# Uponor Multilayer Composite
# pipe system for tap water and heating

**Technical information - UK**

Uponor

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# 1 Uponor MLC Tap water and heating

## 1.1 System description



Whether for a drinking water installation or for connecting a heating system, the Uponor Multilayer Composite pipe system is the perfect solution. The comprehensive system enables installation from the plant-room to the point-of-use. Installation of the Uponor Multilayer system is particularly fast, simple and economical.

Based on a core of an aluminium pipe, layered inside and out with Polyethylene, the pipe is extremely strong and 100% oxygen diffusion tight.

Available in sizes from 12-110mm, in either coils or straight lengths (coils up to 32mm), the pipe is 'form-stable' and can easily be modeled into the optimum profile for each installation. Reducing the number of connections required in a plumbing scheme is in the DNA of the MLC concept. Don't add a connection, make a bend instead.

Using MLC for your installation offers a wide range of benefits. Old plumbing traditions are being replaced by systems more capable of adapting to the demands of modern buildings and designs.

### Uponor composite pipe system

- Pipe dimensions from 12 to 110mm for any property size
- One pipe – many suitable fitting technologies for different installation tasks
- Form stable with low thermal expansion, similar to metal pipes
- Ideal for use with manifold installations
- No hot-works
- Ideal for surface and in-wall mounting
- Comprehensive, practical delivery program for every installation requirement

## 1.2 Component overview - pipes

### Uponor Uni-Pipe PLUS



100% oxygen-diffusion-tight 5-layer composite pipe for drinking water distribution and heating applications

- Unique seamless aluminium layer using SAC technology WRAS and KIWA approved for drinking water distribution
- Removable hygienic pipe caps according to BS EN 806
- Minimum bending radii
- Pipe stiffness optimised for straight bars necessary when mounting on a wall surface
- Dimensions 14 – 32 mm

## Uponor MLC composite pipe
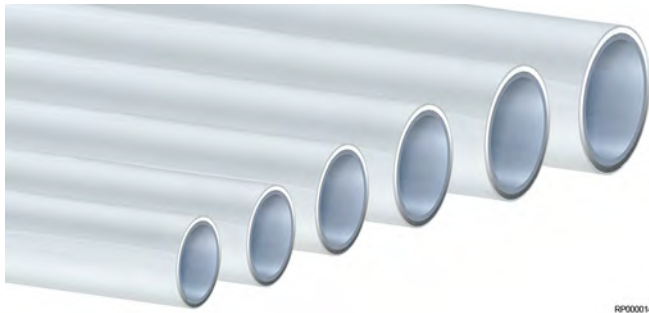


100% oxygen-diffusion-tight 5-layer composite pipe for drinking water distribution and heating applications

- Safety-welded aluminium layer
- WRAS and KIWA approved for drinking water distribution
- Removable hygienic closure according to DIN EN 806
- Dimensions 12, 40 – 110 mm

## Insulated Uponor Uni-Pipe PLUS pipes
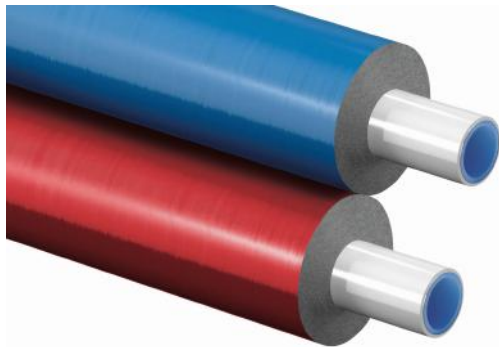


Uponor composite pipes pre-assembled with insulation at the factory

- Pipe assembled with a round extruded pipe insulation made of closed cell Polyethylene foam. Insulation is protected with a moisture proof, hard-wearing plastic foil coating
- S6 (6mm) blue, λ 0.035 W/m*K or 0.04 W/m*K
- S10 (10mm) blue, λ 0.035 W/m*K
- S13 (13mm) red and blue, λ 0.04 W/m*K

Details of reaction to fire classification available upon request

## Uponor Uni-Pipe PLUS pipes in conduit
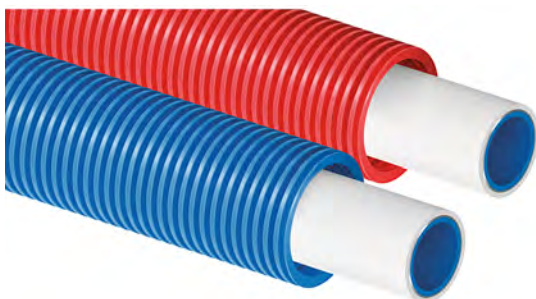


Uponor composite pipes pre-assembled at the factory with HDPE protective tubes.

- Colour differentiation between supply (red) and return heating (blue)
- Uponor Teck protective tubes are also available separately in blue, red and black

# 1.3 Component overview - jointing technology

## Uponor S-Press PLUS fittings



Press fitting for Uponor Uni-Pipe PLUS composite pipes for tap water and heating installations

- Fitting body made of dezincification resistant brass or PPSU
- Flow-efficient design for low pressure loss (zeta values)
- Fixed stainless steel sleeve with press jaw guides
- Unpressed 'leak-path' test safety
- Foil on stainless steel sleeve with 4-way function: Press indicator, size identification, colour coding and printed QR code for additional information
- Dimensions 16 – 32 mm

## Uponor S-Press fittings



Press fitting for Uponor MLC composite pipes in tap water and heating installations

- Fitting made of brass or PPSU
- Fixed stainless steel sleeve
- Unpressed 'leak-path' test safety
- Dimension-specific colour coding using coloured stop rings
- Dimensions 14 mm, 40 – 75 mm

## Uponor RTM fittings



Fitting made of PPSU or brass with integrated tool-free pressing function, press indicator and colour coding. Dimensions 16 – 25 mm

## Uponor RS fitting system



Modular fitting system consisting of base parts and press adapters for distribution and riser pipes 63 – 110 mm.

## Uponor S-Press/S-Press PLUS system adapters



For the easy adaption from traditional copper and stainless steel pipes, Uponor S-Press/S-Press PLUS side with fixed press sleeve, test reliability "unpressed leak-path" as well as press indicator and colour coding. Stainless steel/copper side processed according to the specifications of the specific metal system supplier.

## Uponor Uni



For screw screw connections to system accessories and system components with ½" (Uni-C) or ¾" (Uni-X) threaded connections.

# 1.4 Component overview - tools

## Tools for installation of composite pipe



Pressing tools and press jaws as well as cutting, bending and calibration tools for installing the Uponor composite pipe system in tap water and heating installations.

# 2 Uponor composite pipes

## 2.1 Uponor Uni-Pipe PLUS



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Uponor Uni-Pipe PLUS is the unique composite pipe with no weld seam, which permits increased fixing distances and reduces the bending radii by up to 40% compared to conventional composite pipes. This special pipe construction means fewer pipe fixing points are required and forming bends in the pipe is much easier and makes the system more adaptable to suit the installation - saving time and money by reducing the number of fittings and pipe clamps required.

### Uponor Uni Pipe PLUS

- Seamless construction for maximum safety
- High form stability and minimal thermal expansion
- Improved bending properties
- 100% oxygen-tight
- Low weight
- Dimensional range 14 – 32 mm
- Large mounting distances without clips

### Technical data and delivery dimensions

| Pipe dimension [mm] | 14 x 2.0 | 16 x 2.0 | 20 x 2.25 | 25 x 2.5 | 32 x 3.0 |
|---|---|---|---|---|---|
| Inner diameter ID [mm] | 10 | 12 | 15.5 | 20 | 26 |
| Coil length [m] | 200 | 10/25/100/120/200/500 | 25/100/500 | 50 | 50 |
| Bar length [m] | - | 3/5 | 3/5 | 3/5 | 3/5 |
| Outer diameter of coil [cm] | 80 | 80/80/78/78/80/114 | 80/80/114 | 114 | 114 |
| Weight of coil/bar [g/m] | 91/- | 111/119 | 161/171 | 233/247 | 364/394 |
| Weight of coil/bar with water at 10 °C [g/m] | 170/- | 224/232 | 350/360 | 547/560 | 895/926 |
| Weight per coil [kg] | 18.2 | 1.1/2.8/11.1/14.3/23.8/59.5 | 4/16.1/80.5 | 11.65 | 18.2 |
| Weight per bar [kg] | - | 0.35/0.59 | 0.52/0.86 | 0.74/1.24 | 1.18/1.97 |
| Water volume [l/m] | 0.079 | 0.113 | 0.189 | 0.314 | 0.531 |
| Pipe roughness k [mm] | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 |
| Thermal conductivity λ [W/mK] | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Coefficient of expansion a [m/mK] | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ |

## 2.2 Uponor MLC pipe
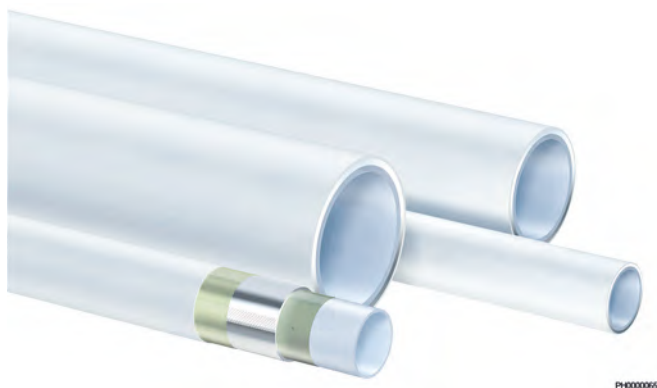


The Uponor MLC composite pipe is used as distribution and riser pipes in drinking water distribution and heating/cooling applications. Uponor MLC (Multilayer Composite) pipes are easy to process, corrosion-free and can be used for a variety of installation tasks, particularly in large residential and commercial properties.

### Uponor MLC

- Safety-welded aluminium layer
- High form stability
- Corrosion-free and sound-absorbing
- Fast installation without soldering or welding
- 100 % oxygen-tight
- Dimensional range 12, 40 – 110 mm

## Technical data and dimensions

| Pipe dimension [mm] | 12 x 1.6 | 40 x 4.0 | 50 x 4.5 | 63 x 6.0 | 75 x 7.5 | 90 x 8.5 | 110 x 10.0 |
|---|---|---|---|---|---|---|---|
| Inner diameter ID [mm] | 8.8 | 32 | 41 | 51 | 60 | 73 | 90 |
| Coil length [m] | - | - | - | - | - | - | - |
| Bar length [m] | - | 3/5 | 3/5 | 3/5 | 5 | 5 | 5 |
| Outer diameter of coil [cm] | | - | - | - | - | - | - |
| Weight of coil/bar [g/m] | | -/508 | -/745 | -/1224 | -/1788 | -/2545 | -/3597 |
| Weight of coil/bar with water at 10 °C [g/m] | | -/1310 | -/2065 | -/3267 | -/4615 | -/6730 | -/9959 |
| Weight per coil [kg] | | - | - | - | - | - | - |
| Weight per bar [kg] | - | 1.52/2.54 | 2.24/3.73 | 3.67/6.12 | 8.94 | 12.73 | 17.99 |
| Water volume [l/m] | 0.061 | 0.800 | 1.320 | 2.040 | 2.827 | 4.185 | 6.362 |
| Pipe roughness k [mm] | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 |
| Thermal conductivity λ [W/mK] | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Coefficient of expansion a [m/mK] | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ | $25 \times 10^{-6}$ |

# 2.3 Temperature ranges (Operating Conditions)

• **Domestic services** - 10°C to 70°C where the water temperature does not continuously exceed 70ºC, 10 bar (Conditions to application Class 2 - BS EN ISO 21003- 1:2008). The maximum short-term malfunction temperature is 95ºC for an accumulative 100 hours over the working life of the system.

• **Heating systems (high temperature radiators)** - where the water temperature does not continuously exceed 80ºC, 10 bar (Conditions to application Class 5 - BS EN ISO 21003-1:2008). The maximum short-term malfunction temperature is 100ºC for an accumulative 100 hours over the working life of the system.

• **Chilled water** - -10°C to 10°C at a maximum pressure of 10 bar. If risk of damage from freezing, a suitable anti-freeze additive must be used. Any additive must be suitable for use with Polyethylene, PPSU, EPDM and CW625N brass

Uponor multi-layer pipe can be used for DHW recirculating systems, provided the operating temperatures and pressures do not exceed the maximum conditions detailed under 'Domestic Services'

# 2.4 Uponor pre-insulated Multilayer composite pipe coils

Uponor composite pipes are available from the factory pre-assembled with thermal insulation to prevent heat losses or unwanted heat gain.

The round extruded pipe insulation is made of closed cell polyethylene foam and is encapsulated within a hard-wearing plastic foil coating. This plastic coating can be in either red or blue colours to make an easier identification of each type of service pipe.

Uponor factory insulated pipes offer distinct advantages over bare pipes which require insulation to be added on site. On the one hand, they ensure rapid installation progress whilst keeping the insulation unbroken from the point of supply to the point of use. The good thermal resistant properties of the insulation materials maintains small outside pipe diameters whilst providing optimum thermal properties.

Pre-insulated pipes consist of three components - the Multilayer pipe, the foam insulation and the plastic foil protective barrier.

The foam insulation is available in two classes to BS EN 13501-1: 2018 *Fire classification of construction products and building elements Classification using data from reaction to fire tests*, either Class E or class BL-S2-D0,

Full details of classifications using reaction to fire test data are available upon request.

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## Pre-insulated composite pipes

- Seamless or OWC-technology for highest level of safety
- Time savings compared to on-site insulation of bare pipes
- Robust and hard-wearing plastic foil coating to protect against damage and moisture

## Pre-insulated Uponor Uni-Pipe PLUS composite pipes

### Insulation class WLS 040

| Pipe OD x material thickness [mm] | In all-round insulation, thickness [mm] | | | | | | | | | | In asymmetrical insulation, thickness [mm] | | | | In conduit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | OD[1] | 6 | OD[1] | 9 | OD[1] | 10 | OD[1] | 13 | OD[1] | 9 | W x H[2] | 26 | W x H[2] | |
| 14 x 2.0 | | | • | 26 | | | | | | | | | | | |
| 16 x 2.0 | • | 24 | • | 28 | • | 34 | | | • | 42 | | | | | |
| 20 x 2.25 | • | 28 | • | 32 | • | 38 | | | • | 46 | | | | | |
| 25 x 2.5 | • | 33 | • | 37 | • | 43 | | | • | 51 | | | | | |
| 32 x 3.0 | • | 40 | | | • | 50 | | | | | | | | | |

1) Outer diameter (OD) [mm]　　　　　　　　　2) Width x height [mm]

### Insulation class WLS 035

| Pipe OD x material thickness [mm] | In all-round insulation, thickness [mm] | | | | | | | | | | In asymmetrical insulation, thickness [mm] | | | | In conduit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | OD[1] | 6 | OD[1] | 9 | OD[1] | 10 | OD[1] | 13 | OD[1] | 9 | W x H[2] | 26 | W x H[2] | |
| 16 x 2.0 | | | • | 28 | | | • | 36 | | | | | | | |
| 20 x 2.25 | | | • | 32 | | | • | 40 | | | | | | | |
| 25 x 2.5 | | | • | 37 | | | • | 45 | | | | | | | |

1) Outer diameter (OD) [mm]

2) Width x height [mm]

# 3 Joint technologies for Uponor composite pipes

## 3.1 Fitting systems - overview

Differing installation situations and different applications demand customised and adapted fitting design concepts. This is why Uponor develops and produces not only pipes, but also the appropriate fitting systems tailored to the respective application. The Uponor fitting range with couplings, elbows, T-joints and a large number of practical system components creates the perfect range for fast, safe and practical installation and exceeds the requirements placed on hygienic drinking water distribution and modern heating systems.

### Overview of the Uponor composite pipe fitting systems



RH0000154

| Uponor fitting system | | Press fitting, metal | | | | Press fitting, composite | | RTM fitting | Uni-C ½" | Uni-X ¾" |
|---|---|---|---|---|---|---|---|---|---|---|
| | | S-Press PLUS | S-Press | | RS | S-Press PLUS | S-Press | | | |
| Colour code/ dimension | Pipe type | A | B | C | D | E | F | G | H | I |
| 12 | MLC | | | | | | | | • | |
| 14 | Uni Pipe PLUS | | • | | | | | | • | • |
| 16 | Uni Pipe PLUS | • | | | • | • | | • | • | • |
| 20 | Uni Pipe PLUS | • | | | • | • | | • | • | • |
| 25 | Uni Pipe PLUS | • | | | • | • | | • | | • |
| 32 | Uni Pipe PLUS | • | | | • | • | | | | |
| 40 | MLC | | | • | • | | • | | | |
| 50 | MLC | | | • | • | | • | | | |
| 63 | MLC | | | • | • | | • | | | |
| 75 | MLC | | | • | • | | • | | | |
| 90 | MLC | | | | • | | | | | |
| 110 | MLC | | | | • | | | | | |

### Properties

| Uponor fitting system | Press fitting, metal | | | | Press fitting, composite | | RTM fitting | Uni-C ½" | Uni-X ¾" |
|---|---|---|---|---|---|---|---|---|---|
| | S-Press PLUS | S-Press | | RS | S-Press PLUS | S-Press | | | |
| | A | B | C | D | E | F | G | H | I |
| Dimension-specific colour coding | • | • | • | • | • | • | • | | |
| Inspection window for checking insertion depth | • | • | • | • | • | • | • | | |

| Uponor fitting system | Press fitting, metal | | | | Press fitting, composite | | RTM fitting | Uni-C ½" | Uni-X ¾" |
|---|---|---|---|---|---|---|---|---|---|
| | S-Press PLUS | S-Press | | | RS | S-Press PLUS | S-Press | | | |
| | A | B | C | D | E | F | G | H | I |
| Press indicated by detachment of the foil from the press sleeve | • | | | | • | | | | |
| Press indicated by removal of the stop ring | | • | | •1) | | | | | |
| Press indicated by press imprint on press sleeve | • | | • | •2) | • | • | | | |
| Assembly without deburring | • | • | | •1) | • | | • | • | • |
| Mounting without calibration | • | • | • | • | • | • | | • | • |
| Connector unpressed, untight | • | • | • | • | • | • | | | |
| Integrated pressing function | | | | | | | • | | |
| Modular fitting system | | | | • | | | | | |

1) Up to a dimension of 32 mm  2) Dimension 40 mm and up

# 3.2 Uponor S-Press PLUS - a new generation of fittings



RP0000155

## Sturdy press sleeves made of stainless steel

Corrosion resistant stainless steel press sleeves protect the O-rings from damage and give the finished connection high pull-out and bending resistance.

## High-quality materials

Fittings are either made made of dezincification resistant brass according to the 4MS positive list, or are alternatively made of the high-performance plastic PPSU allowing unrestricted use in tap water and heating installations.

## Precise press jaw location and pipe insertion control

The special shape of the press sleeves, and the newly designed stop rings, ensure risk-free, precise positioning of the Uponor press jaws. Inspection windows in the stainless steel press sleeves make it easy to check that the pipe has been inserted to the correct depth before pressing the connection.

## Dimension-specific colour coding

The size colour coding and clearly legible figures of the different dimensions are easy to recognise from a great distance and even in difficult lighting conditions.

## Unique pressing control and test safety

The stainless steel press sleeves are sheathed with a colour-coded foil depending on the dimension of the fitting. This foil is released when the fitting is pressed and can be easily removed identifying that the connection has been completed. A second safety feature is the unpressed "leak-path" function.

## Flow-optimised design

The streamlined design provides low pressure loss (zeta values) and ensures an optimal flow performance giving the best system performance.

## Fast and simple installation

Just three steps to complete the connection without the need to deburr or calibrate the pipe: Cut the pipe, add the fitting and press. The slim design of the finished connection also makes adding insulation easier.

## 100 % compatible with existing Uponor components

Uponor S-Press PLUS fittings are matched to the existing Uponor composite pipe systems and tools.

## Simple adjustment

The flexible pipes can still be adjusted to suit the installation until completion of the press. However, even after the pressing process, with care, the pipes can still be formed until the start of the pressure test.

## Online information available via QR code

The printed QR code provides 24/7 access to installation support, project database, item lists and on-line orders.

## Certifications - a few examples

- WRAS
- KIWA KUKReg4
- DVGW

# 3.3 Uponor S-Press PLUS - design

## Uponor S-Press PLUS composite fittings made of PPSU
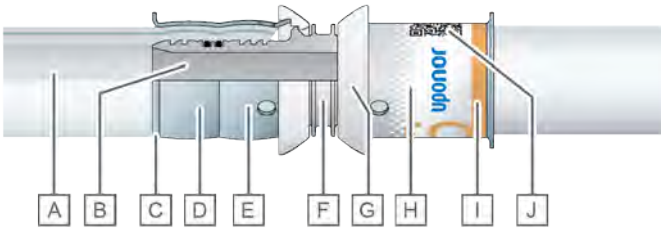


ED0000022

| Item | Description |
|------|-------------|
| A | Uponor MLC or Uni-Pipe PLUS composite pipe 16-32mm |
| B | Flow-optimised design |
| C | Sleeve collar for press jaw centring |
| D | Stainless steel press sleeve |
| E | Inspection window for insertion depth |
| F | Fitting body made of PPSU |
| G | Press jaw stop |
| H | Press indicator film |
| I | Colour-coded dimensional marking |
| J | QR code for additional information |

## Uponor S-Press PLUS made of dezincification resistant brass
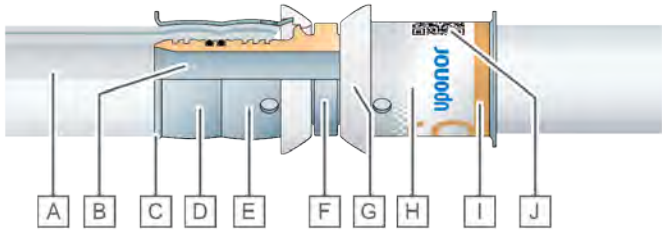


ED0000023

| Item | Description |
|------|-------------|
| A | Uponor MLC or Uni Pipe PLUS composite pipe 16-32mm |
| B | Flow-optimised design |
| C | Sleeve collar for press jaw centring |
| D | Stainless steel press sleeve |
| E | Inspection window for insertion depth |
| F | Fitting body made of dezincification resistant brass |
| G | Press jaw stop |
| H | Press indicator film |
| I | Colour-coded dimensional marking |
| J | QR code for additional information |

## Flow-optimised fitting design
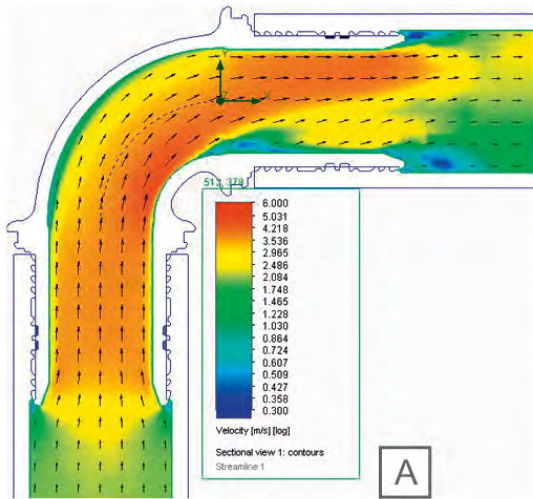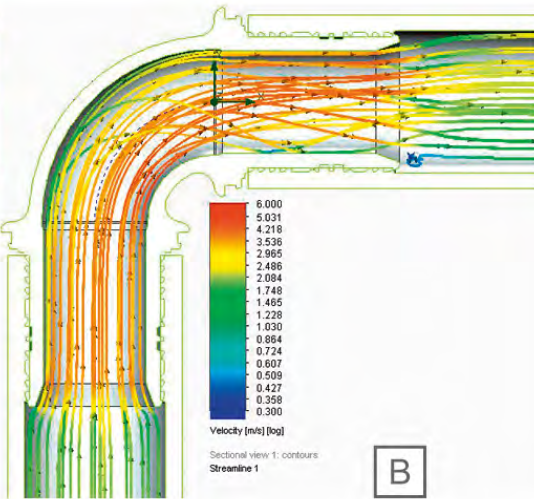


ED0000024

| Velocity [m/s] [log], View | Value |
|----------------------------|-------|
| A | Sectional view 1: contours |
| B | Streamline 1 |

The S-Press PLUS radial press jointing technology is designed to be free of dead space, avoiding any risk of contamination due to stagnating water inside the fitting. Proven by microbiological tests at the Institute for Environmental Hygiene and Toxicology in Gelsenkirchen, Germany.

## 3.4 Uponor S-Press PLUS - fitting/tool combinations



| Item | Description |
|------|-------------|
| A | Manual pressing tool |
| B | Interchangeable inserts |
| C | UP 110, battery tool |
| D | UP 75 EL, electrical tool 230 V |
| E | UPP1, pressing jaw |

| Item | Description |
|------|-------------|
| F | Mini32, battery tool |
| G | Mini KSP0, pressing jaw |
| H | S-Press PLUS/S-Press PLUS PPSU fitting dimensions in mm |

## 3.5 Uponor S-Press PLUS - fitting assembly

### Insert the Uponor composite pipe into the fitting



Insert the Uponor composite pipe into the fitting. The pipe end does not have to be deburred or calibrated beforehand.

### Apply the press jaw



Apply the press jaw, with the same colour coding as the fitting, to the press jaw guide in the stainless steel press sleeve.

## Once the press has been completed the indicator foil is easily removed



After pressing, the press indicator foil can easily be removed and a clear deformation of the stainless steel press sleeve is visible.

## Unpressed connections are reliably detected



Unpressed connections are quickly detected during the leak test due to the unpressed 'leak-path' function. An unpressed fitting also stands out clearly due to the indicator foil still being present on the stainless steel press sleeve.

# 3.6 Uponor S-Press PPSU fittings up to 75 mm



We have extended the dimensional range of our Uponor S-Press PPSU fittings with 63 mm and 75 mm, especially for economical drinking water distribution and heating installations in commercial buildings. Uponor S-Press composite fittings made of the high performance plastic PPSU are light, impact resistant and have very low stress crack sensitivity.

For the direct thread transition there are also 40 — 75 mm tin-plated S-Press adapter sleeves and S-Press adapter nipples made of dezincification resistant brass.

As a supplement to the modular Uponor RS fitting system and in conjunction with the tried and tested Uponor MLC composite pipes, it is now possible to realise pipe networks, including distribution and riser pipes, that are easy to install and cost-effective.

## Uponor S-Press PPSU fitting 40 — 75 mm

| Dimensional range | Description/properties | Material | Colour code/ dimension |
|---|---|---|---|
| <br><br>**40 — 75 mm** | • Unpressed 'leak-path' test safety.<br>• Dimension-specific colour coding of the stop rings.<br>• Press sleeve firmly connected to the fitting protects the O-rings from damage.<br>• Press sleeve with observation windows to easily check the insertion depth of the pipe both before and after pressing.<br>• The flexible pipes can still be adjusted to suit the installation until completion of the press. However, even after the pressing process, with care, the pipes can still be formed until the start of the pressure test.<br>• High pull-out and bending strength for the finished connection. | • Fitting made of PPSU<br>• Press sleeve made of stainless steel<br>• Coloured plastic stop elements | 40<br>50<br>63<br>75 |

## Uponor S-Press PPSU 40 — 75 mm - fitting/tool combinations



| Item | Description |
|------|-------------|
| A | UP 110, battery tool |
| B | UPP1, pressing jaw |
| C | UP 75 EL, electrical tool 230 V |
| D | Base adapter jaw with press chain |
| E | S-Press PPSU fitting dimensions in mm |

## Uponor S-Press PPSU - fitting assembly with press chain

### Insert the deburred composite pipe end



Insert the deburred composite pipe end into the fitting until fully located. Check that the pipe is visible in the observation windows, and place the appropriate press chain (same dimension and same colour code as fitting) around the press sleeve up to the coloured stop.

### Attach the base adapter onto the press chain



Locate the base press adapter onto the press chain and complete the pressing cycle.

### A clear deformation of the press sleeve



After pressing, remove the pressing chain and the successful pressing is visible by a clear deformation of the press sleeve (visual inspection).
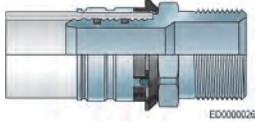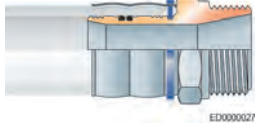
### An unpressed connection leaks
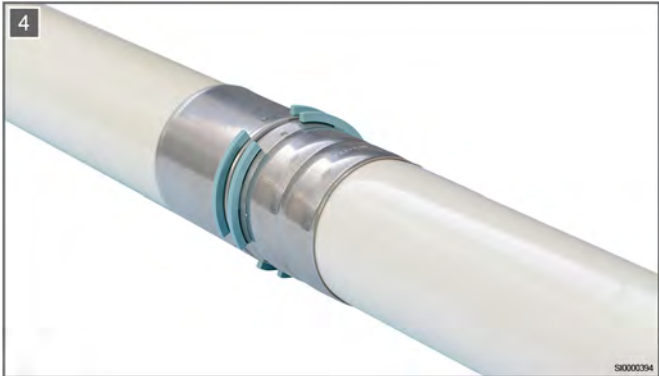


For additional safety, an unpressed connection leaks under pressure load (unpressed 'leak-path' function).

# 3.7 Other fittings for Uponor composite pipes

## Uponor S-Press metal fittings, dimension overview

| Dimensional range | Description/properties | Material | Colour code/ dimension |
|---|---|---|---|
|  **14 mm** | • Unpressed 'leak-path' test safety.<br>• Dimension-specific colour coding of the stop rings.<br>• Pressing indicator by means of coloured stop rings, which detach during the pressing process.<br>• Press sleeve firmly connected to the fitting protects the O-rings from damage.<br>• Press sleeve with observation windows to easily check the insertion depth of the pipe both before and after pressing.<br>• The pipe can be aligned after pressing (until the start of the pressure test).<br>• High pull-out and bending strength for the finished joint.<br>• Assembly without deburring. | • Brass, tin-plated<br>• Profiled aluminium press sleeve<br>• Dimension-specific colour coded stop rings | 14 |

| Dimensional range | Description/properties | Material | Colour code/ dimension |
|---|---|---|---|
|  **40 — 75 mm** | • Unpressed 'leak-path' test safety.<br>• Dimension-specific colour coding of the stop rings.<br>• Press sleeve firmly connected to the fitting protects the O-rings from damage<br>• Press sleeve with observation windows to easily check the insertion depth of the pipe both before and after pressing.<br>• The flexible pipes can still be adjusted to suit the installation until completion of the press. However, even after the pressing process, with care, the pipes can still be formed until the start of the pressure test.<br>• High pull-out and bending strength for the finished connection. | • Brass, tin-plated<br>• Press sleeve made of stainless steel<br>• Dimension-specific colour coded stop rings | 40<br>50<br>63<br>75 |

## Uponor S-Press and S-Press PLUS system adapters

> **Note**
>
> When connecting to a third-party system, the connection specifications of the specific manufacturer or system supplier must be observed.



The Uponor S-Press/S-Press PLUS system adapters are the ideal solution for a transition from Uponor Multilayer to an existing metallic pipe system, particularly when it comes to a renovation or a system extension. The fitting side for connecting to metal pipes is processed according to the manufacturer's specifications using the correct pressing tool and press jaw (M or V profile). The Uponor S-Press/S-Press PLUS side is simply and securely connected to the Uponor composite pipe using the approved Uponor press tool and press jaw.

Copper tail adapters are suitable for use with press connections, and compression fittings to BS EN 1254-2.

## Uponor RS fitting system for distribution lines and risers



The Uponor modular RS fitting system, for distribution and riser pipes, lets you make all required press connections safely and easily on the workbench.
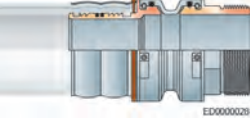
On site, the pre-assembled composite pipe sections are then inserted and locked in to the base fittings without the need for tools. This ensures a fast and safe installation even under the most difficult spatial conditions. Difficult work with heavy pressing tools in cramped construction site situations, or in overhead positions, is a thing of the past.

Uponor RS is a unique fitting system for risers and other supply lines used in tap water and heating/cooling applications. Thanks to the modular concept, hundreds of fitting variants can be produced with only a few system components.

## Uponor RS fitting system - benefits

- Innovative plug-in connection of adapters in to the base bodies for Uponor multilayer pipes up to 110 mm
- Just 40 components will make over 400 different fitting configurations

- Efficient stocking due to only 40 items
- Adjustable until completion of the leak test
- Dimension-specific colour coded stop rings

## Uponor RS fittings, dimension overview

| Dimensional range | Description/properties | Material | Colour code/ dimension | |
|---|---|---|---|---|
| <br>63 — 110 mm | • Unpressed 'leak-path' test safety.<br>• Dimension-specific colour coding of the stop rings.<br>• Modular range of fittings, consisting of matching base bodies and press adapters.<br>• Press adapters with fixed stainless steel press sleeves can be conveniently pressed on to the Uponor composite pipes away from the installation location, e.g. at the workbench.<br>• In the second step, the pre-assembled pipe lengths are inserted into the respective base bodies and fastened using a locking element for a secure connection. | • Brass, tin-plated<br>• Press sleeve made of stainless steel<br>• Coloured plastic stop element<br>• Plastic locking element | | 63 |
| | | | | 75 |
| | | | | 90 |
| | | | | 110 |

## Flexible main manifold structure



Modular manifold structure – with the modular fitting system, RS spacers and RS adapters, manifolds of different sizes can be assembled quickly in just a few simple steps.

### Flexible angles



Flexible angles – walls and ceilings are often not perpendicular to each other, especially in old buildings. Using an RS spacer (5 mm) in conjunction with two 45° angle base bodies, adjustable angles can be achieved just by rotating the components.

### Distance adapters



Simple and quick changes to pipeline levels – using RS spacers in combination with a 45° angle base body, system branches can quickly be made avoiding parallel pipe runs or obstructions.

### Fixed points



Fixing points are often required in pipeline systems with long supply sections. RS2 and RS3 spacers allow these fixing points to be created quickly and easily. The bracket guide in the center of the spacer provide a sturdy fixing point for the fastening of the clamps.

## The RS modular principle
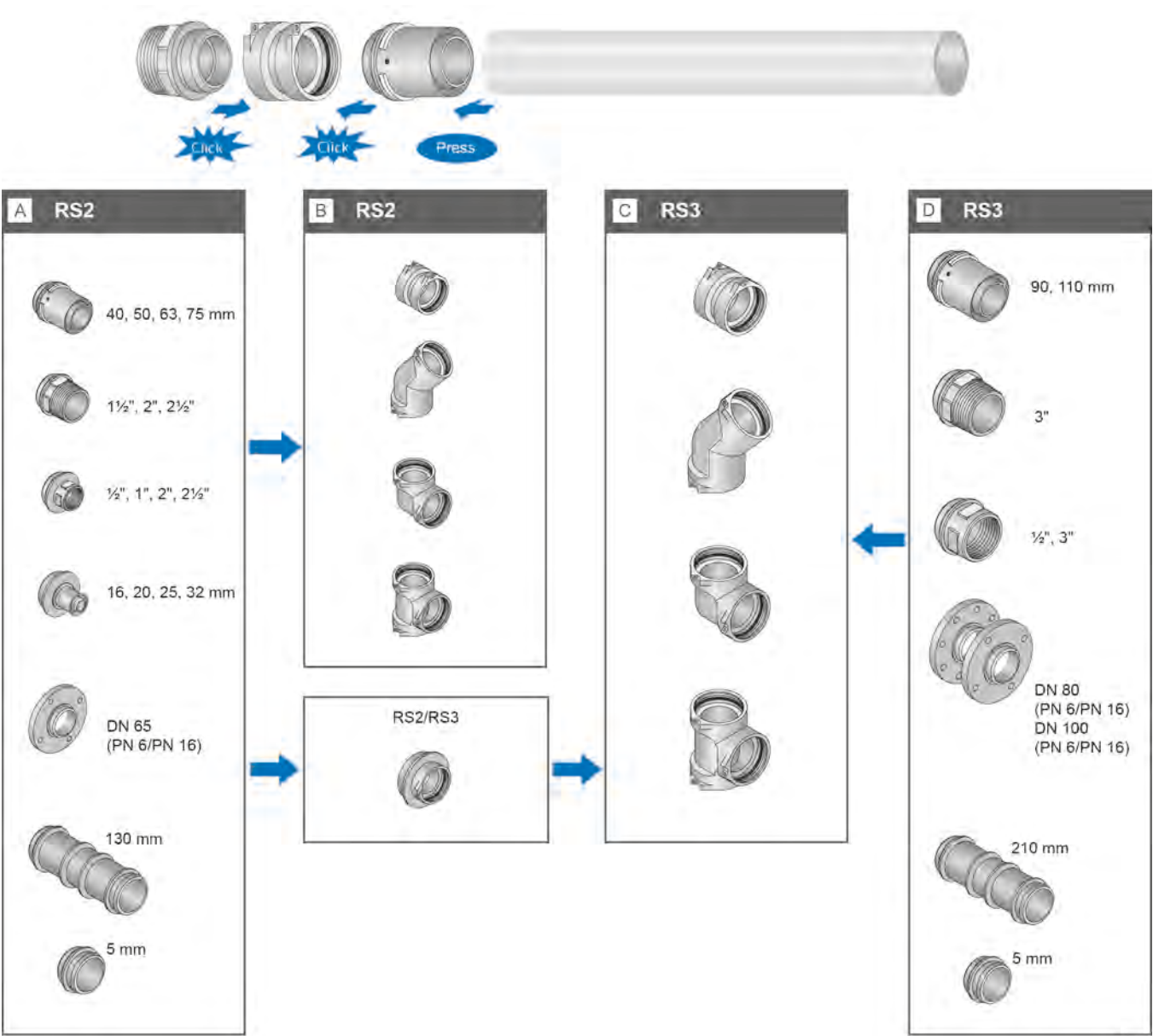
| Item | Description | Item | Description |
|------|-------------|------|-------------|
| A | RS2 Adapter | C | RS3 Base Body |
| B | RS2 Base Body | D | RS3 Adapter |

## Configuration examples

### T-piece with outlets 90 x 16 x 90
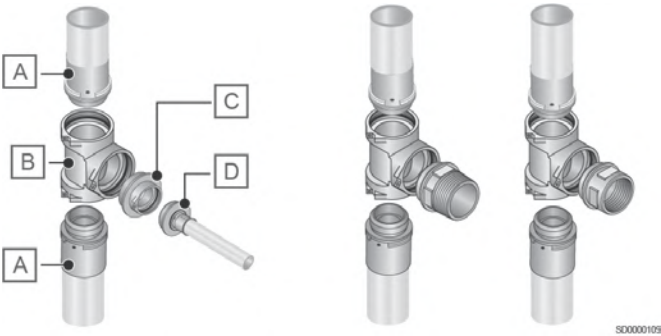
| Item | Description |
|------|-------------|
| A | RS3 Press adapter |
| B | RS3 T-base body |
| C | Reducer RS3 - RS2 |
| D | RS2 Press adapter 16 |

## Angle 90° or 45°
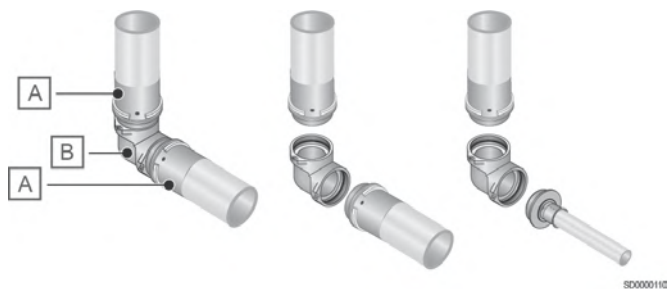


| Item | Description |
|------|-------------|
| A | RS Press adapter |
| B | RS angle 90° |

## Couplings
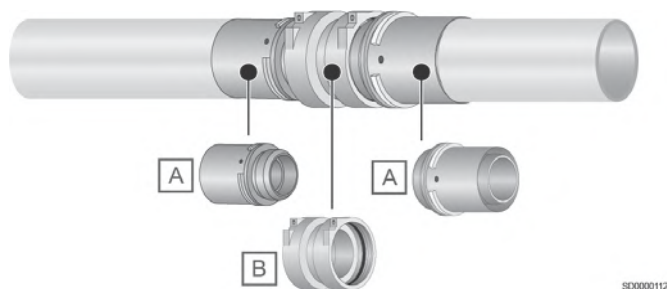


| Item | Description |
|------|-------------|
| A | RS Press adapter |
| B | RS coupling |

## Processing steps for Uponor RS fitting

### Attach press adapter



First the press adapter is inserted on to a composite pipe that has been cut off square and deburred.

### Pressing



A permanent connection is established using the press chain and the base press unit corresponding to the pipe size being pressed

### Connect with base body



Innovative plug-in technology connects the press adapter and base body to one other.

### Locking



Finally, slide the locking pin into the opening of the base body until the locking tooth engages in to the socket

# Uponor RTM fittings
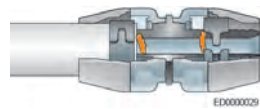


Uponor RTM offers a comprehensive range of fittings for Uponor multilayer pipes, which do not require any expensive assembly tools to create the connection. RTM fittings are quick to install and offer a high level of safety and security, both in drinking water distribution and in heating/cooling applications.

## RTM fitting benefits

- Integrated pressing function
- Dimension-specific colour coding
- No special tools necessary
- Review capability of the successful connection
- Fast and simple to process

## Uponor RTM fittings, dimension overview

| Dimensional range | Description/properties | Material | Colour code/dimension | |
|---|---|---|---|---|
|  **16 — 25 mm** | • One-piece fitting with integrated pressing function (Ring Tension Memory).<br>• The pressing process is initiated by the inserting the pipe; no additional tools are required for pressing.<br>• Audible and visual confirmation of a successful connection<br>• Dimension-specific colour coding of the safety locking device.<br>• The flexible pipes can still be adjusted to suit the installation until completion of the press. However, even after the connection is made, with care, the pipes can still be formed until the start of the pressure test. | • High-performance PPSU plastic or brass<br>• Press ring made of high-strength, specially coated carbon steel | ▬ | 16 |
| | | | ▬ | 20 |
| | | | ▬ | 25 |

## Processing steps for Uponor RTM fittings

### Cut the pipe



Cut the pipe perpendicular to the length using aUponor pipe cutting tool.

### Calibrate



The pipe MUST be calibrated using the RTM calibration tool

### Pressing



Insert the pipe in to the fitting until the audible click is heard

### Insert the pipe until it clicks
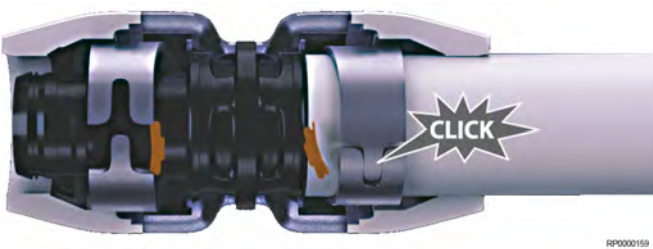


The released safety lock can be seen through the 360° viewing window. It does three things: It holds the press ring in tension until it is pressed, it contains the colour coding for the dimension and it also indicates that the pressing process has been completed.

# Uponor Uni



Uponor Uni includes a selection of connections and fittings for use with ½" adapters and ¾" euro-cone connectors/ compression adapters which can be used for both drinking water distribution and heating/cooling applications.

- Simple transitions to other systems and system components
- High flexibility to suit many applications
- Can be connected using conventional tools



Manifolds can be non-valved or with valves on each outlet to allow isolation of each service or heating loop.

The valved manifolds come with Identification discs with pictograms of outlet types to distinguish each service on each port and the cover disc can be swapped for red or blue to identify hot and cold services.

Manifolds come with either 2, 3 or 4 ports and can be assembled together to make the required number of outlets 3, 4, 5, 6, 7, 8, 9, etc

- Manifolds with or without valved zone control for drinking water and heating applications
- Uponor Uni manifolds can be joined together to make the desired number of outlets

## Uponor Uni screw connection for Multilayer pipes, dimension overview

| Dimensional range | Description/properties | Material |
|---|---|---|
| <br>**14 — 20 mm (Uni-C)**<br>**12 — 25 mm (Uni-X)** | • Two-part screw connection made of brass, with tin-plated union nut and pressure sleeve.<br>• For the direct connection of Uponor composite pipes to ½" Uponor fittings, manifolds and sanitary connections.<br>• The ¾" variant allows connection to ¾" euro-cone moulded parts. | • Union nut, brass - tin-plated<br>• Pressure sleeve - brass, plated |

# 4 Drinking water distribution

## 4.1 System description
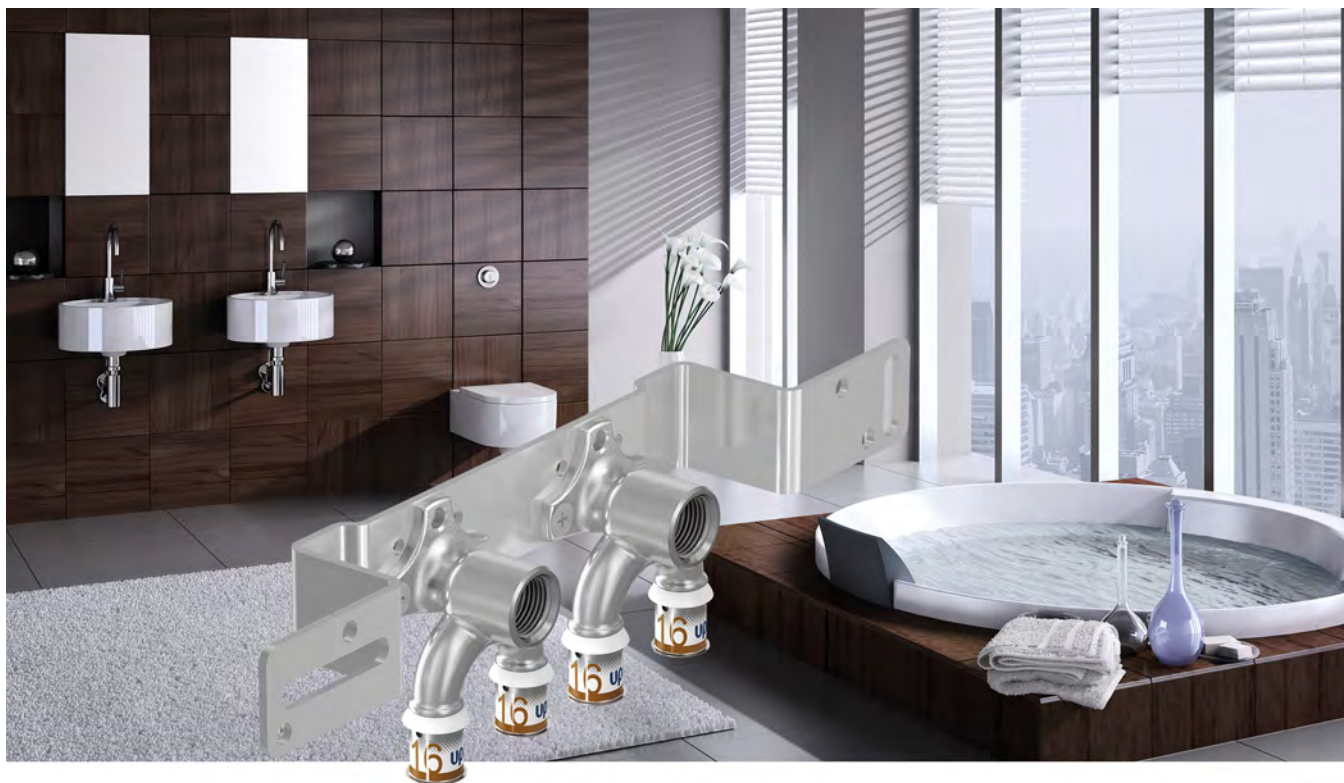


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Special Uponor tap water conections enable a economical and simple installation, as well as hygienic solution once the system is in operation. The multi-functional concept means that fewer components are required for the system making the installation quicker and cheaper.

For example, Uponor wall brackets can be used equally well on mounting plates, mounting rails or directly on the wall. Uponor tap water components allow all common connection designs to be installed, from T-joint installation to hygienic loop or series installation.

### Drinking water distribution with the Uponor composite pipe system

* Wide range of mounting options with only a few components
* Strong, torsion proof connection of wall brackets and mounting rail
* Wall bracket can be used both on the wall and on metal stud rail
* Flow-optimised U-shaped tap mounting connections for lower pressure losses in loop installations
* Matched system with mounting rails, wall brackets, sound insulation and waste water connection
* Proven Uponor press and RTM fitting connection technology

## 4.2 The tap water connection system from Uponor



PH0000102

### Functional and practical

Uponor tap water components in the multilayer pipe system are the result of further refinement of our innovative products. The perfectly coordinated product range enables you to carry out cost-effective, simple assembly even in areas with restricted access..

## More options with fewer components

The multi-functional concept means you need fewer components for your installation. For example, Uponor press wall brackets can be used equally on mounting plates, mounting rails and directly on the wall. The refined design is adapted to all practical requirements.

## Optimal design

The Uponor tap water connection system is designed for a fast, easy and practical installation. Features like the fastening screw with "fall arrest", make your work easier and ensure that assembly is carried out quickly and without unnecessary loss of time.

## Time savings with prefabrication

The Uponor tap water connection system also includes prefabricated assemblies for common installation requirements - saving you valuable time during installation.

## Sophisticated fixing system

Pre-formed mounting rails as well as mounting plates and wall brackets provide the designer and installer many options for each installation.

## Practical accessories

Accessories like the Uponor sound kit and waste water kit complete our delivery programe to ensure that nothing is missing on the construction site that is required for professional installation.

# 4.3 Main tap water components

## Uponor wall brackets – quick and professional installation

**Note**

For an even greater variety of connection types, Uponor S-Press PLUS U wall brackets are now also available with a single-sided reduced connection (16-Rp½"-20 and 20-Rp½"-16 as well as 25-Rp½"-20 and 20-Rp½"-25 ).



*Uponor S-Press PLUS U wall brackets with reduced connection on one side*

Uponor wall brackets together with the matching mounting plates, rails and angles enable quick and versatile connections. The guide pin, which is simply inserted into the back of the mounting rail, allows the tap connector fiitting to be easily locked in the desired position (-45°/90°/+45°). The fixing screws ensure a stable and torsion-proof connection between wall plate and rail.

## Uponor tap elbows

- Made of tin-plated brass
- Can be used either for surface mounting or for use with the Uponor mounting brackets or mounting plates
- Different designs and dimensions for U-shaped, single or double connection
- Available with pressed, RTM or threaded connections

# Feed-throughs for loop and series installation in drywall construction



Uponor wall penetrations with female thread, according to BS EN 10226-1, provide technically perfect, torsion-proof penetrations through walls made from drywall, for both new build and renovation projects. As an option, LWC wall brackets with U-tap connections provide a torsion-proof connection combined with improved hygiene when used within a loop or series installation. Upon request, Uponor feed-throughs are available in lengths for installation depths from 25-35mm. Uponor feed-throughs are available with high performance Uponor S-Press PLUS connections

- Connections for common cisterns, taps and outlet fittings

## Uponor drywall feed-through
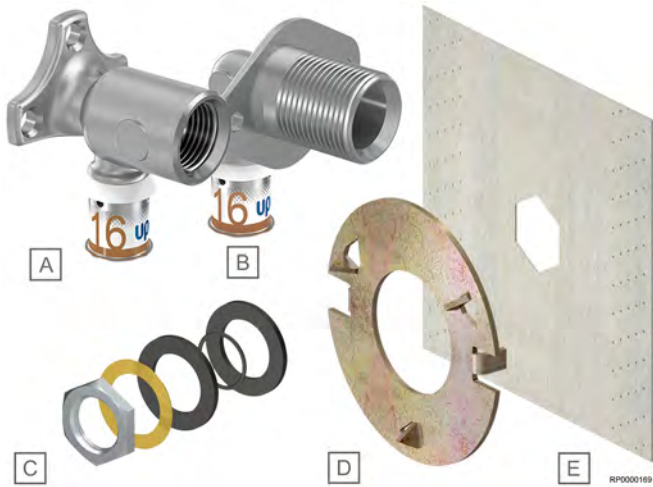


| Item | Description |
|------|-------------|
| A | Uponor S-Press PLUS U corner wall seal LWC for optimum installation for series or loop installations in walls made from drywall |
| B | Uponor S-Press PLUS corner wall seal LWC for individual connection |
| C | Uponor mounting kit LWC |
| D | Uponor anti-twist device LWC |
| E | Uponor sealing flange LWC |

- Variable installation depths of 25 or 35 mm for use in gypsum dry-wall or wooden wall construction
- Also available with optional sound insulation
- Minimum installation depth, can also be used with low cavity wall depths of only 40 mm
- Torsion resistance guaranteed during installation

# Mounting options
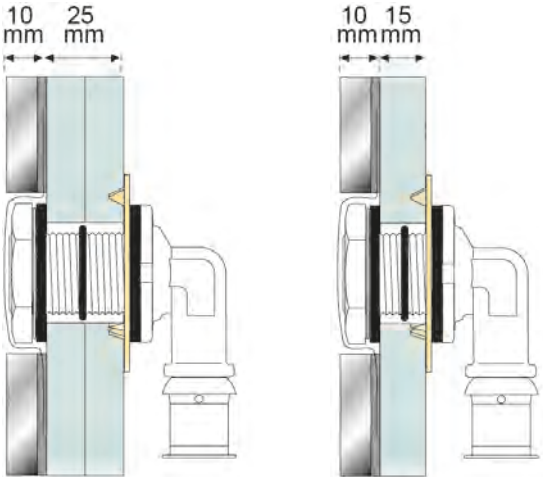


Torsion-proof installation in a plasterboard wall with Uponor anti-twist device LWC
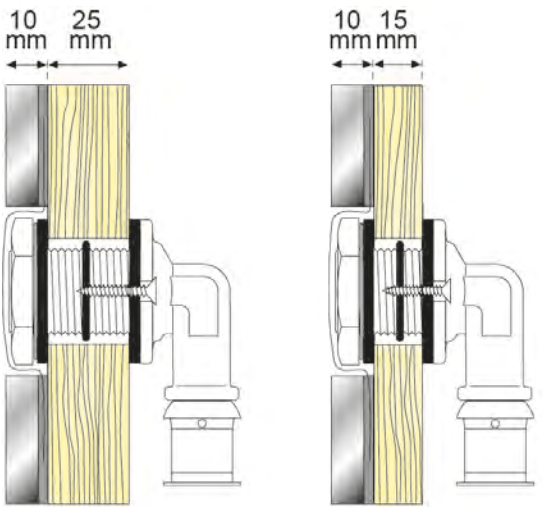


*Torsion-proof installation in wood panels secured with wood screws*

# Loop fittings for hygienic drinking water distribution



*Uponor U-tap elbows and equipment connections enable hygienic loop and series installations*

# 5 Design principles for water distribution

## 5.1 General information

### Drinking water is our most important foodstuff

Drinking water intended for human consumption must be free from pathogens, fit for human consumption and pure. Its quality must be such that it does not adversely affect human health even long after consumption. This is why the strictest demands are made on the quality of drinking water. No other foodstuff is checked as regularly or frequently.

### Protection of drinking water

The protection of drinking water is the responsibility of the government's Drinking Water Inspectorate. However, water undertakers, architects, designers, installers and even property owners also bear the responsibility to ensure that drinking water at every tap complies with the chemical and microbiological requirements (parameters) of the regulations.

### Measures to reduce Legionella growth



*Legionella pneumophila*

If left untreated, Legionella can propagate in both the both hot and cold drinking water systems. Care must be taken that each system design should make considerations to use principals that prevent a concentration of Legionella that can be hazardous to health.

Legionella are rod-shaped bacteria which occur naturally in small amounts in fresh water, e.g. in lakes, rivers and occasionally also in tap water. The group of Legionella includes some 40 known forms. Some Legionella species can cause infections by the inhalation of contaminated aerosols (fine water droplets) into the lungs, for example while showering or from humidifiers in ventilation systems.

In a person with health limitations such as a weakened immune system or chronic bronchitis, this can lead to pneumonia (Legionella pneumonia or Legionnaires' disease) or Pontiac fever.
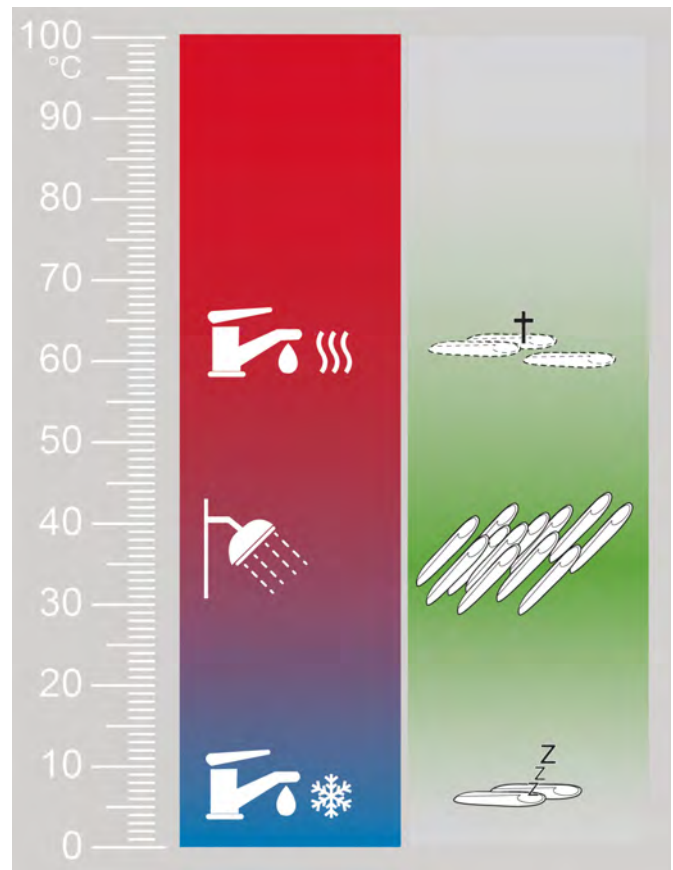


*Influence of water temperature on Legionella proliferation*

According to the government's HSE ACOP L8 document, the risk of infection is directly related to the temperature of the tap water within the drinking water distribution system and the length of time that the water stays in the system. The temperature range at which Legionella growth occurs is between 20°C and 45°C. The code of practice describes the technical measures needed to reduce Legionella growth in drinking water distribution systems, based on the current state of knowledge.

When planning and sizing drinking water pipes, the following points are important from a hygienic (microbiological) point of view:

- The shortest possible pipelines and the smallest, but hydraulically sufficient, pipe diameters should be used in order to achieve the shortest possible time of the tap water remaining in the system.
- Stagnation of tap water in parts of the system that have not had water flowing through should be avoided.
- The heating of cold tap water distribution systems by environmental influences must be avoided.
- Unused parts of the network must be emptied and disconnected.

### Generally recognised engineering practices

The code of practice as well as other laws and guidelines often refer to "generally recognised engineering practices". These include national standards and guidelines (L8, BS, CIBSE, etc) or international standards (BS EN, ISO) and technical data sheets from the relevant associations. These documents are used by observers to assess whether an installation is designed, built and operated in accordance with generally accepted engineering practices.

The generally accepted engineering practices for the construction and operation of drinking water distribution systems are laid down in the European basic standards BS EN 806: 1 - 5, BS EN 1717 and the national supplementary standards BS 8558 "Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. (Complementary guidance to BS EN 806)"

## European standards with national supplements

| European basic standards | National supplementary standards |
|---|---|
| BS EN 1717 Protection against pollution of potable water | Water Supply (Water fittings) Regulations |
| BS EN 806 Part 1: General info | - |
| Part 2: Planning | BS 8558 Planning |
| Part 3: Pipe sizing | BS 8558 Pipe sizing |
| Part 4: Installation | BS 8558 Installation |
| Part 5: Operation and maintenance | - |

**European basic standards with national supplementary standards for the planning and construction of drinking water distribution systems**

## Intergrated, property-specific planning is important

The planning stage already sets the course for hygienic and energy-efficient drinking water distribution. A modern drinking water distribution system must not only comply with current engineering practices to ensure tap water hygiene, it should also be energy-efficient and prevent waste of wholesome water. The demands on the comfort of drinking water distribution have also risen significantly. Modern plumbing fittings with low flow rates combined with strict requirements for hot water output times (e.g. HSE L8, CIBSE TM13) or if specification presents a specific hot water delivery time, can be a challenge for the designer.

In order to meet all requirements, detailed planning involving all the trades concerned is necessary. In these situations a detailed design specification should be presented by the system designer. This should include at least the following specifications:

• a detailed description of the equipment or outlets to be installed
• specifications for intended use including expected flow/loading units
• the concept for drinking water distribution with pipe routing and outlet points
• Expected times for hot water delivery

# 5.2 Installation options

## Series installation
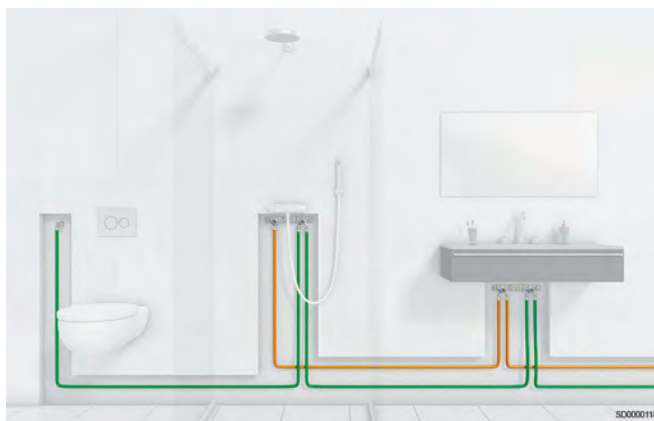


In a series installation, the tapping points are connected to the Uponor S-Press PLUS U-tap connections and the pipes are then joined to each outlet in the 'series'. In this way, when the last outlet on the 'series' is opened, water is drawn through all of the other outlets connected to that pipe 'series'. Therefore, ideally, the most frequently used outlet should really be the last outlet of the series, for example the toilet flush or the washbasin, should be at the end of the series.

This type of plumbing scheme is a simple way to prevent stagnation and dead-legs within a system as long as the last outlet on the system is used.

## Loop installation
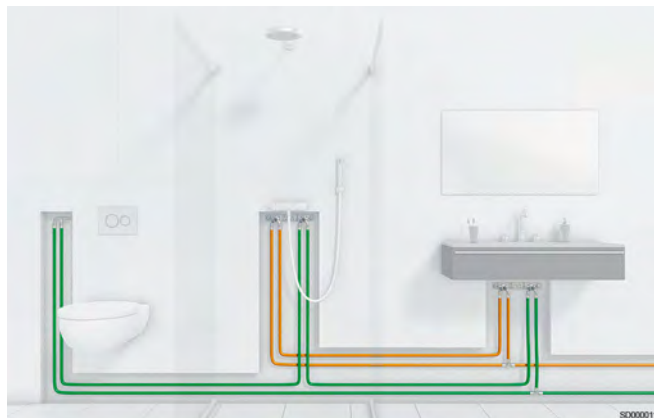


In a 'loop' installation, the tapping points are connected in a similar way to a series installation. However, the line from the last outlet 'loops' back to the starting point. Regardless of what outlet on the 'loop' is opened, the water flows through each of the outlets on the system preventing stagnation and ensuring that all dead legs are removed from the circuit thus protecting the hygiene of the water.

As the outlets are supplied from both sides, the plumber can use a single, smaller dimension pipe throughout the whole 'loop' as each outlet is simultaneously supplied from either side. As well as making the installation easier due to the smaller pipe sizes, this feature also reduces the pressure loss to each outlet.

## T-installation



In a T-installation, all outlets are individually connected to the supply lines via T-joints. The installation is usually started with a larger pipe dimension, which is then reduced progressively until the last tapping point. This type of plumbing scheme does sometimes help to minimise pipe lengths. However, in T-installations there is a risk that water will stagnate in dead-legs and these can be the cause of an unhealthy system providing water that could be unhygienic. For this reason, a T-installation should only be used where all outlets are in regular use.

# 5.3 DHW Circulation systems

These systems (known as recirculating, secondary hot circulation, return or ring main systems) carry continuously pumped hot potable water to outlets where the temperature is between 55°C to 70°C (always check latest government regulations or the project's specification) and is replenished by an incoming water supply to replace the water drawn to outlets. These systems are very different from intermittent systems for hot water distribution, which only pass hot water to the outlets when water is drawn. These intermittent systems can sometimes take considerable time to pass hot water to an open outlet and can often be a cause of an unhealthy system.

## Requirements

The entire hot water distribution system should be operated in such a way that the hot water leaves the water heater at a temperature of at least 60°C and flows back into the heater with a temperature loss of 5°K at the most.

## Protection of cold water pipes from heating pipes
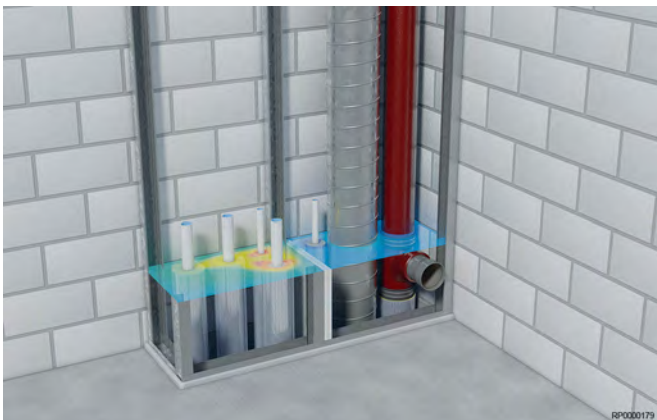


*Thermally isolated cold water line (DCW / BCWS) separated in an installation shaft to prevent unwanted heat transfer from hot water pipes.*

If installed in close proximity to cold water pipes, hot water circulation systems can have a negative effect on tap water hygiene. For example if hot water circulation lines are installed together with cold water lines in shafts or cavities the danger here is that the water in the cold water pipe could warm-up to a point above the permissible value of 25 °C the point at which bacteria such as Legionella will propagate.

To minimise the risk for cold potable water pipes to be exposed to unwanted thermal gain from other hot water services, designers should follow some simple rules,  for example:

- Install warm (heating and DHW) and cold water pipes (DCW / BCWS) separately
- Allow for sufficient insulation of both the hot and cold water lines (BS 5422:2009)
- Reduce the amount of hot water recirculation pipes in a construction by installing decentralised hot tap water generation (heat interface units)

## Calculations

For cold and hot water pipes in buildings with up to six apartments, without circulation lines, the simplified design method described in BS EN 806-3 can be used for calculations.

Alternatively, the Uponor HSE calculation software is available for calculations using the differentiated calculation method.

# 5.4 Use of trace heating

⚠️ **Caution!**

The pressure increase in a system due to the use of a trace heating cable must be considered. Suitable safety measures must be provided to ensure pressure compensation for thermal expansion of the water .The installation guidelines and instructions of the trance heating cable manufacturer must be followed.

Uponor composite pipes are generally suitable for the use of trace heating.

Electric heat tracing, heat tape or surface heating, is a system used to maintain or raise the temperature of pipes and vessels.

Trace heating takes the form of an electrical heating element run in physical contact along the length of a pipe. The pipe is usually covered with thermal insulation to retain heat losses from the pipe. Heat generated by the element then maintains the temperature of the pipe.

Trace heating may be used to protect pipes from freezing, to maintain a constant flow temperature in hot water systems, or to maintain process temperatures for piping that must transport substances that solidify at ambient temperatures.

In order for these electric trace heating systems to be used on a Uponor Multilayer composite pipe installation, the following conditions should be followed:

- The maximum permissible operating temperature for the trace heating must not exceed 60°C. Thermostatic control, independent to control provided by a self limiting heating element, must be used to ensure that temperatures are never able to exceed the maximum permissible temperature of 60°C.

- Fixing of the trace heating system should follow the manufacturer's guidelines for connections to MLC systems. Certain adhesives may contain products that could be damaging to the MLC materials. Connection to the Uponor MLC pipe must have no detrimental effect on the materials and connections within the MLC system.

- Supplementary heating can cause an increase in pressure localised to the area being treated by the trace heating tape. Care must be taken not to exceed the maximum designed operating pressure of the MLC system. If there is potential for pressure to exceed the maximum operating pressure, safety equipment such as expansion vessels and pressure release valves should be added the system.

# 5.5 Connections

## Connection to instantaneous, flow water heaters

Due to their design, hydraulically controlled electric and gas-fired or electric instantaneous, flow water heaters can build up unacceptably high temperatures during normal operation and in the event of a fault, these excessive high temperatures can cause damage to the multilayer composite pipes and connections.

Uponor multi-layer pipes should not be directly connected to boilers or heaters, which have a higher constant temperature of 70°C (malfunction temperature 95°C for 100h) for tap water and constant higher temperature of 80°C (malfunction temperature of 100°C for 100h) for heating: Please also seek advice from the boiler or heater equipment manufacturer.

When using electronically controlled devices for tap water heating, the manufacturer's instructions must be observed.

## Connection to hot water cylinder

In general, when connecting to hot water storage tanks (especially directly fired hot water storage tanks, solar storage tanks and special designs), it must be ensured that in both normal operating conditions, and in the event of a malfunction, the maximum operating limits of Uponor multilayer composite pipes are not exceeded. This applies in particular to the maximum hot water outlet temperature, which must be checked during commissioning or the details must be requested from the manufacturer.

In the case of any doubt, suitable safety measures (such as the installation of a thermostatic service water mixing valve) must be installed.

## Fitting connections

Fitting connections must always be mounted so as to be twist-proof to protect the pipe connections, the building fabric and the equipment that the fitting is connected to.

# 6 Pipe network calculations

## 6.1 Data for pipe network calculations

### Uponor S-Press PLUS – zeta values*

| Single resistance | | | S-Press PLUS fittings | | | | S-Press PLUS composite fittings made of PPSU | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Zeta values ζ | | | | Zeta values ζ | | | |
| | | | DN 12 | DN 15 | DN 20 | DN 25 | DN 12 | DN 15 | DN 20 | DN 25 |
| | | | Pipe outer diameter OD mm | | | | Pipe outer diameter OD mm | | | |
| | | | 16 | 20 | 25 | 32 | 16 | 20 | 25 | 32 |
| T-joint branch for current separation | TA | | 7,4 | 5,2 | 4,7 | 3,4 | 16,5 | 8,8 | 7,4 | 5,8 |
| T-joint passage for current separation | TD | | 2,3 | 1,2 | 1,1 | 0,7 | 4,4 | 2,8 | 2,4 | 1,2 |
| T-joint counter-flow for current separation | TG | | 7,6 | 5,4 | 5 | 4,1 | 17,1 | 9,1 | 7,9 | 6,2 |
| T-joint branch for current merging | TVA | | 13,2 | 8,1 | 7,7 | 6,7 | 29,1 | 15,7 | 15,6 | 10,6 |
| T-joint passage for current merging | TVD | | 26,4 | 21,2 | 17,1 | 14,7 | 58,2 | 32,7 | 30,4 | 20,9 |
| T-joint counter-flow for current merging | TVG | | 18 | 12,1 | 10,6 | 7,9 | 36 | 18,3 | 16,2 | 11,5 |
| Bend 90° | B90 | | 4,1 | 2,6 | 2,2 | 1,6 | — | — | — | — |
| Angle 90° | W90 | | 7,1 | 5,1 | 4,2 | 3,3 | 10,4 | 5,1 | 4,1 | 3,1 |
| Angle/Bend 45° | W45 | | — | — | 2,3 | 1,3 | — | — | — | — |
| Reduction | RED | | 1,6 | 0,7 | 1,1 | — | — | — | — | — |
| Wall bracket | WS | | 6,5 | 4,3 | 3,4 | — | — | — | — | — |
| Double wall bracket passage | WSD | | 6,3 | 4,2 | 3,9 | — | — | — | — | — |
| Double wall bracket branch | WSA | | 4,3 | 4,2 | 5,5 | — | — | — | — | — |
| Coupling/sleeve | K | | 1,9 | 1 | 0,8 | 0,5 | 3,4 | 1,7 | 1,6 | 0,8 |

*Product-related Uponor resistance coefficients according to DIN 1988-300 point 4.3 Individual resistances. The resistance coefficients (ζ values) cited by the manufacturers as calculated in accordance with DVGW Worksheet W 575 or equivalent procedures shall be taken into account.*

# Uponor S-Press – zeta values*

| Single resistance | | | S-Press fittings | | S-Press composite fittings made of PPSU | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | Zeta values ζ | | Zeta values ζ | | | |
| | | | DN 32 | DB 40 | DB 32 | DN 40 | DN 50 | DN 65 |
| | | | Pipe outer diameter OD mm | | Pipe outer diameter OD mm | | | |
| | | | 40 | 50 | 40 | 50 | 63 | 75 |
| T-joint branch for current separation | TA | | 4,1 | 3,1 | 5,5 | 4,4 | 5,2 | 5,0 |
| T-joint passage for current separation | TD | | 0,7 | 0,4 | 1,0 | 0,7 | 1,2 | 1,2 |
| T-joint counter-flow for current separation | TG | | 4,1 | 3,1 | 6,1 | 4,8 | 6,7 | 6,3 |
| T-joint branch for current merging | TVA | | 7,8 | 5,6 | 12,1 | 9,4 | 12,6 | 11,8 |
| T-joint passage for current merging | TVD | | 13,8 | 11,4 | 22,8 | 18,8 | 25,5 | 26,0 |
| T-joint counter-flow for current merging | TVG | | 12,2 | 10,9 | 12,4 | 9,7 | 13,5 | 12,7 |
| Angle 90° | W90 | | 2,4 | 1,8 | 5,1 | 4,3 | 4,4 | 3,8 |
| Angle/Bend 45° | W45 | | 1,3 | 1,2 | 2,1 | 2,0 | 1,7 | 1,7 |
| Reduction | RED | | 1,2 | 1,0 | 0,9 | 1,3 | 1,2 | 1,0 |
| Coupling/sleeve | K | | 0,5 | 0,3 | 0,8 | 0,6 | 0,,6 | 0,6 |

*Product-related Uponor resistance coefficients according to DIN 1988-300 point 4.3 Individual resistances. The resistance coefficients (ζ values) cited by the manufacturers as calculated in accordance with DVGW Worksheet W 575 or equivalent procedures shall be taken into account.*

# Uponor RS – zeta values*

| Single resistance | | | Zeta values ζ | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | DN 32 | DN 40 | DN 50 | DN 65 | DN 80 | DN 100 |
| | | | Pipe outer diameter OD mm | | | | | |
| | | | 40 | 50 | 63 | 75 | 90 | 110 |
| T-joint branch for current separation | TA | | 1,0 | 1,4 | 2,5 | 3,2 | 2,8 | 2,8 |
| T-joint passage for current separation | TD | | 0,7 | 0,5 | 1,0 | 0,7 | 0,2 | 0,2 |
| T-joint counter-flow for current separation | TG | | 3,5 | 3,0 | 3,1 | 4,1 | 4,0 | 4,0 |
| T-joint branch for current merging | TVA | | 5,5 | 4,5 | 4,0 | 3,5 | 3,5 | 3,5 |
| T-joint passage for current merging | TVD | | 10,0 | 9,0 | 8,0 | 7,0 | 6,0 | 6,0 |
| T-joint counter-flow for current merging | TVG | | 8,0 | 7,0 | 6,0 | 5,0 | 5,0 | 5,0 |
| Angle 90° | W90 | | — | — | 2,3 | 3,1 | 2,4 | 2,4 |
| Angle/Bend 45° | W45 | | — | — | 1,0 | 1,0 | 1,0 | 1,5 |
| Reduction | RED | | 0,6 | 0,5 | 0,5 | 0,3 | 0,0 | — |
| Coupling/sleeve | K | | — | — | 0,8 | 0,6 | 0,0 | 0,0 |

*Product-related Uponor resistance coefficients according to DIN 1988-300 point 4.3 Individual resistances. The resistance coefficients (ζ values) cited by the manufacturers as calculated in accordance with DVGW Worksheet W 575 or equivalent procedures shall be taken into account.*

*Product-related Uponor resistance coefficients according to DIN 1988-300 point 4.3 Individual resistances. The resistance coefficients (ζ values) cited by the manufacturers as calculated in accordance*

# Dimensioning of sections (design tables)

The selection of the pipe dimension for a particular part of a system section can be determined from the following pipe friction pressure gradient tables described as functions of peak flow rate for cold tap water (10 °C), or from the pressure loss diagram.

The required rules for the dimensioning of pipes, the required minimum flow pressures and calculated flows can be found in DIN 1988-300.

## Pipe dimensions 14 — 20 mm

| OD x s (ID) — V/l | 14 x 2 mm (10 mm) — 0.078 l/m | | 16 x 2 mm (12 mm) — 0.11 l/m | | 20 x 2,25 mm (15,5 mm) — 0.19 l/m | |
|---|---|---|---|---|---|---|
| $\dot{V}_s$ — l/s | v — m/s | R — mbar/m | v — m/s | R — mbar/m | v — m/s | R — mbar/m |
| 0.01 | 0.13 | 0.51 | 0.09 | 0.22 | 0.05 | 0.07 |
| 0.02 | 0.25 | 1.61 | 0.18 | 0.69 | 0.11 | 0.21 |
| 0.03 | 0.38 | 3.19 | 0.27 | 1.36 | 0.16 | 0.41 |
| 0.04 | 0.51 | 5.21 | 0.35 | 2.21 | 0.21 | 0.66 |
| 0.05 | 0.64 | 7.62 | 0.44 | 3.23 | 0.26 | 0.97 |
| 0.06 | 0.76 | 10.43 | 0.53 | 4.41 | 0.32 | 1.32 |
| 0.07 | 0.89 | 13.59 | 0.62 | 5.75 | 0.37 | 1.72 |
| 0.08 | 1.02 | 17.12 | 0.71 | 7.23 | 0.42 | 2.16 |
| 0.09 | 1.15 | 20.99 | 0.80 | 8.86 | 0.48 | 1.91 |
| 0.10 | 1.27 | 25.20 | 0.88 | 10.63 | 0.53 | 3.17 |
| 0.15 | 1.91 | 51.07 | 1.33 | 21.49 | 0.79 | 6.39 |
| 0.20 | 2.55 | 84.56 | 1.77 | 35.52 | 1.06 | 10.54 |
| 0.25 | 3.18 | 125.23 | 2.21 | 52.55 | 1.32 | 15.56 |
| 0.30 | 3.82 | 172.79 | 2.65 | 72.43 | 1.59 | 21.41 |
| 0.35 | 4.46 | 227.01 | 3.09 | 95.07 | 1.85 | 28.07 |
| 0.40 | 5.09 | 287.69 | 3.54 | 120.39 | 2.12 | 35.52 |
| 0.45 | 5.73 | 354.68 | 3.98 | 148.33 | 2.38 | 43.72 |
| 0.50 | 6.37 | 427.86 | 4.42 | 178.83 | 2.65 | 52.67 |
| 0.55 | 7.00 | 507.11 | 4.86 | 211.85 | 2.91 | 62.35 |
| 0.60 | - | - | 5.31 | 247.33 | 3.18 | 72.74 |
| 0.65 | - | - | 5.75 | 285.24 | 3.44 | 83.84 |
| 0.70 | - | - | 6.19 | 325.56 | 3.71 | 95.64 |
| 0.75 | - | - | 6.63 | 368.25 | 3.97 | 108.13 |
| 0.80 | - | - | 7.07 | 413.27 | 4.24 | 121.29 |
| 0.85 | - | - | - | - | 4.50 | 135.12 |
| 0.90 | - | - | - | - | 4.77 | 149.62 |
| 0.95 | - | - | - | - | 5.03 | 164.77 |
| 1.00 | - | - | - | - | 5.30 | 180.57 |
| 1.05 | - | - | - | - | 5.56 | 197.02 |
| 1.10 | - | - | - | - | 5.83 | 214.11 |
| 1.15 | - | - | - | - | 6.09 | 231.84 |
| 1.20 | - | - | - | - | 6.36 | 250.19 |
| 1.25 | - | - | - | - | 6.62 | 269.17 |
| 1.30 | - | - | - | - | 6.89 | 288.77 |
| 1.35 | - | - | - | - | 7.15 | 308.99 |

$\dot{V}_s$ = Peak flow rate in litres/second according to DIN 1988-300

R = Pipe friction pressure gradient in millibar/metre (1 mbar ≙ 1 hPa)

v = Flow velocity in metres/second

## Correction factors for other water temperatures

| Water temperature [°C] | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Conversion factor | 1.000 | 0.983 | 0.967 | 0.952 | 0.938 | 0.933 | 0.918 | 0.904 | 0.890 | 0.873 | 0.861 |

## Pipe dimensions 25 — 50 mm

| OD x s (ID) — V/l | 25 x 2,5 mm (20 mm) — 0.31 l/m | | 32 x 3 mm (25 mm) — 0.53 l/m | | 40 x 4 mm (32 mm) — 0.80 l/m | | 50 x 4,5 mm (40 mm) — 1.32 l/m | |
|---|---|---|---|---|---|---|---|---|
| $\dot{V}_s$ — l/s | v — m/s | R — mbar/m | v — m/s | R — mbar/m | v — m/s | R — mbar/m | v — m/s | R — mbar/m |
| 0.10 | 0.32 | 0.95 | 0.19 | 0.28 | 0.12 | 0.10 | 0.08 | 0.03 |
| 0.20 | 0.64 | 3.15 | 0.38 | 0.91 | 0.25 | 0.34 | 0.15 | 0.11 |
| 0.30 | 0.95 | 6.38 | 0.57 | 1.84 | 0.37 | 0.69 | 0.23 | 0.21 |
| 0.40 | 1.27 | 10.55 | 0.75 | 3.03 | 0.50 | 1.13 | 0.30 | 0.35 |
| 0.50 | 1.59 | 15.62 | 0.94 | 4.48 | 0.62 | 1.67 | 0.38 | 0.52 |
| 0.60 | 1.91 | 21.55 | 1.13 | 6.17 | 0.75 | 2.30 | 0.45 | 0.71 |
| 0.70 | 2.23 | 28.30 | 1.32 | 8.10 | 0.87 | 3.01 | 0.53 | 0.93 |
| 0.80 | 2.55 | 35.86 | 1.51 | 10.25 | 0.99 | 3.81 | 0.61 | 1.17 |
| 0.90 | 2.86 | 44.20 | 1.70 | 12.63 | 1.12 | 4.69 | 0.68 | 1.44 |
| 1.00 | 3.18 | 53.30 | 1.88 | 15.22 | 1.24 | 5.65 | 0.76 | 1.73 |
| 1.10 | 3.50 | 63.16 | 2.07 | 18.02 | 1.37 | 6.69 | 0.83 | 2.05 |
| 1.20 | 3.82 | 73.76 | 2.26 | 21.03 | 1.49 | 7.80 | 0.91 | 2.39 |
| 1.30 | 4.14 | 85.08 | 2.45 | 24.24 | 1.62 | 8.99 | 0.98 | 2.76 |
| 1.40 | 4.46 | 97.12 | 2.64 | 27.66 | 1.74 | 10.25 | 1.06 | 3.14 |
| 1.50 | 4.77 | 109.88 | 2.83 | 31.28 | 1.87 | 11.59 | 1.14 | 3.55 |
| 1.60 | 5.09 | 123.33 | 3.01 | 35.09 | 1.99 | 13.00 | 1.21 | 3.98 |
| 1.70 | - | - | 3.20 | 39.10 | 2.11 | 14.48 | 1.29 | 4.43 |
| 1.80 | - | - | 3.39 | 43.30 | 2.24 | 16.03 | 1.36 | 4.90 |
| 1.90 | - | - | 3.58 | 47.69 | 2.36 | 17.65 | 1.44 | 5.40 |
| 2.00 | - | - | 3.77 | 52.27 | 2.49 | 19.34 | 1.51 | 5.91 |
| 2.10 | - | - | 3.96 | 57.04 | 2.61 | 21.10 | 1.59 | 6.45 |
| 2.20 | - | - | 4.14 | 61.99 | 2.74 | 22.92 | 1.67 | 7.00 |
| 2.30 | - | - | 4.33 | 67.13 | 2.86 | 24.82 | 1.74 | 7.58 |
| 2.40 | - | - | 4.52 | 72.45 | 2.98 | 26.78 | 1.82 | 8.18 |
| 2.50 | - | - | 4.71 | 77.96 | 3.11 | 28.81 | 1.89 | 8.79 |
| 2.60 | - | - | 4.90 | 83.64 | 3.23 | 30.90 | 1.97 | 9.43 |
| 2.70 | - | - | 5.09 | 89.50 | 3.36 | 33.06 | 2.05 | 10.09 |
| 2.80 | - | - | - | - | 3.48 | 35.28 | 2.12 | 10.76 |
| 2.90 | - | - | - | - | 3.61 | 37.57 | 2.20 | 11.46 |
| 3.00 | - | - | - | - | 3.73 | 39.93 | 2.27 | 12.17 |
| 3.50 | - | - | - | - | 4.35 | 52.65 | 2.65 | 16.04 |
| 4.00 | - | - | - | - | 4.97 | 66.93 | 3.03 | 20.37 |
| 4.50 | - | - | - | - | 5.60 | 82.73 | 3.41 | 25.17 |
| 5.00 | - | - | - | - | - | - | 3.79 | 30.41 |
| 5.50 | - | - | - | - | - | - | 4.17 | 36.09 |
| 6.00 | - | - | - | - | - | - | 4.54 | 42.22 |
| 6.50 | - | - | - | - | - | - | 4.92 | 48.77 |
| 7.00 | - | - | - | - | - | - | 5.30 | 55.74 |
| 7.50 | - | - | - | - | - | - | 5.68 | 63.13 |
| 8.00 | - | - | - | - | - | - | 6.06 | 70.94 |
| 8.50 | - | - | - | - | - | - | 6.44 | 79.16 |
| 9.00 | - | - | - | - | - | - | 6.82 | 87.78 |

$\dot{V}_s$ = Peak flow rate in litres/second according to DIN 1988-300

R = Pipe friction pressure gradient in millibar/metre (1 mbar ≙ 1 hPa)

v = Flow velocity in metres/second

## Pipe dimensions 63 — 110 mm

| OD x s (ID) — V/l | 63 x 6 mm (51 mm) — 2.04 l/m | | 75 x 7,5 mm (60 mm) — 2.83 l/m | | 90 x 8,5 mm (73 mm) — 4.18 l/m | | 110 x 10 mm (90 m) — 6.36 l/m | |
|---|---|---|---|---|---|---|---|---|
| $\dot{V}_s$ — l/s | v — m/s | R — mbar/m | v — m/s | R — mbar/m | v — m/s | R — mbar/m | v — m/s | R — mbar/m |
| 1.00 | 0.49 | 0.61 | 0.35 | 0.28 | 0.24 | 0.11 | 0.16 | 0.04 |
| 1.25 | 0.61 | 0.91 | 0.44 | 0.42 | 0.30 | 0.17 | 0.20 | 0.06 |
| 1.50 | 0.73 | 1.25 | 0.53 | 0.58 | 0.36 | 0.23 | 0.24 | 0.08 |
| 1.75 | 0.86 | 1.65 | 0.62 | 0.76 | 0.42 | 0.30 | 0.28 | 0.11 |
| 2.00 | 0.98 | 2.08 | 0.71 | 0.96 | 0.48 | 0.38 | 0.31 | 0.14 |
| 2.25 | 1.10 | 2.57 | 0.80 | 1.18 | 0.54 | 0.46 | 0.35 | 0.17 |
| 2.50 | 1.22 | 3.10 | 0.88 | 1.43 | 0.60 | 0.56 | 0.39 | 0.21 |
| 2.75 | 1.35 | 3.67 | 0.97 | 1.69 | 0.66 | 0.66 | 0.43 | 0.24 |
| 3.00 | 1.47 | 4.28 | 1.06 | 1.97 | 0.72 | 0.77 | 0.47 | 0.28 |
| 3.25 | 1.59 | 4.94 | 1.15 | 2.27 | 0.78 | 0.89 | 0.51 | 0.33 |
| 3.50 | 1.71 | 5.64 | 1.24 | 2.59 | 0.84 | 1.01 | 0.55 | 0.37 |
| 3.75 | 1.84 | 6.38 | 1.33 | 2.93 | 0.90 | 1.15 | 0.59 | 0.42 |
| 4.00 | 1.96 | 7.16 | 1.41 | 3.29 | 0.96 | 1.29 | 0.63 | 0.47 |
| 4.25 | 2.08 | 7.98 | 1.50 | 3.66 | 1.02 | 1.43 | 0.67 | 0.53 |
| 4.50 | 2.20 | 8.84 | 1.59 | 4.06 | 1.08 | 1.59 | 0.71 | 0.58 |
| 4.75 | 2.33 | 9.73 | 1.68 | 4.47 | 1.13 | 1.75 | 0.75 | 0.64 |
| 5.00 | 2.45 | 10.67 | 1.77 | 4.90 | 1.19 | 1.92 | 0.79 | 0.70 |
| 6.00 | 2.94 | 14.80 | 2.12 | 6.79 | 1.43 | 2.65 | 0.94 | 0.97 |
| 7.00 | 3.43 | 19.53 | 2.48 | 8.95 | 1.67 | 3.49 | 1.10 | 1.28 |
| 8.00 | 3.92 | 24.84 | 2.83 | 11.38 | 1.91 | 4.44 | 1.26 | 1.63 |
| 9.00 | 4.41 | 30.71 | 3.18 | 14.07 | 2.15 | 5.49 | 1.41 | 2.01 |
| 10.00 | 4.90 | 37.15 | 3.54 | 17.01 | 2.39 | 6.63 | 1.57 | 2.43 |
| 11.00 | 5.38 | 44.13 | 3.89 | 20.20 | 2.63 | 7.87 | 1.73 | 2.88 |
| 12.00 | - | - | 4.24 | 23.63 | 2.87 | 9.21 | 1.89 | 3.37 |
| 13.00 | - | - | 4.60 | 27.31 | 3.11 | 10.63 | 2.04 | 3.89 |
| 14.00 | - | - | 4.95 | 31.23 | 3.34 | 12.16 | 2.20 | 4.45 |
| 15.00 | - | - | 5.31 | 35.38 | 3.58 | 13.77 | 2.36 | 5.03 |
| 16.00 | - | - | 5.66 | 39.77 | 3.82 | 15.47 | 2.52 | 5.65 |
| 17.00 | - | - | 6.01 | 44.39 | 4.06 | 17.27 | 2.67 | 6.31 |
| 18.00 | - | - | - | - | 4.30 | 19.15 | 2.83 | 6.99 |
| 19.00 | - | - | - | - | 4.54 | 21.12 | 2.99 | 7.71 |
| 20.00 | - | - | - | - | 4.78 | 23.17 | 3.14 | 8.46 |
| 21.00 | - | - | - | - | 5.02 | 25.31 | 3.30 | 9.24 |
| 22.00 | - | - | - | - | 5.26 | 27.54 | 3.46 | 10.05 |
| 23.00 | - | - | - | - | 5.50 | 29.86 | 3.62 | 10.89 |
| 24.00 | - | - | - | - | 5.73 | 32.25 | 3.77 | 11.77 |
| 25.00 | - | - | - | - | - | - | 3.93 | 12.67 |
| 26.00 | - | - | - | - | - | - | 4.09 | 13.60 |
| 27.00 | - | - | - | - | - | - | 4.24 | 14.57 |
| 28.00 | - | - | - | - | - | - | 4.40 | 15.56 |
| 29.00 | - | - | - | - | - | - | 4.56 | 16.58 |
| 30.00 | - | - | - | - | - | - | 4.72 | 17.63 |

$\dot{V}_s$ = Peak flow rate in litres/second according to DIN 1988-300

R = Pipe friction pressure gradient in millibar/metre (1 mbar ˆ= 1 hPa)

v = Flow velocity in metres/second

# Pressure loss diagram, cold tap water (10 °C)
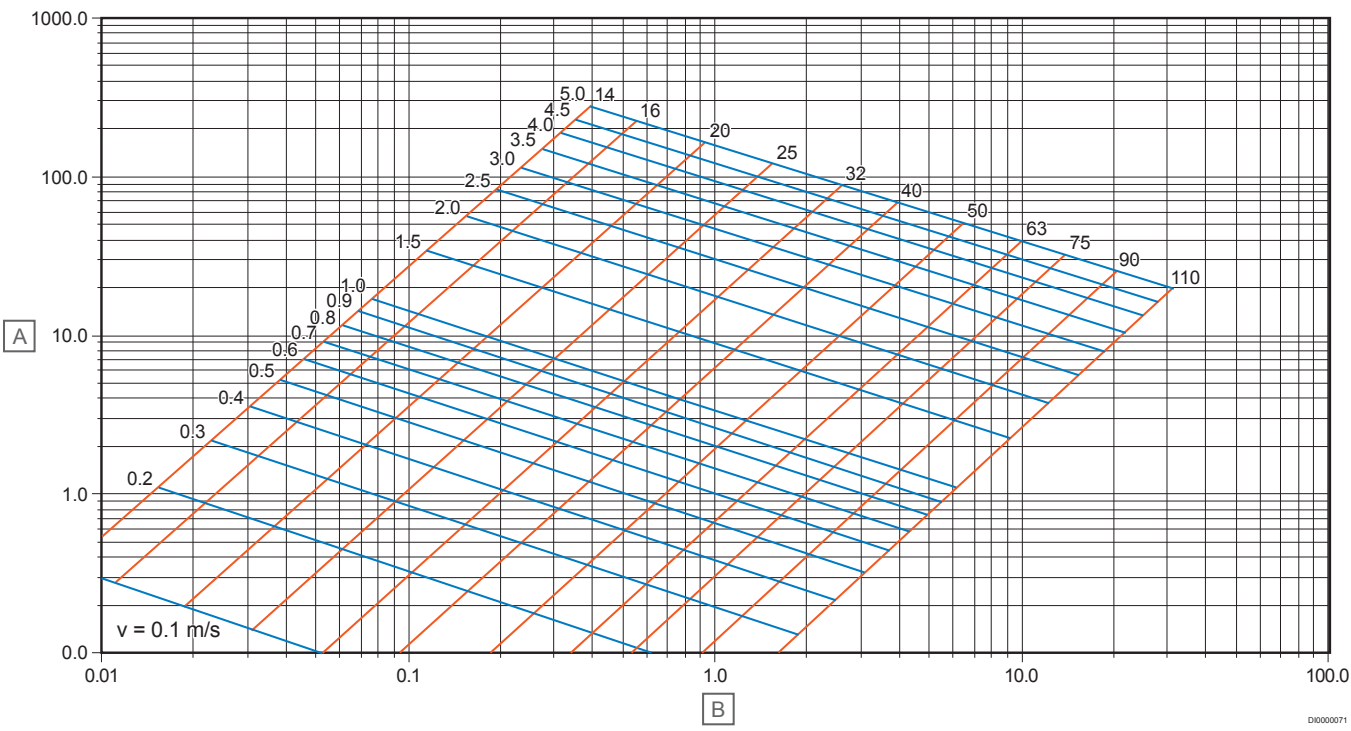


| Item | Description |
|------|-------------|
| A | Pipe friction pressure gradient R [mbam/m] |

| Item | Description |
|------|-------------|
| B | Volume flow rate V̇s [l/s] |

## Correction factors for other water temperatures

| Water temperature [°C] | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Conversion factor | 1.000 | 0.983 | 0.967 | 0.952 | 0.938 | 0.933 | 0.918 | 0.904 | 0.890 | 0.873 | 0.861 |

# 7 Leak test, initial filling and commisioning

## 7.1 Pressure and leak testing

> **Note**
>
> **Legal notice:**
>
> **Pressure testing should only be carried out by a trained, competent person**
>
> Pressure tests are ancillary services under a work contract and are often part of the Contractor's contractual performance, even if not explicitly mentioned in the description of services.
>
> According to current standards a pressure test must be carried out before the system is put into operation.

It is a requirement of The Water Supply (Water fittings) Regulations 1999 for any water distribution system to undergo, a pressure test in accordance with BS EN 806-4 or an equivalent national standard.

Before the pressure test, it must be ensured that all components of the installation are freely accessible and visible, for example in order to locate incorrectly installed fittings. If the pipeline system is to remain unfilled after a pressure test (for example because regular water replacement cannot be guaranteed within seven days after the pressure test procedure), a pressure test with compressed air or inert gases is recommended.

### Leak test with compressed air or inert gas

After a leak test with water, residual water can remain in some sections of the pipe network despite thorough emptying of the system – in case of prolonged stagnation, this is an ideal breeding ground for bacteria. For this reason, leak testing with oil-free compressed air or inert gas (usually nitrogen or carbon dioxide) is recommended, especially in buildings with high hygiene requirements such as hospitals, retirement homes or sport facilities. Once the system has been tested, the system can remain empty until the first fill with potable water shortly before the commissioning of the installation.

A pressure test with compressed air or inert gases is carried out in two steps, the tightness test and the load test, taking recognised engineering practices into consideration.

For both tests (air or water), it is important to wait for a period of time to allow the system temperature to equalise to provide a steady-state condition after the pressure build-up. Appliances, drinking water heaters, fittings or pressure vessels must be isolated from the pipelines before a pressure test with air if their volume can affect safety and testing accuracy. All lines must be directly sealed using metal plugs, metal washers or blind flanges which can withstand the test pressure. Closed shut-off valves are not advised to be used as tight shut-offs.

### Leak test

Before the leak test, all pipe connections must be visually inspected. The manometer used in the test must have a corresponding accuracy of 1 mbar and have suitable scale of accuracy for the pressures to be measured. The system is subjected to a test pressure of 150 mbar (150 hPa). For a system volume of up to 100 liters, the test time must be at least 120 minutes. The required time must be extended by a further 20 minutes per additional 100 litres. No leakage must occur at the connectors during the duration of the test.

### Load test

Following the leak test, the load test is carried out. Here the pressure is increased to max. 3 bar (for pipe size OD ≤ 63 mm) or max. 1 bar (for pipe size OD > 63 mm). For a system volume of up to 100 litres, the test time must be at least 10 minutes.

### Leak test report

The leak test must be documented in a leak test report by the responsible specialist, taking into account the materials used. The tightness of the system must be verified and confirmed.

This report is available at the Uponor services download center.

*https://www.uponor.com/doc/1120118*

### Leak test with water
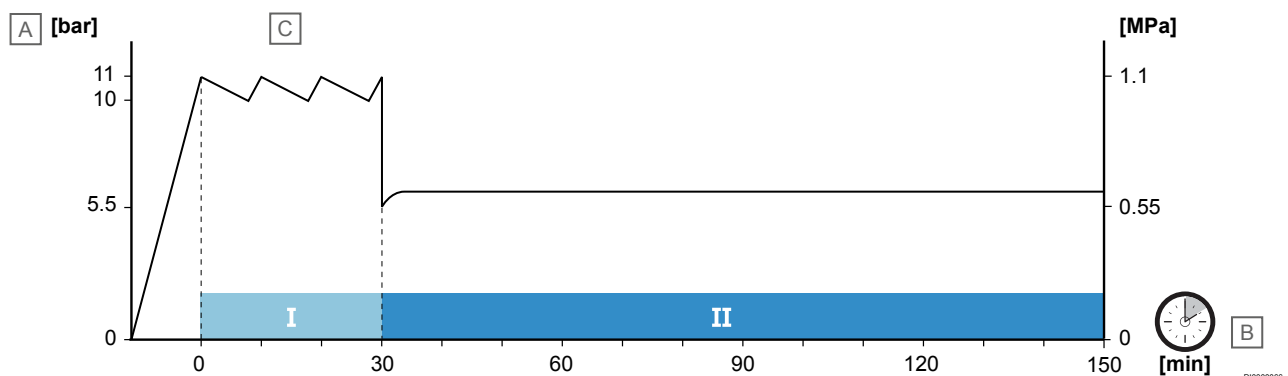


| Item | Description |
|------|-------------|
| A | Test pressure [bar] |
| B | Test time [minutes] |
| C | Maintain pressure, pump |

### Preparing for the leak test

Before performing a leak test with water, a visual inspection of all pipe connections should be completed before the pipes are concealed within walls, ceilings, floors and screeds. If possible, the pressure gauge should be connected to the lowest point of the installation. Only pressure gauges which are accurate enough to determine a pressure change of 0.1 bar should be used.

The system must be filled with filtered tap water (particle size ≤ 150 μm), vented and protected from freezing. Heat sources, equipment and storage tanks should be isolated from the system so that the test pressure is kept away from the rest of the installation being tested.

If there are significant differences (>10 K) between ambient temperature and the water temperature, wait 30 minutes after applying system test pressure to allow temperature equalisation. The pressure must be maintained for at least 10 minutes. There must be no drop in pressure and no visible indication of leakage.

### Uponor fittings with unpressed-untight (leak-path) function

In order to detect a leaking unpressed connection, Uponor fittings with unpressed 'leak-path' function must be tested at 3 bar for 15 minutes before the actual leak test.

### Carrying out the leak test

The pipe network must first be subjected to a test pressure 1.1 times the system's designed operating pressure (relative to the lowest point of the system). The maximum operating pressure according to BS EN 21003 is 10 bar (1 MPa). Accordingly, a maximum test pressure of 11 bar (1.1 MPa) is required. Following the test, an inspection of the pipe system must be carried out in order to detect possible leaks.

After 30 minutes test time, by draining water, reduce the pressure to 5.5 bar (0.55 MPa), corresponding to half the initial test pressure. The test time at this pressure is 120 minutes. No leakage should be detected during this test period. The test pressure at the manometer must remain constant ($\Delta p = 0$). If a pressure drop occurs during the test period, there is a leak in the system. Maintain pressure and locate the leak. The defect must be repaired and then the leak test must be repeated.

### Leak test report

The leak test must be documented in a leak test report by the responsible specialist, taking into account the materials used. The tightness of the system must be verified and confirmed.

This report is available at the Uponor services download center.

*https://www.uponor.com/doc/1120119*



# 7.2 Flushing of Uponor drinking water distribution

**Note**

Uponor tap water lines must be flushed with the local supply pressure and in accordance with BS EN 806-4, Section 6.2.2, unless a different flushing procedure is contractually agreed or required.

The tap water used for flushing must be filtered (filter according to BS EN 13443-1).

Flushing must only take place immediately before the actual start-up of the system.

To ensure the system operates flawlessly, the flushing process must remove contaminants and residues that may have entered the system during installation. This process protects tap water quality, prevents corrosion damage and also prevents malfunctions of valves and equipment.

## Flushing with air and water

The procedure is based on a pulsating current of water and air and is described in more detail in the technical rules for drinking water distribution systems, BS EN 806-4 Section 6.2.3. Suitable flushing equipment must be used for this purpose. The flushing procedure should be used when a sufficient flushing effect cannot be expected when flushing with water alone.

## Flushing method with water

Uponor tap water lines must be flushed to the local supply pressure using the water flushing procedure in accordance with BS EN 806-4, Section 6.2.2, unless another flushing procedure is contractually agreed or required.

The tap water used for flushing must be filtered (filter according to BS EN 13443-1).

**Points to consider:**

- Sensitive fittings (such as solenoid valves, flush valves, thermostatic fittings etc.) and apparatus (such as water heaters) should only be installed after flushing which prevents damage caused by contaminants and assembly residues.
- Aerators, jet regulators, flow-limiters, shower heads and hand showers must be removed from a system during flushing if valves are already installed.
- For in-wall thermostatic fittings and other sensitive fittings which cannot be removed during flushing, the installation instructions of the manufacturer must be followed.
- All maintenance fittings, floor shut-offs and preliminary shut-offs (such as corner valves) must be fully open.
- Any built-in pressure reducers must be fully open and are only adjusted after flushing.
- Built-in fine strainers in front of fittings that cannot be removed or bridged must be cleaned after flushing.

Depending on the size of the system and the installed scheme, flushing may be carried out in sections.

Always maintain one flushing direction away from the main inlet valve, flushing each section line by line (from nearest to the most distant).

Starting from the riser, flushing is carried out floor by floor. Fully open the outlets (see table in the following flushing protocol for the minimum number) and the associated supply pipework for at least 5 minutes each, one after the other, starting at the outlet furthest from the riser.

After a flushing time of 5 minutes at the last opened outlet, the taps are now closed one after the other in reverse order.

## Flushing protocol

The flushing process must be documented by the responsible specialist in a flushing protocol.

This report is available at the Uponor services download center.

*https://www.uponor.com/doc/1120120*

# 8 Handover and documentation

On completion of the construction project, design and construction teams are typically contracted to deliver a structured information handover package to support a client's asset operations and maintenance.

When they are handed the keys at the end of a construction project, what a facilities manager (FM) will be typically given is an information package, be it electronic or physical, filled with information and data. That information should contain explanations on building maintenance, equipment warranties, security operating instructions and asset lists among other things. This information may be in all kinds of formats, including paper and digital media like CDs and memory sticks.

BIM is now growing in it's use, and provides unprecedented levels of information and detail for the building operator and owner. Uponor Multilayer composite systems are available as BIM ready files

The plumbing system, including the heating system and the drinking water system, will be no different to the rest of the building and these detailed records should contain manufacturer details, system information, operating information, commissioning results and expected design performance.

## O&M information

- Construction with description of use and concept of the drinking water distribution system
- Leak test and flushing results
- Commissioning and instruction information
- Protocol for regulating the hot water system
- Test results for the cold and hot water installation
- Inspection and maintenance plan (BS EN 806, part 5)
- Manufacturer's documents, assembly and operating documents
- System design and floor plans of the building with schematic diagram
- If applicable, information on water treatment systems
- Maintenance and hygiene plan
- After commissioning, the following documents must also be submitted to the responsible health authority:
    - Flushing protocols
    - Protocols for regulating the hot water installation
    - Test results of sampling



**Planning in a new dimension. Endless possibilities.**
**The Uponor BIM Platform**
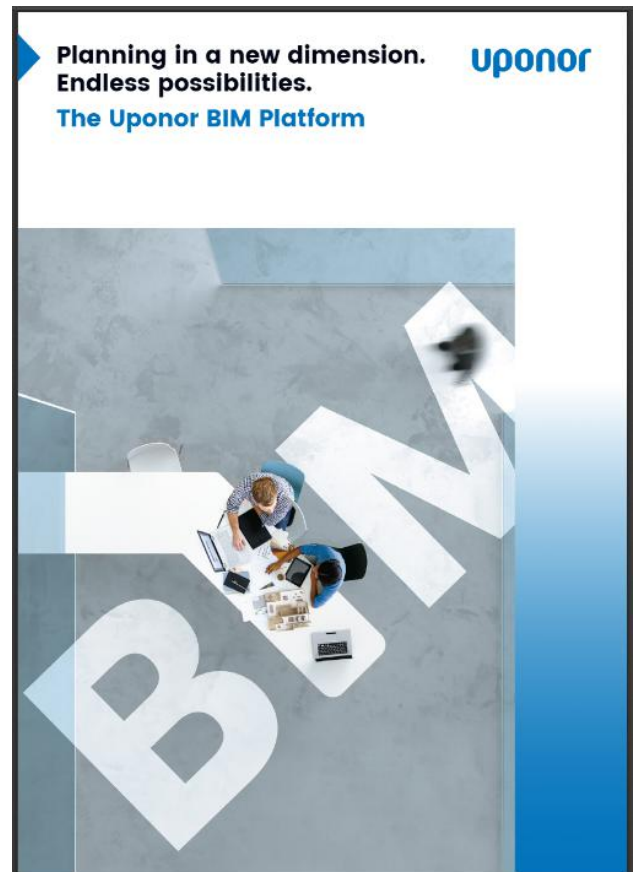
**uponor**

# 9 Heating installation

## 9.1 System description



The versatile range of radiator connections from Uponor includes everything that is required for a safe and quick connection from the heat source to the radiator. Uponor offers a complete range of products for all radiator connection variants - from the traditional single-pipe system with thermostatic valves to a complex distribution system with zone control.

With the Uponor Multilayer composite pipe system, all common radiator connections can be used whether from the floor level, or through the wall. The system also includes special components for the radiator connection from the baseboard, an important aspect in some renovation projects. In addition, pipes and components pre-insulated at the factory, such as the Uponor Smart radi crossing connection encapsulated in insulation, enable rapid installation and with a high level of system perfomance and safety.

### Heating installation

- Wide range of components for different installation options
- Simple planning, low pressure loss
- Simple pressure drop determination and pipe sizing

## 9.2 Uponor main components for heating (overview)

### Uponor radiator adapters and T-joints



Tin-plated brass fittings with Uponor S-Press PLUS connection and either a coated or bare copper pipe 15 x 1 mm in lengths 250 and 1000 mm. Optionally for Uponor composite pipes 12,14,16 and 20mm, radiator connection via Uponor Smart radi compression adapter Cu, or standard copper compression fitting to BS EN 1254-2

# Uponor radiator crossover fitting in insulation box



RP0000181

Uponor Smart Radi Crossings are available either with or without insulation sets. Made of coated brass with Uponor S-Press PLUS joint technology these fittings enable a crossover-free connection of radiators on an unfinished floor or within a tight void. Two-part insulation box made of EPP (expanded polypropylene) with 13 mm insulation. .

# Uponor Smart radi connection block
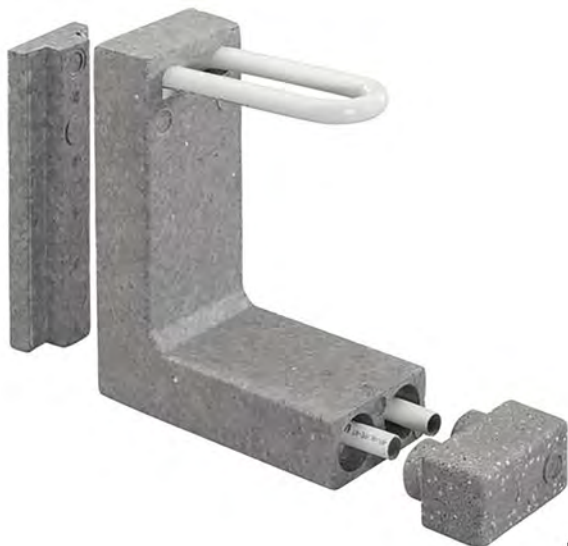


RP0000182

Wall connection cut out with polystyrene thermal insulation and removable protective cap. Insulation box in fire class E according to BS EN 13501-1. Suitable for valve radiators. Insulation box width: 100 mm

# Uponor radiator mounting plate



RP0000183

Factory pre-fabricated unit for radiator connection consisting of two Uponor S-Press PLUS threaded elbows with wall bracket.

16 — Rp½", mounted with anti-torsion connections on a plated steel mounting plate, with either a 35 or 50 mm center distance.

# Uponor baseboard adapter



RP0000184

Connection kit made of coated brass and Uponor S-Press PLUS connection for baseboard installation without the need to chisel out the wall. Connections with Uponor composite pipes with 16 or 20 mm outer diameter or with Uponor Smart Base angle kit.

## Uponor manifold

Complete stainless steel manifold for the connection of between 2 and 12 radiators circuits. Primary connections 1" FT with flat seal. Heating circuit connections ¾" male thread with euro-cone type connections.

## Uponor Uni fittings and transitions

Fittings range for ½" (Uni-C) or ¾" (Uni-X) thread transitions. Suitable for use with 12, 14 and 16mm Multilayer composite pipes combined with compression adapter type connections

## Uponor Smart radi connection kits

Plated brass fitting. Pressure screw with MT and insert with sleeve and clamping ring, O-ring made of EPDM. Suitable connection kits for Heimeier, Danfos or Oventrop radiator valves

## Uponor Smart radi accessories

Fixing and assembly components for installing the Uponor Smart radi system

# 9.3 Planning principles for heating installations

## Connection options

Uponor installation systems contain all the components required for heating systems, including radiator systems. The most common connection options are shown below. When installing each system, the system-specific special features and installation guidelines must be followed. These can be found in the respective system technical descriptions in this manual and in the associated installation instructions.

## Two-pipe system with central heating manifold
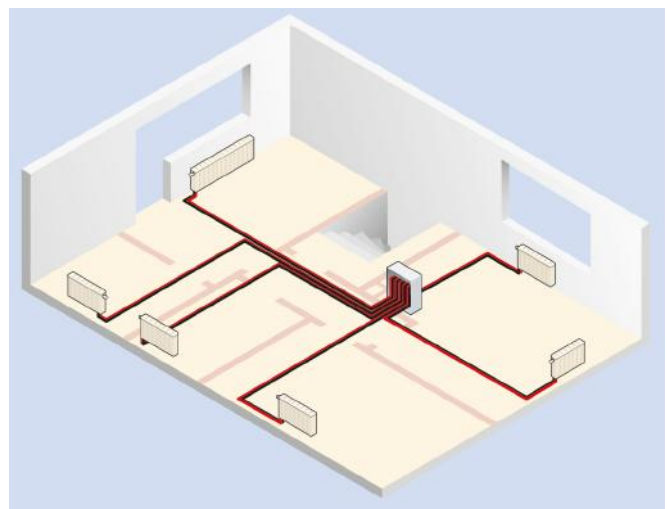
With the two-pipe system with centralised heating manifold, each radiator is connected individually. If required, a heat meter can be mounted on the heating manifold, allowing heat to be measured for each zone or apartment.

## Two-pipe system with T-joint and elbow radiator connection
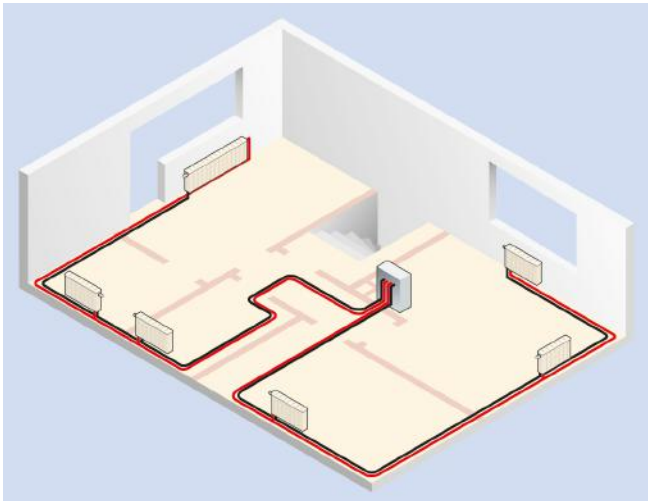


Using the two-pipe system with T-joint radiator connection, loop lines with one or more radiators are connected individually from a central manifold or heat source. Again, if required, a heat meter can be mounted on the heating manifold, allowing heat to be measured for each zone or apartment.

## Two-pipe system as loop line
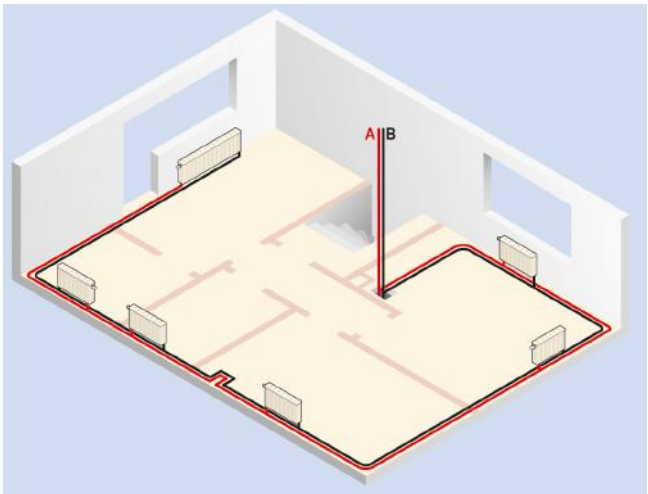


| Item | Description |
|------|-------------|
| A | Supply |
| B | Return |

With the two-pipe system as a loop line, the pipe routing for connecting the radiators to the riser, or supply, begins and ends at exactly the same point.

## Two-pipe system as classic distribution system
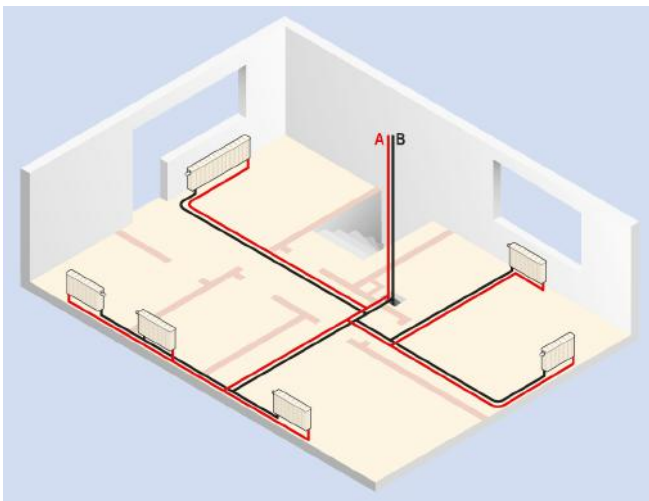


| Item | Description |
|------|-------------|
| A | Supply |
| B | Return |

In the two-pipe system as a classic 'feed and return' distribution system with T-joints, almost all pipe layouts and combinations are possible. Pipe layout for connecting the radiators begins and ends at the riser, or the supply.

## Single-pipe loop system
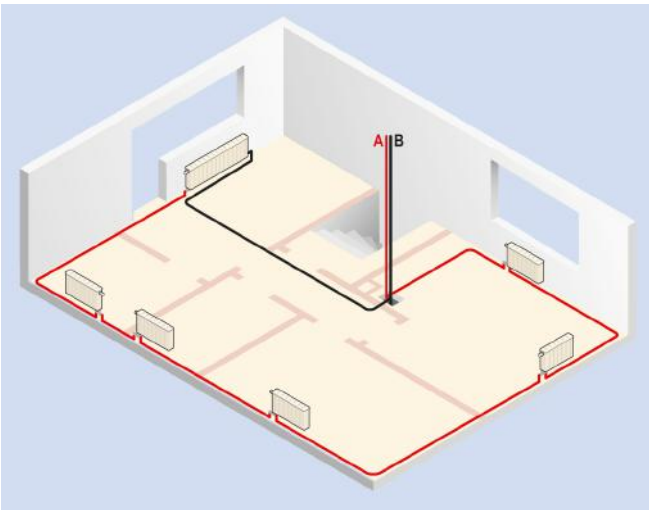


| Item | Description |
|------|-------------|
| A | Supply |
| B | Return |

In the single-pipe system, the pipe routing for connecting the radiators begins and ends at the riser or the supply.

## 9.4 Examples of radiator connections

With the Uponor composite pipe system, all common radiator connections can be used – both from the floor and also from the wall. The system also includes special components for the radiator connection from the baseboard, an important aspect in renovation projects. The most common connection variants are shown below with the components required for each radiator.

# Two-pipe heating with manifold system
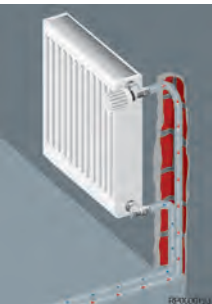
## Uni-X screw connection MLC from the wall

| Number | Designation | | Dimension |
|---|---|---|---|
| | **Uponor Uni-X screw connection MLC** | | |
| 2 units | | • Two-part screw connection made of brass, with tin-plated union nut and pressure sleeve | 14-¾"FT Euro |
| | | • For the direct connection of Uponor composite pipes, Uni Pipe PLUS and MLC, to ¾ FT moulded euro-cone parts as well as manifold H | 16-¾"FT Euro |
| | | • Internal thread according to BS EN ISO 228-1 | 20-¾"FT Euro |
| | | • Connect without deburring | |

## Uponor S-Press adapter nipple from the wall
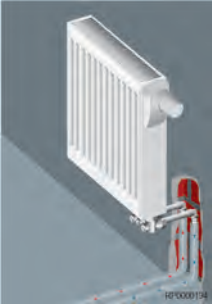
| Number | Designation | | Dimension |
|---|---|---|---|
| | **Uponor S-Press PLUS adapter nipple** | | |
| 2 units | | • Flow optimised fitting | 14-R½"MT |
| | | • Made of tin-plated, dezincification resistant brass, according to 4MS positive list | 16-R½"MT |
| | | | 20-R½"MT |

## Uponor Smart radi connection kit from the wall
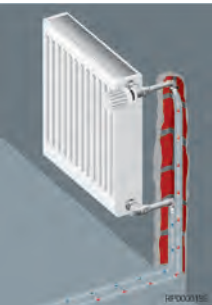
| Number | Designation | | Dimension |
|---|---|---|---|
| | **Uponor Smart radi connection kit Danfoss** | | |
| 2 units | | • Brass coated | 16-G½"MT |
| | | • Pressure screw with MT and insert with sleeve and clamping ring. Suitable for Danfoss radiator valves with female thread | |
| | | • O-ring made of EPDM | |
| | **Uponor Smart radi connection kit Heimeier** | | |
| 2 units | | • Brass coated | 16-G½"MT |
| | | • Pressure screw with MT and insert with sleeve and clamping ring. Suitable for Heimeier radiator valves with female thread | |
| | | • O-ring made of EPDM | |
| | **Uponor Smart radi connection kit Oventrop** | | |
| 2 units | | • Brass coated | 16-G½"MT |
| | | • Pressure screw with MT and insert with sleeve and clamping ring. Suitable for Oventrop radiator valves with female thread | |
| | | • O-ring made of EPDM | |

# Radiator with Uponor S-Press PLUS radiator elbow adapter from the wall

## Option 1

| Number | | Designation | Dimension |
|---|---|---|---|
| **Uponor S-Press PLUS radiator elbow adapter** | | | |
| 2 units | | • Flow optimised fitting | 14-15CU l=350mm |
| | | • Made of brass and coated copper tube | |
| | | • The 15 mm copper pipe can be connected to the radiator using the Uponor Smart radi Cu compression adapter, or a standard brass compression fitting to BS EN 1254-2 | 16-15CU l=350mm |
| | | | 16-15CU l=1000mm |
| **Uponor Smart radi compression adapter Cu** | | | |
| 2 units | | • Eurocone G¾, elastic sealing for the connection of coated copper pipes 15 x 1 mm of Uponor elbow adapters/T-joints to a tap block, radiator or Uponor radiator connecting nipple with G¾ MT euro-cone | 15CU-¾" Euro |
| | | • Union nut brass coated, clamping ring brass bright and EPDM sealing cone | |
| | | • Ribbed union nut with wrench size 30 | |

## Option 2, similar to option 1, but optional connection

| Number | | Designation | Dimension |
|---|---|---|---|
| **Uponor Smart radi connecting nipple** | | | |
| 2 units | | • Brass coated | G¾"MT- |
| | | • Self-sealing | G½"MT |
| | | • For connecting radiators with ½ IG connections, ¾ MT euro-cone for connecting Cu pipe 15 x 1 mm with Uponor compression adapter Cu with ¾ euro-cone | |

# Valve radiator with Uponor S-Press PLUS radi mounting plate and Uponor Smart radi connecting pipes from the wall

| Number | | Designation | Dimension |
|---|---|---|---|
| **Radi mounting plate** | | | |
| 1 unit | | • Prefabricated unit, consisting of two Uponor press wall brackets 16-Rp½, pre-assembled at the factory on a Uponor mounting plate 35/50 mm with torsion proof connections | 16-Rp½"FT c/c 35 mm |
| | | | 16-Rp½"FT c/c 50 mm |
| **Radi connection pipe** | | | |
| 2 units | | • Made of coated copper tube | G½"MT - 15CU l=350mm |
| | | • Copper pipe 15 x 1 mm with self-sealing thread for radiator connection | |
| | | • Suitable for all Uponor press wall brackets and press tap elbows / wall brackets with internal thread Rp½ | |
| | | • Connection to valve block, radiator or Uponor radiator connecting nipple is possible using the Uponor Cu compression adapter with euro-cone, or a standard brass compression fitting to BS EN 1254-2 | |

| Number | Designation | | Dimension |
|---|---|---|---|
| | **Radi compression adapter Cu** | | |
| 2 units | | • Eurocone G¾, elastic sealing for the connection of coated copper pipes 15 x 1 mm of Uponor elbow adapters/T-joints to a tap block, radiator or Uponor radiator connecting nipple with G¾ MT euro-cone | 15CU-¾" Euro |
| | | • Union nut brass coated, clamping ring brass bright and EPDM sealing cone | |
| | | • Ribbed union nut with wrench size 30 | |

## Valve radiator with Uponor Smart radi connection block from the wall

| | Number | Designation | | Dimension |
|---|---|---|---|---|
| | | **Uponor Smart radi connection block** | | |
| | 1 unit | | • Made of polystyrene with removable protective cap | 16 h = 215 mm |
| | | | • Insulation box in fire class E according to BS EN 13501-1 | |
| | | | • Suitable for all common valve radiators | 16 h = 240 mm |
| | | **Uponor S-Press PLUS coupling** | | |
| | 2 units | | • Flow optimised fitting | 16-16 |
| | | | • Made of dezincing resistant brass, according to UBA positive list, tin-plated | |
| | | **Uponor S-Press PLUS coupling** | | |
| | 2 units | | • Two-part screw connection made of brass, with tin-plated union nut and pressure sleeve | 16-¾"FT Euro |
| | | | • For the direct connection of Uponor composite pipes, Uni Pipe PLUS and MLC, to ¾ MT moulded euro-cone parts as well as manifold H | |
| | | | • Internal thread according to BS EN ISO 228-1 | |
| | | | • Connect without deburring | |

## Radiator with Uponor S-Press PLUS radiator elbow adapter from the floor

### Variant 1

| | Number | Designation | | Dimension |
|---|---|---|---|---|
| | | **Uponor S-Press PLUS radiator elbow adapter** | | |
| | 2 units | | • Made of brass and coated copper tube | 14-15CU l=350 mm |
| | | | • The 15 mm copper pipe can be connected to the radiator using the Uponor Smart radi Cu compression adapter. | 16-15CU l=350 mm |
| | | | | 16-15CU l=1000 mm |
| | | **Uponor Smart radi compression adapter Cu** | | |
| | 2 units | | • Eurocone G¾, elastic sealing for the connection of coated copper pipes 15 x 1 mm of Uponor elbow adapters/T-joints to a tap block, radiator or Uponor radiator connecting nipple with G¾ MT euro-cone | 15CU-¾" Euro |
| | | | • Union nut brass coated, clamping ring brass bright and EPDM sealing cone | |
| | | | • Ribbed union nut with wrench size 30 | |

## Variant 2, like variant 1, but additionally

| | Number | Designation | | Dimension |
|---|---|---|---|---|
| | | **Uponor Smart radi connecting nipple** | | |
| | 2 units | • Brass coated | | G¾"MT- |
| | | • Self-sealing | | G½"MT |
| | | • For connecting radiators with ½ IG connections, ¾ MT euro-cone for connecting Cu pipe 15 x 1 mm with Uponor compression adapter Cu with ¾ euro-cone | | |

## Valve radiator with Uponor Uni-X screw MLC connection and Uponor Smart radi connection kit

| | Number | Designation | | Dimension |
|---|---|---|---|---|
| | | **Uponor Smart radi connection kit** | | |
| | 1 unit | • Made of plastic | | 16 |
| | | • For quick, clean fixing of Uponor composite pipes 16 x 2 mm to the radiator | | |
| | | • Comprising: bottom bracket, pipe holder for different valve spacings (centre distance: 50, 45, 40, 35 mm) and cut-to-length, height-adjustable protective tubes | | |
| | | **Uponor Uni-X screw connection MLC** | | |
| | 2 units | • Two-part screw connection made of brass, with tin-plated union nut and pressure sleeve | | 14-¾"FT Euro |
| | | • For the direct connection of Uponor composite pipes, Uni Pipe PLUS and MLC, to ¾ MT moulded euro-cone parts as well as manifold H | | 16-¾"FT Euro |
| | | • Internal thread according to BS EN ISO 228-1 | | 20-¾"FT Euro |
| | | • Connect without deburring | | |

# Two-pipe heating with loop line, radiator connections from below

## Valve radiator with Uponor S-Press PLUS radiator connection T-adapter

### Variant 1

| | Number | Designation | | Dimension |
|---|---|---|---|---|
| | | **Uponor S-Press PLUS radiator T-adapter** | | |
| | 2 units | • Made of brass and offset coated copper tube | | 16-15CU-16 l=350 mm |
| | | • The 15 mm copper pipe can be connected to the radiator using the Uponor Smart radi Cu compression adapter, or a standard brass compression fitting to BS EN 1254-2 | | 20-15CU-20 l=350 mm |
| | | **Uponor Smart radi compression adapter Cu** | | |
| | 2 units | • Eurocone G¾, elastic sealing for the connection of coated copper pipes 15 x 1 mm of Uponor elbow adapters/T-joints to a tap block radiator or Uponor radiator connecting nipple with G¾ MT euro-cone | | 15CU-¾" Euro |
| | | • Union nut brass coated, clamping ring brass bright and EPDM sealing cone | | |
| | | • Ribbed union nut with wrench size 30 | | |

## Variant 2, like variant 1, but additionally

| Number | | Designation | Dimension |
|--------|--|-------------|-----------|
| **Uponor Smart radi connecting nipple** | | | |
| 2 units | | • Brass coated<br>• Self-sealing<br>• For connecting radiators with ½ IG connections, ¾ MT euro-cone for connecting Cu pipe 15 x 1 mm with Uponor compression adapter Cu with ¾ euro-cone | G¾"MT-<br>G½"MT |

## Valve radiator with the Uponor Smart radi connection block from the wall

| Number | | Designation | Dimension |
|--------|--|-------------|-----------|
| **Uponor Smart radi connection block** | | | |
| 1 unit | | • Made of polystyrene with removable protective cap<br>• Insulation box in fire class E according to BS EN 13501-1<br>• Suitable for all common valve radiators | 16 h = 215 mm<br><br>16 h = 240 mm |
| **Uponor S-Press PLUS radiator cross fitting insulated with insulation box** | | | |
| 1 unit | | • Made of tin-plated brass<br>• For crossing-free, pre-insulated connection of a radiator on the unfinished floor<br>• Including EPP insulation box, two-part 13 mm insulation, thermal conductivity 0.035 W/(m*K).<br>• Dimensions of the insulation box (L x W x H): 115 x 115 x 55 mm | 16-16-16<br>20-16-16<br>20-16-20<br>20-20-20 |
| **Uponor Uni-X screw connection MLC** | | | |
| 2 units | | • Two-part screw connection made of brass, with tin-plated union nut and pressure sleeve<br>• For the direct connection of Uponor composite pipes, Uni Pipe PLUS and MLC, to ¾ MT euro-cone parts as well as manifold H<br>• Internal thread according to BS EN ISO 228-1<br>• Connect without deburring | 16-¾"FT Euro |

Connection of a radiator valve using the Uponor Smart radi connection block within the wall and the supply connections in the floor using the Uponor S-Press PLUS Smart Radi cross fitting with insulation box

# Two-pipe heating from the baseboard - connections from below

## Radiator valve connections with Uponor S-Press PLUS baseboard connection kit, adapter and Uponor Smart Base baseboard adapter

| Number | | Designation | Dimension |
|--------|--|-------------|-----------|
| **Uponor S-Press PLUS connection kit adapter** | | | |
| 1 pair | | • For the installation of base board connections without chiselling out the wall. For connection of Uponor composite pipes MLC/Uni Pipe PLUS to radiators with valves<br>• Thread according to BS EN ISO 228-1 | 16-G½" MT-16<br>16-G½" MT-20<br>16-G½" MT-0<br>20-G½" MT-16<br>0-G½" MT-16<br>20-G½" MT-20 |
| **Uponor Smart Base angle baseboard** | | | |

| Number | Designation | | Dimension |
|--------|-------------|--|-----------|
| 1 pair | | • For connection to the radiator during base installation, in conjunction with the Uponor S-Press PLUS baseboard connection kit. The coated copper pipe, 15 x 1 mm, can be connected to the radiator using the Uponor Cu compression adapter. | 15 x 1 |
| **Uponor Smart radi compression adapter Cu** | | | |
| 2 units | | • With G¾ euro-cone elastically sealing for the connection of coated copper pipes 15 x 1 mm of Uponor elbow adapters/T-joints to a tap block, radiator or Uponor radiator connecting nipple with G¾ MT euro-cone<br>• Union nut brass coated, clamping ring brass bright and EPDM sealing cone<br>• Ribbed union nut with wrench size 30 | 15CU-¾" Euro |

# Single-pipe heating with loop line, radiator connections from below

## Radiator and single-pipe valve fitting using Uponor Uni screw MLC connection from the floor

| | Number | Designation | | Dimension |
|--|--------|-------------|--|-----------|
| | Option 1 | | | |
| | **Uponor Uni-C screw connection MLC** | | | |
| | 2 units | | • Two-part brass screw connection, with union nut and pressure sleeve | 14-½"FT Euro |
| | | | • For the connection of Uponor composite pipes MLC/Uni Pipe PLUS to MT- Uponor fittings, sanitary connections and Uni-C manifolds S | 16-½"FT Euro |
| | | | • Internal thread according to BS EN ISO 228-1 | 20-½"FT Euro |
| | | | • Connect without deburring | |
| | Option 2 | | | |
| | **Uponor Uni-C screw connection MLC** | | | |
| | 2 units | | • Two-part brass screw connection, with union nut and pressure sleeve | 14-¾"FT Euro |
| | | | • For the connection of Uponor composite pipes MLC/Uni Pipe PLUS to MT- Uponor fittings, sanitary connections and Uni-C manifolds S | 16-¾"FT Euro |
| | | | • Internal thread according to BS EN ISO 228-1 | 20-¾"FT Euro |
| | | | • Connect without deburring | 25-¾"FT Euro |

## Valve radiator and single-pipe connection block using the Uponor S-Press PLUS radiator connection elbow from the floor

| | Number | Designation | | Dimension |
|--|--------|-------------|--|-----------|
| | **Uponor S-Press PLUS radiator connection elbow** | | | |
| | 2 units | | • Made of brass and coated copper tube | 14-15CU l=350 mm |
| | | | • The 15 mm copper pipe can be connected to the radiator using the Uponor Smart radi Cu compression adapter, or a standard brass compression fitting to BS EN 1254-2 | 16-15CU l=350 mm |
| | | | | 16-15CU l=1000 mm |
| | **Uponor Smart radi compression adapter Cu** | | | |
| | 2 units | | • With G¾ euro-cone elastically sealing for the connection of coated copper pipes 15 x 1 mm of Uponor elbow adapters/T-joints to a tap block, radiator or Uponor radiator connecting nipple with G¾ MT euro-cone<br>• Union nut brass coated, clamping ring brass bright and EPDM sealing cone<br>• Ribbed union nut with wrench size 30 | 15CU-¾" Euro |

# 9.5 Data for pipe network calculations

## Pipe friction pressure gradient for Uponor composite pipes 14 — 40 mm
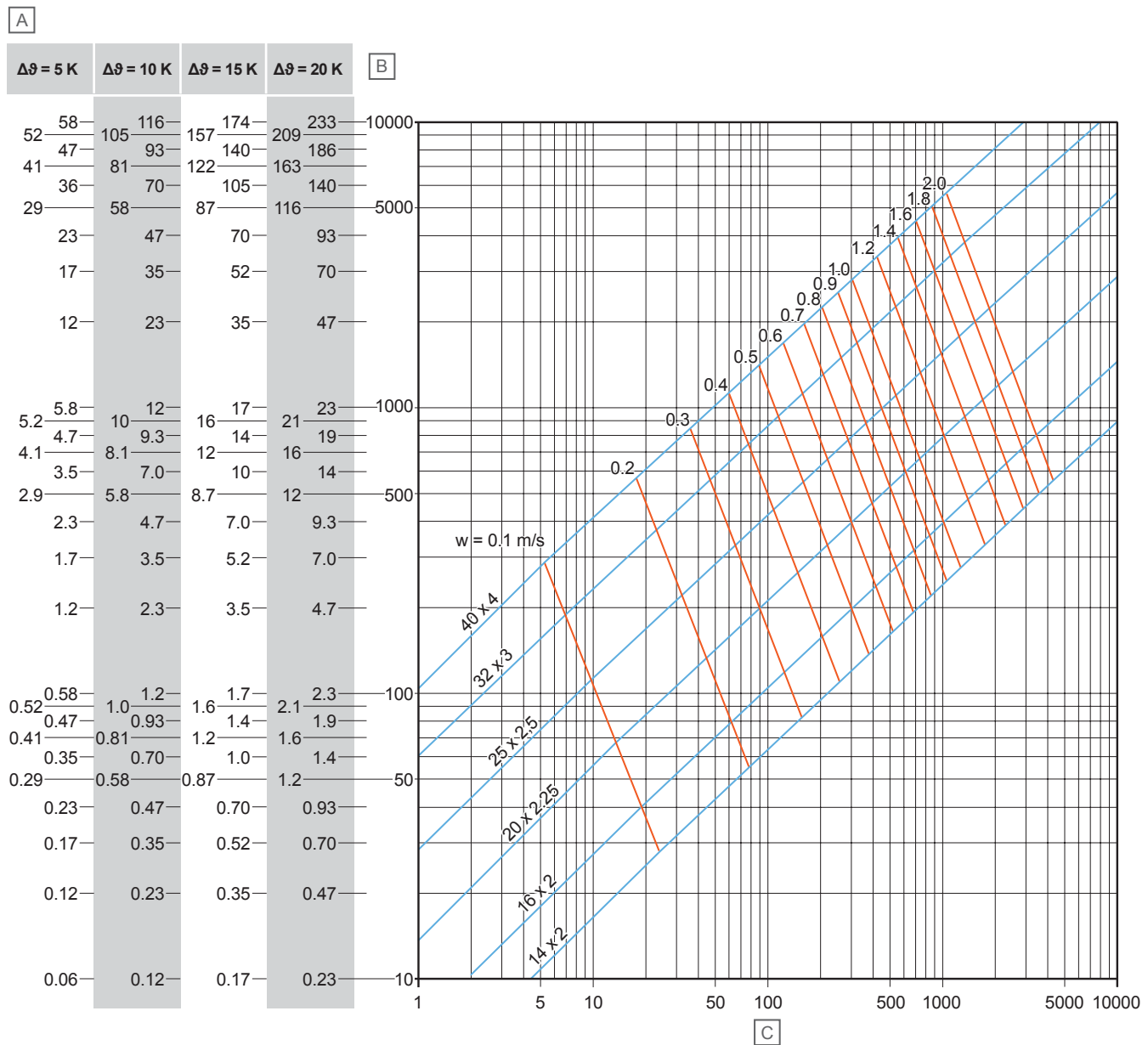


| Item | Description |
|------|-------------|
| A | Power Q kW |
| B | Mass flow m kg/h |
| C | Pipe friction pressure gradient R PA/m |

Pipe friction pressure gradient for Uponor Multilayer composite pipes in heating installations as a function of mass flow at an average water temperature of 60 °C

# Pipe friction pressure gradient for Uponor composite pipes 50 — 110 mm



A

| Δϑ = 5 K | Δϑ = 10 K | Δϑ = 15 K | Δϑ = 20 K | B |
|---|---|---|---|---|
| 581 | 1163 | 1744 | 2325 | 100000 |
| 523 | 1046 | 1569 | 2093 | |
| 465 | 930 | 1395 | 1860 | |
| 407 | 814 | 1221 | 1628 | |
| 349 | 698 | 1046 | 1395 | |
| 291 | 581 | 872 | 1163 | 50000 |
| 233 | 465 | 698 | 930 | |
| 174 | 349 | 523 | 698 | |
| 116 | 233 | 349 | 465 | |
| 58 | 116 | 174 | 233 | 10000 |
| 52 | 105 | 157 | 209 | |
| 47 | 93 | 140 | 186 | |
| 41 | 81 | 122 | 163 | |
| 35 | 70 | 105 | 140 | |
| 29 | 58 | 87 | 116 | 5000 |
| 23 | 47 | 70 | 93 | |
| 17 | 35 | 52 | 70 | |
| 12 | 23 | 35 | 47 | |
| 5.8 | 12 | 17 | 23 | 1000 |
| 5.2 | 10 | 16 | 21 | |
| 4.7 | 9.3 | 14 | 19 | |
| 4.1 | 8.1 | 12 | 16 | |
| 3.5 | 7.0 | 10 | 14 | |
| 2.9 | 5.8 | 8.7 | 12 | 500 |
| 2.3 | 4.7 | 7.0 | 9.3 | |
| 1.7 | 3.5 | 5.2 | 7.0 | |
| 1.2 | 2.3 | 3.5 | 4.7 | |
| 0.6 | 1.2 | 1.7 | 2.3 | 100 |

C

DI0000122

## Pipe friction tables for heating/cooling

The following tables describe the pipe friction pressure gradient (heating or cooling mode) for water as a function of heat or mass flow. Conditions for the respective results are given at the top of each table.

When Multilayer composite pipes are used for cooling, possible condensation must be taken into account. If necessary, suitable measures must be taken for condensate drainage and insufficiently insulated cold water pipes can lead to condensation on the surface of the insulation layer. Unsuitable materials can become damp and this could effect the thermal resistant properties of the insulation and may also shorten the lifespan of the insulation itself. Closed cell or comparable insulation materials with a high water vapour diffusion resistance should be used. All joints, cuts, seams and ends must be sealed and made water/vapour-tight.

# Heating mode: $\triangle\vartheta$ = 20 K (80 °C/60 °C) - 14 — 16 mm

| OD x s (ID) — V/l | | 14 x 2 mm (10 mm) — 0.08 l/m | | 16 x 2 mm (12 mm) — 0.11 l/m | |
|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 400 | 17 | 0.06 | 10 | 0.04 | 4 |
| 600 | 26 | 0.09 | 20 | 0.06 | 9 |
| 800 | 34 | 0.12 | 33 | 0.09 | 14 |
| 1000 | 43 | 0.16 | 48 | 0.11 | 21 |
| 1200 | 52 | 0.19 | 66 | 0.13 | 28 |
| 1400 | 60 | 0.22 | 86 | 0.15 | 26 |
| 1600 | 69 | 0.25 | 108 | 0.17 | 26 |
| 1800 | 78 | 0.28 | 132 | 0.19 | 56 |
| 2000 | 86 | 0.31 | 159 | 0.22 | 67 |
| 2200 | 95 | 0.34 | 187 | 0.24 | 79 |
| 2400 | 103 | 0.37 | 218 | 0.26 | 92 |
| 2600 | 112 | 0.41 | 250 | 0.28 | 105 |
| 2800 | 121 | 0.44 | 284 | 0.30 | 120 |
| 3000 | 129 | 0.47 | 321 | 0.32 | 135 |
| 3200 | 138 | 0.50 | 359 | 0.35 | 151 |
| 3400 | 146 | 0.53 | 399 | 0.37 | 168 |
| 3600 | 155 | 0.56 | 441 | 0.39 | 186 |
| 3800 | 164 | 0.59 | 484 | 0.41 | 204 |
| 4000 | 172 | 0.62 | 530 | 0.43 | 223 |
| 4200 | 181 | 0.65 | 577 | 0.45 | 243 |
| 4400 | 189 | 0.69 | 626 | 0.48 | 263 |
| 4600 | 198 | 0.72 | 677 | 0.50 | 284 |
| 4800 | 207 | 0.75 | 729 | 0.52 | 306 |
| 5000 | 215 | 0.78 | 783 | 0.54 | 329 |
| 5200 | 224 | 0.81 | 839 | 0.56 | 353 |
| 5400 | 233 | 0.84 | 897 | 0.58 | 377 |
| 5600 | 241 | 0.87 | 956 | 0.61 | 401 |
| 5800 | 250 | 0.90 | 1017 | 0.63 | 427 |
| 6000 | 258 | 0.93 | 1079 | 0.65 | 453 |
| 6200 | 267 | 0.97 | 1143 | 0.67 | 480 |
| 6400 | 276 | 1.00 | 1209 | 0.69 | 507 |
| 6600 | 284 | | | 0.71 | 536 |
| 6800 | 293 | | | 0.74 | 564 |
| 7000 | 301 | | | 0.76 | 594 |
| 7200 | 310 | | | 0.78 | 624 |
| 7400 | 319 | | | 0.80 | 655 |
| 7600 | 327 | | | 0.82 | 687 |
| 7800 | 336 | | | 0.84 | 719 |
| 8000 | 344 | | | 0.87 | 751 |
| 8500 | 366 | | | 0.92 | 836 |
| 9000 | 388 | | | 0.97 | 925 |
| 9500 | 409 | | | 1.03 | 1018 |
| 10000 | 431 | | | | |
| 10500 | 452 | | | | |
| 11000 | 474 | | | | |
| 11500 | 495 | | | | |
| 12000 | 517 | | | | |
| 12500 | 538 | | | | |
| 13000 | 560 | | | | |
| 13500 | 581 | | | | |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\triangle\vartheta$ = 20 K (80 °C/60 °C) - 20 — 32 mm

| OD x s (ID) — V/l | | 20 x 2,25 mm (15,5 mm)— 0.19 l/m | | 25 x 2,5 mm (20 mm) — 0.31 l/m | | 32 x 2 mm (26 mm) — 0.53 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 1000 | 43 | 0.06 | 6 | 0.04 | 2 | 0.02 | 1 |
| 2000 | 86 | 0.13 | 20 | 0.08 | 6 | 0.05 | 2 |
| 3000 | 129 | 0.19 | 66 | 0.12 | 12 | 0.07 | 4 |
| 4000 | 172 | 0.026 | 98 | 0.16 | 20 | 0.09 | 6 |
| 5000 | 215 | 0.32 | 134 | 0.19 | 29 | 0.12 | 8 |
| 6000 | 258 | 0.45 | 176 | 0.23 | 40 | 0.14 | 12 |
| 7000 | 301 | 0.52 | 222 | 0.27 | 52 | 0.16 | 15 |
| 8000 | 344 | 0.58 | 273 | 0.31 | 66 | 0.18 | 19 |
| 9000 | 388 | 0.65 | 329 | 0.35 | 81 | 0.21 | 23 |
| 10000 | 431 | 0.71 | 389 | 0.39 | 98 | 0.23 | 28 |
| 11000 | 474 | 0.78 | 454 | 0.43 | 116 | 0.25 | 33 |
| 12000 | 517 | 0.84 | 523 | 0.47 | 135 | 0.28 | 39 |
| 13000 | 560 | 0.91 | 596 | 0.51 | 155 | 0.30 | 44 |
| 14000 | 603 | 0.97 | 673 | 0.55 | 177 | 0.32 | 51 |
| 15000 | 646 | 1.04 | 755 | 0.58 | 200 | 0.35 | 57 |
| 16000 | 689 | | | 0.62 | 224 | 0.37 | 64 |
| 17000 | 732 | | | 0.66 | 249 | 0.39 | 71 |
| 18000 | 775 | | | 0.70 | 275 | 0.41 | 79 |
| 19000 | 818 | | | 0.74 | 303 | 0.44 | 87 |
| 20000 | 861 | | | 0.78 | 332 | 0.46 | 95 |
| 21000 | 904 | | | 0.82 | 362 | 0.48 | 103 |
| 22000 | 947 | | | 0.86 | 393 | 0.51 | 112 |
| 23000 | 990 | | | 0.90 | 425 | 0.53 | 122 |
| 24000 | 1033 | | | 0.93 | 459 | 0.55 | 131 |
| 25000 | 1077 | | | 0.97 | 493 | 0.58 | 141 |
| 26000 | 1120 | | | 1.01 | 529 | 0.60 | 151 |
| 27000 | 1163 | | | 1.05 | 566 | 0.62 | 161 |
| 28000 | 1206 | | | 1.09 | 603 | 0.65 | 172 |
| 29000 | 1249 | | | 1.13 | 642 | 0.67 | 183 |
| 30000 | 1292 | | | 1.17 | 682 | 0.69 | 195 |
| 32000 | 1378 | | | 1.25 | 766 | 0.74 | 218 |
| 34000 | 1464 | | | 1.32 | 853 | 0.78 | 243 |
| 36000 | 1550 | | | 1.40 | 945 | 0.83 | 269 |
| 38000 | 1636 | | | 1.48 | 1041 | 0.88 | 296 |
| 40000 | 1722 | | | 1.56 | 1140 | 0.92 | 325 |
| 42000 | 1809 | | | | | 0.97 | 354 |
| 44000 | 1895 | | | | | 1.01 | 385 |
| 46000 | 1981 | | | | | 1.06 | 417 |
| 48000 | 2067 | | | | | 1.11 | 449 |
| 50000 | 2153 | | | | | 1.15 | 483 |
| 52000 | 2239 | | | | | 1.20 | 519 |
| 54000 | 2325 | | | | | 1.24 | 555 |
| 56000 | 2411 | | | | | 1.29 | 592 |
| 58000 | 2498 | | | | | 1.34 | 630 |
| 60000 | 2584 | | | | | 1.38 | 670 |
| 62000 | 2670 | | | | | 1.43 | 710 |
| 64000 | 2756 | | | | | 1.48 | 752 |
| 66000 | 2842 | | | | | 1.52 | 795 |
| 68000 | 2928 | | | | | 1.57 | 838 |
| 70000 | 3041 | | | | | 1.61 | 883 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

# Heating mode: $\triangle\vartheta$ = 20 K (80 °C/60 °C) - 40 — 63 mm

| OD x s (ID) — V/l | | 40 x 4 mm (32 mm) — 0.80 l/m | | 50 x 4,5 mm (41 mm) — 1.32 l/m | | 63 x 6 mm (51 mm) — 2.04 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 5000 | 215 | 0.08 | 3 | 0.05 | 1 | 0.03 | 1 |
| 10000 | 431 | 0.15 | 10 | 0.09 | 3 | 0.06 | 1 |
| 15000 | 646 | 0.23 | 21 | 0.14 | 7 | 0.09 | 2 |
| 20000 | 861 | 0.30 | 35 | 0.19 | 11 | 0.12 | 4 |
| 25000 | 1077 | 0.38 | 52 | 0.23 | 16 | 0.15 | 6 |
| 30000 | 1292 | 0.46 | 72 | 0.28 | 22 | 0.18 | 8 |
| 35000 | 1507 | 0.53 | 95 | 0.32 | 29 | 0.21 | 10 |
| 40000 | 1722 | 0.61 | 120 | 0.37 | 37 | 0.24 | 13 |
| 45000 | 1938 | 0.68 | 148 | 0.42 | 45 | 0.27 | 16 |
| 50000 | 2153 | 0.76 | 179 | 0.46 | 55 | 0.30 | 19 |
| 55000 | 2368 | 0.84 | 212 | 0.51 | 65 | 0.33 | 23 |
| 60000 | 2584 | 0.91 | 248 | 0.56 | 76 | 0.36 | 27 |
| 65000 | 2799 | 0.99 | 286 | 0.60 | 87 | 0.39 | 31 |
| 70000 | 3014 | 1.07 | 326 | 0.65 | 100 | 0.42 | 35 |
| 75000 | 3230 | 1.14 | 369 | 0.70 | 113 | 0.45 | 40 |
| 80000 | 3445 | 1.22 | 414 | 0.74 | 126 | 0.48 | 44 |
| 85000 | 3660 | 1.29 | 462 | 0.79 | 141 | 0.51 | 50 |
| 90000 | 3876 | 1.37 | 512 | 0.83 | 156 | 0.54 | 55 |
| 95000 | 4091 | 1.45 | 564 | 0.88 | 172 | 0.57 | 60 |
| 100000 | 4306 | 1.52 | 619 | 0.93 | 188 | 0.60 | 66 |
| 105000 | 4522 | | | 0.97 | 206 | 0.63 | 72 |
| 110000 | 4737 | | | 1.02 | 223 | 0.66 | 78 |
| 115000 | 4952 | | | 1.07 | 242 | 0.69 | 85 |
| 120000 | 5167 | | | 1.11 | 261 | 0.72 | 92 |
| 125000 | 5383 | | | 1.16 | 281 | 0.75 | 99 |
| 130000 | 5598 | | | 1.20 | 302 | 0.78 | 106 |
| 135000 | 5813 | | | 1.25 | 323 | 0.81 | 113 |
| 140000 | 6029 | | | 1.30 | 345 | 0.84 | 121 |
| 145000 | 6244 | | | 1.34 | 367 | 0.87 | 129 |
| 150000 | 6459 | | | 1.39 | 390 | 0.90 | 137 |
| 160000 | 6890 | | | 1.48 | 438 | 0.96 | 154 |
| 170000 | 7321 | | | 1.58 | 489 | 1.02 | 171 |
| 180000 | 7751 | | | | | 1.08 | 190 |
| 190000 | 8182 | | | | | 1.14 | 209 |
| 200000 | 8612 | | | | | 1.20 | 230 |
| 210000 | 9043 | | | | | 1.26 | 251 |
| 220000 | 9474 | | | | | 1.32 | 273 |
| 230000 | 9904 | | | | | 1.38 | 295 |
| 240000 | 10335 | | | | | 1.44 | 319 |
| 250000 | 10766 | | | | | 1.50 | 343 |
| 260000 | 11196 | | | | | 1.56 | 368 |
| 270000 | 11627 | | | | | 1.62 | 394 |
| 280000 | 12057 | | | | | 1.68 | 421 |
| 290000 | 12488 | | | | | 1.74 | 449 |
| 300000 | 12919 | | | | | 1.80 | 477 |
| 310000 | 13349 | | | | | 1.86 | 506 |
| 320000 | 13780 | | | | | 1.92 | 536 |
| 330000 | 14211 | | | | | 1.98 | 567 |
| 340000 | 14641 | | | | | 2.04 | 599 |
| 350000 | 15072 | | | | | 2.10 | 630 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\triangle\vartheta$ = 20 K (80 °C/60 °C) - 75 — 110 mm

| OD x s (ID) — V/l | | 75 x 7,5 mm (60 mm) — 2.83 l/m | | 90 x 8,5 mm (73 mm) — 4.18 l/m | | 110 x 10 mm (90 mm) — 6.36 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 60000 | 2584 | 0.26 | 12 | 0.18 | 5 | 0.12 | 2 |
| 80000 | 3445 | 0.35 | 20 | 0.23 | 8 | 0.15 | 3 |
| 100000 | 4306 | 0.43 | 30 | 0.29 | 12 | 0.19 | 4 |
| 120000 | 5167 | 0.52 | 42 | 0.35 | 16 | 0.23 | 6 |
| 140000 | 6029 | 0.61 | 55 | 0.41 | 22 | 0.27 | 8 |
| 160000 | 6890 | 0.69 | 70 | 0.47 | 28 | 0.31 | 10 |
| 180000 | 7751 | 0.78 | 87 | 0.53 | 34 | 0.35 | 12 |
| 200000 | 8612 | 0.87 | 105 | 0.58 | 41 | 0.38 | 15 |
| 220000 | 9474 | 0.95 | 125 | 0.64 | 49 | 0.42 | 18 |
| 240000 | 10335 | 1.04 | 146 | 0.70 | 57 | 0.46 | 21 |
| 260000 | 11196 | 1.13 | 169 | 0.76 | 66 | 0.50 | 24 |
| 280000 | 12057 | 1.21 | 193 | 0.82 | 75 | 0.54 | 28 |
| 300000 | 12919 | 1.30 | 218 | 0.88 | 85 | 0.58 | 31 |
| 320000 | 13780 | 1.38 | 245 | 0.94 | 96 | 0.62 | 35 |
| 340000 | 14641 | 1.47 | 274 | 0.99 | 107 | 0.65 | 39 |
| 360000 | 15502 | 1.56 | 304 | 1.05 | 118 | 0.69 | 43 |
| 380000 | 16364 | 1.64 | 335 | 1.11 | 130 | 0.73 | 48 |
| 400000 | 17225 | 1.73 | 367 | 1.17 | 143 | 0.77 | 52 |
| 420000 | 18086 | 1.82 | 401 | 1.23 | 156 | 0.81 | 57 |
| 440000 | 18947 | 1.90 | 437 | 1.29 | 170 | 0.85 | 62 |
| 460000 | 19809 | 1.99 | 473 | 1.34 | 184 | 0.88 | 67 |
| 480000 | 20670 | | | 1.40 | 199 | 0.92 | 73 |
| 500000 | 21531 | | | 1.46 | 214 | 0.96 | 78 |
| 520000 | 22392 | | | 1.52 | 230 | 1.00 | 84 |
| 540000 | 23254 | | | 1.58 | 246 | 1.04 | 90 |
| 560000 | 24115 | | | 1.64 | 263 | 1.08 | 96 |
| 580000 | 24976 | | | 1.70 | 280 | 1.12 | 102 |
| 600000 | 25837 | | | 1.75 | 298 | 1.15 | 109 |
| 620000 | 26699 | | | 1.81 | 316 | 1.19 | 115 |
| 640000 | 27560 | | | 1.87 | 335 | 1.23 | 122 |
| 660000 | 28421 | | | 1.93 | 354 | 1.27 | 129 |
| 680000 | 29282 | | | 1.99 | 374 | 1.31 | 136 |
| 700000 | 30144 | | | | | 1.35 | 144 |
| 720000 | 31005 | | | | | 1.38 | 151 |
| 740000 | 31866 | | | | | 1.42 | 159 |
| 760000 | 32727 | | | | | 1.46 | 167 |
| 780000 | 33589 | | | | | 1.50 | 175 |
| 800000 | 34450 | | | | | 1.54 | 183 |
| 820000 | 35311 | | | | | 1.58 | 192 |
| 840000 | 36172 | | | | | 1.62 | 200 |
| 860000 | 37033 | | | | | 1.65 | 209 |
| 880000 | 37895 | | | | | 1.69 | 218 |
| 900000 | 38756 | | | | | 1.73 | 227 |
| 920000 | 39617 | | | | | 1.77 | 236 |
| 940000 | 40478 | | | | | 1.81 | 245 |
| 960000 | 41340 | | | | | 1.85 | 255 |
| 980000 | 42201 | | | | | 1.89 | 265 |
| 1000000 | 43062 | | | | | 1.92 | 275 |
| 1020000 | 43923 | | | | | 1.96 | 285 |
| 1040000 | 44785 | | | | | 2.00 | 295 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: Δϑ = 20 K (70 °C/50 °C) - 14 — 16 mm

| OD x s (ID) — V/l | | 14 x 2 mm (10 mm) — 0.08 l/m | | 16 x 2 mm (12 mm) — 0.11 l/m | |
|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 200 | 9 | 0.03 | 3 | 0.02 | 1 |
| 400 | 17 | 0.06 | 11 | 0.04 | 5 |
| 600 | 26 | 0.09 | 21 | 0.06 | 9 |
| 800 | 34 | 0.12 | 34 | 0.09 | 15 |
| 1000 | 43 | 0.15 | 50 | 0.11 | 21 |
| 1200 | 52 | 0.19 | 68 | 0.13 | 29 |
| 1400 | 60 | 0.22 | 89 | 0.15 | 38 |
| 1600 | 69 | 0.25 | 112 | 0.17 | 47 |
| 1800 | 78 | 0.28 | 137 | 0.19 | 58 |
| 2000 | 86 | 0.31 | 114 | 0.22 | 69 |
| 2200 | 95 | 0.34 | 194 | 0.24 | 82 |
| 2400 | 103 | 0.37 | 225 | 0.26 | 95 |
| 2600 | 112 | 0.40 | 258 | 0.28 | 109 |
| 2800 | 121 | 0.43 | 294 | 0.30 | 124 |
| 3000 | 129 | 0.46 | 331 | 0.32 | 140 |
| 3200 | 138 | 0.50 | 370 | 0.34 | 156 |
| 3400 | 146 | 0.53 | 411 | 0.37 | 173 |
| 3600 | 155 | 0.56 | 454 | 0.39 | 192 |
| 3800 | 164 | 0.59 | 499 | 0.41 | 210 |
| 4000 | 172 | 0.62 | 546 | 0.43 | 230 |
| 4200 | 181 | 0.65 | 595 | 0.45 | 250 |
| 4400 | 189 | 0.68 | 645 | 0.47 | 271 |
| 4600 | 198 | 0.71 | 697 | 0.50 | 293 |
| 4800 | 207 | 0.74 | 751 | 0.52 | 316 |
| 5000 | 215 | 0.77 | 807 | 0.54 | 339 |
| 5200 | 224 | 0.81 | 864 | 0.56 | 363 |
| 5400 | 233 | 0.84 | 923 | 0.58 | 388 |
| 5600 | 241 | 0.87 | 984 | 0.60 | 414 |
| 5800 | 250 | 0.90 | 1046 | 0.62 | 440 |
| 6000 | 258 | 0.93 | 1111 | 0.65 | 467 |
| 6200 | 267 | 0.96 | 1177 | 0.67 | 494 |
| 6400 | 276 | 0.99 | 1244 | 0.69 | 522 |
| 6600 | 284 | 1.02 | 1313 | 0.71 | 551 |
| 6800 | 293 | | | 0.73 | 581 |
| 7000 | 301 | | | 0.75 | 611 |
| 7500 | 323 | | | 0.81 | 690 |
| 8000 | 344 | | | 0.86 | 773 |
| 8500 | 366 | | | 0.91 | 860 |
| 9000 | 388 | | | 0.97 | 651 |
| 9500 | 409 | | | 1.02 | 1046 |
| 10000 | 431 | | | | |
| 10500 | 452 | | | | |
| 11000 | 474 | | | | |
| 11500 | 495 | | | | |
| 12000 | 517 | | | | |
| 12500 | 538 | | | | |
| 13000 | 560 | | | | |
| 13500 | 581 | | | | |
| 14000 | 603 | | | | |
| 14500 | 624 | | | | |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: Δϑ = 20 K (70 °C/50 °C) - 20 — 32 mm

| OD x s (ID) — V/l | | 20 x 2,25 mm (15,5 mm) — 0.19 l/m | | 25 x 2,5 mm (20 mm) — 0.31 l/m | | 32 x 2 mm (26 mm) — 0.53 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 1000 | 43 | 0.06 | 6 | 0.04 | 2 | 0.02 | 1 |
| 2000 | 86 | 0.13 | 21 | 0.08 | 6 | 0.05 | 2 |
| 3000 | 129 | 0.19 | 42 | 0.12 | 13 | 0.07 | 4 |
| 4000 | 172 | 0.26 | 68 | 0.15 | 21 | 0.09 | 6 |
| 5000 | 215 | 0.32 | 101 | 0.19 | 30 | 0.11 | 9 |
| 6000 | 258 | 0.39 | 138 | 0.23 | 41 | 0.14 | 12 |
| 7000 | 301 | 0.45 | 181 | 0.27 | 54 | 0.16 | 16 |
| 8000 | 344 | 0.52 | 229 | 0.31 | 68 | 0.18 | 120 |
| 9000 | 388 | 0.58 | 281 | 0.35 | 84 | 0.21 | 24 |
| 10000 | 431 | 0.64 | 338 | 0.39 | 101 | 0.23 | 29 |
| 11000 | 474 | 0.71 | 400 | 0.43 | 119 | 0.25 | 34 |
| 12000 | 517 | 0.77 | 466 | 0.46 | 139 | 0.28 | 40 |
| 13000 | 560 | 0.84 | 537 | 0.50 | 160 | 0.30 | 46 |
| 14000 | 603 | 0.90 | 612 | 0.54 | 182 | 0.32 | 52 |
| 15000 | 646 | 0.97 | 692 | 0.58 | 205 | 0.34 | 59 |
| 16000 | 689 | 1.03 | 755 | 0.62 | 230 | 0.37 | 66 |
| 17000 | 732 | | | 0.66 | 256 | 0.39 | 73 |
| 18000 | 775 | | | 0.70 | 283 | 0.41 | 81 |
| 19000 | 818 | | | 0.74 | 311 | 0.44 | 89 |
| 20000 | 861 | | | 0.77 | 341 | 0.46 | 98 |
| 21000 | 904 | | | 0.81 | 372 | 0.48 | 106 |
| 22000 | 947 | | | 0.85 | 404 | 0.50 | 115 |
| 23000 | 990 | | | 0.89 | 437 | 0.53 | 125 |
| 24000 | 1033 | | | 0.93 | 471 | 0.55 | 135 |
| 25000 | 1077 | | | 0.97 | 506 | 0.57 | 145 |
| 26000 | 1120 | | | 1.01 | 543 | 0.60 | 155 |
| 27000 | 1163 | | | 1.05 | 580 | 0.62 | 166 |
| 28000 | 1206 | | | 1.08 | 619 | 0.64 | 177 |
| 29000 | 1249 | | | 1.12 | 659 | 0.66 | 185 |
| 30000 | 1292 | | | 1.16 | 700 | 0.69 | 200 |
| 32000 | 1378 | | | 1.24 | 785 | 0.73 | 224 |
| 34000 | 1464 | | | 1.32 | 875 | 0.78 | 249 |
| 36000 | 1550 | | | 1.39 | 969 | 0.83 | 276 |
| 38000 | 1636 | | | 1.47 | 1067 | 0.87 | 304 |
| 40000 | 1722 | | | 1.55 | 1169 | 0.92 | 333 |
| 42000 | 1809 | | | | | 0.96 | 363 |
| 44000 | 1895 | | | | | 1.01 | 395 |
| 46000 | 1981 | | | | | 1.05 | 427 |
| 48000 | 2067 | | | | | 1.10 | 461 |
| 50000 | 2153 | | | | | 1.15 | 496 |
| 52000 | 2239 | | | | | 1.19 | 532 |
| 54000 | 2325 | | | | | 1.24 | 569 |
| 56000 | 2411 | | | | | 1.28 | 607 |
| 58000 | 2498 | | | | | 1.33 | 646 |
| 60000 | 2584 | | | | | 1.38 | 686 |
| 62000 | 2670 | | | | | 1.42 | 728 |
| 64000 | 2756 | | | | | 1.47 | 770 |
| 66000 | 2842 | | | | | 1.51 | 814 |
| 68000 | 2928 | | | | | 1.56 | 859 |
| 70000 | 3041 | | | | | 1.60 | 905 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\Delta\vartheta = 20$ K (70 °C/50 °C) - 40 — 63 mm

| OD x s (ID) — V/l | | 40 x 4 mm (32 mm) — 0.80 l/m | | 50 x 4,5 mm (41 mm) — 1.32 l/m | | 63 x 6 mm (51 mm) — 2.04 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 10000 | 431 | 0.15 | 11 | 0.09 | 3 | 0.06 | 1 |
| 15000 | 646 | 0.23 | 22 | 0.14 | 7 | 0.09 | 2 |
| 20000 | 861 | 0.30 | 36 | 0.18 | 11 | 0.12 | 4 |
| 25000 | 1077 | 0.38 | 54 | 0.23 | 17 | 0.15 | 6 |
| 30000 | 1292 | 0.45 | 74 | 0.28 | 23 | 0.18 | 8 |
| 35000 | 1507 | 0.53 | 97 | 0.32 | 30 | 0.21 | 11 |
| 40000 | 1722 | 0.61 | 123 | 0.37 | 38 | 0.24 | 13 |
| 45000 | 1938 | 0.68 | 152 | 0.41 | 47 | 0.27 | 16 |
| 50000 | 2153 | 0.76 | 184 | 0.46 | 56 | 0.30 | 20 |
| 55000 | 2368 | 0.83 | 217 | 0.51 | 67 | 0.33 | 23 |
| 60000 | 2584 | 0.91 | 254 | 0.55 | 78 | 0.36 | 27 |
| 65000 | 2799 | 0.98 | 293 | 0.60 | 89 | 0.39 | 32 |
| 70000 | 3014 | 1.06 | 334 | 0.65 | 102 | 0.42 | 36 |
| 75000 | 3230 | 1.13 | 378 | 0.69 | 115 | 0.45 | 41 |
| 80000 | 3445 | 1.21 | 425 | 0.74 | 130 | 0.48 | 46 |
| 85000 | 3660 | 1.29 | 473 | 0.78 | 144 | 0.51 | 51 |
| 90000 | 3876 | 1.36 | 524 | 0.83 | 160 | 0.54 | 56 |
| 95000 | 4091 | 1.44 | 578 | 0.88 | 176 | 0.57 | 62 |
| 100000 | 4306 | 1.51 | 633 | 0.92 | 193 | 0.60 | 68 |
| 105000 | 4522 | | | 0.97 | 211 | 0.63 | 74 |
| 110000 | 4737 | | | 1.01 | 229 | 0.66 | 80 |
| 115000 | 4952 | | | 1.06 | 248 | 0.69 | 87 |
| 120000 | 5167 | | | 1.11 | 267 | 0.71 | 94 |
| 125000 | 5383 | | | 1.15 | 288 | 0.74 | 101 |
| 130000 | 5598 | | | 1.20 | 309 | 0.77 | 108 |
| 135000 | 5813 | | | 1.24 | 330 | 0.80 | 116 |
| 140000 | 6029 | | | 1.29 | 353 | 0.83 | 124 |
| 145000 | 6244 | | | 1.34 | 376 | 0.86 | 132 |
| 150000 | 6459 | | | 1.38 | 399 | 0.89 | 140 |
| 160000 | 6890 | | | 1.47 | 448 | 0.95 | 157 |
| 170000 | 7321 | | | 1.57 | 500 | 1.01 | 175 |
| 180000 | 7751 | | | | | 1.07 | 194 |
| 190000 | 8182 | | | | | 1.13 | 214 |
| 200000 | 8612 | | | | | 1.19 | 235 |
| 210000 | 9043 | | | | | 1.25 | 256 |
| 220000 | 9474 | | | | | 1.31 | 279 |
| 230000 | 9904 | | | | | 1.37 | 302 |
| 240000 | 10335 | | | | | 1.43 | 326 |
| 250000 | 10766 | | | | | 1.49 | 351 |
| 260000 | 11196 | | | | | 1.55 | 377 |
| 270000 | 11627 | | | | | 1.61 | 403 |
| 280000 | 12057 | | | | | 1.67 | 431 |
| 290000 | 12488 | | | | | 1.73 | 459 |
| 300000 | 12919 | | | | | 1.79 | 488 |
| 310000 | 13349 | | | | | 1.85 | 518 |
| 320000 | 13780 | | | | | 1.91 | 548 |
| 330000 | 14211 | | | | | 1.97 | 579 |
| 340000 | 14641 | | | | | 2.03 | 612 |
| 350000 | 15072 | | | | | 2.09 | 644 |
| 360000 | 15502 | | | | | 2.14 | 678 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: Δϑ = 20 K (70 °C/50 °C) - 75 — 110 mm

| OD x s (ID) — V/l | | 75 x 7,5 mm (60 mm) — 2.83 l/m | | 90 x 8,5 mm (73 mm) — 4.18 l/m | | 110 x 10 mm (90 mm) — 6.36 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 70000 | 3014 | 0.30 | 17 | 0.20 | 6 | 0.13 | 2 |
| 90000 | 3876 | 0.39 | 26 | 0.26 | 10 | 0.17 | 4 |
| 110000 | 4737 | 0.47 | 37 | 0.32 | 14 | 0.21 | 5 |
| 130000 | 5598 | 0.56 | 50 | 0.38 | 19 | 0.25 | 7 |
| 150000 | 6459 | 0.65 | 64 | 0.44 | 25 | 0.29 | 9 |
| 170000 | 7321 | 0.73 | 80 | 0.49 | 31 | 0.33 | 12 |
| 190000 | 8182 | 0.82 | 98 | 0.55 | 38 | 0.36 | 14 |
| 210000 | 9043 | 0.90 | 118 | 0.61 | 46 | 0.40 | 17 |
| 230000 | 9904 | 0.99 | 138 | 0.67 | 54 | 0.44 | 20 |
| 250000 | 10766 | 1.08 | 161 | 0.73 | 63 | 0.48 | 23 |
| 270000 | 11627 | 1.16 | 185 | 0.79 | 72 | 0.52 | 26 |
| 290000 | 12488 | 1.25 | 210 | 0.84 | 82 | 0.55 | 30 |
| 310000 | 13349 | 1.33 | 237 | 0.90 | 92 | 0.59 | 34 |
| 330000 | 14211 | 1.42 | 265 | 0.96 | 103 | 0.63 | 38 |
| 350000 | 15072 | 1.51 | 295 | 1.02 | 115 | 0.67 | 42 |
| 370000 | 15933 | 1.59 | 326 | 1.08 | 127 | 0.71 | 46 |
| 390000 | 16794 | 1.68 | 359 | 1.13 | 140 | 0.75 | 51 |
| 410000 | 17656 | 1.76 | 392 | 1.19 | 153 | 0.78 | 56 |
| 430000 | 18517 | 1.85 | 428 | 1.25 | 167 | 0.82 | 61 |
| 450000 | 19378 | 1.94 | 464 | 1.31 | 181 | 0.86 | 66 |
| 470000 | 20239 | 2.02 | 503 | 1.37 | 196 | 0.90 | 71 |
| 490000 | 21100 | | | 1.42 | 211 | 0.94 | 77 |
| 510000 | 21962 | | | 1.48 | 227 | 0.98 | 83 |
| 530000 | 22823 | | | 1.54 | 243 | 1.01 | 89 |
| 550000 | 23254 | | | 1.60 | 260 | 1.05 | 95 |
| 570000 | 24545 | | | 1.66 | 277 | 1.09 | 101 |
| 590000 | 25407 | | | 1.72 | 295 | 1.13 | 108 |
| 610000 | 26268 | | | 1.77 | 313 | 1.17 | 114 |
| 630000 | 27129 | | | 1.83 | 332 | 1.21 | 121 |
| 650000 | 27990 | | | 1.89 | 352 | 1.24 | 128 |
| 670000 | 28852 | | | 1.95 | 372 | 1.28 | 136 |
| 690000 | 29713 | | | 2.01 | 392 | 1.32 | 143 |
| 710000 | 30574 | | | | | 1.36 | 151 |
| 730000 | 31435 | | | | | 1.40 | 158 |
| 750000 | 32297 | | | | | 1.43 | 166 |
| 770000 | 33158 | | | | | 1.47 | 174 |
| 790000 | 34019 | | | | | 1.51 | 183 |
| 810000 | 34880 | | | | | 1.55 | 191 |
| 830000 | 35742 | | | | | 1.59 | 200 |
| 850000 | 36603 | | | | | 1.63 | 209 |
| 870000 | 37464 | | | | | 1.66 | 218 |
| 890000 | 38325 | | | | | 1.70 | 227 |
| 910000 | 39187 | | | | | 1.74 | 236 |
| 930000 | 40048 | | | | | 1.78 | 246 |
| 950000 | 40909 | | | | | 1.82 | 255 |
| 970000 | 41770 | | | | | 1.86 | 265 |
| 990000 | 42632 | | | | | 1.89 | 275 |
| 1010000 | 43493 | | | | | 1.93 | 285 |
| 1030000 | 44354 | | | | | 1.97 | 296 |
| 1050000 | 45215 | | | | | 2.01 | 306 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\triangle\vartheta$ = 15 K (70 °C/55 °C) - 14 — 16 mm

| OD x s (ID) — V/l | | 14 x 2 mm (10 mm) — 0.08 l/m | | 16 x 2 mm (12 mm) — 0.11 l/m | |
|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 200 | 11 | 0.04 | 5 | 0.03 | 2 |
| 400 | 23 | 0.08 | 17 | 0.06 | 7 |
| 600 | 34 | 0.12 | 34 | 0.09 | 14 |
| 800 | 46 | 0.17 | 55 | 0.11 | 24 |
| 1000 | 57 | 0.21 | 81 | 0.14 | 34 |
| 1200 | 69 | 0.25 | 111 | 0.17 | 47 |
| 1400 | 80 | 0.29 | 145 | 0.20 | 61 |
| 1600 | 92 | 0.33 | 182 | 0.23 | 77 |
| 1800 | 103 | 0.37 | 223 | 0.26 | 94 |
| 2000 | 115 | 0.41 | 268 | 0.29 | 113 |
| 2200 | 126 | 0.46 | 316 | 0.32 | 133 |
| 2400 | 138 | 0.50 | 367 | 0.34 | 155 |
| 2600 | 149 | 0.54 | 422 | 0.37 | 178 |
| 2800 | 161 | 0.58 | 480 | 0.40 | 202 |
| 3000 | 172 | 0.62 | 542 | 0.43 | 228 |
| 3200 | 184 | 0.66 | 606 | 0.46 | 255 |
| 3400 | 195 | 0.70 | 674 | 0.49 | 284 |
| 3600 | 207 | 0.74 | 745 | 0.52 | 313 |
| 3800 | 218 | 0.79 | 819 | 0.55 | 344 |
| 4000 | 230 | 0.83 | 896 | 0.57 | 377 |
| 4200 | 241 | 0.87 | 976 | 0.60 | 410 |
| 4400 | 253 | 0.91 | 1060 | 0.63 | 445 |
| 4600 | 264 | 0.95 | 1146 | 0.66 | 481 |
| 4800 | 276 | 0.99 | 1235 | 0.69 | 518 |
| 5000 | 287 | 1.03 | 1327 | 0.72 | 557 |
| 5200 | 299 | | | 0.75 | 597 |
| 5400 | 310 | | | 0.78 | 638 |
| 5600 | 322 | | | 0.80 | 680 |
| 5800 | 333 | | | 0.83 | 723 |
| 6000 | 344 | | | 0.86 | 767 |
| 6200 | 356 | | | 0.89 | 813 |
| 6400 | 367 | | | 0.92 | 860 |
| 6600 | 379 | | | 0.95 | 908 |
| 6800 | 390 | | | 0.98 | 957 |
| 7000 | 402 | | | 1.01 | 1007 |
| 7200 | 413 | | | | |
| 7400 | 425 | | | | |
| 7600 | 436 | | | | |
| 7800 | 448 | | | | |
| 8000 | 459 | | | | |
| 8200 | 471 | | | | |
| 8400 | 482 | | | | |
| 8600 | 494 | | | | |
| 8800 | 505 | | | | |
| 9000 | 517 | | | | |
| 9200 | 528 | | | | |
| 9400 | 540 | | | | |
| 9600 | 551 | | | | |
| 9800 | 563 | | | | |
| 10000 | 574 | | | | |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\triangle\vartheta$ = 15 K (70 °C/55 °C) - 20 — 32 mm

| OD x s (ID) — V/l | | 20 x 2,25 mm (15,5 mm) — 0.19 l/m | | 25 x 2,5 mm (20 mm) — 0.31 l/m | | 32 x 2 mm (26 mm) — 0.53 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 1000 | 57 | 0.09 | 10 | 0.05 | 3 | 0.03 | 1 |
| 1500 | 86 | 0.13 | 21 | 0.08 | 6 | 0.05 | 2 |
| 2000 | 115 | 0.17 | 34 | 0.10 | 10 | 0.06 | 3 |
| 2500 | 144 | 0.22 | 50 | 0.13 | 15 | 0.08 | 4 |
| 3000 | 172 | 0.26 | 68 | 0.16 | 20 | 0.09 | 6 |
| 3500 | 201 | 0.30 | 89 | 0.18 | 27 | 0.11 | 8 |
| 4000 | 230 | 0.34 | 112 | 0.21 | 33 | 0.12 | 10 |
| 4500 | 258 | 0.39 | 137 | 0.23 | 41 | 0.14 | 12 |
| 5000 | 287 | 0.43 | 165 | 0.26 | 49 | 0.15 | 14 |
| 5500 | 316 | 0.47 | 195 | 0.28 | 58 | 0.17 | 17 |
| 6000 | 344 | 0.52 | 227 | 0.31 | 68 | 0.18 | 19 |
| 6500 | 373 | 0.56 | 261 | 0.34 | 78 | 0.20 | 22 |
| 7000 | 402 | 0.60 | 298 | 0.36 | 89 | 0.21 | 25 |
| 7500 | 431 | 0.65 | 336 | 0.39 | 100 | 0.23 | 29 |
| 8000 | 459 | 0.69 | 376 | 0.41 | 112 | 0.24 | 32 |
| 8500 | 488 | 0.73 | 419 | 0.44 | 124 | 0.26 | 36 |
| 9000 | 517 | 0.78 | 463 | 0.47 | 138 | 0.28 | 40 |
| 9500 | 545 | 0.82 | 509 | 0.49 | 151 | 0.29 | 43 |
| 10000 | 574 | 0.86 | 558 | 0.52 | 166 | 0.31 | 48 |
| 10500 | 603 | 0.90 | 608 | 0.54 | 180 | 0.32 | 52 |
| 11000 | 632 | 0.95 | 660 | 0.57 | 196 | 0.34 | 56 |
| 11500 | 660 | 0.99 | 714 | 0.59 | 212 | 0.35 | 61 |
| 12000 | 689 | 1.03 | 770 | 0.62 | 228 | 0.37 | 65 |
| 12500 | 718 | | | 0.65 | 245 | 0.38 | 70 |
| 13000 | 746 | | | 0.67 | 263 | 0.40 | 75 |
| 13500 | 775 | | | 0.70 | 281 | 0.41 | 80 |
| 14000 | 804 | | | 0.72 | 300 | 0.43 | 86 |
| 14500 | 833 | | | 0.75 | 319 | 0.44 | 91 |
| 15000 | 861 | | | 0.78 | 339 | 0.46 | 97 |
| 16000 | 919 | | | 0.83 | 380 | 0.49 | 109 |
| 17000 | 976 | | | 0.88 | 423 | 0.52 | 121 |
| 18000 | 1033 | | | 0.93 | 468 | 0.55 | 134 |
| 19000 | 1091 | | | 0.98 | 515 | 0.58 | 147 |
| 20000 | 1148 | | | 1.03 | 564 | 0.61 | 161 |
| 22000 | 1263 | | | 1.14 | 668 | 0.67 | 191 |
| 24000 | 1378 | | | 1.24 | 780 | 0.73 | 222 |
| 26000 | 1493 | | | 1.34 | 900 | 0.80 | 256 |
| 28000 | 1608 | | | 1.45 | 1027 | 0.86 | 293 |
| 30000 | 1722 | | | 1.55 | 1161 | 0.92 | 331 |
| 32000 | 1837 | | | | | 0.98 | 371 |
| 34000 | 1952 | | | | | 1.04 | 413 |
| 36000 | 2067 | | | | | 1.10 | 458 |
| 38000 | 2182 | | | | | 1.16 | 504 |
| 40000 | 2297 | | | | | 1.22 | 552 |
| 42000 | 2411 | | | | | 1.29 | 603 |
| 44000 | 2526 | | | | | 1.35 | 655 |
| 46000 | 2641 | | | | | 1.41 | 709 |
| 48000 | 2756 | | | | | 1.47 | 766 |
| 50000 | 2871 | | | | | 1.53 | 824 |
| 52000 | 2986 | | | | | 1.59 | 884 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

# Heating mode: $\triangle\vartheta$ = 15 K (70 °C/55 °C) - 40 — 63 mm

| OD x s (ID) — V/l | | 40 x 4 mm (32 mm) — 0.80 l/m | | 50 x 4,5 mm (41 mm) — 1.32 l/m | | 63 x 6 mm (51 mm) — 2.04 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 8000 | 459 | 0.16 | 12 | 0.10 | 4 | 0.06 | 1 |
| 10000 | 574 | 0.20 | 18 | 0.12 | 5 | 0.08 | 2 |
| 12000 | 689 | 0.24 | 24 | 0.15 | 8 | 0.10 | 3 |
| 14000 | 804 | 0.28 | 32 | 0.17 | 10 | 0.11 | 3 |
| 16000 | 919 | 0.32 | 40 | 0.20 | 12 | 0.13 | 4 |
| 18000 | 1033 | 0.36 | 50 | 0.22 | 15 | 0.14 | 5 |
| 20000 | 1148 | 0.40 | 60 | 0.25 | 18 | 0.16 | 7 |
| 22000 | 1263 | 0.44 | 71 | 0.27 | 22 | 0.17 | 8 |
| 24000 | 1378 | 0.48 | 83 | 0.30 | 25 | 0.19 | 9 |
| 26000 | 1493 | 0.53 | 95 | 0.32 | 29 | 0.21 | 10 |
| 28000 | 1608 | 0.57 | 108 | 0.34 | 33 | 0.22 | 12 |
| 30000 | 1722 | 0.61 | 123 | 0.37 | 38 | 0.24 | 13 |
| 32000 | 1837 | 0.65 | 137 | 0.39 | 42 | 0.25 | 15 |
| 34000 | 1952 | 0.69 | 153 | 0.42 | 47 | 0.27 | 17 |
| 36000 | 2067 | 0.73 | 170 | 0.44 | 52 | 0.29 | 18 |
| 38000 | 2182 | 0.77 | 187 | 0.47 | 57 | 0.30 | 20 |
| 40000 | 2297 | 0.81 | 204 | 0.49 | 63 | 0.32 | 22 |
| 42000 | 2411 | 0.85 | 223 | 0.52 | 68 | 0.33 | 24 |
| 44000 | 2526 | 0.89 | 242 | 0.54 | 74 | 0.35 | 26 |
| 46000 | 2641 | 0.93 | 263 | 0.57 | 80 | 0.37 | 28 |
| 48000 | 2756 | 0.97 | 283 | 0.59 | 86 | 0.38 | 30 |
| 50000 | 2871 | 1.01 | 304 | 0.62 | 93 | 0.40 | 33 |
| 55000 | 3158 | 1.11 | 361 | 0.68 | 110 | 0.44 | 39 |
| 60000 | 3445 | 1.21 | 422 | 0.74 | 129 | 0.48 | 45 |
| 65000 | 3732 | 1.31 | 487 | 0.80 | 148 | 0.52 | 52 |
| 70000 | 4019 | 1.41 | 556 | 0.86 | 169 | 0.56 | 60 |
| 75000 | 4306 | 1.51 | 629 | 0.92 | 192 | 0.60 | 67 |
| 80000 | 4593 | | | 0.98 | 215 | 0.64 | 76 |
| 85000 | 4880 | | | 1.05 | 240 | 0.68 | 84 |
| 90000 | 5167 | | | 1.11 | 266 | 0.72 | 93 |
| 95000 | 5455 | | | 1.17 | 293 | 0.76 | 103 |
| 100000 | 5742 | | | 1.23 | 321 | 0.80 | 113 |
| 105000 | 6029 | | | 1.29 | 351 | 0.84 | 123 |
| 110000 | 6316 | | | 1.35 | 381 | 0.87 | 134 |
| 115000 | 6603 | | | 1.42 | 413 | 0.91 | 145 |
| 120000 | 6890 | | | 1.48 | 446 | 0.95 | 156 |
| 125000 | 7177 | | | 1.54 | 480 | 0.99 | 168 |
| 130000 | 7464 | | | | | 1.03 | 180 |
| 140000 | 8038 | | | | | 1.11 | 206 |
| 150000 | 8612 | | | | | 1.19 | 233 |
| 160000 | 9187 | | | | | 1.27 | 262 |
| 170000 | 9761 | | | | | 1.35 | 292 |
| 180000 | 10335 | | | | | 1.43 | 324 |
| 190000 | 10909 | | | | | 1.51 | 357 |
| 200000 | 11483 | | | | | 1.59 | 392 |
| 210000 | 12057 | | | | | 1.67 | 428 |
| 220000 | 12632 | | | | | 1.75 | 466 |
| 230000 | 13206 | | | | | 1.83 | 505 |
| 240000 | 13780 | | | | | 1.91 | 545 |
| 250000 | 14354 | | | | | 1.99 | 587 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\triangle\vartheta$ = 15 K (70 °C/55 °C) - 75 — 110 mm

| OD x s (ID) — V/l | | 75 x 7,5 mm (60 mm) — 2.83 l/m | | 90 x 8,5 mm (73 mm) — 4.18 l/m | | 110 x 10 mm (90 mm) — 6.36 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 40000 | 2297 | 0.23 | 10 | 0.16 | 4 | 0.10 | 1 |
| 50000 | 2871 | 0.29 | 15 | 0.19 | 6 | 0.13 | 2 |
| 60000 | 3445 | 0.34 | 21 | 0.23 | 8 | 0.15 | 3 |
| 70000 | 4019 | 0.40 | 27 | 0.27 | 11 | 0.18 | 4 |
| 80000 | 4593 | 0.46 | 35 | 0.31 | 14 | 0.20 | 5 |
| 90000 | 5167 | 0.52 | 43 | 0.35 | 17 | 0.23 | 6 |
| 100000 | 5742 | 0.57 | 52 | 0.39 | 20 | 0.26 | 7 |
| 110000 | 6316 | 0.63 | 61 | 0.43 | 24 | 0.28 | 9 |
| 120000 | 6890 | 0.69 | 72 | 0.47 | 28 | 0.31 | 10 |
| 130000 | 7464 | 0.75 | 83 | 0.50 | 32 | 0.33 | 12 |
| 140000 | 8038 | 0.80 | 95 | 0.54 | 37 | 0.36 | 14 |
| 150000 | 8612 | 0.86 | 107 | 0.58 | 42 | 0.38 | 15 |
| 160000 | 9187 | 0.92 | 120 | 0.62 | 47 | 0.41 | 17 |
| 170000 | 9761 | 0.98 | 134 | 0.66 | 52 | 0.43 | 19 |
| 180000 | 10335 | 1.03 | 148 | 0.70 | 58 | 0.46 | 21 |
| 190000 | 10909 | 1.09 | 164 | 0.74 | 64 | 0.49 | 23 |
| 200000 | 11483 | 1.15 | 180 | 0.78 | 70 | 0.51 | 26 |
| 220000 | 12632 | 1.26 | 213 | 0.85 | 83 | 0.56 | 30 |
| 240000 | 13780 | 1.38 | 249 | 0.93 | 97 | 0.61 | 36 |
| 260000 | 14928 | 1.49 | 288 | 1.01 | 112 | 0.66 | 41 |
| 280000 | 16077 | 1.61 | 329 | 1.09 | 128 | 0.72 | 47 |
| 300000 | 17225 | 1.72 | 373 | 1.16 | 145 | 0.77 | 53 |
| 320000 | 18373 | 1.84 | 419 | 1.24 | 163 | 0.82 | 60 |
| 340000 | 19522 | 1.95 | 468 | 1.32 | 182 | 0.87 | 67 |
| 360000 | 20670 | 2.07 | 519 | 1.40 | 202 | 0.92 | 74 |
| 380000 | 21818 | | | 1.48 | 223 | 0.97 | 81 |
| 400000 | 22967 | | | 1.55 | 244 | 1.02 | 89 |
| 420000 | 24115 | | | 1.63 | 267 | 1.07 | 97 |
| 440000 | 25263 | | | 1.71 | 290 | 1.12 | 106 |
| 460000 | 26411 | | | 1.79 | 315 | 1.17 | 115 |
| 480000 | 28560 | | | 1.86 | 340 | 1.23 | 124 |
| 500000 | 28708 | | | 1.94 | 366 | 1.28 | 134 |
| 520000 | 29856 | | | 2.02 | 393 | 1.33 | 143 |
| 540000 | 31005 | | | | | 1.38 | 154 |
| 560000 | 32153 | | | | | 1.43 | 164 |
| 580000 | 33301 | | | | | 1.48 | 175 |
| 600000 | 34450 | | | | | 1.53 | 186 |
| 620000 | 35598 | | | | | 1.58 | 197 |
| 640000 | 36746 | | | | | 1.63 | 209 |
| 660000 | 37895 | | | | | 1.69 | 221 |
| 680000 | 39043 | | | | | 1.74 | 233 |
| 700000 | 40191 | | | | | 1.79 | 246 |
| 720000 | 41340 | | | | | 1.84 | 259 |
| 740000 | 42488 | | | | | 1.89 | 272 |
| 760000 | 43636 | | | | | 1.94 | 286 |
| 780000 | 44785 | | | | | 1.99 | 299 |
| 800000 | 45933 | | | | | 2.04 | 314 |
| 820000 | 47081 | | | | | 2.09 | 328 |
| 840000 | 48230 | | | | | 2.15 | 343 |
| 860000 | 49378 | | | | | 2.20 | 358 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\triangle\vartheta$ = 10 K (55 °C/45 °C) - 14 — 16 mm

| OD x s (ID) — V/l | | 14 x 2 mm (10 mm) — 0.08 l/m | | 16 x 2 mm (12 mm) — 0.11 l/m | |
|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 200 | 17 | 0.06 | 11 | 0.04 | 5 |
| 300 | 26 | 0.09 | 22 | 0.06 | 9 |
| 400 | 34 | 0.12 | 36 | 0.09 | 15 |
| 500 | 43 | 0.15 | 52 | 0.11 | 22 |
| 600 | 52 | 0.19 | 71 | 0.13 | 30 |
| 700 | 60 | 0.22 | 93 | 0.15 | 39 |
| 800 | 69 | 0.25 | 116 | 0.17 | 49 |
| 900 | 78 | 0.28 | 142 | 0.19 | 60 |
| 1000 | 86 | 0.31 | 171 | 0.21 | 72 |
| 1100 | 95 | 0.34 | 201 | 0.24 | 85 |
| 1200 | 103 | 0.37 | 234 | 0.26 | 99 |
| 1300 | 112 | 0.40 | 268 | 0.28 | 113 |
| 1400 | 121 | 0.43 | 305 | 0.30 | 129 |
| 1500 | 129 | 0.46 | 343 | 0.32 | 145 |
| 1600 | 138 | 0.49 | 384 | 0.34 | 162 |
| 1700 | 146 | 0.52 | 427 | 0.36 | 180 |
| 1800 | 155 | 0.56 | 471 | 0.39 | 199 |
| 1900 | 164 | 0.59 | 517 | 0.41 | 218 |
| 2000 | 172 | 0.62 | 566 | 0.43 | 238 |
| 2100 | 181 | 0.65 | 616 | 0.45 | 259 |
| 2200 | 189 | 0.68 | 668 | 0.47 | 281 |
| 2300 | 198 | 0.71 | 722 | 0.49 | 304 |
| 2400 | 207 | 0.74 | 777 | 0.51 | 327 |
| 2500 | 215 | 0.77 | 835 | 0.54 | 351 |
| 2600 | 224 | 0.80 | 894 | 0.56 | 376 |
| 2700 | 233 | 0.83 | 955 | 0.58 | 402 |
| 2800 | 241 | 0.86 | 1018 | 0.60 | 428 |
| 2900 | 250 | 0.89 | 1082 | 0.62 | 455 |
| 3000 | 258 | 0.93 | 1148 | 0.64 | 483 |
| 3200 | 276 | 0.99 | 1286 | 0.69 | 540 |
| 3400 | 293 | 1.05 | 1430 | 0.73 | 601 |
| 3600 | 310 | | | 0.77 | 664 |
| 3800 | 327 | | | 0.81 | 730 |
| 4000 | 344 | | | 0.86 | 799 |
| 4200 | 362 | | | 0.90 | 870 |
| 4400 | 349 | | | 0.94 | 945 |
| 4600 | 396 | | | 0.99 | 1021 |
| 4800 | 413 | | | 1.03 | 1101 |
| 5000 | 431 | | | | |
| 5200 | 448 | | | | |
| 5400 | 465 | | | | |
| 5600 | 482 | | | | |
| 5800 | 500 | | | | |
| 6000 | 517 | | | | |
| 6200 | 534 | | | | |
| 6400 | 551 | | | | |
| 6600 | 568 | | | | |
| 6800 | 586 | | | | |
| 7000 | 603 | | | | |
| 7200 | 620 | | | | |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\Delta\vartheta$ = 10 K (55 °C/45 °C) - 20 — 32 mm

| OD x s (ID) — V/l | | 20 x 2,25 mm (15,5 mm) — 0.19 l/m | | 25 x 2,5 mm (20 mm) — 0.31 l/m | | 32 x 2 mm (26 mm) — 0.53 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 500 | 43 | 0.06 | 7 | 0.04 | 2 | 0.02 | 1 |
| 1000 | 86 | 0.13 | 22 | 0.08 | 7 | 0.05 | 2 |
| 1500 | 129 | 0.19 | 43 | 0.12 | 13 | 0.07 | 4 |
| 2000 | 172 | 0.26 | 71 | 0.15 | 21 | 0.09 | 6 |
| 2500 | 215 | 0.32 | 104 | 0.19 | 31 | 0.11 | 9 |
| 3000 | 258 | 0.39 | 143 | 0.23 | 43 | 0.14 | 12 |
| 3500 | 301 | 0.45 | 188 | 0.27 | 56 | 0.16 | 16 |
| 4000 | 344 | 0.51 | 237 | 0.31 | 71 | 0.18 | 20 |
| 4500 | 388 | 0.58 | 291 | 0.35 | 87 | 0.21 | 25 |
| 5000 | 431 | 0.64 | 350 | 0.39 | 104 | 0.23 | 30 |
| 5500 | 474 | 0.71 | 414 | 0.42 | 123 | 0.25 | 35 |
| 6000 | 517 | 0.77 | 482 | 0.46 | 143 | 0.27 | 41 |
| 6500 | 560 | 0.83 | 555 | 0.50 | 165 | 0.30 | 47 |
| 7000 | 603 | 0.90 | 632 | 0.54 | 188 | 0.32 | 54 |
| 7500 | 646 | 0.96 | 714 | 0.58 | 212 | 0.34 | 61 |
| 8000 | 689 | 1.03 | 800 | 0.62 | 237 | 0.37 | 68 |
| 8500 | 732 | | | 0.66 | 264 | 0.39 | 76 |
| 9000 | 775 | | | 0.69 | 292 | 0.41 | 84 |
| 9500 | 818 | | | 0.73 | 321 | 0.43 | 92 |
| 10000 | 861 | | | 0.77 | 352 | 0.46 | 101 |
| 10500 | 904 | | | 0.81 | 383 | 0.48 | 110 |
| 11000 | 947 | | | 0.85 | 416 | 0.50 | 119 |
| 11500 | 990 | | | 0.89 | 450 | 0.52 | 129 |
| 12000 | 1033 | | | 0.93 | 486 | 0.55 | 139 |
| 12500 | 1077 | | | 0.96 | 522 | 0.57 | 149 |
| 13000 | 1120 | | | 1.00 | 560 | 0.59 | 160 |
| 13500 | 1163 | | | 1.04 | 598 | 0.62 | 171 |
| 14000 | 1206 | | | 1.08 | 638 | 0.64 | 182 |
| 14500 | 1249 | | | 1.12 | 679 | 0.66 | 194 |
| 15000 | 1292 | | | 1.16 | 721 | 0.68 | 206 |
| 16000 | 1378 | | | 1.23 | 809 | 0.73 | 231 |
| 17000 | 1464 | | | 1.31 | 901 | 0.78 | 257 |
| 18000 | 1550 | | | 1.39 | 997 | 0.82 | 285 |
| 19000 | 1636 | | | 1.47 | 1098 | 0.87 | 313 |
| 20000 | 1722 | | | 1.54 | 1203 | 0.91 | 343 |
| 21000 | 1809 | | | | | 0.96 | 374 |
| 22000 | 1895 | | | | | 1.00 | 406 |
| 23000 | 1981 | | | | | 1.05 | 440 |
| 24000 | 2067 | | | | | 1.10 | 474 |
| 25000 | 2153 | | | | | 1.14 | 510 |
| 26000 | 2239 | | | | | 1.19 | 547 |
| 27000 | 2325 | | | | | 1.23 | 585 |
| 28000 | 2411 | | | | | 1.28 | 624 |
| 29000 | 2498 | | | | | 1.32 | 665 |
| 30000 | 2584 | | | | | 1.37 | 706 |
| 31000 | 2670 | | | | | 1.41 | 749 |
| 32000 | 2756 | | | | | 1.46 | 792 |
| 33000 | 2842 | | | | | 1.51 | 837 |
| 34000 | 2928 | | | | | 1.55 | 883 |
| 35000 | 3014 | | | | | 1.60 | 930 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

# Heating mode: $\Delta\vartheta$ = 10 K (55 °C/45 °C) - 40 — 63 mm

| OD x s (ID) — V/l | | 40 x 4 mm (32 mm) — 0.80 l/m | | 50 x 4,5 mm (41 mm) — 1.32 l/m | | 63 x 6 mm (51 mm) — 2.04 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 2000 | 172 | 0.06 | 2 | 0.04 | 1 | 0.02 | 1 |
| 4000 | 344 | 0.12 | 8 | 0.07 | 2 | 0.05 | 1 |
| 6000 | 517 | 0.18 | 15 | 0.11 | 5 | 0.07 | 2 |
| 8000 | 689 | 0.24 | 25 | 0.15 | 8 | 0.09 | 3 |
| 10000 | 861 | 0.30 | 38 | 0.18 | 12 | 0.12 | 4 |
| 12000 | 1033 | 0.36 | 52 | 0.22 | 16 | 0.14 | 6 |
| 14000 | 1206 | 0.42 | 68 | 0.26 | 21 | 0.17 | 7 |
| 16000 | 1378 | 0.48 | 86 | 0.29 | 26 | 0.19 | 9 |
| 18000 | 1550 | 0.54 | 106 | 0.33 | 32 | 0.21 | 11 |
| 20000 | 1722 | 0.60 | 127 | 0.37 | 39 | 0.24 | 14 |
| 22000 | 1895 | 0.66 | 151 | 0.40 | 46 | 0.26 | 16 |
| 24000 | 2067 | 0.72 | 176 | 0.44 | 54 | 0.28 | 19 |
| 26000 | 2239 | 0.78 | 203 | 0.48 | 62 | 0.31 | 22 |
| 28000 | 2411 | 0.84 | 231 | 0.51 | 71 | 0.33 | 25 |
| 30000 | 2584 | 0.90 | 261 | 0.55 | 80 | 0.36 | 28 |
| 32000 | 2756 | 0.96 | 293 | 0.59 | 90 | 0.38 | 32 |
| 34000 | 2928 | 1.02 | 327 | 0.62 | 100 | 0.40 | 35 |
| 36000 | 3100 | 1.08 | 362 | 0.66 | 111 | 0.43 | 39 |
| 38000 | 3273 | 1.14 | 398 | 0.70 | 122 | 0.45 | 43 |
| 40000 | 3445 | 1.20 | 437 | 0.73 | 133 | 0.47 | 47 |
| 42000 | 3617 | 1.27 | 476 | 0.77 | 145 | 0.50 | 51 |
| 44000 | 3789 | 1.33 | 518 | 0.81 | 158 | 0.52 | 56 |
| 46000 | 3962 | 1.39 | 561 | 0.84 | 171 | 0.55 | 60 |
| 48000 | 4134 | 1.45 | 605 | 0.88 | 185 | 0.57 | 65 |
| 50000 | 4306 | 1.51 | 651 | 0.92 | 199 | 0.59 | 70 |
| 55000 | 4737 | | | 1.01 | 235 | 0.65 | 83 |
| 60000 | 5167 | | | 1.10 | 275 | 0.71 | 97 |
| 65000 | 5598 | | | 1.19 | 317 | 0.77 | 112 |
| 70000 | 6029 | | | 1.28 | 362 | 0.83 | 127 |
| 75000 | 6459 | | | 1.38 | 410 | 0.89 | 144 |
| 80000 | 6890 | | | 1.47 | 461 | 0.95 | 162 |
| 85000 | 7321 | | | 1.56 | 514 | 1.01 | 180 |
| 90000 | 7751 | | | | | 1.07 | 200 |
| 95000 | 8182 | | | | | 1.13 | 220 |
| 100000 | 8612 | | | | | 1.19 | 241 |
| 105000 | 9043 | | | | | 1.25 | 263 |
| 110000 | 9474 | | | | | 1.30 | 286 |
| 115000 | 9904 | | | | | 1.36 | 310 |
| 120000 | 10335 | | | | | 1.42 | 335 |
| 125000 | 10766 | | | | | 1.48 | 360 |
| 130000 | 11196 | | | | | 1.54 | 387 |
| 135000 | 11627 | | | | | 1.60 | 414 |
| 140000 | 12057 | | | | | 1.66 | 442 |
| 145000 | 12488 | | | | | 1.72 | 471 |
| 150000 | 12919 | | | | | 1.78 | 500 |
| 155000 | 13349 | | | | | 1.84 | 531 |
| 160000 | 13780 | | | | | 1.90 | 562 |
| 165000 | 14211 | | | | | 1.96 | 594 |
| 170000 | 14641 | | | | | 2.02 | 627 |
| 175000 | 15072 | | | | | 2.08 | 661 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\Delta\vartheta$ = 10 K (55 °C/45 °C) - 75 — 110 mm

| OD x s (ID) — V/l | | 75 x 7,5 mm (60 mm) — 2.83 l/m | | 90 x 8,5 mm (73 mm) — 4.18 l/m | | 110 x 10 mm (90 mm) — 6.36 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 40000 | 3445 | 0.34 | 22 | 0.23 | 8 | 0.13 | 3 |
| 50000 | 4306 | 0.43 | 32 | 0.29 | 13 | 0.17 | 5 |
| 60000 | 5167 | 0.51 | 44 | 0.35 | 17 | 0.21 | 6 |
| 70000 | 6029 | 0.60 | 58 | 0.41 | 23 | 0.25 | 8 |
| 80000 | 6890 | 0.69 | 74 | 0.46 | 29 | 0.29 | 11 |
| 90000 | 7751 | 0.77 | 92 | 0.52 | 36 | 0.33 | 13 |
| 100000 | 8612 | 0.86 | 111 | 0.58 | 43 | 0.36 | 16 |
| 110000 | 9474 | 0.94 | 131 | 0.64 | 51 | 0.40 | 19 |
| 120000 | 10335 | 1.03 | 153 | 0.69 | 60 | 0.44 | 22 |
| 130000 | 11196 | 1.11 | 177 | 0.75 | 69 | 0.48 | 25 |
| 140000 | 12057 | 1.20 | 202 | 0.81 | 79 | 0.52 | 29 |
| 150000 | 12919 | 1.29 | 229 | 0.87 | 89 | 0.55 | 33 |
| 160000 | 13780 | 1.37 | 257 | 0.93 | 100 | 0.59 | 37 |
| 170000 | 14641 | 1.46 | 287 | 0.98 | 112 | 0.63 | 41 |
| 180000 | 15502 | 1.54 | 318 | 1.04 | 124 | 0.67 | 45 |
| 190000 | 16364 | 1.63 | 351 | 1.10 | 137 | 0.71 | 50 |
| 200000 | 17225 | 1.71 | 385 | 1.16 | 150 | 0.75 | 55 |
| 210000 | 18086 | 1.80 | 420 | 1.22 | 164 | 0.78 | 60 |
| 220000 | 18947 | 1.88 | 457 | 1.27 | 178 | 0.82 | 65 |
| 230000 | 19809 | 1.97 | 495 | 1.33 | 193 | 0.86 | 71 |
| 240000 | 20670 | 2.06 | 535 | 1.39 | 208 | 0.90 | 76 |
| 250000 | 21531 | | | 1.45 | 224 | 0.94 | 82 |
| 260000 | 22392 | | | 1.50 | 241 | 0.98 | 88 |
| 270000 | 23254 | | | 1.56 | 258 | 1.01 | 94 |
| 280000 | 24115 | | | 1.62 | 275 | 1.05 | 101 |
| 290000 | 24976 | | | 1.68 | 293 | 1.09 | 107 |
| 300000 | 25837 | | | 1.74 | 312 | 1.13 | 114 |
| 310000 | 26699 | | | 1.79 | 331 | 1.17 | 121 |
| 320000 | 27560 | | | 1.85 | 350 | 1.21 | 128 |
| 330000 | 28421 | | | 1.91 | 371 | 1.24 | 135 |
| 340000 | 29282 | | | 1.97 | 391 | 1.28 | 143 |
| 350000 | 30144 | | | 2.03 | 412 | 1.32 | 150 |
| 360000 | 31005 | | | | | 1.36 | 158 |
| 370000 | 31866 | | | | | 1.40 | 166 |
| 380000 | 32727 | | | | | 1.43 | 175 |
| 390000 | 33589 | | | | | 1.47 | 183 |
| 400000 | 34450 | | | | | 1.51 | 192 |
| 410000 | 35311 | | | | | 1.55 | 200 |
| 420000 | 36172 | | | | | 1.59 | 209 |
| 430000 | 37033 | | | | | 1.63 | 218 |
| 440000 | 37895 | | | | | 1.66 | 228 |
| 450000 | 38756 | | | | | 1.70 | 237 |
| 460000 | 39617 | | | | | 1.74 | 247 |
| 470000 | 40478 | | | | | 1.78 | 257 |
| 480000 | 41340 | | | | | 1.82 | 267 |
| 490000 | 42201 | | | | | 1.86 | 277 |
| 500000 | 43062 | | | | | 1.89 | 287 |
| 510000 | 43923 | | | | | 1.93 | 298 |
| 520000 | 44785 | | | | | 1.97 | 308 |
| 530000 | 45646 | | | | | 2.01 | 319 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\triangle\vartheta$ = 5 K (50 °C/45 °C) - 14 — 16 mm

| OD x s (ID) — V/l | | 14 x 2 mm (10 mm) — 0.08 l/m | | 16 x 2 mm (12 mm) — 0.11 l/m | |
|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 200 | 34 | 0.12 | 36 | 0.09 | 16 |
| 250 | 43 | 0.15 | 53 | 0.11 | 23 |
| 300 | 52 | 0.18 | 72 | 0.13 | 31 |
| 350 | 60 | 0.22 | 94 | 0.15 | 40 |
| 400 | 69 | 0.25 | 118 | 0.17 | 50 |
| 450 | 78 | 0.28 | 144 | 0.19 | 61 |
| 500 | 86 | 0.31 | 173 | 0.21 | 73 |
| 550 | 95 | 0.34 | 203 | 0.24 | 86 |
| 600 | 103 | 0.37 | 236 | 0.26 | 100 |
| 650 | 112 | 0.40 | 271 | 0.28 | 115 |
| 700 | 121 | 0.43 | 308 | 0.30 | 130 |
| 750 | 129 | 0.46 | 347 | 0.32 | 146 |
| 800 | 138 | 0.49 | 388 | 0.34 | 164 |
| 850 | 146 | 0.52 | 431 | 0.36 | 182 |
| 900 | 155 | 0.55 | 476 | 0.39 | 201 |
| 950 | 164 | 0.59 | 523 | 0.41 | 220 |
| 1000 | 172 | 0.62 | 571 | 0.43 | 241 |
| 1050 | 181 | 0.65 | 622 | 0.45 | 262 |
| 1100 | 189 | 0.68 | 674 | 0.47 | 284 |
| 1150 | 198 | 0.71 | 729 | 0.49 | 307 |
| 1200 | 207 | 0.74 | 785 | 0.51 | 330 |
| 1250 | 215 | 0.77 | 843 | 0.53 | 355 |
| 1300 | 224 | 0.80 | 902 | 0.56 | 380 |
| 1350 | 233 | 0.83 | 964 | 0.58 | 406 |
| 1400 | 241 | 0.86 | 1027 | 0.60 | 432 |
| 1450 | 250 | 0.89 | 1092 | 0.62 | 459 |
| 1500 | 258 | 0.92 | 1159 | 0.64 | 487 |
| 1550 | 267 | 0.96 | 1227 | 0.66 | 516 |
| 1600 | 276 | 0.99 | 1298 | 0.68 | 546 |
| 1650 | 284 | 1.02 | 1370 | 0.71 | 576 |
| 1700 | 293 | | | 0.73 | 607 |
| 1750 | 301 | | | 0.75 | 638 |
| 1800 | 310 | | | 0.77 | 670 |
| 1850 | 319 | | | 0.79 | 703 |
| 1900 | 327 | | | 0.81 | 737 |
| 1950 | 336 | | | 0.83 | 771 |
| 2000 | 344 | | | 0.86 | 806 |
| 2100 | 362 | | | 0.90 | 878 |
| 2200 | 379 | | | 0.94 | 953 |
| 2300 | 396 | | | 0.98 | 1030 |
| 2400 | 413 | | | 1.03 | 1111 |
| 2500 | 431 | | | | |
| 2600 | 448 | | | | |
| 2700 | 465 | | | | |
| 2800 | 482 | | | | |
| 3900 | 500 | | | | |
| 3000 | 517 | | | | |
| 3100 | 534 | | | | |
| 3200 | 551 | | | | |
| 3300 | 568 | | | | |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\triangle\vartheta$ = 5 K (50 °C/45 °C) - 20 — 32 mm

| OD x s (ID) — V/l | | 20 x 2,25 mm (15,5 mm) — 0.19 l/m | | 25 x 2,5 mm (20 mm) — 0.31 l/m | | 32 x 2 mm (26 mm) — 0.53 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 400 | 69 | 0.10 | 15 | 0.06 | 5 | 0.04 | 1 |
| 600 | 103 | 0.15 | 30 | 0.09 | 9 | 0.05 | 3 |
| 800 | 138 | 0.21 | 49 | 0.12 | 15 | 0.07 | 4 |
| 1000 | 172 | 0.26 | 72 | 0.15 | 22 | 0.09 | 6 |
| 1200 | 207 | 0.31 | 98 | 0.18 | 29 | 0.11 | 9 |
| 1400 | 241 | 0.36 | 128 | 0.22 | 38 | 0.13 | 11 |
| 1600 | 276 | 0.41 | 162 | 0.25 | 48 | 0.15 | 14 |
| 1800 | 310 | 0.46 | 199 | 0.28 | 59 | 0.16 | 17 |
| 2000 | 344 | 0.51 | 239 | 0.31 | 71 | 0.18 | 21 |
| 2200 | 379 | 0.56 | 282 | 0.34 | 84 | 0.20 | 24 |
| 2400 | 413 | 0.62 | 329 | 0.37 | 98 | 0.22 | 28 |
| 2600 | 448 | 0.67 | 378 | 0.40 | 113 | 0.24 | 32 |
| 2800 | 482 | 0.72 | 431 | 0.43 | 128 | 0.26 | 37 |
| 3000 | 517 | 0.77 | 486 | 0.46 | 145 | 0.27 | 42 |
| 3200 | 551 | 0.82 | 545 | 0.49 | 162 | 0.29 | 47 |
| 3400 | 586 | 0.87 | 606 | 0.52 | 180 | 0.31 | 52 |
| 3600 | 620 | 0.92 | 670 | 0.55 | 199 | 0.33 | 57 |
| 3800 | 655 | 0.97 | 737 | 0.59 | 219 | 0.35 | 63 |
| 4000 | 689 | 1.03 | 807 | 0.62 | 240 | 0.36 | 69 |
| 4200 | 723 | | | 0.65 | 261 | 0.38 | 75 |
| 4400 | 758 | | | 0.68 | 283 | 0.40 | 81 |
| 4600 | 792 | | | 0.71 | 306 | 0.42 | 88 |
| 4800 | 827 | | | 0.74 | 330 | 0.44 | 95 |
| 5000 | 861 | | | 0.77 | 355 | 0.46 | 102 |
| 5200 | 896 | | | 0.80 | 380 | 0.47 | 109 |
| 5400 | 930 | | | 0.83 | 407 | 0.49 | 116 |
| 5600 | 965 | | | 0.86 | 434 | 0.51 | 124 |
| 5800 | 999 | | | 0.89 | 461 | 0.53 | 132 |
| 6000 | 1033 | | | 0.92 | 490 | 0.55 | 140 |
| 6500 | 1120 | | | 1.00 | 564 | 0.59 | 161 |
| 7000 | 1206 | | | 1.08 | 643 | 0.64 | 184 |
| 7500 | 1292 | | | 1.16 | 727 | 0.68 | 208 |
| 8000 | 1378 | | | 1.23 | 815 | 0.73 | 233 |
| 8500 | 1464 | | | 1.31 | 908 | 0.77 | 259 |
| 9000 | 1550 | | | 1.39 | 1005 | 0.82 | 287 |
| 9500 | 1636 | | | 1.46 | 1107 | 0.87 | 316 |
| 10000 | 1722 | | | 1.54 | 1213 | 0.91 | 346 |
| 10500 | 1809 | | | | | 0.96 | 377 |
| 11000 | 1895 | | | | | 1.00 | 410 |
| 11500 | 1981 | | | | | 1.05 | 443 |
| 12000 | 2067 | | | | | 1.09 | 478 |
| 12500 | 2153 | | | | | 1.14 | 514 |
| 13000 | 2239 | | | | | 1.18 | 551 |
| 13500 | 2325 | | | | | 1.23 | 590 |
| 14000 | 2411 | | | | | 1.28 | 629 |
| 14500 | 2498 | | | | | 1.32 | 670 |
| 15000 | 2584 | | | | | 1.37 | 712 |
| 15500 | 2670 | | | | | 1.41 | 755 |
| 16000 | 2756 | | | | | 1.46 | 799 |
| 16500 | 2842 | | | | | 1.50 | 844 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Heating mode: $\Delta\vartheta$ = 5 K (50 °C/45 °C) - 40 — 63 mm

| OD x s (ID) — V/l | | 40 x 4 mm (32 mm) — 0.80 l/m | | 50 x 4,5 mm (41 mm) — 1.32 l/m | | 63 x 6 mm (51 mm) — 2.04 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 4000 | 689 | 0.24 | 26 | 0.15 | 8 | 0.09 | 3 |
| 5000 | 861 | 0.30 | 38 | 0.18 | 12 | 0.12 | 4 |
| 6000 | 1033 | 0.36 | 52 | 0.22 | 16 | 0.14 | 6 |
| 7000 | 1206 | 0.42 | 68 | 0.26 | 21 | 0.17 | 7 |
| 8000 | 1378 | 0.48 | 87 | 0.29 | 27 | 0.19 | 9 |
| 9000 | 1550 | 0.54 | 107 | 0.33 | 33 | 0.21 | 12 |
| 10000 | 1722 | 0.60 | 128 | 0.37 | 39 | 0.24 | 14 |
| 11000 | 1895 | 0.66 | 152 | 0.40 | 47 | 0.26 | 16 |
| 12000 | 2067 | 0.72 | 177 | 0.44 | 54 | 0.28 | 19 |
| 13000 | 2239 | 0.78 | 204 | 0.48 | 63 | 0.31 | 22 |
| 14000 | 2411 | 0.84 | 233 | 0.51 | 71 | 0.33 | 25 |
| 15000 | 2584 | 0.90 | 264 | 0.55 | 81 | 0.36 | 28 |
| 16000 | 2756 | 0.96 | 296 | 0.59 | 90 | 0.38 | 32 |
| 17000 | 2928 | 1.02 | 329 | 0.62 | 101 | 0.40 | 36 |
| 18000 | 3100 | 1.08 | 365 | 0.66 | 111 | 0.43 | 39 |
| 19000 | 3273 | 1.14 | 402 | 0.70 | 123 | 0.45 | 43 |
| 20000 | 3445 | 1.20 | 440 | 0.73 | 134 | 0.47 | 47 |
| 22000 | 3789 | 1.32 | 522 | 0.81 | 159 | 0.52 | 56 |
| 24000 | 4134 | 1.44 | 610 | 0.88 | 186 | 0.57 | 66 |
| 26000 | 4478 | 1.56 | 704 | 0.95 | 215 | 0.62 | 76 |
| 28000 | 4823 | | | 1.03 | 245 | 0.66 | 86 |
| 30000 | 5167 | | | 1.10 | 277 | 0.71 | 97 |
| 32000 | 5512 | | | 1.17 | 311 | 0.76 | 109 |
| 34000 | 5856 | | | 1.25 | 347 | 0.81 | 122 |
| 36000 | 6201 | | | 1.32 | 384 | 0.85 | 135 |
| 38000 | 6545 | | | 1.39 | 423 | 0.90 | 149 |
| 40000 | 6890 | | | 1.47 | 464 | 0.95 | 163 |
| 42000 | 7234 | | | 1.54 | 506 | 0.99 | 178 |
| 44000 | 7579 | | | | | 1.04 | 193 |
| 46000 | 7923 | | | | | 1.09 | 209 |
| 48000 | 8268 | | | | | 1.14 | 226 |
| 50000 | 8612 | | | | | 1.18 | 243 |
| 52000 | 8957 | | | | | 1.23 | 261 |
| 54000 | 9301 | | | | | 1.28 | 279 |
| 56000 | 9646 | | | | | 1.33 | 298 |
| 58000 | 9990 | | | | | 1.37 | 317 |
| 60000 | 10335 | | | | | 1.42 | 337 |
| 62000 | 10679 | | | | | 1.47 | 358 |
| 64000 | 11024 | | | | | 1.52 | 379 |
| 66000 | 11368 | | | | | 1.56 | 400 |
| 68000 | 11713 | | | | | 1.61 | 422 |
| 70000 | 12057 | | | | | 1.66 | 445 |
| 72000 | 12402 | | | | | 1.71 | 468 |
| 74000 | 12746 | | | | | 1.75 | 492 |
| 76000 | 13091 | | | | | 1.80 | 516 |
| 78000 | 13435 | | | | | 1.85 | 541 |
| 80000 | 13780 | | | | | 1.90 | 566 |
| 82000 | 14124 | | | | | 1.94 | 592 |
| 84000 | 14469 | | | | | 1.99 | 618 |
| 86000 | 14813 | | | | | 2.04 | 645 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

# Heating mode: $\triangle\vartheta$ = 5 K (50 °C/45 °C) - 75 — 110 mm

| OD x s (ID) — V/l | | 75 x 7,5 mm (60 mm) — 2.83 l/m | | 90 x 8,5 mm (73 mm) — 4.18 l/m | | 110 x 10 mm (90 mm) — 6.36 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| 20000 | 3445 | 0.34 | 22 | 0.23 | 9 | 0.15 | 3 |
| 25000 | 4306 | 0.43 | 32 | 0.29 | 13 | 0.19 | 5 |
| 30000 | 5167 | 0.51 | 45 | 0.35 | 18 | 0.23 | 6 |
| 35000 | 6029 | 0.60 | 59 | 0.40 | 23 | 0.27 | 8 |
| 40000 | 6890 | 0.69 | 75 | 0.46 | 29 | 0.30 | 11 |
| 45000 | 7751 | 0.77 | 92 | 0.52 | 36 | 0.34 | 13 |
| 50000 | 8612 | 0.86 | 112 | 0.58 | 44 | 0.38 | 16 |
| 55000 | 9474 | 0.94 | 132 | 0.64 | 52 | 0.42 | 19 |
| 60000 | 10335 | 1.03 | 155 | 0.69 | 60 | 0.46 | 22 |
| 65000 | 11196 | 1.11 | 178 | 0.75 | 70 | 0.49 | 26 |
| 700000 | 12057 | 1.20 | 204 | 0.81 | 80 | 0.53 | 29 |
| 75000 | 12919 | 1.28 | 231 | 0.87 | 90 | 0.57 | 33 |
| 80000 | 13780 | 1.37 | 259 | 0.93 | 101 | 0.61 | 37 |
| 85000 | 14641 | 1.45 | 289 | 0.98 | 113 | 0.65 | 41 |
| 90000 | 15502 | 1.54 | 321 | 1.04 | 125 | 0.68 | 46 |
| 95000 | 16364 | 1.63 | 353 | 1.10 | 138 | 0.72 | 50 |
| 100000 | 17225 | 1.71 | 388 | 1.16 | 151 | 0.76 | 55 |
| 105000 | 18086 | 1.80 | 423 | 1.21 | 165 | 0.80 | 60 |
| 110000 | 18947 | 1.88 | 460 | 1.27 | 179 | 0.84 | 66 |
| 115000 | 19809 | 1.97 | 499 | 1.33 | 194 | 0.87 | 71 |
| 120000 | 20670 | 2.05 | 539 | 1.39 | 210 | 0.91 | 77 |
| 125000 | 21531 | | | 1.45 | 226 | 0.95 | 83 |
| 130000 | 22392 | | | 1.50 | 242 | 0.99 | 89 |
| 135000 | 23254 | | | 1.56 | 260 | 1.03 | 95 |
| 140000 | 24115 | | | 1.62 | 277 | 1.06 | 101 |
| 145000 | 24976 | | | 1.68 | 295 | 1.10 | 108 |
| 150000 | 25837 | | | 1.73 | 314 | 1.14 | 115 |
| 155000 | 26699 | | | 1.79 | 333 | 1.18 | 122 |
| 160000 | 27560 | | | 1.85 | 353 | 1.22 | 129 |
| 165000 | 28421 | | | 1.91 | 373 | 1.26 | 136 |
| 170000 | 29282 | | | 1.97 | 394 | 1.29 | 144 |
| 175000 | 30144 | | | 2.02 | 415 | 1.33 | 152 |
| 180000 | 31005 | | | | | 1.37 | 159 |
| 185000 | 31866 | | | | | 1.41 | 168 |
| 190000 | 32727 | | | | | 1.45 | 176 |
| 195000 | 33589 | | | | | 1.48 | 184 |
| 200000 | 34450 | | | | | 1.52 | 193 |
| 205000 | 35311 | | | | | 1.56 | 202 |
| 210000 | 36172 | | | | | 1.60 | 211 |
| 215000 | 37033 | | | | | 1.64 | 220 |
| 220000 | 37895 | | | | | 1.67 | 229 |
| 225000 | 38756 | | | | | 1.71 | 239 |
| 230000 | 39617 | | | | | 1.75 | 248 |
| 235000 | 40478 | | | | | 1.79 | 258 |
| 240000 | 41340 | | | | | 1.83 | 268 |
| 245000 | 42201 | | | | | 1.86 | 279 |
| 250000 | 43062 | | | | | 1.90 | 289 |
| 255000 | 43923 | | | | | 1.94 | 300 |
| 260000 | 44785 | | | | | 1.98 | 310 |
| 265000 | 45646 | | | | | 2.02 | 321 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Cooling mode: $\triangle\vartheta$ = 6 K (6 °C/12 °C) - 14 — 16 mm

| OD x s (ID) — V/l | | 14 x 2 mm (10 mm) — 0.08 l/m | | 16 x 2 mm (12 mm) — 0.11 l/m | |
|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| -100 | 14 | 0.05 | 12 | 0.04 | 5 |
| -200 | 29 | 0.10 | 36 | 0.07 | 15 |
| -300 | 43 | 0.15 | 69 | 0.11 | 30 |
| -400 | 57 | 0.20 | 112 | 0.14 | 48 |
| -500 | 72 | 0.25 | 162 | 0.18 | 69 |
| -600 | 86 | 0.30 | 220 | 0.21 | 94 |
| -700 | 100 | 0.36 | 286 | 0.25 | 122 |
| -800 | 115 | 0.41 | 358 | 0.28 | 152 |
| -900 | 129 | 0.46 | 437 | 0.32 | 186 |
| -1000 | 144 | 0.51 | 523 | 0.35 | 222 |
| -1100 | 158 | 0.56 | 615 | 0.39 | 261 |
| -1200 | 172 | 0.61 | 714 | 0.42 | 303 |
| -1300 | 187 | 0.66 | 818 | 0.46 | 347 |
| -1400 | 201 | 0.71 | 929 | 0.49 | 394 |
| -1500 | 215 | 0.76 | 1046 | 0.53 | 443 |
| -1600 | 230 | 0.81 | 1169 | 0.56 | 495 |
| -1700 | 244 | 0.86 | 1297 | 0.60 | 549 |
| -1800 | 258 | 0.91 | 1432 | 0.63 | 605 |
| -1900 | 273 | 0.96 | 1572 | 0.67 | 664 |
| -2000 | 287 | 1.02 | 1717 | 0.71 | 726 |
| -2100 | 301 | | | 0.74 | 789 |
| -2200 | 316 | | | 0.78 | 855 |
| -2300 | 330 | | | 0.81 | 923 |
| -2400 | 344 | | | 0.85 | 994 |
| -2500 | 359 | | | 0.88 | 1066 |
| -2600 | 373 | | | 0.92 | 1141 |
| -2700 | 388 | | | 0.95 | 1218 |
| -2800 | 402 | | | 0.99 | 1297 |
| -2900 | 416 | | | 1.02 | 1379 |
| -3000 | 431 | | | | |
| -3100 | 445 | | | | |
| -3200 | 459 | | | | |
| -3300 | 474 | | | | |
| -3400 | 488 | | | | |
| -3500 | 502 | | | | |
| -3600 | 517 | | | | |
| -3700 | 531 | | | | |
| -3800 | 545 | | | | |
| -3900 | 560 | | | | |
| -4000 | 574 | | | | |
| -4100 | 589 | | | | |
| -4200 | 603 | | | | |
| -4300 | 617 | | | | |
| -4400 | 632 | | | | |
| -4500 | 646 | | | | |
| -4600 | 660 | | | | |
| -4700 | 675 | | | | |
| -4800 | 689 | | | | |
| -4900 | 703 | | | | |
| -5000 | 718 | | | | |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Cooling mode: $\triangle\vartheta$ = 6 K (6 °C/12 °C) - 20 — 32 mm

| OD x s (ID) — V/l | | 20 x 2,25 mm (15,5 mm) — 0.19 l/m | | 25 x 2,5 mm (20 mm) — 0.31 l/m | | 32 x 2 mm (26 mm) — 0.53 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| -400 | 57 | 0.08 | 15 | 0.05 | 4 | 0.03 | 1 |
| -600 | 86 | 0.13 | 28 | 0.08 | 9 | 0.05 | 3 |
| -800 | 115 | 0.17 | 46 | 0.10 | 14 | 0.06 | 4 |
| -1000 | 144 | 0.21 | 67 | 0.13 | 20 | 0.08 | 6 |
| -1200 | 172 | 0.25 | 91 | 0.15 | 28 | 0.09 | 8 |
| -1400 | 201 | 0.30 | 118 | 0.18 | 36 | 0.11 | 10 |
| -1600 | 230 | 0.34 | 148 | 0.20 | 45 | 0.12 | 13 |
| -1800 | 258 | 0.38 | 181 | 0.23 | 55 | 0.14 | 16 |
| -2000 | 287 | 0.42 | 217 | 0.25 | 65 | 0.15 | 19 |
| -2200 | 316 | 0.47 | 255 | 0.28 | 77 | 0.17 | 22 |
| -2400 | 344 | 0.51 | 297 | 0.30 | 89 | 0.18 | 26 |
| -2600 | 373 | 0.55 | 340 | 0.33 | 102 | 0.20 | 30 |
| -2800 | 402 | 0.59 | 387 | 0.36 | 116 | 0.21 | 34 |
| -3000 | 431 | 0.63 | 436 | 0.38 | 131 | 0.23 | 38 |
| -3200 | 459 | 0.68 | 487 | 0.41 | 146 | 0.24 | 42 |
| -3400 | 488 | 0.72 | 541 | 0.43 | 162 | 0.26 | 47 |
| -3600 | 517 | 0.76 | 597 | 0.46 | 179 | 0.27 | 52 |
| -3800 | 545 | 0.80 | 656 | 0.48 | 196 | 0.29 | 57 |
| -4000 | 574 | 0.85 | 717 | 0.51 | 214 | 0.30 | 62 |
| -4200 | 603 | 0.89 | 780 | 0.53 | 233 | 0.32 | 68 |
| -4400 | 632 | 0.93 | 846 | 0.56 | 253 | 0.33 | 73 |
| -4600 | 660 | 0.97 | 914 | 0.58 | 273 | 0.35 | 79 |
| -4800 | 689 | 1.01 | 984 | 0.61 | 294 | 0.36 | 85 |
| -5000 | 718 | | | 0.63 | 316 | 0.38 | 91 |
| -5500 | 789 | | | 0.70 | 372 | 0.41 | 108 |
| -6000 | 861 | | | 0.76 | 433 | 0.45 | 125 |
| -6500 | 933 | | | 0.83 | 498 | 0.49 | 144 |
| -7000 | 1005 | | | 0.89 | 567 | 0.53 | 163 |
| -7500 | 1077 | | | 0.95 | 639 | 0.56 | 184 |
| -8000 | 1148 | | | 1.02 | 715 | 0.60 | 206 |
| -8500 | 1220 | | | 1.08 | 796 | 0.64 | 229 |
| -9000 | 1292 | | | 1.14 | 879 | 0.68 | 253 |
| -9500 | 1364 | | | 1.21 | 964 | 0.71 | 278 |
| -10000 | 1435 | | | 1.27 | 1058 | 0.75 | 304 |
| -10500 | 1507 | | | 1.33 | 1152 | 0.79 | 331 |
| -11000 | 1579 | | | 1.40 | 1250 | 0.83 | 359 |
| -11500 | 1651 | | | 1.46 | 1352 | 0.86 | 388 |
| -12000 | 1722 | | | 1.52 | 1457 | 0.90 | 418 |
| -12500 | 1794 | | | | | 0.94 | 449 |
| -13000 | 1866 | | | | | 0.98 | 481 |
| -13500 | 1938 | | | | | 1.01 | 514 |
| -14000 | 2010 | | | | | 1.05 | 548 |
| -14500 | 2081 | | | | | 1.09 | 583 |
| -15000 | 2153 | | | | | 1.13 | 619 |
| -16000 | 2297 | | | | | 1.20 | 693 |
| -17000 | 2440 | | | | | 1.28 | 771 |
| -18000 | 2584 | | | | | 1.35 | 853 |
| -19000 | 2727 | | | | | 1.43 | 938 |
| -20000 | 2871 | | | | | 1.50 | 1027 |
| -21000 | 3014 | | | | | 1.58 | 1120 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Cooling mode: $\triangle\vartheta$ = 6 K (6 °C/12 °C) - 40 — 63 mm

| OD x s (ID) — V/l | | 40 x 4 mm (32 mm) — 0.80 l/m | | 50 x 4,5 mm (41 mm) — 1.32 l/m | | 63 x 6 mm (51 mm) — 2.04 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| -4000 | 574 | 0.20 | 23 | 0.12 | 7 | 0.08 | 3 |
| -6000 | 861 | 0.30 | 47 | 0.18 | 15 | 0.12 | 5 |
| -8000 | 1148 | 0.40 | 77 | 0.24 | 24 | 0.16 | 9 |
| -10000 | 1435 | 0.50 | 114 | 0.30 | 35 | 0.20 | 12 |
| -12000 | 1722 | 0.60 | 156 | 0.36 | 48 | 0.23 | 17 |
| -14000 | 2010 | 0.69 | 204 | 0.42 | 63 | 0.27 | 22 |
| -16000 | 2297 | 0.79 | 258 | 0.48 | 79 | 0.31 | 28 |
| -18000 | 2584 | 0.89 | 317 | 0.54 | 98 | 0.35 | 35 |
| -20000 | 2871 | 0.99 | 382 | 0.60 | 117 | 0.39 | 42 |
| -22000 | 3158 | 1.09 | 452 | 0.66 | 139 | 0.43 | 49 |
| -24000 | 3445 | 1.19 | 527 | 0.73 | 162 | 0.47 | 57 |
| -26000 | 3732 | 1.29 | 607 | 0.79 | 186 | 0.51 | 66 |
| -28000 | 4019 | 1.39 | 692 | 0.85 | 212 | 0.55 | 75 |
| -30000 | 4306 | 1.49 | 781 | 0.91 | 101 | 0.59 | 85 |
| -32000 | 4593 | 1.59 | 876 | 0.97 | 269 | 0.62 | 95 |
| -34000 | 4880 | | | 1.03 | 299 | 0.66 | 106 |
| -36000 | 5167 | | | 1.09 | 331 | 0.70 | 117 |
| -38000 | 5455 | | | 1.15 | 364 | 0.74 | 129 |
| -40000 | 5742 | | | 1.21 | 399 | 0.78 | 141 |
| -42000 | 6029 | | | 1.27 | 435 | 0.82 | 153 |
| -44000 | 6316 | | | 1.33 | 472 | 0.86 | 167 |
| -46000 | 6603 | | | 1.39 | 511 | 0.90 | 180 |
| -48000 | 6890 | | | 1.45 | 551 | 0.94 | 194 |
| -50000 | 7177 | | | 1.51 | 592 | 0.98 | 209 |
| -52000 | 7464 | | | | | 1.02 | 224 |
| -54000 | 7751 | | | | | 1.05 | 239 |
| -56000 | 8038 | | | | | 1.09 | 255 |
| -58000 | 8325 | | | | | 1.13 | 272 |
| -60000 | 8612 | | | | | 1.17 | 289 |
| -62000 | 8900 | | | | | 1.21 | 306 |
| -64000 | 9187 | | | | | 1.25 | 324 |
| -66000 | 9474 | | | | | 1.29 | 342 |
| -68000 | 9761 | | | | | 1.33 | 360 |
| -70000 | 10048 | | | | | 1.37 | 379 |
| -72000 | 10335 | | | | | 1.41 | 399 |
| -74000 | 10622 | | | | | 1.44 | 419 |
| -76000 | 10909 | | | | | 1.48 | 439 |
| -78000 | 11196 | | | | | 1.52 | 460 |
| -80000 | 11483 | | | | | 1.56 | 481 |
| -82000 | 11770 | | | | | 1.60 | 503 |
| -84000 | 12057 | | | | | 1.64 | 525 |
| -86000 | 12344 | | | | | 1.68 | 547 |
| -88000 | 12632 | | | | | 1.72 | 570 |
| -90000 | 12919 | | | | | 1.76 | 594 |
| -92000 | 13206 | | | | | 1.80 | 618 |
| -94000 | 13493 | | | | | 1.84 | 642 |
| -96000 | 13780 | | | | | 1.87 | 666 |
| -98000 | 14067 | | | | | 1.91 | 691 |
| -100000 | 14354 | | | | | 1.95 | 717 |
| -102000 | 14641 | | | | | 1.99 | 742 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Cooling mode: $\triangle\vartheta$ = 6 K (6 °C/12 °C) - 75 — 110 mm

| OD x s (ID) — V/l | | 75 x 7,5 mm (60 mm) — 2.83 l/m | | 90 x 8,5 mm (73 mm) — 4.18 l/m | | 110 x 10 mm (90 mm) — 6.36 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| -10000 | 1435 | 0.14 | 6 | 0.10 | 2 | 0.06 | 1 |
| -15000 | 2153 | 0.21 | 12 | 0.14 | 5 | 0.09 | 2 |
| -20000 | 2871 | 0.28 | 19 | 0.19 | 8 | 0.13 | 3 |
| -25000 | 3589 | 0.35 | 28 | 0.24 | 11 | 0.16 | 4 |
| -30000 | 4306 | 0.42 | 39 | 0.29 | 15 | 0.19 | 6 |
| -35000 | 5024 | 0.49 | 51 | 0.33 | 20 | 0.22 | 7 |
| -40000 | 5742 | 0.56 | 65 | 0.38 | 26 | 0.25 | 9 |
| -45000 | 6459 | 0.63 | 80 | 0.43 | 31 | 0.28 | 12 |
| -50000 | 7177 | 0.71 | 96 | 0.48 | 38 | 0.31 | 14 |
| -55000 | 7895 | 0.78 | 114 | 0.52 | 45 | 0.34 | 16 |
| -60000 | 8612 | 0.85 | 133 | 0.57 | 52 | 0.38 | 19 |
| -65000 | 9330 | 0.92 | 153 | 0.62 | 60 | 0.41 | 22 |
| -70000 | 10048 | 0.99 | 175 | 0.67 | 68 | 0.44 | 25 |
| -75000 | 10766 | 1.06 | 197 | 0.71 | 77 | 0.47 | 28 |
| -80000 | 11483 | 1.13 | 221 | 0.76 | 87 | 0.50 | 32 |
| -85000 | 12201 | 1.20 | 246 | 0.81 | 97 | 0.53 | 36 |
| -90000 | 12919 | 1.27 | 273 | 0.86 | 107 | 0.56 | 39 |
| -95000 | 13636 | 1.34 | 300 | 0.91 | 118 | 0.60 | 43 |
| -100000 | 14354 | 1.41 | 329 | 0.95 | 129 | 0.63 | 47 |
| -105000 | 15072 | 1.48 | 359 | 1.00 | 141 | 0.66 | 52 |
| -110000 | 15789 | 1.55 | 390 | 1.05 | 153 | 0.69 | 56 |
| -115000 | 16507 | 1.62 | 422 | 1.10 | 165 | 0.72 | 61 |
| -120000 | 17225 | 1.69 | 456 | 1.14 | 178 | 0.75 | 66 |
| -125000 | 17943 | 1.76 | 490 | 1.19 | 192 | 0.78 | 70 |
| -130000 | 18660 | 1.83 | 526 | 1.24 | 206 | 0.82 | 76 |
| -135000 | 19378 | 1.90 | 563 | 1.29 | 220 | 0.85 | 81 |
| -140000 | 20096 | 1.97 | 601 | 1.33 | 235 | 0.88 | 86 |
| -145000 | 20813 | 2.05 | 640 | 1.38 | 250 | 0.91 | 92 |
| -150000 | 21531 | | | 1.43 | 266 | 0.94 | 97 |
| -160000 | 22967 | | | 1.52 | 298 | 1.00 | 109 |
| -170000 | 24402 | | | 1.62 | 332 | 1.07 | 122 |
| -180000 | 25837 | | | 1.72 | 368 | 1.13 | 135 |
| -190000 | 27273 | | | 1.81 | 405 | 1.19 | 149 |
| -200000 | 28708 | | | 1.91 | 444 | 1.25 | 163 |
| -210000 | 30144 | | | 2.00 | 485 | 1.32 | 178 |
| -220000 | 31579 | | | | | 1.38 | 193 |
| -230000 | 33014 | | | | | 1.44 | 209 |
| -240000 | 34450 | | | | | 1.50 | 226 |
| -250000 | 35885 | | | | | 1.57 | 243 |
| -260000 | 37321 | | | | | 1.63 | 261 |
| -270000 | 38756 | | | | | 1.69 | 279 |
| -280000 | 40191 | | | | | 1.76 | 298 |
| -290000 | 41627 | | | | | 1.82 | 317 |
| -300000 | 43062 | | | | | 1.88 | 337 |
| -310000 | 44498 | | | | | 1.94 | 358 |
| -320000 | 45933 | | | | | 2.01 | 379 |
| -330000 | 47368 | | | | | 2.07 | 400 |
| -340000 | 48804 | | | | | 2.13 | 422 |
| -350000 | 50239 | | | | | 2.19 | 445 |
| -360000 | 51675 | | | | | 2.26 | 468 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Cooling mode: $\triangle\vartheta$ = 3 K (17 °C/20 °C) - 14 — 16 mm

| OD x s (ID) — V/l | | 14 x 2 mm (10 mm) — 0.08 l/m | | 16 x 2 mm (12 mm) — 0.11 l/m | |
|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| -50 | 14 | 0.05 | 11 | 0.04 | 5 |
| -100 | 29 | 0.10 | 33 | 0.07 | 14 |
| -150 | 43 | 0.15 | 64 | 0.11 | 27 |
| -200 | 57 | 0.20 | 103 | 0.14 | 44 |
| -250 | 72 | 0.25 | 149 | 0.18 | 64 |
| -300 | 86 | 0.31 | 203 | 0.21 | 86 |
| -350 | 100 | 0.36 | 264 | 0.25 | 112 |
| -400 | 115 | 0.41 | 332 | 0.28 | 141 |
| -450 | 129 | 0.46 | 405 | 0.32 | 172 |
| -500 | 144 | 0.51 | 485 | 0.35 | 206 |
| -550 | 158 | 0.56 | 572 | 0.39 | 242 |
| -600 | 172 | 0.61 | 664 | 0.42 | 281 |
| -650 | 187 | 0.66 | 762 | 0.46 | 322 |
| -700 | 201 | 0.71 | 866 | 0.49 | 366 |
| -750 | 215 | 0.76 | 975 | 0.53 | 412 |
| -800 | 230 | 0.81 | 1090 | 0.57 | 460 |
| -850 | 244 | 0.86 | 1211 | 0.60 | 511 |
| -900 | 258 | 0.92 | 1337 | 0.64 | 564 |
| -950 | 273 | 0.97 | 1468 | 0.67 | 619 |
| -1000 | 287 | 1.02 | 1605 | 0.71 | 677 |
| -1050 | 301 | | | 0.74 | 736 |
| -1100 | 316 | | | 0.78 | 798 |
| -1150 | 330 | | | 0.81 | 862 |
| -1200 | 344 | | | 0.85 | 928 |
| -1250 | 359 | | | 0.88 | 996 |
| -1300 | 373 | | | 0.92 | 1067 |
| -1350 | 388 | | | 0.95 | 1139 |
| -1400 | 402 | | | 0.99 | 1213 |
| -1450 | 416 | | | 1.02 | 1290 |
| -1500 | 431 | | | | |
| -1550 | 445 | | | | |
| -1600 | 459 | | | | |
| -1650 | 474 | | | | |
| -1700 | 488 | | | | |
| -1750 | 502 | | | | |
| -1800 | 517 | | | | |
| -1850 | 531 | | | | |
| -1900 | 545 | | | | |
| -1950 | 560 | | | | |
| -2000 | 574 | | | | |
| -2050 | 589 | | | | |
| -2100 | 603 | | | | |
| -2150 | 617 | | | | |
| -2200 | 632 | | | | |
| -2250 | 646 | | | | |
| -2300 | 660 | | | | |
| -2350 | 675 | | | | |
| -2400 | 689 | | | | |
| -2450 | 703 | | | | |
| -2500 | 718 | | | | |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Cooling mode: △ϑ = 3 K (17 °C/20 °C) - 20 — 32 mm

| OD x s (ID) — V/l | | 20 x 2,25 mm (15,5 mm) — 0.19 l/m | | 25 x 2,5 mm (20 mm) — 0.31 l/m | | 32 x 2 mm (26 mm) — 0.53 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| -200 | 57 | 0.08 | 13 | 0.05 | 4 | 0.03 | 1 |
| -400 | 115 | 0.17 | 42 | 0.10 | 13 | 0.06 | 4 |
| -600 | 172 | 0.25 | 84 | 0.15 | 25 | 0.09 | 7 |
| -800 | 230 | 0.34 | 138 | 0.20 | 41 | 0.12 | 12 |
| -1000 | 287 | 0.42 | 202 | 0.25 | 61 | 0.15 | 18 |
| -1200 | 344 | 0.51 | 276 | 0.31 | 83 | 0.18 | 24 |
| -1400 | 402 | 0.59 | 361 | 0.36 | 108 | 0.21 | 31 |
| -1600 | 459 | 0.68 | 455 | 0.41 | 136 | 0.24 | 39 |
| -1800 | 517 | 0.76 | 558 | 0.46 | 167 | 0.27 | 48 |
| -2000 | 574 | 0.85 | 671 | 0.51 | 200 | 0.30 | 58 |
| -2200 | 632 | 0.93 | 792 | 0.56 | 236 | 0.33 | 68 |
| -2400 | 689 | 1.02 | 922 | 0.61 | 275 | 0.36 | 79 |
| -2600 | 746 | | | 0.66 | 316 | 0.39 | 91 |
| -2800 | 804 | | | 0.71 | 360 | 0.42 | 104 |
| -3000 | 861 | | | 0.76 | 406 | 0.45 | 117 |
| -3200 | 919 | | | 0.81 | 454 | 0.48 | 131 |
| -3400 | 976 | | | 0.86 | 505 | 0.51 | 145 |
| -3600 | 1033 | | | 0.92 | 559 | 0.54 | 161 |
| -3800 | 1091 | | | 0.97 | 614 | 0.57 | 177 |
| -4000 | 1148 | | | 1.02 | 672 | 0.60 | 193 |
| -4200 | 1206 | | | 1.07 | 732 | 0.63 | 210 |
| -4400 | 1263 | | | 1.12 | 794 | 0.66 | 228 |
| -4600 | 1321 | | | 1.17 | 859 | 0.69 | 247 |
| -4800 | 1378 | | | 1.22 | 926 | 0.72 | 266 |
| -5000 | 1435 | | | 1.27 | 995 | 0.75 | 285 |
| -5200 | 1493 | | | 1.32 | 1066 | 0.78 | 306 |
| -5400 | 1550 | | | 1.37 | 1139 | 0.81 | 327 |
| -5600 | 1608 | | | 1.42 | 1215 | 0.84 | 348 |
| -5800 | 1665 | | | 1.47 | 1293 | 0.87 | 370 |
| -6000 | 1722 | | | 1.53 | 1372 | 0.90 | 393 |
| -6200 | 1780 | | | | | 0.93 | 417 |
| -6400 | 1837 | | | | | 0.96 | 440 |
| -6600 | 1895 | | | | | 0.99 | 465 |
| -6800 | 1952 | | | | | 1.02 | 490 |
| -7000 | 2010 | | | | | 1.05 | 516 |
| -7200 | 2067 | | | | | 1.08 | 542 |
| -7400 | 2124 | | | | | 1.11 | 569 |
| -7600 | 2182 | | | | | 1.14 | 596 |
| -7800 | 2239 | | | | | 1.17 | 624 |
| -8000 | 2297 | | | | | 1.20 | 653 |
| -8200 | 2354 | | | | | 1.23 | 682 |
| -8400 | 2411 | | | | | 1.26 | 712 |
| -8600 | 2469 | | | | | 1.29 | 742 |
| -8800 | 2526 | | | | | 1.32 | 773 |
| -9000 | 2584 | | | | | 1.35 | 804 |
| -9200 | 2641 | | | | | 1.38 | 836 |
| -9400 | 2699 | | | | | 1.41 | 868 |
| -9600 | 2756 | | | | | 1.44 | 901 |
| -9800 | 2813 | | | | | 1.47 | 935 |
| -10000 | 2871 | | | | | 1.50 | 969 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Cooling mode: △𝜗 = 3 K (17 °C/20 °C) - 40 — 63 mm

| OD x s (ID) — V/l | | 40 x 4 mm (32 mm) — 0.80 l/m | | 50 x 4,5 mm (41 mm) — 1.32 l/m | | 63 x 6 mm (51 mm) — 2.04 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| -2000 | 574 | 0.20 | 22 | 0.12 | 7 | 0.08 | 2 |
| -3000 | 861 | 0.30 | 44 | 0.18 | 14 | 0.12 | 5 |
| -4000 | 1148 | 0.40 | 72 | 0.24 | 22 | 0.16 | 8 |
| -5000 | 1435 | 0.50 | 106 | 0.30 | 33 | 0.20 | 12 |
| -6000 | 1722 | 0.60 | 146 | 0.36 | 45 | 0.23 | 16 |
| -7000 | 2010 | 0.70 | 192 | 0.42 | 59 | 0.27 | 21 |
| -8000 | 2297 | 0.79 | 243 | 0.48 | 75 | 0.31 | 26 |
| -9000 | 2584 | 0.89 | 299 | 0.54 | 92 | 0.35 | 33 |
| -10000 | 2871 | 0.99 | 360 | 0.61 | 110 | 0.39 | 39 |
| -11000 | 3158 | 1.09 | 426 | 0.67 | 131 | 0.43 | 46 |
| -12000 | 3445 | 1.19 | 497 | 0.73 | 152 | 0.47 | 54 |
| -13000 | 3732 | 1.29 | 572 | 0.79 | 175 | 0.51 | 62 |
| -14000 | 4019 | 1.39 | 653 | 0.85 | 200 | 0.55 | 71 |
| -15000 | 4306 | 1.49 | 738 | 0.91 | 226 | 0.59 | 80 |
| -16000 | 4593 | 1.59 | 828 | 0.97 | 253 | 0.63 | 89 |
| -17000 | 4880 | | | 1.03 | 282 | 0.66 | 100 |
| -18000 | 5167 | | | 1.09 | 312 | 0.70 | 110 |
| -19000 | 5455 | | | 1.15 | 344 | 0.74 | 121 |
| -20000 | 5742 | | | 1.21 | 376 | 0.78 | 133 |
| -21000 | 6029 | | | 1.27 | 411 | 0.82 | 145 |
| -22000 | 6316 | | | 1.33 | 446 | 0.86 | 157 |
| -23000 | 6603 | | | 1.39 | 483 | 0.90 | 170 |
| -24000 | 6890 | | | 1.45 | 521 | 0.94 | 183 |
| -25000 | 7177 | | | 1.51 | 560 | 0.98 | 197 |
| -26000 | 7464 | | | | | 1.02 | 211 |
| -27000 | 7751 | | | | | 1.06 | 226 |
| -28000 | 8038 | | | | | 1.10 | 241 |
| -29000 | 8325 | | | | | 1.13 | 257 |
| -30000 | 8612 | | | | | 1.17 | 273 |
| -31000 | 8900 | | | | | 1.21 | 289 |
| -32000 | 9187 | | | | | 1.25 | 306 |
| -33000 | 9474 | | | | | 1.29 | 323 |
| -34000 | 9761 | | | | | 1.33 | 341 |
| -35000 | 10048 | | | | | 1.37 | 359 |
| -36000 | 10335 | | | | | 1.41 | 378 |
| -37000 | 10622 | | | | | 1.45 | 397 |
| -38000 | 10909 | | | | | 1.49 | 416 |
| -39000 | 11196 | | | | | 1.53 | 436 |
| -40000 | 11483 | | | | | 1.56 | 456 |
| -41000 | 11770 | | | | | 1.60 | 476 |
| -42000 | 12057 | | | | | 1.64 | 497 |
| -43000 | 12344 | | | | | 1.68 | 519 |
| -44000 | 12632 | | | | | 1.72 | 541 |
| -45000 | 12919 | | | | | 1.76 | 563 |
| -46000 | 13206 | | | | | 1.80 | 585 |
| -47000 | 13493 | | | | | 1.84 | 608 |
| -58000 | 13780 | | | | | 1.88 | 632 |
| -49000 | 14067 | | | | | 1.92 | 656 |
| -50000 | 14354 | | | | | 1.96 | 680 |
| -51000 | 14641 | | | | | 1.99 | 704 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

## Cooling mode: $\triangle \vartheta$ = 3 K (17 °C/20 °C) - 75 — 110 mm

| OD x s (ID) — V/l | | 75 x 7,5 mm (60 mm) — 2.83 l/m | | 90 x 8,5 mm (73 mm) — 4.18 l/m | | 110 x 10 mm (90 mm) — 6.36 l/m | |
|---|---|---|---|---|---|---|---|
| Q, W | m, kg/h | v, m/s | R, Pa/m | v, m/s | R, Pa/m | v, m/s | R, Pa/m |
| -8000 | 2297 | 0.23 | 12 | 0.15 | 5 | 0.10 | 2 |
| -10000 | 2871 | 0.28 | 18 | 0.19 | 7 | 0.13 | 3 |
| -12000 | 3445 | 0.34 | 25 | 0.23 | 10 | 0.15 | 4 |
| -14000 | 4019 | 0.40 | 33 | 0.27 | 13 | 0.18 | 5 |
| -16000 | 4593 | 0.45 | 41 | 0.31 | 16 | 0.20 | 6 |
| -18000 | 5167 | 0.51 | 51 | 0.34 | 20 | 0.23 | 7 |
| -20000 | 5742 | 0.57 | 61 | 0.38 | 24 | 0.25 | 9 |
| -22000 | 6316 | 0.62 | 72 | 0.42 | 28 | 0.28 | 10 |
| -24000 | 6890 | 0.68 | 84 | 0.46 | 33 | 0.30 | 12 |
| -26000 | 7464 | 0.73 | 97 | 0.50 | 38 | 0.33 | 14 |
| -28000 | 8038 | 0.79 | 111 | 0.53 | 44 | 0.35 | 16 |
| -30000 | 8612 | 0.85 | 125 | 0.57 | 49 | 0.38 | 18 |
| -32000 | 9187 | 0.90 | 141 | 0.61 | 55 | 0.40 | 20 |
| -34000 | 9761 | 0.96 | 157 | 0.65 | 61 | 0.43 | 23 |
| -36000 | 10335 | 1.02 | 174 | 0.69 | 68 | 0.45 | 25 |
| -38000 | 10909 | 1.07 | 191 | 0.73 | 75 | 0.48 | 28 |
| -40000 | 11483 | 1.13 | 209 | 0.76 | 82 | 0.50 | 30 |
| -42000 | 12057 | 1.19 | 228 | 0.80 | 89 | 0.53 | 33 |
| -44000 | 12632 | 1.24 | 248 | 0.84 | 97 | 0.55 | 36 |
| -46000 | 13206 | 1.30 | 269 | 0.88 | 105 | 0.58 | 39 |
| -48000 | 13780 | 1.36 | 290 | 0.92 | 113 | 0.60 | 42 |
| -50000 | 14354 | 1.41 | 312 | 0.95 | 122 | 0.63 | 45 |
| -52000 | 14928 | 1.47 | 335 | 0.99 | 131 | 0.65 | 48 |
| -54000 | 15502 | 1.53 | 358 | 1.03 | 140 | 0.68 | 51 |
| -56000 | 16077 | 1.58 | 382 | 1.07 | 149 | 0.70 | 55 |
| -58000 | 16651 | 1.64 | 407 | 1.11 | 159 | 0.73 | 58 |
| -60000 | 17225 | 1.70 | 432 | 1.15 | 169 | 0.75 | 62 |
| -62000 | 17799 | 1.75 | 459 | 1.18 | 179 | 0.78 | 66 |
| -64000 | 18373 | 1.81 | 485 | 1.22 | 190 | 0.80 | 70 |
| -66000 | 18947 | 1.86 | 513 | 1.26 | 200 | 0.83 | 74 |
| -68000 | 19522 | 1.92 | 541 | 1.30 | 211 | 0.85 | 78 |
| -70000 | 20096 | 1.98 | 570 | 1.34 | 223 | 0.88 | 82 |
| -75000 | 21531 | 2.12 | 645 | 1.43 | 252 | 0.94 | 92 |
| -80000 | 22967 | | | 1.53 | 283 | 1.00 | 104 |
| -85000 | 24402 | | | 1.62 | 315 | 1.07 | 116 |
| -90000 | 25837 | | | 1.72 | 349 | 1.13 | 128 |
| -95000 | 27273 | | | 1.81 | 385 | 1.19 | 141 |
| -100000 | 28708 | | | 1.91 | 422 | 1.26 | 155 |
| -105000 | 30144 | | | 2.00 | 461 | 1.32 | 169 |
| -110000 | 31579 | | | | | 1.38 | 183 |
| -115000 | 33014 | | | | | 1.44 | 199 |
| -120000 | 34450 | | | | | 1.51 | 215 |
| -125000 | 35885 | | | | | 1.57 | 231 |
| -130000 | 37321 | | | | | 1.63 | 248 |
| -135000 | 38756 | | | | | 1.70 | 265 |
| -140000 | 40191 | | | | | 1.76 | 283 |
| -145000 | 41627 | | | | | 1.82 | 302 |
| -150000 | 43062 | | | | | 1.88 | 321 |
| -155000 | 44498 | | | | | 1.95 | 340 |
| -160000 | 45933 | | | | | 2.01 | 360 |

Q = Power in Watt, v = Flow velocity in metres/second

R = Pipe friction pressure gradient in Pascal/Meter (100 Pa = 1 hPa = 1 mbar, 1 hPa ~ 10 mm WS)

# Sample calculation

> **Note**
>
> For system-connected heating circuits (single-pipe heating) the entire circuit volume flow, including all of the radiators, must be taken into account!

The selection of the respective pipe dimension depends on the required mass flow (volume flow) for the respective pipe section. Depending on pipe dimension OD x s, the flow velocity v and the pipe friction pressure gradient R change. If the pipe is sized too small, the flow velocity v and the pipe friction pressure gradient R increase. This leads to a potential increase in noise relating to flow and higher power consumption of the circulation pump.

We therefore recommend that the following speed guide values are not exceeded when designing the pipe network:

- Radiator connection pipe: v ≤ 0.3 m/s
- Heating distribution pipes: v ≤ 0.5 m/s
- Heating riser and cellar pipes: v ≤ 1.0 m/s

The pipe network must be designed in such a way that the flow velocity from the boiler to the most distant radiator decreases evenly. The guide values for the flow velocity must be observed.

The following tables show the maximum transferable heat output QN, taking into account the maximum flow velocity, depending on the type of piping, the expansion $\Delta\vartheta$ and the pipe dimension OD x s.

## Radiator connection pipe: v ≤ 0.3 m/s

| Pipe OD x s [mm] | 14 x 2 | 16 x 2 | 20 x 2.25 | 25 x 2.5 | 32 x 3 |
|---|---|---|---|---|---|
| Mass flow ṁ (kg/h) | 85 | 122 | 204 | 339 | 573 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 5 K | 493 | 710 | 1185 | 1972 | 3333 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 10 K | 986 | 1420 | 2369 | 3944 | 6666 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 15 K | 1479 | 2130 | 3554 | 5916 | 9999 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 20 K | 1972 | 2840 | 4738 | 7889 | 13332 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 25 K | 2465 | 3550 | 5923 | 9861 | 16665 |

## Heating distribution pipes: v ≤ 0.5 m/s

| Pipe OD x s [mm] | 14 x 2 | 16 x 2 | 20 x 2.25 | 25 x 2.5 | 32 x 3 | 40 x 4 |
|---|---|---|---|---|---|---|
| Mass flow ṁ (kg/h) | 141 | 204 | 340 | 565 | 956 | 1448 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 5 K | 822 | 1183 | 1974 | 3287 | 5555 | 8414 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 10 K | 1643 | 2367 | 3948 | 6574 | 11110 | 16829 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 15 K | 2465 | 3550 | 5923 | 9861 | 16665 | 25243 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 20 K | 3287 | 4733 | 7897 | 13148 | 22219 | 33658 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 25 K | 4109 | 5916 | 9871 | 16434 | 27774 | 42072 |

## Heating riser and cellar pipes: v ≤ 1.0 m/s

| Pipe OD x s [mm] | 14 x 2 | 16 x 2 | 20 x 2.25 | 25 x 2.5 | 32 x 3 | 40 x 4 |
|---|---|---|---|---|---|---|
| Mass flow ṁ (kg/h) | 283 | 407 | 679 | 1131 | 1911 | 2895 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 5 K | 1643 | 2367 | 3948 | 6574 | 11110 | 16829 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 10 K | 3287 | 4733 | 7897 | 13148 | 22219 | 33658 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 15 K | 4930 | 7100 | 11845 | 19721 | 33329 | 50487 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 20 K | 6574 | 9466 | 15794 | 26295 | 44439 | 67316 |
| Heat output $Q_N$ (W) at $\Delta\vartheta$ = 25 K | 8217 | 11833 | 19742 | 32869 | 55548 | 84144 |

## Example

| Calculation of mass flow ṁ (kg/h) | Where: |
|---|---|
| $\dot{m} = Q_N / [c_W \times (\vartheta_{VL} - \vartheta_{RL})]$ | $c_W$ = specific heat capacity of hot water ≈ 1.163 Wh/(kgK) |
| $\dot{m}$ = 1977 W/[1.163 Wh/(kg K) x (70 °C - 50 °C)] | $\vartheta_{VL}$ = Flow temperature in °C |
| $\dot{m}$ = 85 kg/h | $\vartheta_{RL}$ = Return flow temperature in °C |
| | $Q_N$ = Rated power in W |

# 10 Pressure and leak testing of Uponor heating installations

> **Note**
>
> **Pressure testing should only be carried out by a trained, competent person**
>
> Pressure tests are ancillary services under a work contract and are often part of the contractor's contractual performance, even if not explicitly mentioned in the description of service

The following procedures describe the pressure and leak test for Uponor Multilayer composite pipe installations for heating systems.

## 10.1 Leak test with water for heating installations

The heating engineer/installer must subject the heating pipes to a leak test after installation and before closing in the pipes with walls, ceilings, floors, screeds or another covering. As a rule, tap water can be used for the leak test. The water should meet the requirements as detailed by DWI. The heating system must be filled slowly and should be completely purged of any air.

If there is a risk of freezing, suitable measures must be taken (e.g. use of antifreeze or temperature control of the building). If frost protection is no longer required for the intended operation of the system, antifreeze agents must be removed by draining and flushing the system with at least three water changes.

Once filled and pressurised, a period should be allowed to permit the temperature compensation between the ambient temperature and the temperature of the filling water. Once this balancing period has finished, If necessary, restore the test pressure.

Only pressure gauges which are accurate enough to determine a pressure change of 0.1 bar should be used. If possible, the pressure gauge should be placed at the lowest point of the system.

The pipe system and water heating system must be tested at a pressure corresponding to the set pressure of the safety valve. Alternatively, 1.3 times the designed operating pressure can be used as the pressure for the test in accordance with BS EN 14336.

The test pressure must be maintained for two hours and may not drop by more than 0.2 bar. No leaks must occur during that time.

The leak test must be documented by the test engineer in a 'pressure test report' and this document should make a record of the equipment used, the duration of the test and the tightness of the system.

This report is available at the Uponor services download center.

*https://www.uponor.com/doc/1120121*

## 10.2 Leak test for heating installation with compressed air or inert gas

A pressure test for heating installations can be carried out with compressed air or inert gas in accordance with BS EN 14336 or in accordance with another recognised national standard.

To document the test, the "leak test protocol for Uponor drinking water distribution - test medium: Compressed air or inert gases" is applicable.

This report is available at the Uponor services download center.

*https://www.uponor.com/doc/1120118*

# 11 General planning principles

## 11.1 Fire protection requirements

Building regulations in the United Kingdom are statutory instruments or statutory regulations that seek to ensure that the policies set out in the relevant legislation are carried out. Building regulations approval is required for most building work in the UK.

In the UK, the requirements for fire protection are detailed in the relevant government documents :

**England** - Fire Safety, Approved Document B (fire safety volume 1: Dwellings, 2019 edition incorporating 2020 amendments **or** Fire Safety Approved Document B (fire safety volume 2: Buildings other than dwellings, 2019 edition incorporating 2020 amendments

**Scotland** - Building standards technical handbook 2019: domestic (2. Fire **or** Building standards technical handbook 2019: non-domestic (2.Fire

**Wales** - Welsh Building Regulations 2010, Volume 1 - Dwellinghouses, Approved Document incorporating 2010, 2016 and 2020 amendments **or** Welsh Building Regulations 2010, Volume 2 - Buildings other than Dwellinghouses, Approved Document incorporating 2010, 2013, 2016, 2017 and 2020 amendments

In modern buildings, there are strict regulations governing fire safety and the protection of all areas of a building.

It is sometimes necessary for pipes and other services to pass through fire-separating elements. If a fire-separating element is to be effective, every opening to allow services to pass through should be adequately protected by sealing with appropriate fire-stopping methods so that the fire resistance of the element is not impaired.

In order to guarantee preventive fire protection, the choice of the right building materials is very important. The selection of building materials is regulated and detailed in the above national standards and these standards also contain a list of technical building regulations which must be observed.

In addition to the relevant national standards, product information to the European standard BS EN 13501-1 'Fire Classification of Construction Products and Building Elements' and the British National standard BS 476 'Fire tests on building materials and structures - methods of test to determine the classification of the surface spread of flame of products' are also important information required by the projects' engineers.

With regards to Uponor pipe systems and the use fire stopping measures, our advice is to always follow the guidance from the project's engineers. If deemed suitable by the engineers, fire collars and fire bandages may be used as long as any adhesive or methods of application do not damage or compromise the materials of the Uponor system.

In many projects, intumescent sealants need to be applied. Unless the sealant has been approved by Uponor for use in direct contact with our products, we do not recommend they are applied directly onto our pipe systems. In some cases, these sealants can damage our pipe materials and may restrict movement.

In all instances, any fire-stopping solutions used must demonstrate the ability to provide the correct fire rating by means of certificated 3rd party fire test data.

In a fire situation, different types of plastics perform differently. Any fire stop solutions must therefore be tested on specific pipe types, and this performance testing can then provide engineers with the necessary evidence and information to maintain the correct fire rating for that specific sealing element.

Whatever system is to be used, in order to comply to the relevant regulations, every element must be 'installed as tested' and fire-stopping engineers must seek the correct certification and installation detail from the chosen products' manufacturer.

> ⚠️ **Caution!**
>
> All decisions relating to fire safety of any building must be the responsibility of the appointed, trained fire safety professional. Always seek advice from an appropriately qualified engineer.

## 11.2 Pipe insulation

> **Note**
>
> Insulation of the individual services must be added to ensure that the performance of the system is not adversely affected. Requirements for the insulation performance must follow the guidance of the project specification and should comply with the relevant national standard.

Insulation of pipelines is primarily used to reduce heat loss from DHW and LTHW systems and also to prevent unwanted thermal transfer that can heat cold drinking water in DCW/BCW pipes. However, insulation or cladding can also be useful, or even necessary, to avoid freezing, corrosion, condensation and sound transmission. The insulation requirements for new and existing buildings, for both hot and cold pipes, are described in various guidance standards such as BS 5422  and BS EN 806, and insulation must be applied as required by the Building regulations Part L 'Conservation of fuel and power' (or equivalent national standard for Scotland and Wales).

Factory assembled pre-insulated pipes offer distinct advantages over pipes which require insulation to be added on site. On the one hand, they ensure rapid installation progress whilst at the same time they provide an unbroken thermal insulation with good thermal resistance, with a sturdy colour coded vapour barrier to provide protection for the insulation.

With the need for project build times always being reduced, there is an ever increasing demand for a fast, high quality installation of the pipe system. Using Uponor pre-insulated pipes means that the installation can be completed by the pipe installation engineers and so there is no need for additional expense employing a specialist contractor to follow and add the insulation once the pipes are in-situ. This also leads to less trades on site, which makes a more safe working environment for everyone.

# 12 Pressing tools for fitting assembly

## 12.1 System description
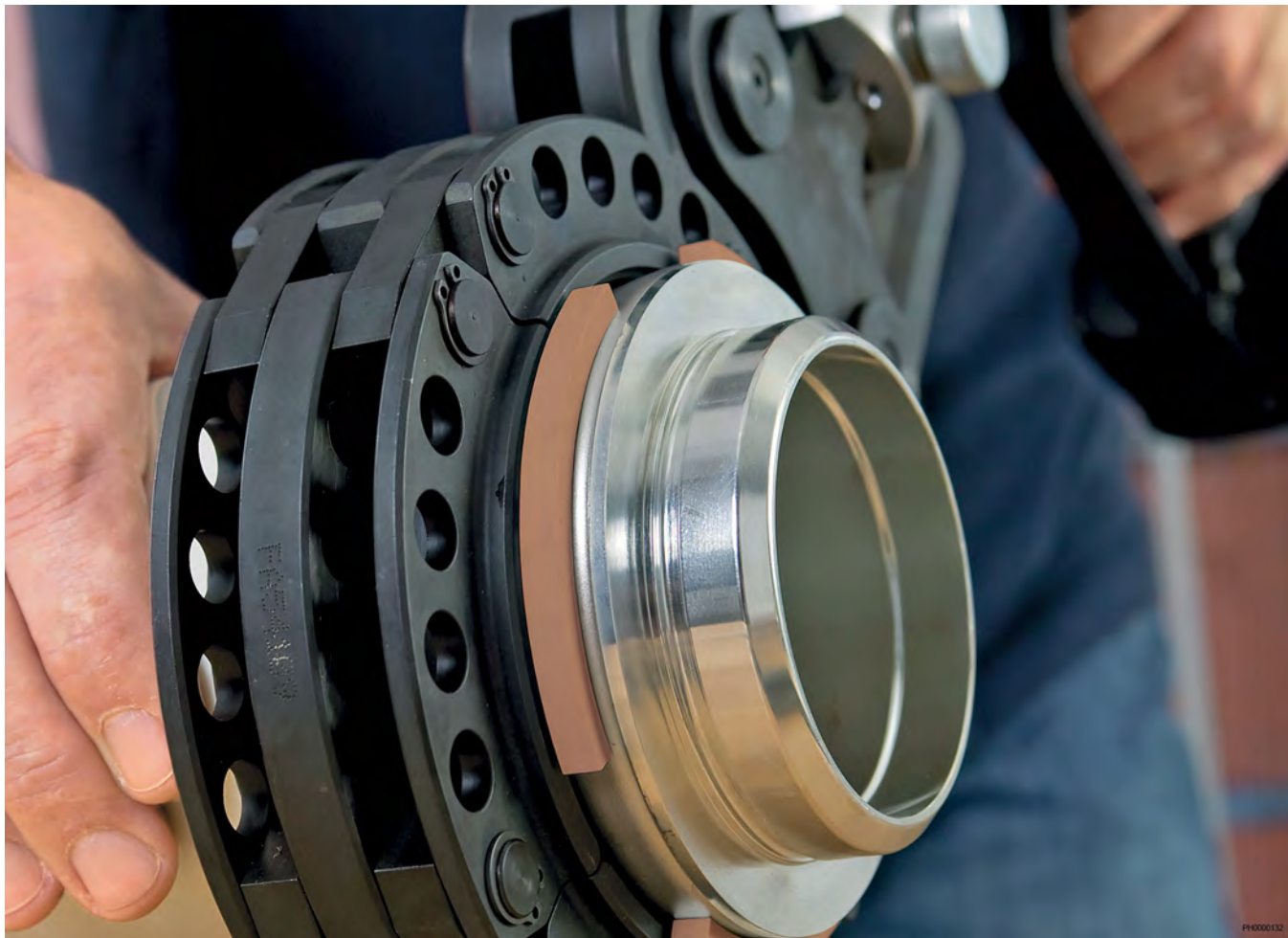


The Uponor system concept is based on the perfect interaction of all individual system components. Everything fits together and has been tested and approved, not only by Uponor, but also to many internationally recognised standards. In addition to high-quality installation components such as pipes, fittings and assembly accessories, we also place a great importance to the use of the correct, high quality tools which have been designed for use with the Uponor fitting systems.

Accross the Uponor press range, the press jaws and press chains have the same dimension-specific colour coding as the Uponor press fittings so that nothing can be confused on the construction site.

Uponor pressing tools are an integral part of the Uponor declaration of liability and enable a fast, reliable, safe and uncomplicated assembly of the system.

- Uponor press machines and press jaws from renowned manufacturers
- Pressing machines can be either battery powered, mains 230V or manual press pliers
- Dimension-specific color coding of the press jaws and collars
- Use of the correct tool equipment is part of the Uponor declaration of liability

# 12.2 Uponor pressing tool concept

**⚠ Caution!**

'U' profile press jaws from a third party tool manufacturer are not accepted to be used on Uponor press systems. Their use will invalidate any connection warranty and could cause leaks.

## Uponor press jaws MLC UPP1



*Uponor press jaws MLC UPP1 with battery pressing machine UP 110 (as well as UP 75 and EL UP75)*

### Markings on the press jaw UPP1



| Item | Description |
|------|-------------|
| A | Dimension |
| B | Maintenance sticker |
| C | Colour code dimension-specific |

## Uponor press jaws MLC Mini KSP0



*Uponor press jaws MLC Mini KSP0 with battery pressing machine Mini 32*

### Markings on the press jaw KSP0
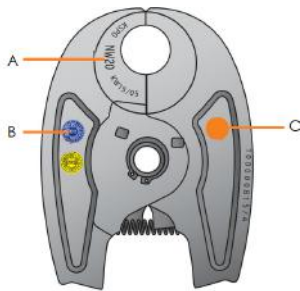


| Item | Description |
|------|-------------|
| A | Dimension |
| B | Maintenance sticker |
| C | Colour code dimension-specific |

## Dimension-specific colour coding



*Colour coding of Uponor S-Press PLUS fittings 16 — 32 mm*

The colour coding on the Uponor press fittings and also on the associated Uponor press jaws indicates the correct dimension of each of the components.

# 12.3 Overview tools for fitting assembly



| Item | Description |
|---|---|
| A | Manual pressing tool + Interchangeable inserts |
| B | UP 110, battery tool or UP 75 EL, electrical tool 230 V + UPP1, pressing jaw |
| C | UP 110, battery tool or UP 75 EL, electrical tool 230 V + UPP1, pressing jaw |
| D | UP 110, battery tool or UP 75 EL, electrical tool 230 V + Basic press jaw with press chain |
| E | Mini 32, battery tool + Mini KSP0, pressing jaw |
| F | Fixed wrench |
| G | Hand installation, no tools required |

| | Uponor tools | | | | | | |
|---|---|---|---|---|---|---|---|
| Uponor fittings | A | B | C | D | E | F | G |
| S-Press PLUS<br>S-Press PLUS PPSU | 16 — 20 | 16 — 32 | — | — | 16 — 32 | — | — |
| S-Press | 16 — 20 | 14 — 32 | — | — | 14 — 32 | — | — |
| S-Press<br>S-Press PPSU | — | — | 40 — 50 | 63 — 75 | — | — | — |
| RS | — | 16 — 32 | 40 — 50 | 63 — 110 | 16 — 32 | — | — |
| Uni | — | — | — | — | — | 12 — 25 | — |
| RTM | — | — | — | — | — | — | 16 — 25 |

# 12.4 List of approved tools

**Caution!**

Although there are number of tools that have been tested for use with Uponor press systems, ONLY press jaws and press collars supplied from Uponor can be used to press our connections

**Caution!**

Before using any press tool, please ensure you familiarise yourself with the correct handling procedures for that specific tool and if uncertain, please seek training for the safe use of the hydraulic press machine.

**Caution!**

'U' profile press jaws from a third party tool manufacturer are not accepted to be used on Uponor press systems. Their use will invalidate any connection warranty and could cause leaks.

**Note**

Installation and operation manuals are included with the products or can be downloaded from the Uponor website: www.uponor.co.uk. For details of Uponor's free, certificated, on-site installation training
please contact : enquiries.uk@uponor.com

Uponor UPP1 pressing jaws and pressing chain are specially designed for use in combination with the Klauke UP 110 (1083612), the UP 75 battery-powered pressing machine, the UP 75 EL electric pressing machine (1007082) and the Klauke Mini 32 KSP0 (1083674).

Uponor have undertaken stringent testing to prove the use of third party tools in combination with the Uponor jaws and collars. However, when using other brands of pressing machines, you should have their suitability, warranty and occupational safety confirmed by the respective manufacturer.

All Uponor press jaws and collars are subject to an inspection cycle as described in the operating instructions. For use in drinking water distribution and heating installations, we recommend an inspection of the press jaws  and collars every 3 years.

Klauke press tools must also be inspected periodically to ensure that they are functioning correctly and safely. Please read the operating instructions to ensure that you are familiar with how to identify the correct inspection period.

# Machine type (for Uponor UP 110 & UP 75)

| Machine type (for Uponor UP 110 & UP 75) | | Uponor press jaw dimensions | | |
|---|---|---|---|---|
| Manufacturer | Model No. | Type 14–32 | Type 40–50 | Type 63-110* |
| Viega Type 2 | Type 2, serial number starting with 96; lateral linkage for bolt monitoring | yes | no | no |
| Mannesmann "Old" | Type EFP 1; head not rotatable | yes | no | no |
| Mannesmann "Old" | Type EFP 2; head rotatable | yes | no | no |
| Geberit "New" | Type PWH - 75; blue sleeve over press jaw holder | yes | no | no |
| Novopress | ECO 1 / ACO 1 | yes | yes | no |
| | ACO 201 / ACO 202 / ACO 203 | yes | yes | no |
| | ECO 201 / ECO 202 / ECO 203 | yes | yes | no |
| | AFP 201 / EFP 201 | yes | yes | no |
| | AFP 202 / EFP 202 | yes | yes | no |
| Milwaukee | Milwaukee M18 HPT | yes | yes | no |
| | Milwaukee M18 BLHPT | yes | yes | no |
| Ridge Tool by Arx | Ridgid RP300 Viega PT2 H | yes | no | no |
| | Ridgid RP300 B Viega PT3 AH | yes | yes | no |
| | Viega PT3 EH | yes | yes | no |
| | Ridgid RP 10B | yes | yes | no |
| | Ridgid RP 10S | yes | yes | no |
| | Ridgid RP 330C Viega Pressgun 4E | yes | yes | no |
| | Ridgid RP 330B Viega Pressgun 4B | yes | yes | no |
| | Ridgid RP 340B/C | yes | yes | no |
| | Viega Pressgun 5B | yes | yes | no |
| Rems | REMS Akku-Press ACC (Art. No. 571004/571014) | yes | yes | no |
| | REMS Power-Press ACC (Art. No. 577000/577010) | yes | yes | no |
| | REMS Akku ACC 22V (not Mini-press) | yes | yes | no |
| Rothenberger | Romax 3000 AC | yes | no | no |
| | Romax 4000 | yes | no | no |
| Klauke | UAP3L / UAP2 / UNP2 | yes | yes | no |
| Hilti | NPR 032 IE-A22 (Inline) NPR 032 PE-A22 (Pistol) | yes | yes | yes |

* with modular press chains

| Machine type (for Uponor Mini and Mini2) | | Uponor press jaw dimensions | | |
|---|---|---|---|---|
| Manufacturer | Attributes | Type 14–32 | Type 40–50 | Type 63-110* |
| Klauke | MAP1 / MAP2L | yes | no | no |

* with modular press chains

# 13 General processing instructions

## 13.1 Installation instructions

| | Note |
|---|---|
| ! | Installation must be performed by a competent person in accordance with national standards and regulations. |

| | Note |
|---|---|
| ! | Installation and operation manuals are included with the products or can be downloaded from the Uponor website: www.uponor.co.uk. For details of Uponor's free, certificated installation training contact : enquiries.uk@uponor.com |

Before installation, the installer must check all components for possible transport damage and must also read, understand and observe the relevant installation and operating manuals.

For the professional use of the Uponor composite pipe system, the applicable technical guidance and the building regulations must be observed. The installation must be carried out in accordance with generally recognised engineering practices such as BS EN 806 or BS 8558:2015. In addition, all installation, accident prevention and safety regulations must be observed.

### Installation dimensions: minimum requirements

### Pipe length between two fittings



| Pipe OD × s [mm] | Min. pipe length $L_{min}$ between two | |
|---|---|---|
| | Press fittings [mm] | RTM fittings [mm] |
| 14 x 2.0 | 50 | — |
| 16 x 2.0 | 50 | 50 |
| 20 x 2.25 | 55 | 55 |
| 25 x 2.5 | 70 | 60 |
| 32 x 3.0 | 70 | — |
| 40 x 4.0 | 100 | — |

| Pipe OD × s [mm] | Min. pipe length $L_{min}$ between two | |
|---|---|---|
| | Press fittings [mm] | RTM fittings [mm] |
| 50 x 4.5 | 100 | — |
| 63 x 6.0 | 150 | — |
| 75 x 7.5 | 150 | — |
| 90 x 8.5 | 160 | — |
| 110 x 10.0 | 160 | — |

### Minimum space requirement for manual pressing tool
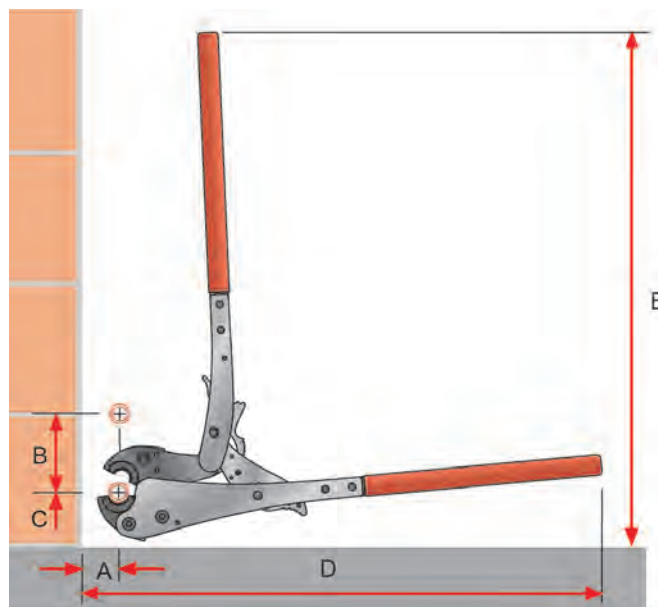


| Pipe OD × s [mm] | Dim. A [mm] | Dim. B* [mm] | Dim. C [mm] | Dim. D [mm] | Dim. E [mm] |
|---|---|---|---|---|---|
| 14 × 2.0 | 25 | 50 | 55 | 510 | 510 |
| 16 × 2.0 | 25 | 50 | 55 | 510 | 510 |
| 20 × 2.25 | 25 | 50 | 55 | 510 | 510 |

*For equal pipe outer diameters*

## Pressing process with pressing machines (UP 110, UP 75, UP 75 EL, Mini2 and Mini 32)
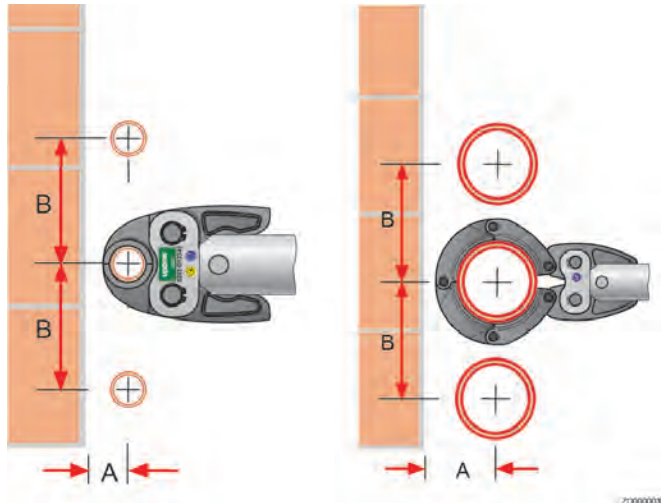


| Pipe OD × s [mm] | Dim. A [mm] | Dim. B* [mm] |
|---|---|---|
| 14 x 2.0 | 15 | 45 |
| 16 x 2.0 | 15 | 45 |
| 20 x 2.25 | 18 | 48 |
| 25 x 2.5 | 27 | 71 |
| 32 x 3.0 | 27 | 75 |
| 40 x 4.0 | 45 | 105 |
| 50 x 4.5 | 50 | 105 |
| 63 x 6.0** | 80 | 125 |
| 75 x 7.5 ** | 82 | 130 |
| 90 x 8.5** | 95 | 140 |
| 110 x 10.0** | 105 | 165 |

* For equal pipe outer diameters

** Modular RS-System, pressing on the working bench possible
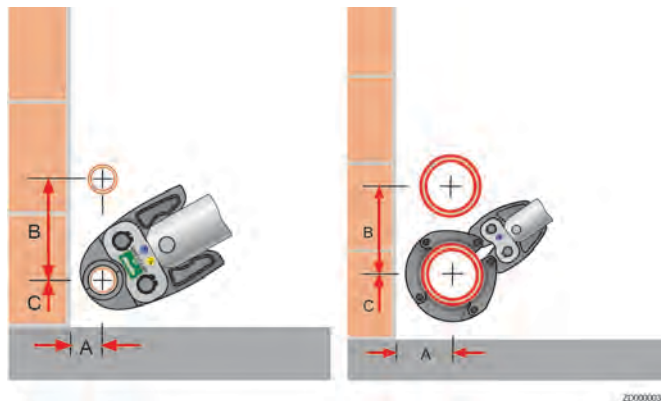


| Pipe OD × s [mm] | Dim. A [mm] | Dim. B* [mm] | Dim. C [mm] |
|---|---|---|---|
| 14 x 2.0 | 30 | 88 | 30 |
| 16 x 2.0 | 30 | 88 | 30 |
| 20 x 2.25 | 32 | 90 | 32 |
| 25 x 2.5 | 49 | 105 | 49 |
| 32 x 3.0 | 50 | 110 | 50 |
| 40 x 4.0 | 55 | 115 | 60 |
| 50 x 4.5 | 60 | 135 | 60 |
| 63 x 6.0 | 80 | 125 | 75 |
| 75 x 7.5 | 82 | 130 | 82 |
| 90 x 8.5 | 95 | 140 | 95 |
| 110 x 10.0 | 105 | 165 | 105 |

* For equal pipe outer diameters

# 13.2 Installation according to Z dimension

> **Note**
>
> Z dimensions of the Uponor press fittings can be made available via the Uponor BIM files, or upon request.
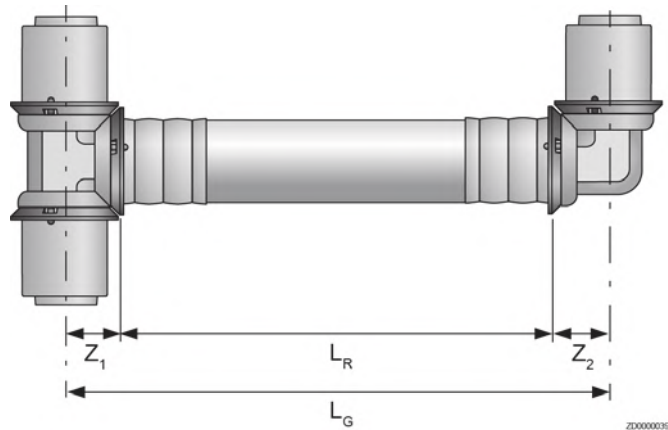


As the basis for efficient planning, work preparation and prefabrication, the Z-measurement method makes work considerably easier and saves the installer money.

The principal for the Z-measurement method is using calculated uniform measurements. All the pipe sets to be created are recorded via the axial line by measuring from centre to centre (intersection of the axial lines). Using the Z-dimension data for Uponor S-Press and S-Press PLUS fittings, the installer can quickly and easily calculate the exact pipe length between fittings using a mathematical method.

(Example: $L_R = L_G - Z_1 - Z_2$).

By precise design of the pipe routing and coordination with the architect, planner and construction management in the run-up to the actual installation, large parts of the system can be cost-effectively pre-assembled.

## 13.3 Consideration of thermal length expansion

Due to the thermal expansion caused by the changing operating temperatures of the water medium, calculations must be made in order that suitable engineered expansion relief can be designed in to the system to prevent unnecessary stress and potential damage.

Thermal expansion can be compensated in the traditional ways such as Omega loops, expansion bellows, bending legs and changes of direction.

The change in length can be determined using a diagram or calculated using the following formula: **$\Delta L = a \times L \times \Delta\vartheta$**

Here:

- $\Delta L$ = Linear expansion (mm)
- a = Linear expansion coefficient (0.025 mm/mK)
- L = Line length (m)
- $\Delta\vartheta$ = Temperature difference (K)

### Length change diagram for Uponor composite pipes
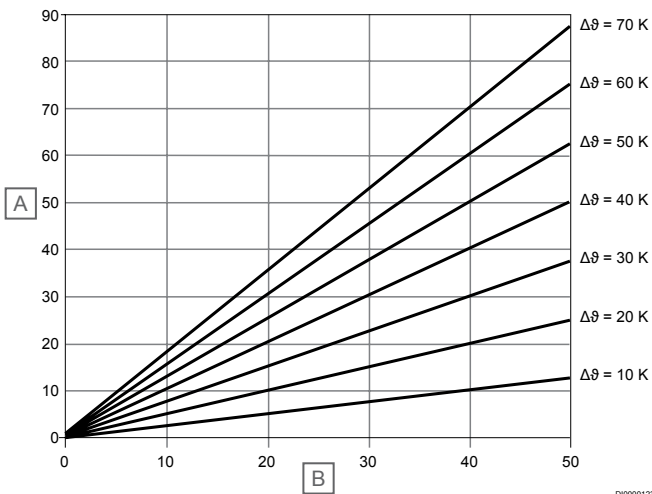


| Item | Description |
|------|-------------|
| A | Change in length $\Delta L$ [mm] |
| B | Line length L [m] |

## 13.4 Expansion relief using a bending leg
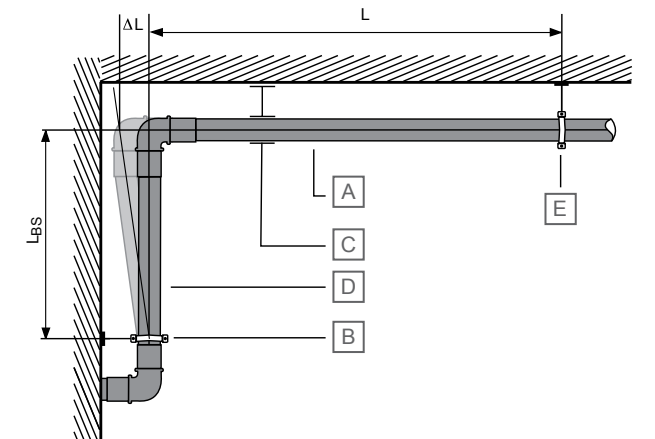


| Item | Description |
|------|-------------|
| A | Expansion leg |
| B | Fixed point |
| C | Sliding clamp |
| D | Bending leg |
| E | Fixed point |
| L | Length of bending leg in m |
| $L_{BS}$ | Bending leg length in mm |

When planning expansion relief to be made by the use of a bending leg, the correct calculations must be made to ensure that the movement is sufficient to compensate the required expansion movement without placing too much stress on the system components or the building fabric.

Uponor multi-layer composite pipes that are to be used for any heated water service must not be installed rigidly (without expansion relief) between two fixed points. The change in length of the pipes must always be absorbed or guided.

Uponor multi-layer composite pipes which are exposed to full thermal expansion must be provided with a corresponding expansion compensation. This requires knowledge of the location of all fixed points. Compensation is always performed between two fixed points (FP) or changes in direction (bending leg).

# 13.5 Determination of the bending leg length
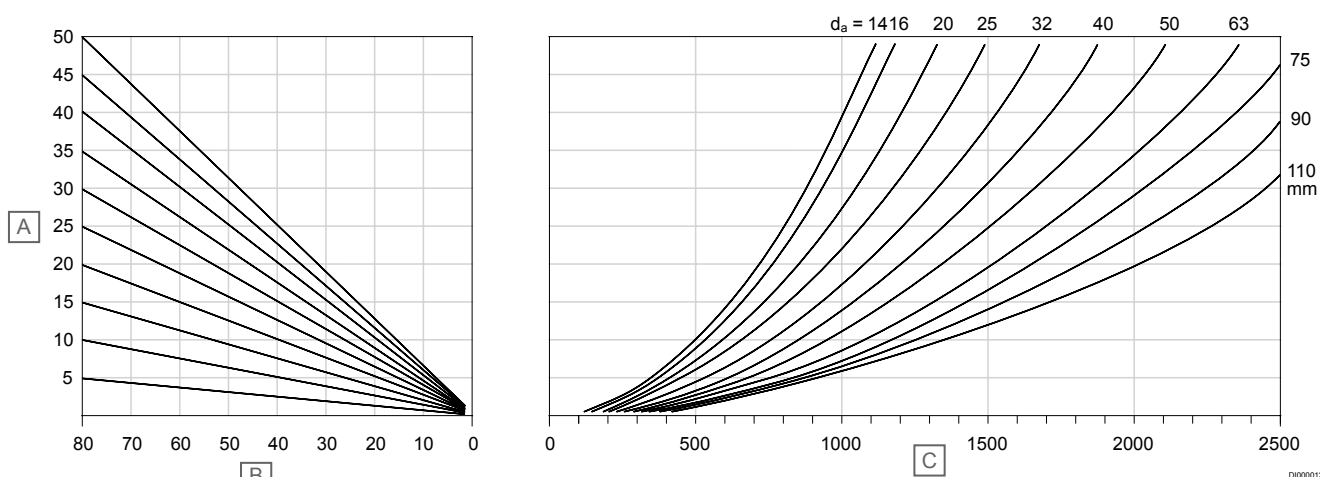


| Item | Description |
|------|-------------|
| A | Length of expansion leg L (m) |
| B | Temperature difference $\Delta\vartheta$ |
| C | Bending leg length $L_{BS}$ [mm] |

## Reading example

| Description | Value |
|-------------|-------|
| Installation temperature | 20 °C |
| Operating temperature | 60 °C |
| Temperature difference $\Delta\vartheta$ | 40 K |
| Length of expansion leg | 25 m |
| Pipe dimension OD x s | 32 × 3 mm |
| Required bending leg length LBS | approx. 850 mm |

## Calculation formula:

| Description | Value |
|-------------|-------|
| $L_{BS}$ | $k \cdot \sqrt{OD \cdot (\Delta\vartheta \cdot a \cdot L)}$ |
| OD | Pipe outer diameter in mm |
| L | Length of bending leg in m |
| $L_{BS}$ | Bending leg length in mm |
| a | Coefficient of linear expansion [0.025 mm/mK] |
| $\Delta\vartheta$ | Temperature difference in K |
| k | 30 (material constant) |

# 13.6 Bending Uponor composite pipes

⚠️ **Caution!**

The hot bending of Uponor composite pipes using open flames (e.g. soldering flame) or other heat sources (e.g. hot air gun, industrial hairdryer) is not permitted! Repeated bending around the same bending point is also prohibited!

Uponor composite pipes 12 – 32 mm can be bent by hand. Sizes 14 - 32mm can also be bent with a bending spring, either internal or external, or a suitable bending tool.

The minimum bending radii in the following table must be respected. For information regarding the bending of larger Uponor composite pipe dimensions, please contact Uponor for information. If narrower dimensions than the minimum bending radius are required (e.g. at the transition from the floor to the wall), we recommend installing flow-optimised Uponor S-Press PLUS bends or S-Press PLUS elbow fittings.

If an Uponor composite pipe is inadvertently kinked or otherwise damaged, it must be replaced immediately or an Uponor press or screw coupling installed to replace the damaged area.

## Bending radii with/without auxiliary equipment

⚠️ **Caution!**

Pipes routed through ceiling recesses and wall openings must never be allowed to be bent over edges!





*Uponor Uni Pipe PLUS bending tool. Complete with case and bending segments 16 — 32 mm.*

| Pipe OD × s [mm] | Pipe type | Min. bending radius without tools (by hand) [mm] | | Min. bending radius with internal bending spring[2] [mm] | | Min. bending radius with external bending spring [mm] | | Min. bending radius with bending tool[1] [mm] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Coil | Bar | Coil | Bar | Coil | Bar | Coil | Bar |
| 12 × 1.6 | Uni Pipe | 60 | — | — | — | — | — | — | — |
| 14 × 2.0 | Uni Pipe PLUS | 70 | — | 56 | — | 56 | — | 46 | — |
| 16 × 2.0 | Uni Pipe PLUS | 64 | 64 | 48 | 48 | 48 | 48 | 32 | 32 |
| 20 × 2.25 | Uni Pipe PLUS | 80 | 80 | 60 | 60 | 60 | 60 | 40 | 40 |
| 25 × 2.5 | Uni Pipe PLUS | 125 | 125 | 75 | 75 | 75 | 75 | 62.5 | 62.5 |
| 32 × 3.0 | Uni Pipe PLUS | 160 | — | 96 | — | — | — | 80 | 80 |

*1) Follow the operating instructions for the tools*

*2) Not recommended for hygienic reasons when using drinking water*

Bending radii for Uponor composite pipes with and without auxiliary equipment

## 13.7 Fixing distances



ZD0000041

| Pipe OD × s [mm] | Max. fastening distance between the pipe clamps L [m] | | |
|---|---|---|---|
| | Horizontal | | Vertical |
| | Coil | Bar | |
| 12 × 1.6 | 1.20 | — | 1.70 |
| 14 × 2.0 | 1.20 | — | 1.70 |
| 16 x 2.0 | 1.20 | 2.00 | 2.30 |
| 20 x 2.25 | 1.30 | 2.30 | 2.60 |
| 25 x 2.5 | 1.50 | 2.60 | 3.00 |
| 32 x 3.0 | 1.60 | 2.60 | 3.00 |
| 40 x 4.0 | — | 2.00 | 2.20 |
| 50 x 4.5 | — | 2.00 | 2.60 |
| 63 x 6.0 | — | 2.20 | 2.85 |
| 75 x 7.5 | — | 2.40 | 3.10 |
| 90 x 8.5 | — | 2.40 | 3.10 |
| 110 x 10.0 | — | 2.40 | 3.10 |

The above table shows the maximum fixing distance "L" between the individual pipe clamps for the different pipe dimensions (shorter fixing distances may need to be used in certain systems). Pipe fixing points must be laid out based on the total mass (weight of pipe + weight of medium + weight of insulation) and installed in accordance with recognised engineering practices. It is recommended to place the pipe supports as close as possible to the fittings.

Valve and device connections, as well as connections for measuring and control equipment, must always be torsion-proof. All pipelines must be routed in such a way that movement due to thermal expansion (heating and cooling) is not impeded. The change in length between two fixed points can be absorbed by expansion bellows, Omega loops, compensators or by changing the direction of the pipeline.

## 13.8 Pipeline laying on a concrete substrate

When laying pipelines on a raw concrete substrate, through a floor, or within a service duct recognised engineering practices must be observed. Where required by Part E The Building Regulations - Resistance To The Passage of Sound, Impact sound insulation must be installed to prevent unwanted noise transmission.

The thermal mobility of pipelines during thermal expansion must also be taken into account (see section "Thermal expansion"). If screeds are applied to insulation layers (floating screed), BS8204 "Screed bases and in situ floorings. Concrete bases and cementitious leveling screeds to receive floorings." guidance must be followed regarding the minimum depth for the screed type to be considered as suitably 'load-bearing'. Screeds with floor heating in floating screeds should follow guidance from BS1264 parts 1 - 4.

- The load-bearing substrate must be sufficiently dry to accommodate the floating screed and have an even surface. It must not have any point elevations, pipelines or the like which could lead to acoustic bridges and/or fluctuations in the thickness of the screed.
- For heated screeds made of prefabricated elements, the manufacturer's special requirements regarding the even surface of the load-bearing substrate must also be observed.
- If pipelines are laid on the load-bearing substrate, they must be fixed. A level surface for the absorption of the insulation layer - but at least for the impact sound insulation - must be created again by means of compensation. The construction height required for this must be planned in.
- Leveling layers must have a bonded form when installed. Bulk materials may be used if their suitability for the purpose has been proven. Pressure-resistant insulating materials may be used as leveling layers.
- Waterproofing against soil moisture and non-pressing water must be determined by the building planner and must be carried out before the screed is installed.
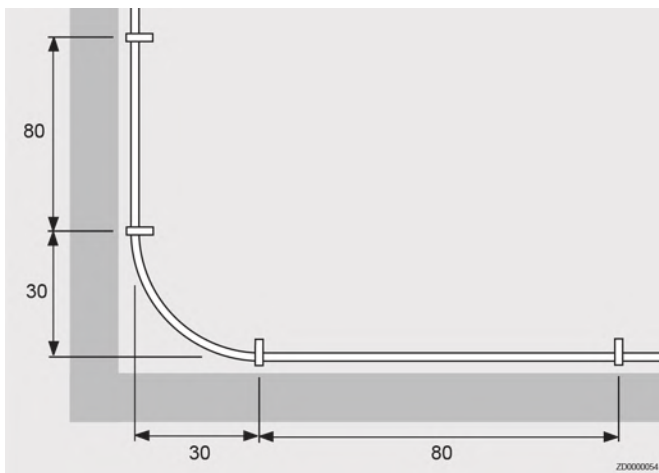
The installation of Uponor composite pipes on the unfinished concrete floor should be laid in a straight line, parallel to the axis and the wall and should be as free from cross-overs as possible. Preparation of a schematic plan before the actual installation of the pipes will make the overall installed quality much better and will also speed up the whole process.

## Fastening distances when laying pipelines
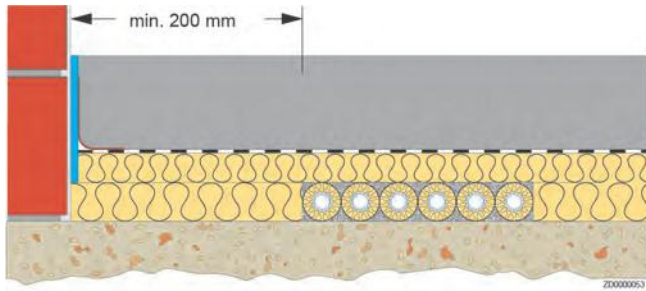


*Distance from wall to pipe/pipe routes including insulation and screed in corridors*

## Pipe routing



When installing Uponor composite pipes on an unfinished concrete floor, a fixing distance of 80 cm is recommended. Before and after each bend a fastener must be placed at a distance of 30 cm. Pipe crossings are to be fixed. Fastening can be carried out with the plastic dowel hooks for single or double pipe fixing. If perforated plastic or metal fixing strip is used for fastening, care must be taken to ensure that the Uponor multi-layer composite pipe remains free to move with/without protective tube or insulation. If the pipe is firmly fixed, noises can occur during the thermal expansion of the pipe. If the Uponor composite pipe system is laid directly in the screed, the fittings must be protected against corrosion (except S-Press PLUS). Joints must also be arranged above construction joints in the insulation layer and in the screed (expansion joints) to prevent damage to the screed and floor coverings.

| Application | Width or distance dimension |
| --- | --- |
| Width of the support next to a route (with the narrowest possible pipe laying next to each other) | ≥ 200 mm |
| Distance from wall to pipe/pipe route including insulation as support for screed in rooms other than corridors | ≥ 500 mm |
| Distance from wall to pipe/pipe route including insulation as support for screed in corridors | ≥ 200 mm |



*Distance from wall to pipe/pipe routes including insulation and screed in rooms other than corridors*

| Item | Description |
| --- | --- |
| A | Screed |
| B | Moisture barrier |
| C | Step sound protection |
| D | Levelling material |
| E | Bound fill |
| F | Unfinished concrete ceiling |

Pipes and other installations in the floor structure must be planned free of crossings. Pipes on the unfinished floor should be as straight as possible and parallel to the axis and wall. The following route dimensions for pipelines and other installations should be observed:

| Application | Width or distance dimension |
| --- | --- |
| Route width of parallel pipelines including pipe insulation | ≤ 300 mm |

# 14 Transport, storage and processing conditions

## 14.1 General information

The Uponor composite pipe system is designed in such a way that maximum system safety is achieved when used as intended. All components of the system must be transported, stored and processed in such a way that proper functioning of the installation is guaranteed. The system components should be stored in a system-related manner to avoid confusion with components from other application areas. In addition to the following instructions, the guidance within the respective assembly instructions for the individual system components and tools must also be followed.

## 14.2 Processing temperatures

The permissible installation temperature for the Uponor multilayer composite pipe system (pipes and fittings) is between –10 °C and +40 °C. The permissible operating temperature ranges for the pressing tools can be found in the respective operating instructions of the devices.

## 14.3 Uponor composite pipes

Pipes must be protected from mechanical damage, dirt and direct sunlight (UV radiation) during transport, storage and during installation. The pipes should therefore be kept in their original packaging until they are to be processed and off-cuts intended for installation at a later time should be capped to protect hygiene and should placed back in to a safe storage until their installation. Pipe ends must be closed until processing to prevent dirt from entering the pipes. Damaged, bent or deformed pipes must not be used. Protective tubular cartons with ring bundles can be stacked up to a max. height of 2m. Straight lengths/bars must be transported and stored in such a way that they cannot be accidentally bent. The corresponding Uponor storage instructions must be observed.

## 14.4 Uponor fittings

Uponor fittings are packaged in a way to protect them during transport and handling. However, care must be taken to ensure they are not dropped or damaged due to careless handling. Fittings should be kept in their original packaging until they are to be installed to prevent damage and contamination. Damaged fittings or fittings with damaged O-rings must not be used.

## 14.5 Installation in the ground and outdoors

**Caution!**

In the case of permanent exposure to moisture and a simultaneous pH value greater than 12.5, Uponor fittings must be protected with a suitable jacket (e.g. protective tape or shrink sleeve).
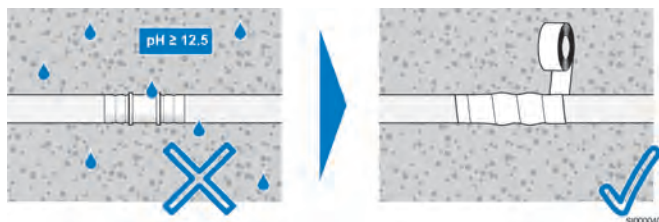


Uponor composite pipes can be laid in the ground or outdoors with the appropriate jointing technique, taking the following points into account:

*   Pipelines laid in the ground must not be exposed to traffic loads.
*   No coarse-grained, sharp-edged material may be used for backfilling the trench.
*   When laying the pipes in the ground, care must be taken to ensure that the Uponor composite pipes are protected from mechanical influences.
*   Fittings and the cut edges of the composite pipes must be protected from direct contact with the ground by means of suitable corrosion protection tape.
*   For outdoor use above ground, Uponor composite pipes must be protected against direct, or increased, UV radiation and against mechanical influences. This is best done by using UV-protected corrugated protective tubes from Uponor, which are available in various dimensions to suit each pipe size.

# 15 System compatibility

In the history of Uponor, the composite pipe has been supplied in various variants:

- Red Unipipe F composite pipe (PE-MD/AL/PE-MD) for underfloor heating installation
- Brown Unipipe S composite pipe (PE-X/AL/PE-X) for drinking water distribution
- White Unipipe H composite pipe (PE-X/AL/PE-X) for heating installations

Since the beginning of 1997, the white Uponor MLC composite pipe (PE-RT/AL/PE-RT) has been supplied for all applications (sanitary, heating and surface heating installations).

In the event that systems with Uponor MLC composite pipes with dimensions of 16 – 32 mm are to be extended or repaired, the current Uponor S-Press/S-Press PLUS fittings can be used to switch to the current Uponor Uni Pipe PLUS composite pipe.

## 15.1 Transitions from Uni-pipe old installations

| Old installation (until 1997) | | | | Fitting designation | New installation | | |
|---|---|---|---|---|---|---|---|
| Pipe designation | Application | Colour | Dimension | | Pipe designation | | Application |
| Unipipe F | Underfloor heating | Red | 16 mm | Uponor Uni-X Reno transition MLC | Uponor Uni Pipe PLUS | | Drinking water, heating |
| Unipipe S | Potable water | Brown | 16 — 20 mm | Uponor Uni-X Reno transition MLC | Uponor Uni Pipe PLUS | | Drinking water, heating |
| Unipipe H | Heating | White | 16 — 20 mm | Uponor Uni-X Reno transition MLC | Uponor Uni Pipe PLUS | | Drinking water, heating |

| Old installation (1997 to 2020) | | | | Fitting designation | New installation | | |
|---|---|---|---|---|---|---|---|
| Pipe designation | Application | Colour | Dimension | | Pipe designation | | Application |
| Uponor MLC | Potable water, heating | White | 14 — 32 mm | S-Press PLUS, S-Press, RTM, Uni-X, Uni-C | Uponor Uni Pipe PLUS | | Drinking water, heating |

# 16 Risk of mixed installation

**Note**

**Uponor Declaration of Warranty:** Please contact Uponor UK Ltd at :

enquiries.uk@uponor.com

**Note**

Components from the different Uponor systems may only be mixed with one another if approved by Uponor and if the service conditions of either system is not exceeded

Opinions and interpretations vary relating to mixed installations. Different information exists in the marketplace regarding unrestricted compatibility with our products, so as a precautionary measure, Uponor states the following: Uponor offers no guarantee regarding the compatibility of the relevant third party products with our products. The use of third party items will affect the system warranty.

Documention available to Uponor from dealers/third-party manufacturers state that it is not apparent that the compatibility claimed by them is covered by a full warranty.

In cases of mixed installations, the 25-year Uponor Declaration of Warranty may be affected unless third party products are

connected through a recognised connection technology (e.g. a flange, or a threaded connection) that is detailed in a recognised national standard. The legal warranty period will still apply.

## 16.1 Installation configurations

**Note**

In a mixed installation, the warranty provided by themanufacturer of the pipe oniy covers the pipe, whiist the warranty provided by the manufacturer of the fitting only covers the fitting iteself. Neither warranty covers the connection point nor do they cover the system in its entirety. When mixing a system, the responsibility to cover the warranty is borne solely by the installer.

**Caution!**

If third party products are used to connect directly on to an Uponor pipe, and not via a method as described in the note  above, the installation will no longer be covered by hygiene approvals such as the WRAS Approved Product scheme and KIWA KukReg4.

| Pipe | Fittings and tools | Uponor system approval |
|---|---|---|
| Uponor MLC and Uni-Pipe PLUS | Uponor fitting with Uponor press jaws | Yes |
| Uponor MLC and Uni-Pipe PLUS | Fitting from a third party manufacturer | No |
| Multi-layer composite pipe from third party manufacturer | Uponor fitting | No |
| Uponor MLC and Uni-Pipe PLUS | Uponor fitting with third party jaw manufacturer | No |

# 17 Sustainability

## 17.1 General information

Since its foundation, Uponor acts responsibly and produces resource efficient products and solutions. Therefore, we always have three central themes in mind:



Increasing requirements for building and construction as well as tighter regulations call for rethinking how we use our resources more effectively, efficiently and responsibly.

- **Scarcity of water -** Clean freshwater is an essential ingredient for a healthy human life, but 1.1 billion people lack access to water and 2.7 billion experience water scarcity at least one month a year. By 2025, two-thirds of the world's population may be facing water shortages. When waters run dry, people can't get enough to drink, wash, or feed crops and economic decline may occur.
- **Circular economy and material efficiency -** The circular economy is an economic system in which materials are designed to be used, not used up. From the outset, products and the systems they sit within should be designed to ensure no materials are lost and the maximum use is achieved from every process, material and component. If applied correctly, the circular economy benefits society, the environment and the economy.
- **Climate change and carbon neutrality -** The UK and the EU aims to be climate-neutral by 2050 – an economy with net-zero greenhouse gas emissions. This objective is at the heart of the European Green Deal and in line with the combined commitment to global climate action under the Paris Agreement.

  The transition to a climate-neutral society is both an urgent challenge and an opportunity to build a better future for all.

  All parts of society and economic sectors will play a role – from the power sector to industry, mobility, construction, efficient buildings, agriculture and forestry.

## 17.2 Uponor's sustainability agenda

> **Note**
>
> Uponor are members of the World Green Building Council and several other national green building councils
>
> 

Uponor As active members of the Worlds Green Building Council and several other national Green Building Councils, and also participants in the Carbon Disclosure Project (CDP). We aim to continually reduce our impact on the environment whilst working to enhance the positive effect that our products can have on the industry's drive towards achieving the Nett Zero

## 17.3 EPD's (Environmental Product Declarations)

> **Note**
>
> There are many myths about traditional pipe materials that claim to be 'environmentally friendly'. When making a decision which pipe material to use, engineers should seek independantly assesed environmental information that has been measured and reported to a recognised international test standard.

An Environmental Product Declaration, or EPD, is a document which transparently communicates the environmental performance or impact of any product or material over its lifetime.

Within the construction industry, EPDs support carbon emission reduction by making it possible to compare the impacts of different materials and products in order to select the most sustainable option.

Architects, engineers and designers are able to choose the most sustainable option for their project.

Manufacturers are able to optimise the impact of their products and market their carbon transparency.

An EPD is usually valid for five years, and is generated according to the relevant standards. Construction EPDs are based on the ISO 14040/14044, ISO 14025, BS EN 15804 or ISO 21930 standards.



> **Note**
>
> For information of EPD's regarding Uponor's Multilayer plumbing system please contact:
>
> enquiries.uk@uponor.com

EPDs in construction projects and manufacturing are voluntary. However, their use is rapidly growing in line with awareness about environmental impacts. The public, designers and private stakeholders are increasingly demanding EPDs, and their use can offer a range of benefits:

- **Nett zero :** using EPDs will help you to present the environmental impacts of your project.
- **Regulation and legal requirements:** many public procurement bodies in the UK and the EU are required to use EPDs to assess the environmental footprint of products.
- **Credits and certification:** LCA credits are very cost-efficient and easy compared to other credits' requirements for your building's certifications and EPDs are also recognized by LEED and BREEAM, among other market-based systems.

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