.17	8
16'500	1'419							0.74	259	0.46	86	0.28	28	0.17	9
17'000	1'462							0.76	273	0.47	90	0.29	29	0.18	9

Layout table: 55/45° C

Spread = 10 K

Pipe dimension	d	16		20		26		32		40		50		63	
Nominal width	DN	12		15		20		25		32		40		50	
		v	R	v	R	v	R	v	R	v	R	v	R	v	R
Q [W]	[kg/h]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]
17'500	1'505							0.79	287	0.49	95	0.30	31	0.18	10
18'000	1'548							0.81	301	0.50	99	0.31	32	0.19	10
18'500	1'591							0.83	315	0.52	104	0.32	34	0.19	11
19'000	1'634							0.85	330	0.53	109	0.33	36	0.20	11
19'500	1'677							0.88	345	0.54	114	0.34	37	0.20	12
20'000	1'720							0.90	360	0.56	119	0.34	39	0.21	12
20'500	1'763							0.92	376	0.57	124	0.35	41	0.21	13
21'000	1'806							0.94	391	0.59	129	0.36	42	0.22	13
21'500	1'849							0.97	407	0.60	135	0.37	44	0.22	14
22'000	1'892							0.99	424	0.61	140	0.38	46	0.23	14
22'500	1'935							1.01	440	0.63	146	0.39	48	0.23	15
23'000	1'978									0.64	151	0.40	49	0.24	15
23'500	2'021									0.66	157	0.41	51	0.25	16
24'000	2'064									0.67	163	0.41	53	0.25	17
24'500	2'107									0.68	168	0.42	55	0.26	17
25'000	2'150									0.70	174	0.43	57	0.26	18
25'500	2'193									0.71	180	0.44	59	0.27	18
26'000	2'236									0.73	186	0.45	61	0.27	19
26'500	2'279									0.74	192	0.46	63	0.28	20
27'000	2'322									0.75	199	0.47	65	0.28	20
27'500	2'365									0.77	205	0.47	67	0.29	21
28'000	2'408									0.78	211	0.48	69	0.29	21
28'500	2'451									0.80	218	0.49	71	0.30	22
29'000	2'494									0.81	224	0.50	73	0.30	23
29'500	2'537									0.82	231	0.51	75	0.31	23
30'000	2'580									0.84	238	0.52	78	0.31	24
31'000	2'666									0.87	252	0.53	82	0.32	26
32'000	2'752									0.89	266	0.55	87	0.33	27
33'000	2'837									0.92	280	0.57	91	0.34	28
34'000	2'923									0.95	294	0.59	96	0.35	30
35'000	3'009									0.98	309	0.60	101	0.37	31
36'000	3'095									1.01	325	0.62	106	0.38	33
37'000	3'181									1.03	340	0.64	111	0.39	35
38'000	3'267									1.06	356	0.66	116	0.40	36
39'000	3'353									1.09	372	0.67	121	0.41	38
40'000	3'439									1.12	389	0.69	127	0.42	40
41'000	3'525											0.71	132	0.43	41
42'000	3'611											0.72	138	0.44	43
43'000	3'697											0.74	144	0.45	45
44'000	3'783											0.76	149	0.46	46
45'000	3'869											0.78	155	0.47	48
46'000	3'955											0.79	161	0.48	50
47'000	4'041											0.81	167	0.49	52
48'000	4'127											0.83	173	0.50	54
49'000	4'213											0.84	179	0.51	56
50'000	4'299											0.86	186	0.52	58
52'500	4'514											0.91	202	0.55	63
55'000	4'729											0.95	218	0.57	68
57'500	4'944											0.99	236	0.60	73
60'000	5'159											1.03	253	0.63	79
62'500	5'374											1.08	272	0.65	85
65'000	5'589											1.12	290	0.68	90
67'500	5'804											1.16	310	0.70	96
70'000	6'019											1.21	330	0.73	103

Layout table: 55/45° C

Spread = 10 K

Pipe dimension	d	16		20		26		32		40		50		63	
Nominal width	DN	12		15		20		25		32		40		50	
		v	R	v	R	v	R	v	R	v	R	v	R	v	R
Q [W]	[kg/h]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]
72'500	6'234											1.25	350	0.76	109
75'000	6'449											1.29	371	0.78	115
77'500	6'664													0.81	122
80'000	6'879													0.83	129
82'500	7'094													0.86	136
85'000	7'309													0.89	143
87'500	7'524													0.91	150
90'000	7'739													0.94	158
92'500	7'954													0.96	165
95'000	8'169													0.99	173
97'500	8'383													1.02	181
100'000	8'598													1.04	189
105'000	9'028													1.10	205
110'000	9'458													1.15	222
115'000	9'888													1.20	239
120'000	10'318													1.25	258

Pipe friction pressure decline for water is dependent upon the heat resp. mass flow [m] at medium water temperature [t_m] of 62.5° C.



NB
Layout table

Recommendation:
Heating element-connecting pipe [v] ≤ 0.3 m/s
Heating-distributor pipe [v] ≤ 0.5 m/s
Heating riser- and Cellar pipes [v] ≤ 0.8 m/s

Layout table: 70/55° C

Spread = 15 K

Pipe dimension	d	16		20		26		32		40		50		63	
Nominal width	DN	12		15		20		25		32		40		50	
		v	R	v	R	v	R	v	R	v	R	v	R	v	R
Q [W]	[kg/h]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]
150	9	0.02	2												
300	17	0.05	6												
400	23	0.06	10												
500	29	0.08	14												
600	34	0.09	19	0.05	6										
700	40	0.11	25	0.06	7										
800	46	0.12	31	0.07	9										
900	52	0.14	38	0.08	11										
1'000	57	0.15	46	0.09	13										
1'100	63	0.17	54	0.10	16										
1'200	69	0.18	62	0.11	18										
1'300	75	0.20	72	0.12	21	0.07	5								
1'400	80	0.21	81	0.13	24	0.07	6								
1'500	86	0.23	91	0.14	27	0.08	7								
1'600	92	0.25	102	0.14	30	0.08	8								
1'700	97	0.26	113	0.15	33	0.09	9								
1'800	103	0.28	125	0.16	36	0.09	10								
1'900	109	0.29	137	0.17	40	0.10	10								
2'000	115	0.31	149	0.18	43	0.10	11								
2'500	143	0.38	219	0.23	64	0.13	17	0.07	5						
3'000	172	0.46	298	0.27	87	0.15	23	0.09	7						
3'500	201	0.54	388	0.32	113	0.18	30	0.10	9						
4'000	229	0.61	487	0.36	142	0.20	37	0.12	11						
4'500	258	0.69	596	0.41	174	0.23	46	0.13	14						
5'000	287	0.77	713	0.45	208	0.25	55	0.15	16	0.09	5				
5'500	315	0.84	839	0.50	244	0.28	64	0.16	19	0.10	6				
6'000	344			0.54	284	0.30	75	0.18	22	0.11	7				
6'500	373			0.59	325	0.33	86	0.19	25	0.12	8				
7'000	401			0.63	369	0.35	97	0.21	29	0.13	9				
7'500	430			0.68	415	0.38	109	0.22	32	0.14	11				
8'000	459			0.72	463	0.41	122	0.24	36	0.15	12				
8'500	487			0.77	514	0.43	135	0.25	40	0.16	13				
9'000	516			0.81	567	0.46	149	0.27	44	0.17	15				
9'500	545					0.48	163	0.28	48	0.18	16	0.11	5		
10'000	573					0.51	178	0.30	53	0.19	17	0.11	6		
10'500	602					0.53	194	0.31	57	0.20	19	0.12	6		
11'000	631					0.56	210	0.33	62	0.20	21	0.13	7		
11'500	659					0.58	226	0.34	67	0.21	22	0.13	7		
12'000	688					0.61	243	0.36	72	0.22	24	0.14	8		
12'500	717					0.63	261	0.37	77	0.23	26	0.14	8		
13'000	745					0.66	279	0.39	83	0.24	27	0.15	9		
13'500	774					0.68	298	0.40	88	0.25	29	0.16	10		
14'000	803					0.71	317	0.42	94	0.26	31	0.16	10		
14'500	831					0.73	336	0.43	99	0.27	33	0.17	11		
15'000	860					0.76	356	0.45	105	0.28	35	0.17	11		
15'500	889					0.79	377	0.46	111	0.29	37	0.18	12		
16'000	917					0.81	398	0.48	118	0.30	39	0.18	13		
16'500	946					0.84	419	0.49	124	0.31	41	0.19	13		
17'000	974					0.86	441	0.51	130	0.32	43	0.20	14		

Layout table: 70/55° C

Spread = 15 K

Pipe dimension	d	16		20		26		32		40		50		63	
Nominal width	DN	12		15		20		25		32		40		50	
		v	R	v	R	v	R	v	R	v	R	v	R	v	R
Q [W]	[kg/h]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]
17'500	1'003					0.89	463	0.52	137	0.33	45	0.20	15		
18'000	1'032					0.91	486	0.54	144	0.34	48	0.21	16		
18'500	1'060					0.94	510	0.55	151	0.34	50	0.21	16		
19'000	1'089					0.96	533	0.57	158	0.35	52	0.22	17	0.13	5
19'500	1'118					0.99	557	0.58	165	0.36	55	0.22	18	0.14	6
20'000	1'146					1.01	582	0.60	172	0.37	57	0.23	19	0.14	6
20'500	1'175							0.61	180	0.38	59	0.24	19	0.14	6
21'000	1'204							0.63	187	0.39	62	0.24	20	0.15	6
21'500	1'232							0.64	195	0.40	64	0.25	21	0.15	7
22'000	1'261							0.66	203	0.41	67	0.25	22	0.15	7
22'500	1'290							0.67	211	0.42	70	0.26	23	0.16	7
23'000	1'318							0.69	219	0.43	72	0.26	24	0.16	7
23'500	1'347							0.70	227	0.44	75	0.27	24	0.16	8
24'000	1'376							0.72	235	0.45	78	0.28	25	0.17	8
24'500	1'404							0.73	243	0.46	80	0.28	26	0.17	8
25'000	1'433							0.75	252	0.47	83	0.29	27	0.17	8
25'500	1'462							0.76	261	0.47	86	0.29	28	0.18	9
26'000	1'490							0.78	269	0.48	89	0.30	29	0.18	9
26'500	1'519							0.79	278	0.49	92	0.30	30	0.18	9
27'000	1'548							0.81	287	0.50	95	0.31	31	0.19	10
27'500	1'576							0.82	297	0.51	98	0.32	32	0.19	10
28'000	1'605							0.84	306	0.52	101	0.32	33	0.19	10
28'500	1'634							0.85	315	0.53	104	0.33	34	0.20	11
29'000	1'662							0.87	325	0.54	107	0.33	35	0.20	11
29'500	1'691							0.88	334	0.55	111	0.34	36	0.21	11
30'000	1'720							0.90	344	0.56	114	0.34	37	0.21	12
31'000	1'777							0.93	364	0.58	120	0.36	39	0.22	12
32'000	1'834							0.96	384	0.60	127	0.37	41	0.22	13
33'000	1'892							0.99	405	0.61	134	0.38	44	0.23	14
34'000	1'949							1.02	426	0.63	141	0.39	46	0.24	14
35'000	2'006									0.65	148	0.40	48	0.24	15
36'000	2'064									0.67	155	0.41	51	0.25	16
37'000	2'121									0.69	163	0.43	53	0.26	17
38'000	2'178									0.71	170	0.44	56	0.26	17
39'000	2'236									0.73	178	0.45	58	0.27	18
40'000	2'293									0.74	186	0.46	61	0.28	19
41'000	2'350									0.76	194	0.47	63	0.29	20
42'000	2'408									0.78	202	0.48	66	0.29	21
43'000	2'465									0.80	210	0.49	69	0.30	21
44'000	2'522									0.82	219	0.51	71	0.31	22
45'000	2'580									0.84	227	0.52	74	0.31	23
46'000	2'637									0.86	236	0.53	77	0.32	24
47'000	2'694									0.88	245	0.54	80	0.33	25
48'000	2'752									0.89	254	0.55	83	0.33	26
49'000	2'809									0.91	263	0.56	86	0.34	27
50'000	2'866									0.93	272	0.57	89	0.35	28
52'500	3'009									0.98	296	0.60	96	0.37	30
55'000	3'153									1.02	320	0.63	104	0.38	33
57'500	3'296											0.66	113	0.40	35
60'000	3'439											0.69	121	0.42	38
62'500	3'583											0.72	130	0.43	40
65'000	3'726											0.75	139	0.45	43
67'500	3'869											0.78	148	0.47	46
70'000	4'013											0.80	158	0.49	49

Layout table: 70/55° C

Spread = 15 K

Pipe dimension	d	16		20		26		32		40		50		63	
Nominal width	DN	12		15		20		25		32		40		50	
		v	R	v	R	v	R	v	R	v	R	v	R	v	R
Q [W]	[kg/h]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]	[m/s]	[Pa/m]
77'500	4'443											0.89	188	0.54	58
80'000	4'586											0.92	198	0.56	62
82'500	4'729											0.95	209	0.57	65
85'000	4'872											0.98	220	0.59	68
87'500	5'016											1.01	231	0.61	72
90'000	5'159											1.03	242	0.63	75
92'500	5'302											1.06	254	0.64	79
95'000	5'446											1.09	265	0.66	83
97'500	5'589											1.12	277	0.68	86
100'000	5'732											1.15	290	0.70	90
105'000	6'019											1.21	315	0.73	98
110'000	6'306													0.76	106
115'000	6'592													0.80	115
120'000	6'879													0.83	123
125'000	7'165													0.87	132
130'000	7'452													0.90	141
135'000	7'739													0.94	151
140'000	8'025													0.97	160
145'000	8'312													1.01	170
150'000	8'598													1.04	180
155'000	8'885													1.08	191
160'000	9'172													1.11	201
165'000	9'458													1.15	212
170'000	9'745													1.18	223
175'000	10'032													1.22	234
180'000	10'318													1.25	246
185'000	10'605													1.29	258
190'000	10'891													1.32	270

Zeta-value (single resistance)

The single resistance in the pressure loss calculation can be obtained via the pressure loss-coefficient.

Pressure loss-coefficient ζ for the single resistances from JRG Sanipex MT® Calor-fittings.

The calculation is based upon a water flow rate of 0,5 to 1,0 m/s.

Dimensions $d_s \times s$ [mm] Inside diameter d_i [mm] Zeta-value	16 x 2,25 11.5 z	20 x 2,5 15 z	26 x 3,0 20 z	32 x 3,0 26 z	40 x 3,5 33 z	50 x 4,0 42 z	63 x 4,5 54 z
Bend 90°, 3.5 x d	0,2	0,3	0,3	0,3	0,3	0,3	0,3
Elbow 90°	1,8	1,7	1,6	1,5	1,5	1,5	1,5
Elbow 45°	0,7	0,7	0,6	0,6	0,6	0,6	0,6
Reduction	0,2	0,2	0,2	0,2	0,2	0,2	0,2
Branch at Flow separation, TAT		1,6	1,6	1,6	1,6	1,6	1,6
Flow at Flow separation, TDT		0,3	0,3	0,3	0,3	0,3	0,3
Branch at Flow separation, TAV		1,0	1,0	1,0	1,0	1,0	1,0
Flow at Flow union, TDV		0,5	0,5	0,5	0,5	0,5	0,5
Return flow at Separation, TG		3,0	3,0	3,0	3,0	3,0	3,0
Return flow at Union, TG		3,0	3,0	3,0	3,0	3,0	3,0
Distributor exit	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Distributor-input	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Heating element*	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Boiler*	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Straight-way cock*	1,5	1,5	1,5	1,0	1,0	1,0	1,0
Slider*	1,0	1,0	0,5	0,5	0,5	0,3	0,3
Stop valve*	0,3	0,3	0,3	0,3	0,5	0,5	0,8
Flow valve*	8,5	8,5	6,0	6,0	5,0	5,0	5,0
Angle valve*	4,0	4,0	4,0	2,0	2,0	2,0	2,0

The pressure loss coefficient ζ is assigned to the flow volume (partial flow) which is denoted by the symbol "→"

*Technical literature pumps-hot water heating

Design example two pipe system

This architect's design shows the layout of radiators and the JRG Sanipex MT® connecting pipes for the examples

Radiator-Nr.:	101 / 300 W
Model:	Z 49/7
Length:	1000 mm
Height:	490 mm
Depth:	101 mm
Valve:	RA-N 10, -4-
Thread.:	RL-V 10
Connection:	d16, JRG Sanipex MT®

Radiator-Nr.:	102 / 600 W
Model:	Z 49/7
Length:	2600 mm
Height:	490 mm
Depth:	101 mm
Valve:	RA-N 15, -N-
Thread.:	RL-V 15
Connection:	d16, JRG Sanipex MT®

Radiator-Nr.:	103 / 350 W
Model:	Z 49/7
Length:	1200 mm
Height:	490 mm
Depth:	101 mm
Valve:	RA-N 10, -6-
Thread.:	RL-V 10
Connection:	d16, JRG Sanipex MT®

Radiator-Nr.:	104a / 150 W
Model:	M 49/7
Length:	1100 mm
Height:	490 mm
Depth:	126 mm
Valve:	RA-N 10, -2-
Thread.:	RL-V 10
Connection:	d16, JRG Sanipex MT®

Radiator-Nr.:	104b / 350 W
Model:	Z 49/7
Length:	1200 mm
Height:	490 mm
Depth:	101 mm
Valve:	RA-N 10, -6-
Thread.:	RL-V 10
Connection:	d16, JRG Sanipex MT®

Radiator-Nr.:	105 / 200 W
Model:	Z 49/7
Length:	800 mm
Height:	490 mm
Depth:	101 mm
Valve:	RA-N 10, -3-
Thread.:	RL-V 10
Connection:	d16, JRG Sanipex MT®

Radiator-Nr.:	106 / 100 W
Model:	SN-075-60
Length:	600 mm
Height:	1166 mm
Depth:	120 mm
Valve:	RA-N 10, -1-
Thread.:	RL-V 10
Connection:	d16, JRG Sanipex MT®

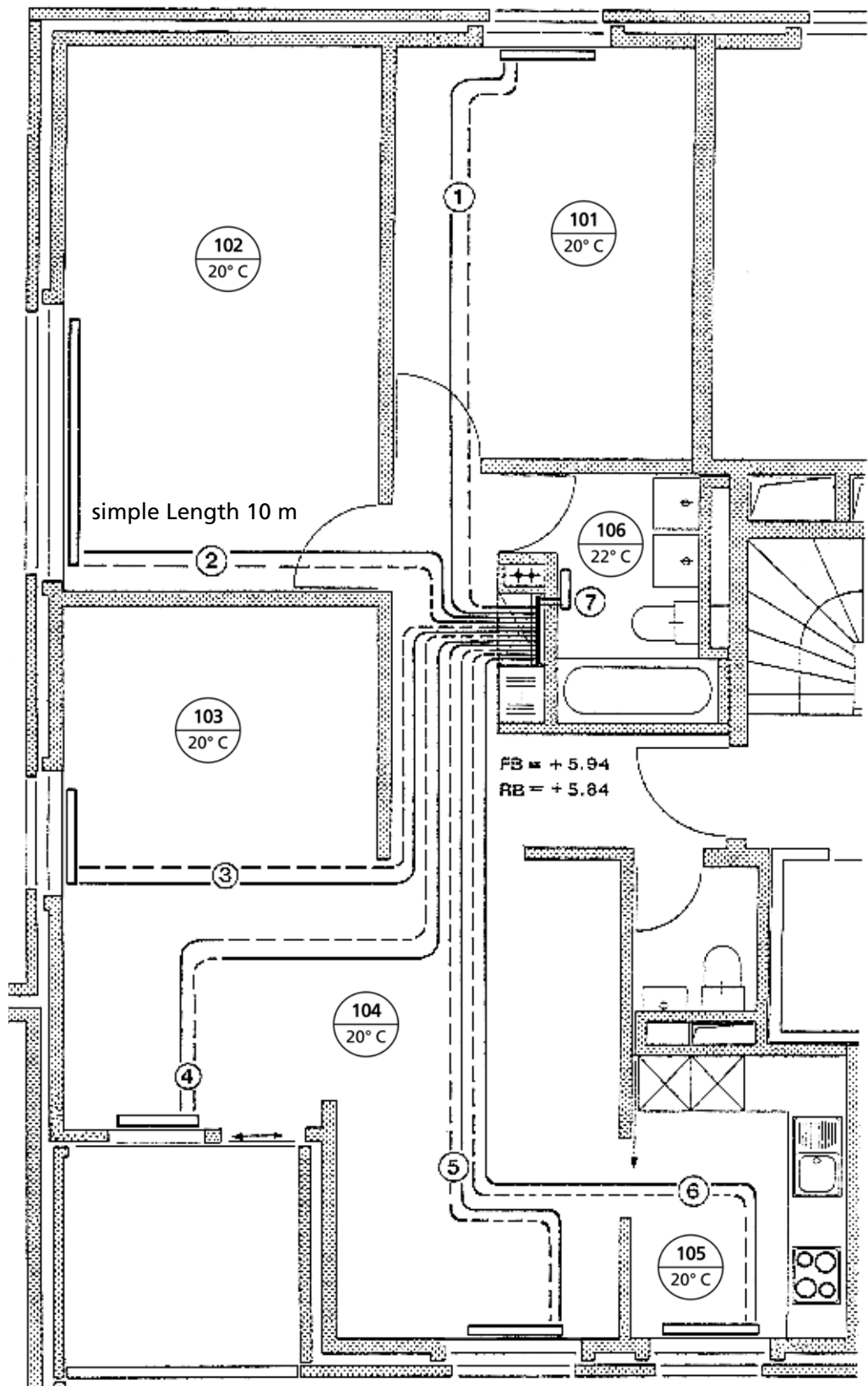


Fig. 1, Architect design

Calculation procedure

Basics

- Project plans with drawn in radiators and radiator connecting system
- Heat requirements calculation based on the agreed upon room temperatures
- System temperature adjusted for the heat generating plans and the legal requirements (chosen temperature-pairing for the calculation example: 55/40° C)
- Technical documentation JRG Sanipex MT® Calor

Column 1	Number of partial sections (if necessary with storey, distributor and room)
Column 2	Heat production of the radiator (if necessary with the section in Watt)
Column 3	Mass flow of heating medium $\dot{m}$ in kg/h from formula (1)
Column 4	Chosen pipe cross section (Dimension) from the pressure-loss diagramm Fig. 1
Column 5	Water flow rate v [m/s] should not exceed 0.3 m/s for the radiator connection
Column 6	Pipe friction-pressure loss per meter water pipe. R -Value in Pa/m
Column 7	Total pipe length l [m] is obtainable from the project plans (Sum Σl from pre-flow and return-flow)
Column 8	Pressure loss in Pre- and Return flow for a heating loop $[R \cdot l]$ in Pascal (Pa)
Column 9	Sum of Zeta-values $\Sigma \zeta$ from the single resistances of distributors, form pieces and radiators etc.
Column 10	Sum of single resistances from Formula (2) in Pa
Column 11	Div. Pressure loss , here radiator-return screw connection Danfoss RLV, $\Delta p_{div,RLV}$ in Pa from formula (4), $k_{vs} = 1.9$ for RLV DN10 DG, $k_{vs} = 2.5$ for RLV DN15 DG
Column 12	Pressure loss radiator-thermostat valve , here Danfoss TH-V, $\Delta p_{v, TH-V}$ in Pa from formula (4), $k_{vs} 0,34$ at $x_p=1K$ für RA-N DN10, $k_{vs} 0,43$ at $x_p=1K$ für RA-N DN15
Column 13	Total pressure loss in heating ring Δp_e in Pa from formula (3), here Column 8+10+11+12
Column 14	Differential pressure between pressure loss of unsuitable heating loop and any other heating loop
Column 15	Valve pre-setting. The required k_v -Value is determined from the basic water quantity from column 3 and the differential pressure from column 14. Formula (5)

Legend:	t_v	Proflow temperature in ° C	Δp	Pressure difference in Pa
	t_R	Returnflow temperature in ° C	R	Pipe friction resistance per metre in Pa/m
	v	Water flow rate in m/s	K	Kelvin
	ρ	Density of water, here expressed in 1000 kg/m³		

Formula

Mass flow in heating loop

$$\dot{m} = \frac{\dot{Q}_N}{c \cdot \Delta t} \text{ in kg/h} \quad ①$$

Single resistance

$$\Delta p_z = \Sigma \zeta \cdot \frac{\rho}{2} \cdot v^2 \text{ in Pascal} \quad ②$$

Total pressure loss in heating loop

$$\Delta p_G = R \cdot l + Z + \Delta p_v \text{ in Pascal} \quad ③$$

Single resistance TH-V und RLV

$$\Delta p_v = \left(\frac{\dot{m}}{k_{vs}} \right)^2 \cdot 0,1 \text{ in Pascal} \quad ④$$

Required kv-value TH-Valve

$$k_{v,erf.} = \frac{\dot{m}}{\sqrt{\frac{\Delta p}{0,1}}} \text{ in m}^3 / h \quad ⑤$$

The equation ① up to ⑤ apply with following units

$$\begin{aligned} [v] &= \text{m/s} & [\dot{m}] &= \text{kg/h} \\ [d] &= \text{mm} & [\rho] &= \text{kg/m}^3 \\ [R] &= \text{Pa/m} & [\Delta p] &= \text{Pa} \\ \rho/2 &= 500 \text{ kg/m}^3 \end{aligned}$$

Zeta-values [z]

- Distributor outflow d12	1.2	- Connecting box-straight, d12	1.1
- Distributor outflow d16	1.1	- Connecting box-straight, d16	0.4
- Connecting box 90°, d12	1.3	- Bath radiator	3.0
- Connecting box 90°, d16	1.5	- Zehnder Heating wall	2.2

Tab. 1, Zeta-value

Calculation step-by-step

Calculation steps														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Part section	Heat Product.	Mass flow	JRG Sanipex MT® pipe	Water flow rate	Pressure loss per m	Pipe length	Pressure loss Calor pipe	Sum Zeta Values	Single resistance	Pressure loss RLV	Pressure loss TH-V	Total Pressure loss	Difference Pressure	Valve settings
Nr.	Q _{HK} W	m _H kg/h	d _a mm	v m/s	R Pa/m	l m	R · l Pa	Σζ -	+Z Pa	+Δp _v Pa	+Δp _v Pa	p _g Pa	Δp Pa	N° -
							7 · 8					8+10+11+12	13 _{max} · 13	
1	300	17	16	0.05	6	24	144	6.8	7	8	256	415	665	4
2	600	34	16	0.09	20	20	400	5.2	22	19	640	1'081	0	N
3	350	20	16	0.05	8	16	128	6.8	10	11	348	497	584	6
4	150	9	16	0.02	2	30	60	7.2	2	2	64	128	953	2
5	350	20	16	0.05	8	26	208	6.8	10	11	348	577	504	6
6	200	11	16	0.03	3	30	90	6.8	3	4	114	211	870	3
7	100	6	16	0.02	1	4	4	7.6	1	1	28	34	1'046	1
Σ	2'050	118				150								

Tab. 2, Calculation of heating loop (Δp) with valve settings for the temperature pairings 55/40° C; xp=1K

Plant-N°:	:	Storey	:	Page	:
Project / Building	:	Distributor-N°	:	Date	:
Owner	:	System temp.	:		
	:	Heat insulation	:	Sign.	:

[illegible]

Protocol pressure test

JRG Sanipex MT® Calor – installations, wherever visible must be pressure-tested with water. The pressure test is to be carried out according to recognized technical methods.

Every connection is to be visually checked.

Building aim

Building section

Examining person

Permissible max. Operating pressure: (based on lowest point of plant) _____ bar

Height of plant: _____ m

Layout parameters

Pre flow temperature: _____ °C

Return flow temperature: _____ °C

Start

Date: _____

Clock time: _____

Test pressure _____ bar (min. 4 to max. 6 bar)

End

Date: _____

Clock time: _____ h (min. 60 min)

Pressure fall: _____ bar (max. 0,1 bar)

The above named plant is on heated to the max. design temperature and no leaks were found. After cooling no leaks were found. In case of freezing, suitable prevention measures are to be taken (e.g. use of antifreeze, building temperature). Assuming for the specified operation of the plant, no more antifreeze is required, then the antifreeze is to be removed by emptying and flushing the system 3 times with water.

Antifreeze was added to the water: ☐ Yes ☐ No

Process carried out as above: ☐ Yes ☐ No

Test result

- ☐ All connections have been tested
- ☐ The pressure tests were performed successfully
- ☐ The pressure tests could not be successfully completed
They must be repeated

Confirmation

Place, Date

Signature building management

Signature examining person

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Argentina / Southern South America

Georg Fischer Central Plastics
Sudamérica S.R.L.
Buenos Aires, Argentina
Phone +54 11 4512 02 90
gfcentral.ps.ar@georgfischer.com
www.gfps.com/ar

Australia

George Fischer Pty Ltd
Riverwood NSW 2210 Australia
Phone +61 (0) 2 9502 8000
australia.ps@georgfischer.com
www.gfps.com/au

Austria

Georg Fischer Rohrleitungssysteme GmbH
3130 Herzogenburg
Phone +43 (0) 2782 856 43-0
austria.ps@georgfischer.com
www.gfps.com/at

Georg Fischer Fittings GmbH
3160 Traisen
Phone +43 (0) 2762 90300
fittings.ps@georgfischer.com
www.fittings.at

Belgium / Luxembourg

Georg Fischer NV/SA
1070 Bruxelles/Brüssel
Phone +32 (0) 2 556 40 20
be.ps@georgfischer.com
www.gfps.com/be

Brazil

Georg Fischer Sist. de Tub. Ltda.
04795-100 São Paulo
Phone +55 (0) 11 5525 1311
br.ps@georgfischer.com
www.gfps.com/br

Canada

Georg Fischer Piping Systems Ltd
Mississauga, ON L5T 2B2
Phone +1 (905) 670 8005
Fax +1 (905) 670 8513
ca.ps@georgfischer.com
www.gfps.com/ca

China

Georg Fischer Piping Systems Ltd
Shanghai 201319
Phone +86 21 3899 3899
china.ps@georgfischer.com
www.gfps.com/cn

Chinaust Plastics Corp. Ltd.
Songlindian, Zhuozhou city,
Hebei province, China, 072761
Phone +86 312 395 2000
Fax +86 312 365 2222
chinaust@chinaust.com
www.chinaust.com.cn

Denmark / Iceland

Georg Fischer A/S
2630 Taastrup
Phone +45 (0) 70 22 19 75
info.dk.ps@georgfischer.com
www.gfps.com/dk

Finland

Georg Fischer AB
01510 VANTAA
Phone +358 (0) 9 586 58 25
Fax +358 (0) 9 586 58 29
info.fi.ps@georgfischer.com
www.gfps.com/fi

France

Georg Fischer SAS
95932 Roissy Charles de Gaulle Cedex
Phone +33 (0) 1 41 84 68 84
fr.ps@georgfischer.com
www.gfps.com/fr

Germany

Georg Fischer GmbH
73095 Albershausen
Phone +49 (0) 7161 302-0
info.de.ps@georgfischer.com
www.gfps.com/de

India

Georg Fischer Piping Systems Ltd
400 076 Mumbai
Phone +91 224007 2001
branchoffice@georgfischer.com
www.gfps.com/in

Italy

Georg Fischer S.p.A.
20063 Cernusco S/N (MI)
Phone +39 02 921 861
it.ps@georgfischer.com
www.gfps.com/it

Georg Fischer TPA S.r.l.
IT-16012 Busalla (GE)
Phone +39 010 962 47 11
tpa.ps@georgfischer.com
www.gfps.com/it

Japan

Georg Fischer Ltd
556-0011 Osaka,
Phone +81 (0) 6 6635 2691
jp.ps@georgfischer.com
www.gfps.com/jp

Korea

Georg Fischer Piping Systems
271-3 Seohyeon-dong Bundang-gu
Seongnam-si, Gyeonggi-do
Seoul 463-824
Phone +82 31 8017 1450
Fax +82 31 8017 1454
kor.ps@georgfischer.com
www.gfps.com/kr

Malaysia

Georg Fischer (M) Sdn. Bhd.
40460 Shah Alam, Selangor Darul Ehsan
Phone +60 (0) 3 5122 5585
my.ps@georgfischer.com
www.gfps.com/my

Mexico / Northern Latin America

Georg Fischer S.A. de C.V.
Apodaca, Nuevo Leon
CP66636 Mexico
Phone +52 (81) 1340 8586
Fax +52 (81) 1522 8906
mx.ps@georgfischer.com
www.gfps.com/mx

Middle East

Georg Fischer
Piping Systems (Switzerland) Ltd
Dubai, United Arab Emirates
Phone +971 4 289 49 60
gss.ps@georgfischer.com
www.gfps.com/int

Netherlands

Georg Fischer N.V.
8161 PA Epe
Phone +31 (0) 578 678 222
nL.ps@georgfischer.com
www.gfps.com/nl

Georg Fischer Waga N.V.
NL-8160 AG Epe
Phone +31 (0) 578 678 378
waga.ps@georgfischer.com
www.waga.nl

New Zealand

Georg Fischer Ltd
13 Jupiter Grove, Upper Hutt 5018
PO Box 40399, Upper Hutt 5140
Phone +64 (0) 4 527 9813
nz.ps@georgfischer.com
www.gfps.com/nz

Norway

Georg Fischer AS
1351 Rud
Phone +47 67 18 29 00
no.ps@georgfischer.com
www.gfps.com/no

Poland

Georg Fischer Sp. z o.o.
05-090 Sekocin Nowy
Phone +48 (0) 22 31 31 0 50
poland.ps@georgfischer.com
www.gfps.com/pl

Romania

Georg Fischer
Piping Systems (Switzerland) Ltd
020257 Bucharest - Sector 2
Phone +40 (0) 21 230 53 80
ro.ps@georgfischer.com
www.gfps.com/int

Russia

Georg Fischer
Piping Systems (Switzerland) Ltd
Moscow 125047
Phone +7 495 258 60 80
ru.ps@georgfischer.com
www.gfps.com/ru

Singapore

George Fischer Pte Ltd
11 Tampines Street 92, #04-01/07
528 872 Singapore
Phone +65 6747 0611
sgp.ps@georgfischer.com
www.gfps.com/sg

Spain / Portugal

Georg Fischer S.A.
28046 Madrid
Phone +34 (0) 91 781 98 90
es.ps@georgfischer.com
www.gfps.com/es

Sweden

Georg Fischer AB
117 43 Stockholm
Phone +46 (0) 8 506 775 00
info.se.ps@georgfischer.com
www.gfps.com/se

Switzerland

Georg Fischer
Rohrleitungssysteme [Schweiz] AG
8201 Schaffhausen
Phone +41 (0) 52 631 30 26
ch.ps@georgfischer.com
www.gfps.com/ch

Taiwan

Georg Fischer Co., Ltd
San Chung Dist., New Taipei City
Phone +886 2 8512 2822
Fax +886 2 8512 2823
www.gfps.com/tw

United Kingdom / Ireland

Georg Fischer Sales Limited
Coventry, CV2 2ST
Phone +44 (0) 2476 535 535
uk.ps@georgfischer.com
www.gfps.com/uk

USA / Caribbean

Georg Fischer LLC
Tustin, CA 92780-7258
Phone +1 (714) 731 88 00
Toll Free 800/854 40 90
us.ps@georgfischer.com
www.gfpiping.com

Georg Fischer Central Plastics LLC
Shawnee, OK 74801
Phone +1 (405) 273 63 02
gfcentral.ps@georgfischer.com
www.centralplastics.com

Vietnam

George Fischer Pte Ltd
136E Tran Vu, Ba Dinh District, Hanoi
Phone +84 4 3715 3290
Fax +84 4 3715 3285

International

Georg Fischer
Piping Systems (Switzerland) Ltd
8201 Schaffhausen/Switzerland
Phone +41 (0) 52 631 30 03
Fax +41 (0) 52 631 28 93
info.export@georgfischer.com
www.gfps.com/int

37 200 62

0.2 (11.14) SMS

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Hauptstrasse 130

CH-4450 Sissach/Switzerland

Telefon +41 (0) 61 975 22 22

info.jrg.ps@georgfischer.com

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