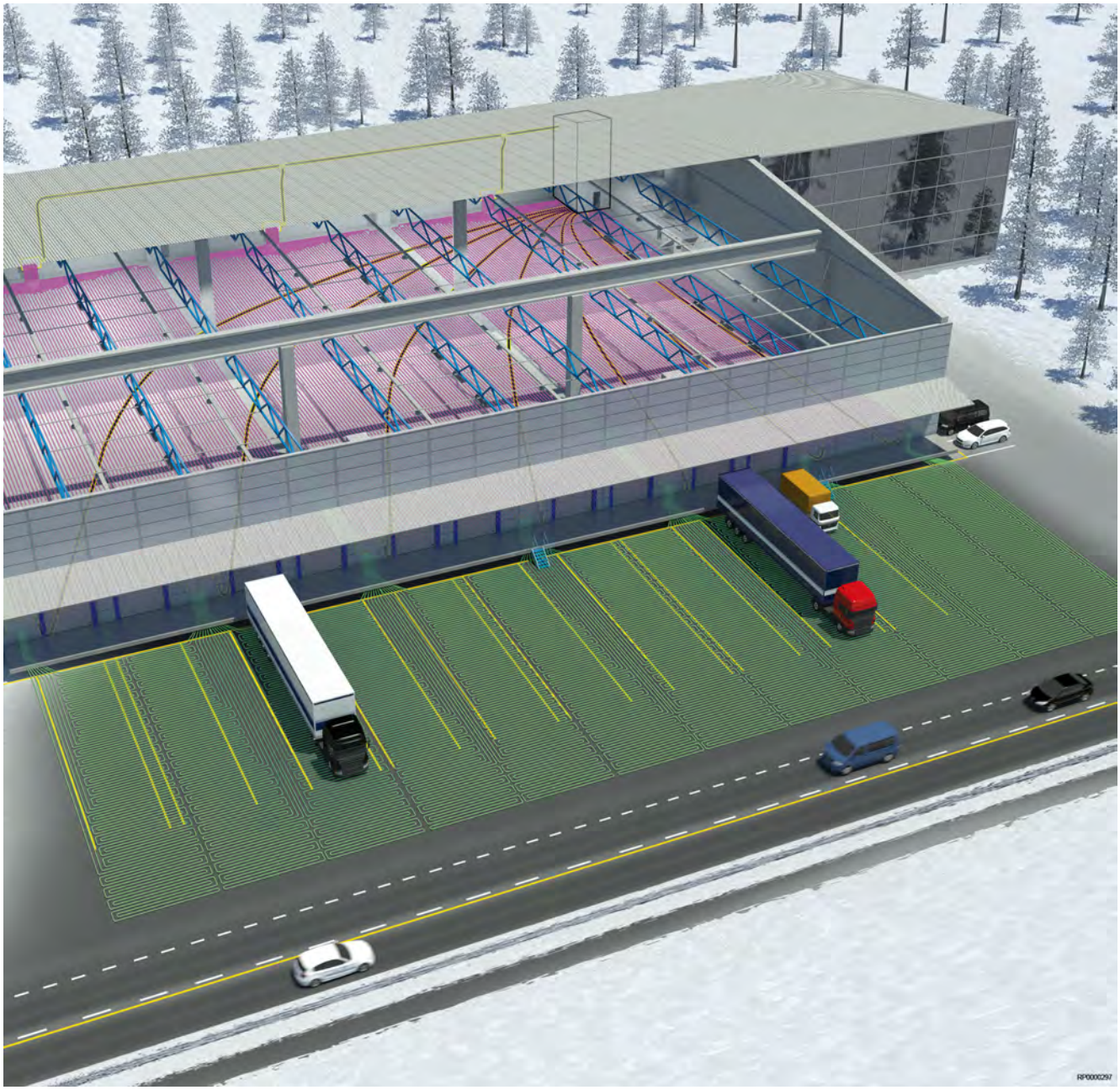
Uponor Magna industrial underfloor heating system

EN Technical information



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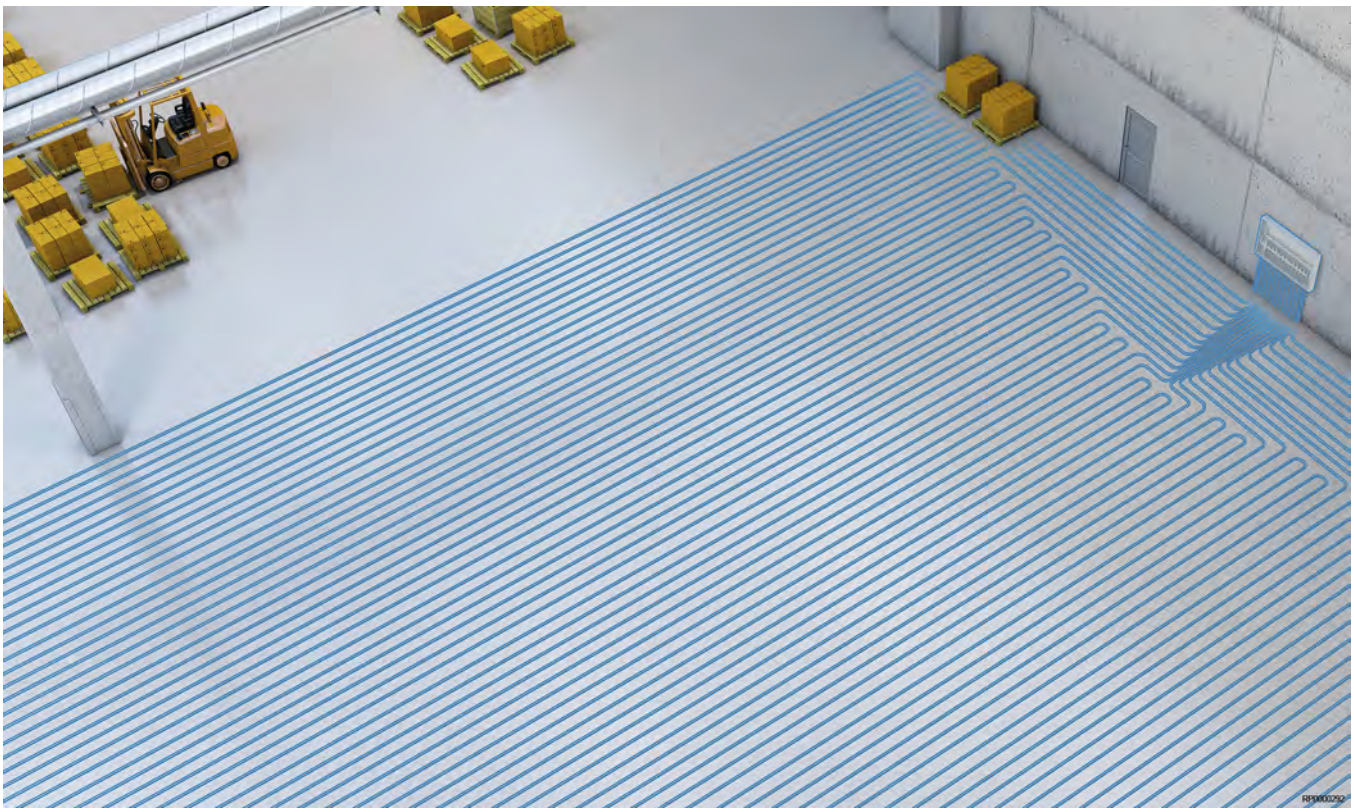


Uponor Magna is a large variant of underfloor heating for industrial buildings. It consists of just a few components including manifolds, installation accessories for different fixation methods and two pipe dimensions 20 mm and 25 mm made of Uponor PE-Xa. This makes planning and installing the Uponor Magna quite easy and is supported by Uponor international design service.

Uponor Magna offers the opportunity to include radiant floor cooling as well. However, the large concrete thicknesses above the pipe only allow for basic cooling loads. For this reason, pipe spacing between 15 cm and 20 cm is required. Given typical design parameters (flow temperature return temperature 16/20 °C and indoor temperature 26 °C), cooling loads of approx. 20 W/m² to 30 W/m² can be achieved.

1.1 Benefits

Uponor Magna comes well-structured and beneficial in a nutshell:

- **Invisible**: heating and cooling from one invisible system
- **Easy and flexible**: optimal use of space, few components and no extra space for heaters
- **Cost efficient**: rapid return on investment, no maintenance costs
- **Reliable**: long-lifetime proven technology
- **Comfortable**: constant temperature, no dust

1.2 Components

Note

For more detailed information, product range and documentation please visit the Uponor website: www.uponor.com.

Note

Detailed information about the range of components, dimensions etc is available in the price list.

Pipes

Uponor Magna Pipe PLUS

Uponor Magna Pipe PLUS is a highly flexible PE-Xa pipe with 5 layers available in dimensions 20 x 2,0 mm and 25 x 2,3 mm.

The pipe fulfils the requirements for oxygen diffusion resistance as per DIN 4726 and ISO 22391.

Uponor Comfort Pipe PLUS Blue

RP0000302

Uponor Comfort Pipe PLUS Blue is a highly flexible PE-Xa pipe with 5 layers available in dimension 20 x 2,0 mm.

The material in this pipe is 100 % based on bio-based PEX (mass balance) certified by the globally applicable sustainability certification system ISCC (International Sustainability & Carbon Certification).

Uponor Comfort Pipe PLUS Blue fulfils the requirements for oxygen diffusion resistance as per DIN 4726 and ISO 22391.

Manifolds

Uponor Magna manifold segment with valve G¾ eurocone

RP0000299

The Uponor Magna manifold segment with valve G¾ eurocone is used for connection with additional segments and basic kit.

The supply segment is equipped with control valves for pre-adjustment and heating loop connection for G¾ eurocone. The return segment has a thermostat upper section including a cap for locking.

The manifold can be equipped with Uponor actuators, mounted directly on the return manifold.

Heating loops of Uponor Comfort Pipe PLUS or Magna Pipe PLUS 20 x 2,0 mm are connected with G¾ eurocone.

Uponor Magna manifold segment with valve 25 mm

RP0000298

The Uponor Magna manifold segment with valve 25 mm is used for connection with additional segments and basic kit.

The supply segment is equipped with control valves for pre-adjustment and heating loop connection for G¾ eurocone. The return segment has a thermostat upper section including a cap for locking.

The manifold can be equipped with Uponor actuators, mounted directly on the return manifold.

Heating loops of Uponor Magna Pipe PLUS 25 x 2,3 mm are connected with compression adapters.

Uponor Magna manifold bayonet segment G1½”

RP0000300

Uponor Magna manifold bayonet segment G1 ½” consists of flow and return as single segments. It is used for connection with additional segments and basic kit. For supply segments, it is used with control valves for pre-adjustment and for return segment with thermostat upper section including cap for locking.

The manifold can be equipped with Uponor actuators, mounted directly on the return manifold.

Industrial Basic Kit and Uponor Magna manifold bayonet joints are required for the installation (ordered separately).

Fittings

Note

Only use fittings recommended by Uponor or its representatives.

Uponor Q&E fittings have been specially developed for use with Uponor pipes.

Compression fittings designed for these Uponor pipes are also available. Ensure they have split compression rings.

Always use fittings with support sleeves together with Uponor pipes.

Accessories

Item	Description
A	Uponor Magna manifold bracket kit The kit includes 2 short brackets, 2 long brackets and 1 mounting material (8 screws 6x60 mm)
B	Uponor Magna manifold kit K1 The kit includes 2 short brackets, 2 long brackets, 2 filling valves in brass, 2 thermometers (0 - 60 °C), 1 manometer, 2 end caps and 2 flat sealing screw connections
C	Uponor Magna ball valve, set The valves are made of brass with G1½" connections
D	Uponor Magna manifold flowmeter The flowmeter has a shut-off function and is made of fibreglass reinforced polyamide

1.3 Disclaimer

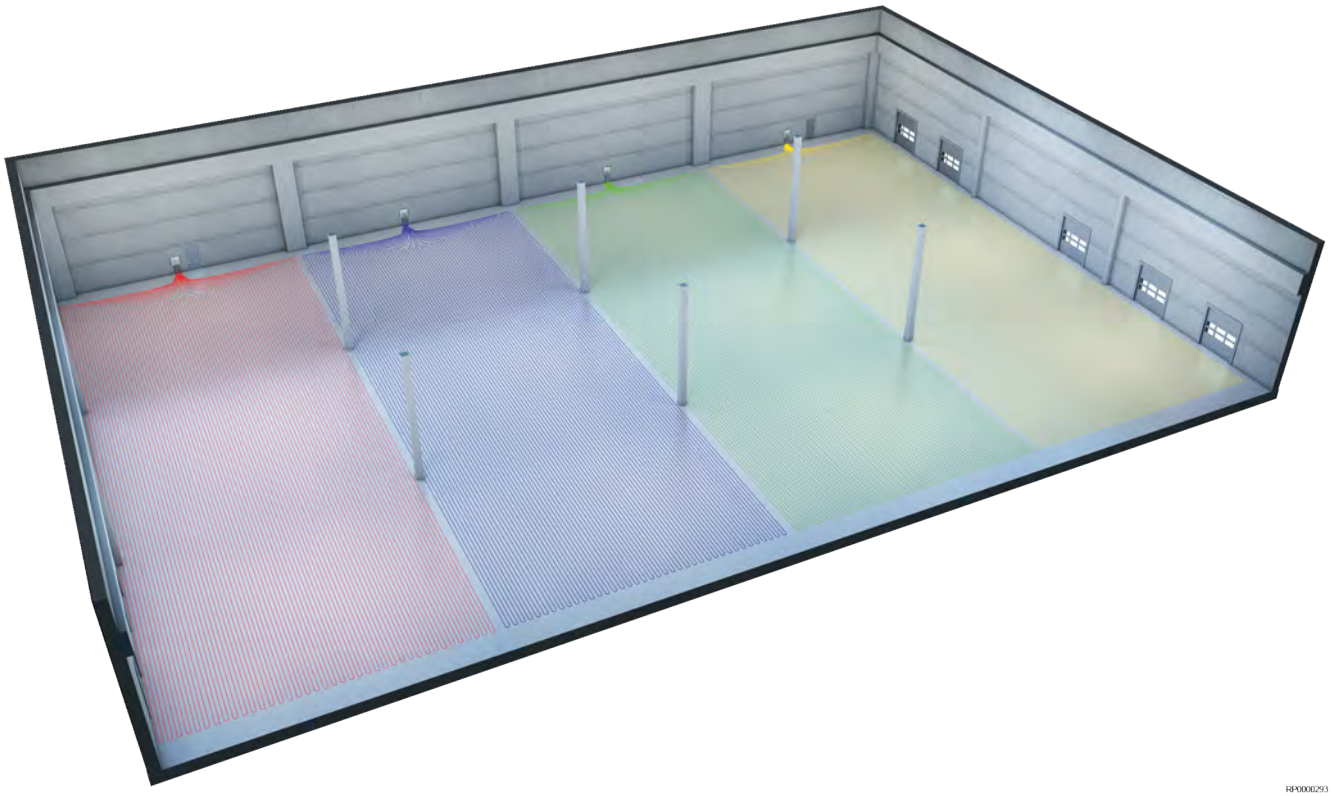
This is a generic, European-wide document version. The information in this document is provided on an ”as is” basis and no warranty of any kind is given in relation thereto.

This document may show products that are not available in your location for technical, legal, commercial or other reasons. Therefore, please check always in advance from the applicable Uponor product or price list whether the products are available in the location and for the time they are intended for.

The design and specifications of the products are subject to change without notice and may vary from those shown. Images displayed are for illustration purposes only. A full compliance with the local regulations, standards or ways of working may not be guaranteed.

While Uponor has made effort at the time of publication this document to ensure the accuracy of the information provided herein, this information is subject to change without notice. For any questions or queries, please visit Uponor local website or approach your Uponor contact.

2 Planning/design



RP0000293

2.1 Easy design

Note

Installation examples and joint descriptions are available in the chapter "Installation and operation".

Note

The use of insulation has to be calculated according to local standards and regulations.

When using a Uponor industrial underfloor heating system to heat industrial buildings, the pipes must be chosen in accordance with the requirements, location and basic design of the building in question.

Check the best and optimised solution for the industrial building with your local Uponor representative.

When the floor structure is designed without insulation, use a humidity barrier underneath the floor structure to prevent soil moisture from raising up from the ground to the floor structure.

2.2 Joint layout

Note

Always consider the joint plan created by the structural engineer.

Note

Always agree about the placement of heating loops and connecting pipes in the the joint plan.

Note

If possible, design the base slabs without joints in either low-shrinkage rolled concrete or continuous steel reinforcement.

Joint planning is the responsibility of the structural engineer and, due to the low temperature of the heating surface, is unaffected by industrial underfloor heating. The specialist heating engineer must request a joint plan, which will be used to agree the layout of the heating circuits and connecting pipes.

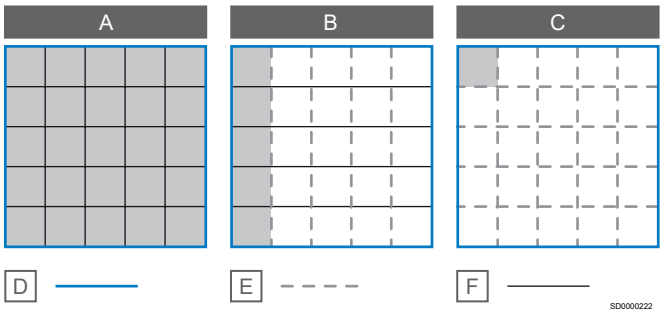
The type and positioning of a joint depends on numerous factors, for example:

- Slab thickness
- Other objects in vicinity (supports, walls, ducts)
- Long-term loading
- Type of concrete placement

The bay size is dependent on various factors, for example the quality and load capacity of the substructure and can therefore only be determined by a structural engineer. Edge joints around the concrete slab or fixtures in the concrete slab must be implemented as expansion joints and also shown on the joint plan.

Possible joint arrangements

Examples of possible joint arrangements for different methods of concrete placement.



Item	Description
A	Placing of concrete in one work step placement
B	Placing of concrete in lanes
C	Placing of concrete in fields
D	Expansion joint
E	Dummy joint
F	Construction joint (day joint)

2.3 Heating layout

The planning and installation of Uponor Magna industrial underfloor heating system is easy. Depending on the heating load, heat source and size of the building to be heated, the length of heating circuits will range between 200 m and 300 m.

Using Uponor 90° pipe guidance arcs, each heating circuit is separately connected to the Uponor Magna manifold.

Given an area of 2000 m² and a mass flow of approximately 10000 kg/h, the heating effect received from the underfloor heating system can be presented as shown in the following tables.

Criteria for all three options

- **Floor structure**: 250 mm with no insulation or floor covering
- **Ground temperature**: 10 °C
- **Concrete lamda value**: 2,1 W/mK

Heating effect option 1

Description	Value
Indoor temperature	16 °C
Maximum heating output	80 W/m²
Supply -/return water temperature	50/35 °C
Pipe distance to surface	217 mm
Pipe distance (c/c)	300 mm

Heating effect option 2

Description	Value
Indoor temperature	16 °C
Maximum heating output	80 W/m²
Supply -/return water temperature	50/35 °C
Pipe distance to surface	217 mm
Pipe distance (c/c)	300 mm

Heating effect option 3

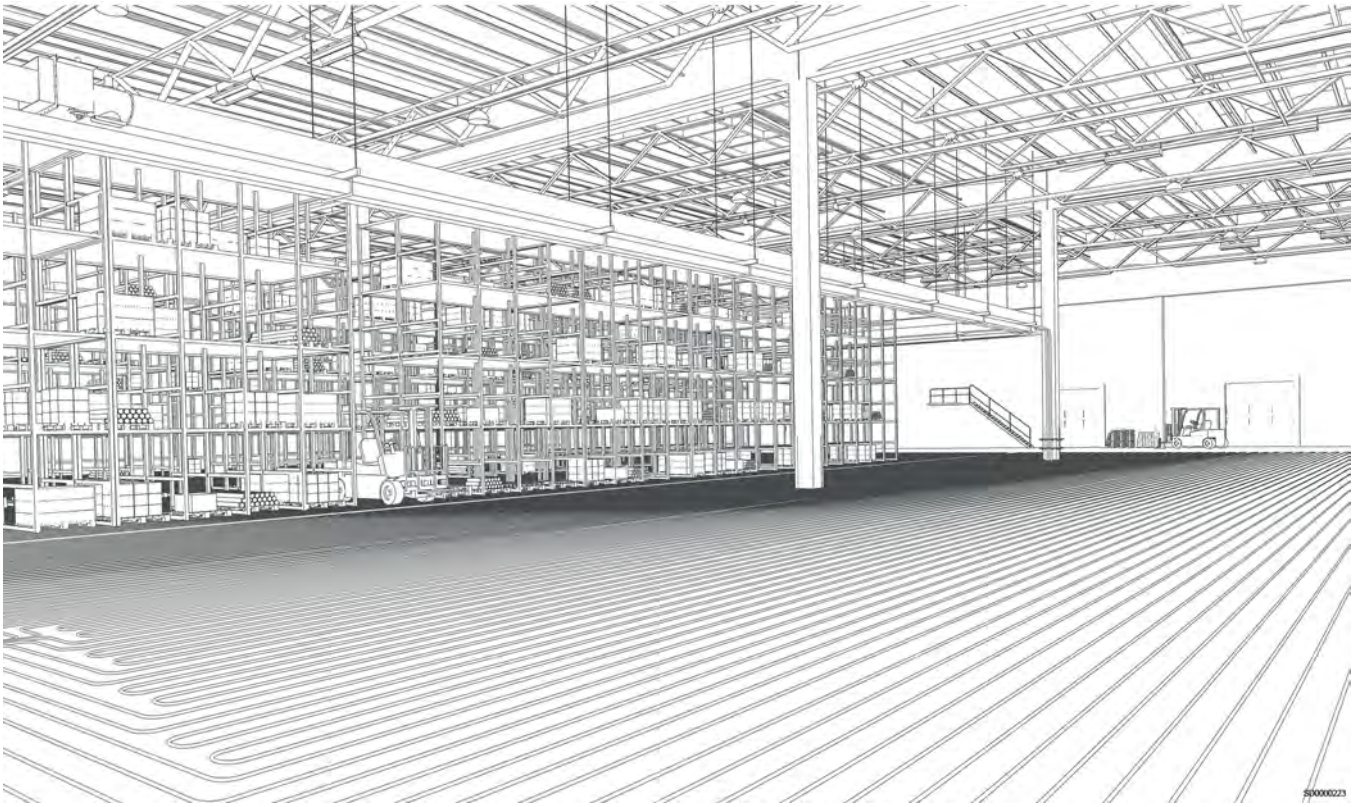
Description	Value
Indoor temperature	20 °C
Maximum heating output	65 W/m²
Supply -/return water temperature	50/35 °C
Pipe distance to surface	217 mm
Pipe distance (c/c)	300 mm

2.4 Cooling layout

Uponor Magna industrial underfloor heating system is also applicable for cooling. The cooling effect received from the underfloor heating system can be presented as shown in the following table.

Description	Value
Required heat flow density	25 W/m²
Average flow specification	18 °C
Maximum temperature spread	4 K
Room temperature	26 °C
Pipe covering (concrete slab)	200 mm
Thermal resistance $R_{i,B}$	0,02 m²/W
Maximum pressure loss	350 mbar

3 Installation and operation



3.1 General information

Note

The installation must be carried out in accordance with current local standards and regulations!

Note

Always read and follow the installation manual and recommendations from Uponor when performing the installation!

The following sections shortly describe different installation options for Uponor Magna.

3.2 Installation examples

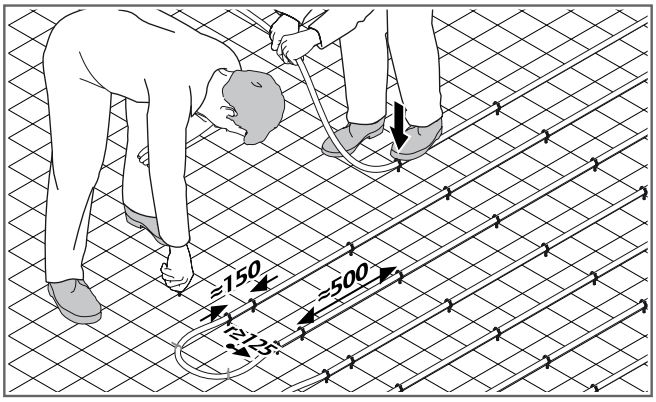
The Uponor industrial manifold is an easy and adjustable solution for different sizes of industrial buildings. It is a modular manifold system created from separate manifold blocks. This makes design, purchase and installation easier and safer.

Manifolds can be adjusted either by increasing or decreasing manifold blocks to the existing underfloor heating manifold even during the construction phase.

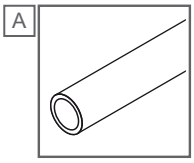
In case of different heating capacity needs, different pipe spacings allow individual optimisation of heat transfer capacities. Floor surface temperatures in permissible range according to physiological aspects of heating.

Reinforcement mesh and pipe clip

The underfloor heating pipe is fixated to the reinforcement mesh with Uponor plastic pipe clips.



Main installation components

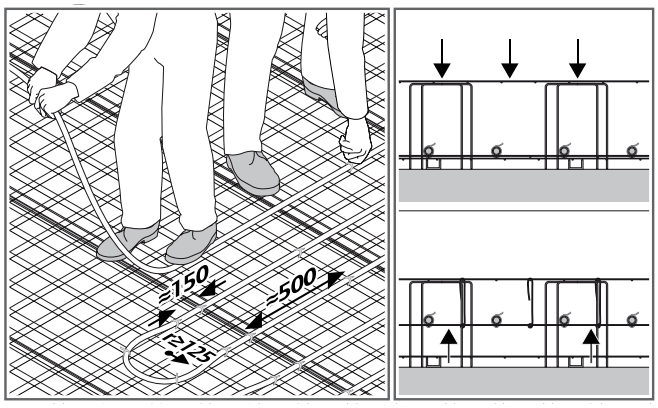


Item	Description
A	Uponor Magna pipe or Comfort Pipe PLUS

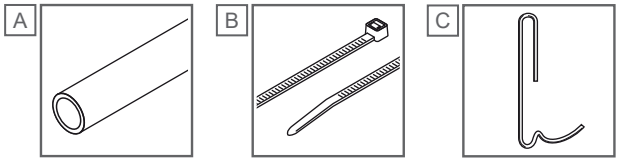
Reinforcement mesh with mounting support

The heating pipes are fixated to the reinforcement mesh with Uponor Multi cable ties PA.

The reinforcement mesh is adjusted to the precise height with mounting support.



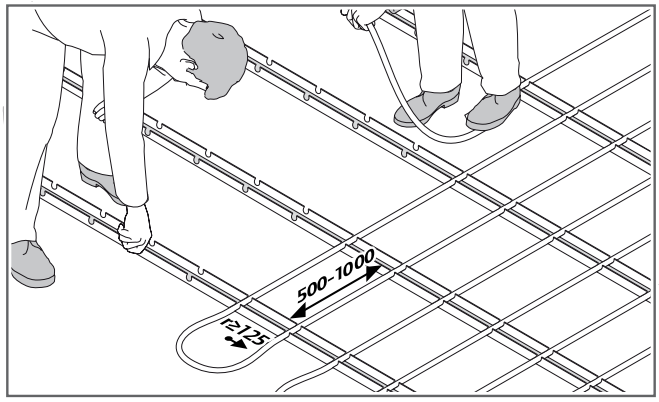
Main installation components



Item	Description
A	Uponor Magna pipe or Comfort Pipe PLUS
B	Uponor Multi cable ties PA
C	Uponor Contec hook

Insulation with clamp track

To prevent the Uponor Magna industrial underfloor heating system from buying upwards, the pipe fastening rails must be tightly anchored to the ground/insulation using appropriate ground nails.



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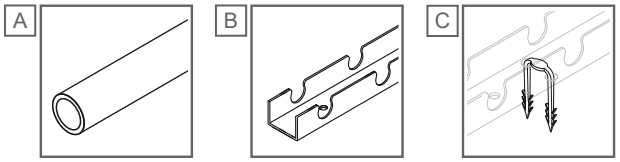
Main installation components



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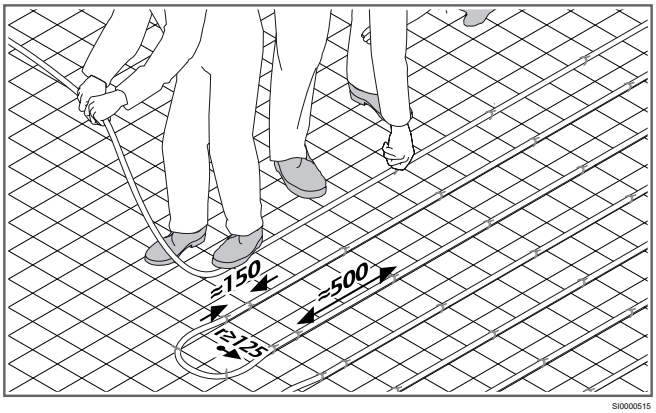
Item	Description
A	Uponor Magna pipe or Comfort Pipe PLUS
B	Uponor PE-Xa clamp track
C	Uponor clamp track nail

Reinforcement mesh and cable ties

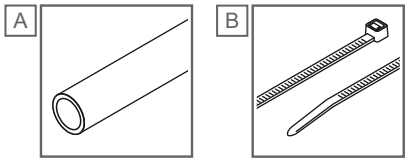

RF0000294

Heating pipes fixated to reinforcement mesh with Uponor Multi cable ties PA.



SI0000515

Main installation components



CD0000533

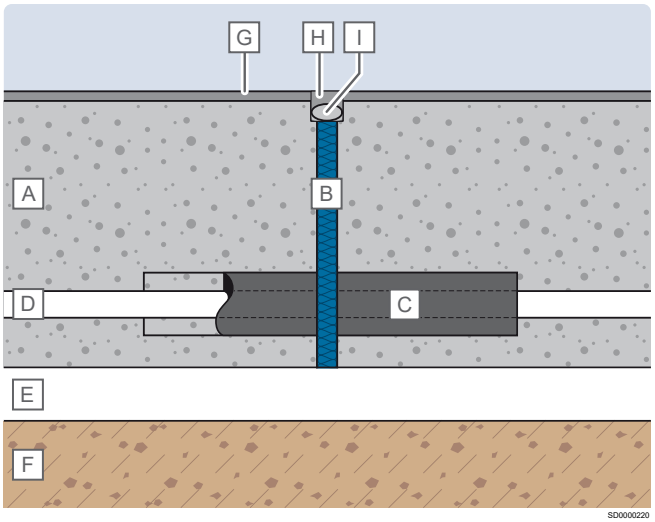
Item	Description
A	Uponor Magna pipe or Comfort Pipe PLUS
B	Uponor Multi cable ties PA

3.3 Crossing concrete joints

Expansion joint

Note

Expansion joints are not designed to break up the floor, but rather to provide separation from other objects like ducts, conduits, supports and walls.



SD0000220

Item	Description
A	Concrete slabs
B	Expansion joint
C	Protective pipe sleeve
D	Uponor Magna pipe or Comfort Pipe PLUS
E	Insulation material
F	Ground/gravel
G	Wearing layer
H	Joint sealing compound
I	Foam rubber

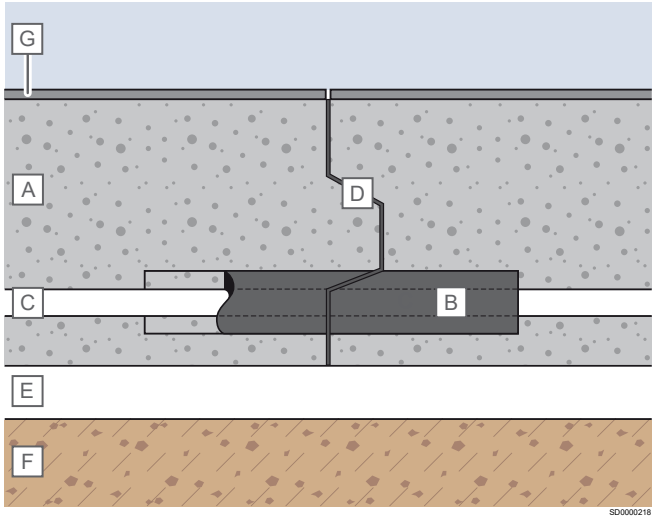
Joints that allow movement are generally known in the concrete construction trade as expansion joints. These provide continuous separation of the concrete slabs to a distance of approx. 15-20 mm and are filled with a soft jointing material (e.g. foam sheet or fibre board), which is fixed in place before the concrete is poured.

The underfloor heating system does not affect the planning of the expansion joints but the connecting pipes that cross over expansion joints must be protected against the anticipated mechanical stresses in the area around the joint using protective pipe sleeves of 1 m in length. This can be insulation material or a protective pipe for instance.

Construction joint (day joint)

Note

Heating pipes that are subject to mechanical stress during installation, where they cross construction joints, must be sheathed with protective pipe sleeves or protective pipes.



Item	Description
A	Concrete slabs
B	Protective pipe sleeve
C	Uponor Magna pipe or Comfort Pipe PLUS
D	Dummy joint
E	Insulation material
G	Ground/gravel
H	Wearing layer

Neighbouring areas of the concrete slabs are connected to each other by construction joints. These are not movement joints, but rather occur simply as a result of adjoining bays being poured at different times. In order to ensure proper transmission of force from one slab to the next, these sections are combined by using tongue and groove joints or creating a positive connection with dowelled joints.

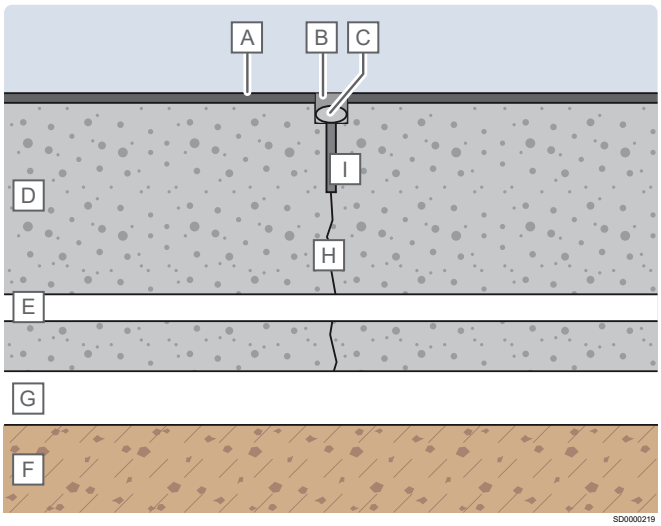
Heating pipes that cross a construction joint must be sheathed for a distance of 1 m using protective pipe sleeves or protective pipes in cases where the heating pipe is subject to mechanical stress before pouring the concrete, for example due to the positioning of formwork over the heating pipe. It is advisable to design and install the underfloor heating system in such a way that crossing these joints is avoided.

Dummy joints

Note

Check the joint layout with the structural engineer before preparing designs for an industrial underfloor heating system.

Agree with the building engineer about the maximum possible depth of cut.



Item	Description
A	Wearing layer
B	Joint sealing compound
C	Foam rubber
D	Concrete slabs
E	Uponor Magna pipe or Comfort Pipe PLUS
F	Ground/gravel
G	Insulation material
H	Thin crack
I	Dummy joint

Dummy joints are cut into the concrete slab after it is formed and serve as predetermined breaking points. These cuts are approximately 3–4 mm wide and cut to a depth of around 25–30 % of the slab thickness. The intentional crack that occurs below the cut has a certain amount of denticulation that allows transverse forces to be transferred from one concrete slab to the next.

Dummy joints do not require the use of protective pipe sleeves or protective pipes. These joints can also be of a "closed" type, created by cutting a post-casting groove approximately 25 mm deep, then using a special sealing compound and partially filling with foam rubber.

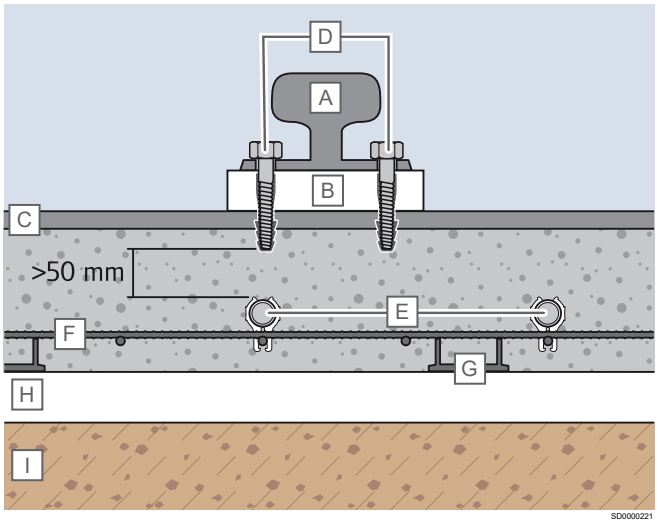
3.4 Equipment in the halls

Note

Determine the maximum depth of penetration into the concrete slab of all anchor points and foundations for all equipment to be installed in the building.

Note

Always observe a minimum safety distance of 50 mm from the pipe.



Item	Description
A	Rails for industrial trucks
B	Equalisation base
C	Wearing layer
D	Anchors
E	Uponor Magna pipe or Comfort Pipe PLUS
F	Reinforcement mesh
F	Ground/gravel
G	Spacer
H	Insulation material
I	Ground/gravel

Commercial buildings often have footings for various equipment, for example high rack storage and machine foundations, anchored into the concrete floor.

The specialist heating engineer must be fully informed about how deeply these foundations and anchor points penetrate the concrete slab. Occasionally there may be a risk that they penetrate far enough into the concrete slab to reach the level of the heating pipes. Should this be the case due to the concrete slab being insufficiently thick, then the heating pipes must be left out of this area, creating a so-called blind area.

3.5 Wearing layer

Note

Always consider the possible thermal resistance of the wearing layer.

Floors that are subject to heavy wear due to, for example, being driven on by forklifts and heavy industrial trucks, are exposed to a lot of abrasion and therefore need a stable surface layer, a wearing layer, as otherwise the surface of the concrete slab may suffer excessive wear.

Which type of wear layer is best suited to a specific situation must be decided by the responsible building engineer. For example, the following may be applied to the surface of the concrete: mastic asphalt screed, magnesite screed, and cementitious hard-aggregate screed.

The plasticity of the wearing layer and the concrete slab must be matched to each other. Joints in the concrete slab must therefore also be considered in the surface layer. Which type of wear layer is best suited to a specific situation must be decided by the responsible building engineer. For example, the following may be applied to the surface of the concrete: mastic asphalt screed, magnesite screed, and cementitious hard-aggregate screed.

Floors that are subject to less heavy wear do not necessarily require a separate surface layer. In many cases the concrete surface will be roughened by brushing or, in the case of floors that need to be extremely level, sanded down.

4 Technical data

4.1 Technical specifications

Uponor Magna pipe PLUS

Description	Value	Value
Product name	Uponor Magna pipe PLUS 20x2,0mm	Uponor Magna pipe PLUS 25x2,3mm
Pipe dimension	20 x 2,0 mm	20 x 2,3 mm
Coil length	240; 480 m	300; 640 m
Material	PE-Xa, 5-layer pipe	PE-Xa, 5-layer pipe
Colour	White outer layer with 2 blue longitudinal stripes	White outer layer with 2 blue longitudinal stripes
Pipe marking	Uponor Magna pipe PLUS 20x2,0 EN ISO 15875 C PE-Xa Class 5/6 bar, Oxygen diffusion tight/DIN 4726 (Country code,Material code pipe,Material code evoh,Machine,Year,Month,Date) Made in Sweden	Uponor Magna pipe PLUS 25x2,3 EN ISO 15875 C PE-Xa Class 5/6 bar, Oxygen diffusion tight/DIN 4726 (Country code,Material code pipe,Material code evoh,Machine,Year,Month,Date) Made in Sweden
Manufacturing	According to EN ISO 15875; UAX™ technology	According to EN ISO 15875; UAX™ technology
Certificates	KOMO K98949; DIN CERTCO 3V415	KOMO K98949; DIN CERTCO 3V415
Application	Class 4 + 5 / 6 bar (EN ISO 15875)	Class 4 + 5 / 6 bar (EN ISO 15875)
Max. operating temperature	90 °C (EN ISO 15875)	90 °C (EN ISO 15875)
Max. peak temperature	100 °C (EN ISO 15875)	100 °C (EN ISO 15875)
Max. operating pressure	6,5 bar at 70 °C (safety factor 1,5) (EN ISO 15875)	6,5 bar at 70 °C (safety factor 1,5) (EN ISO 15875)
Pipe jointings	Uponor compression fittings (e.g. Rapex) Uponor Q&E fittings	Uponor compression fittings (e.g. Rapex) Uponor Q&E fittings
Weight	0,122 kg/m	0,174 kg/m
Water volume	0,191 l/m	0,312 l/m
Oxygen tightness	According to ISO 17455; DIN 4726	According to ISO 17455; DIN 4726
Density	0,934 g/cm³/more flexible	0,934 g/cm³/more flexible
Thermal conductivity	0,35 W/mK	0,35 W/mK
Linear expansion coefficient	at 20 °C, 0,00014 m/mK at 100 °C, 0,000205 m/mK	at 20 °C, 0,00014 m/mK at 100 °C, 0,000205 m/mK
Crystallite melting temperature	+130 °C	+130 °C
Building material class	B2 or E according to DIN 4102 or EN 13501	B2 or E according to DIN 4102 or EN 13501
Min. bending radius	8xd if free bending 5xd if supported bend (70 mm)	8xd if free bending 5xd if supported bend (70 mm)
Pipe roughness	0,0005 mm	0,0005 mm
Best mounting temperature	≥ 0 °C	≥ 0 °C
UV protection	Opaque cardboard (store remaining quantities in the cardboard box)	Opaque cardboard (store remaining quantities in the cardboard box)
Water additives	Uponor anti-freeze agent GNF, material class 3 (DIN 1988, part 4)	Uponor anti-freeze agent GNF, material class 3 (DIN 1988, part 4)

Uponor Comfort Pipe PLUS Blue

Description	Value	Value
Product name	Uponor Comfort Pipe PLUS Blue 16x2,0mm	Uponor Comfort Pipe PLUS Blue 20x2,0mm
Pipe dimension	16 x 2,0 mm	20 x 2,0 mm
Coil length	640 m	480 m
Material	PE-Xa, 5-layer pipe	PE-Xa, 5-layer pipe
Colour	White outer layer with 2 blue longitudinal stripes	White outer layer with 2 blue longitudinal stripes
Pipe marking	Uponor Comfort Pipe PLUS Blue 16x2,0 EN ISO 15875 C PE-Xa Sauerstoffdicht DIN 4726 ISCC DIN CERTCO 3V372 AENOR 001/000744 Class 5/6 bar KOMO K79614 ATG 3027 KIP 106324 KIWA-UNI MPA-DA (Land code,Material code pipe,Material code evoh,Machine,Year,Month,Datum) Made in (country)	Uponor Comfort Pipe PLUS Blue 20x2,0 EN ISO 15875 C PE-Xa Sauerstoffdicht DIN 4726 ISCC DIN CERTCO 3V372 AENOR 001/000744 Class 5/6 bar KOMO K79614 ATG 3027 KIP 106324 KIWA-UNI MPA-DA (Land code,Material code pipe,Material code evoh,Machine,Year,Month,Datum) Made in (country)
Manufacturing	According to EN ISO 15875; UAX™ technology	According to EN ISO 15875; UAX™ technology
Certificates	KOMO K79614; DIN CERTCO 3V372	KOMO K79614; DIN CERTCO 3V372
Application	Class 4 + 5 / 6 bar (EN ISO 15875)	Class 4 + 5 / 6 bar (EN ISO 15875)
Max. operating temperature	90 °C (EN ISO 15875)	90 °C (EN ISO 15875)
Max. peak temperature	100 °C (EN ISO 15875)	100 °C (EN ISO 15875)
Max. operating pressure	8,8 bar at 70 °C (safety factor 1,5) (EN ISO 15875)	8,8 bar at 70 °C (safety factor 1,5) (EN ISO 15875)
Pipe jointings	Uponor compression fittings (e.g. Rapex) Uponor Q&E fittings	Uponor compression fittings (e.g. Rapex) Uponor Q&E fittings
Weight	0,091 kg/m	0,115 kg/m
Water volume	0,108 l/m	0,197 l/m
Oxygen tightness	According to ISO 17455; DIN 4726	According to ISO 17455; DIN 4726
Density	0,934 g/cm³/more flexible	0,934 g/cm³/more flexible
Thermal conductivity	0,35 W/mK	0,35 W/mK
Linear expansion coefficient	at 20 °C, 0,00014 m/mK at 100 °C, 0,000205 m/mK	at 20 °C, 0,00014 m/mK at 100 °C, 0,000205 m/mK
Crystallite melting temperature	+130 °C	+130 °C
Building material class	B2 or E according to DIN 4102 or EN 13501	B2 or E according to DIN 4102 or EN 13501
Min. bending radius	8xd if free bending 5xd if supported bend (70 mm)	8xd if free bending 5xd if supported bend (70 mm)
Pipe roughness	0,0005 mm	0,0005 mm
Best mounting temperature	≥ 0 °C	≥ 0 °C
UV protection	Opaque cardboard (store remaining quantities in the cardboard box)	Opaque cardboard (store remaining quantities in the cardboard box)
Water additives	Uponor anti-freeze agent GNF, material class 3 (DIN 1988, part 4)	Uponor anti-freeze agent GNF, material class 3 (DIN 1988, part 4)

Mechanical and physical properties of a Uponor PE-Xa base pipe

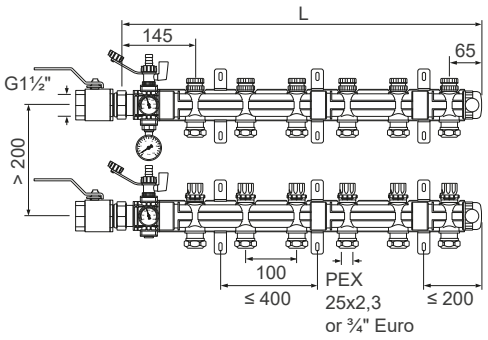
Description	Value	Value
Tensile strength	at 20 °C, 15-22 N/mm² (ISO 6259)	at 20 °C, 15-22 N/mm² (ISO 6259)
Fracture limit	at 20 °C, 25-30 N/mm² (ISO 6259)	at 20 °C, 25-30 N/mm² (ISO 6259)
Elongation at fracture	at 20 °C, 700-900 % (ISO 6259)	at 20 °C, 700-900 % (ISO 6259)
E-module (secant) in tensile test at 100 % min. and 1 % elongation	at 20 °C, 400-600 N/mm² (ISO 527)	at 20 °C, 400-600 N/mm² (ISO 527)
Impact resistance	at -20 °C without fracture (ISO 179) at 100 °C without fracture (ISO 179)	at -20 °C without fracture (ISO 179) at 100 °C without fracture (ISO 179)
Cross-linking level	≥ 70 % (EN ISO 15875)	≥ 70 % (EN ISO 15875)

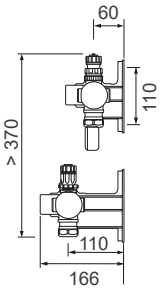
4.2 Dimensions

Uponor Magna manifold G¾ and 25 mm

G¾ Euro

25 mm





ϑ_{sec} = 15 – 60 °C

P_{max} = 6 bar

P_{test} = 10 bar

kvs = 2,35 m^3/h

kvs = 3,1 m^3/h

kvs = 8 m^3/h

	2	3	4	5	6	7	8	9	10	11
L [mm]	310	410	510	610	710	810	910	1010	1110	1210

	12	13	14	15	16	17	18	19	20
L [mm]	1310	1410	1510	1610	1710	1810	1910	2010	2110

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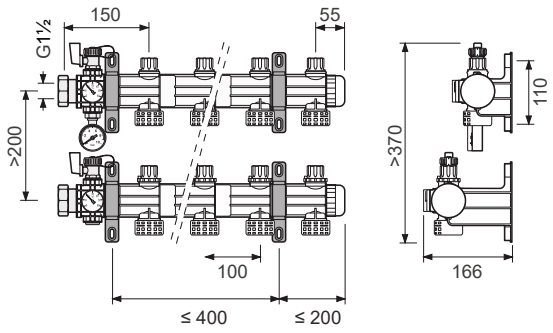
Uponor Magna manifold G1½

G1½



ϑ_{sec} = 15 – 60 °C

P_{max} = 6 bar

P_{test} = 10 bar

kvs = 3,6 m^3/h

kvs = 3,1 m^3/h

kvs = 8 m^3/h

	2	3	4	5	6	7	8	9	10
L [mm]	310	410	510	610	710	810	910	1010	1110

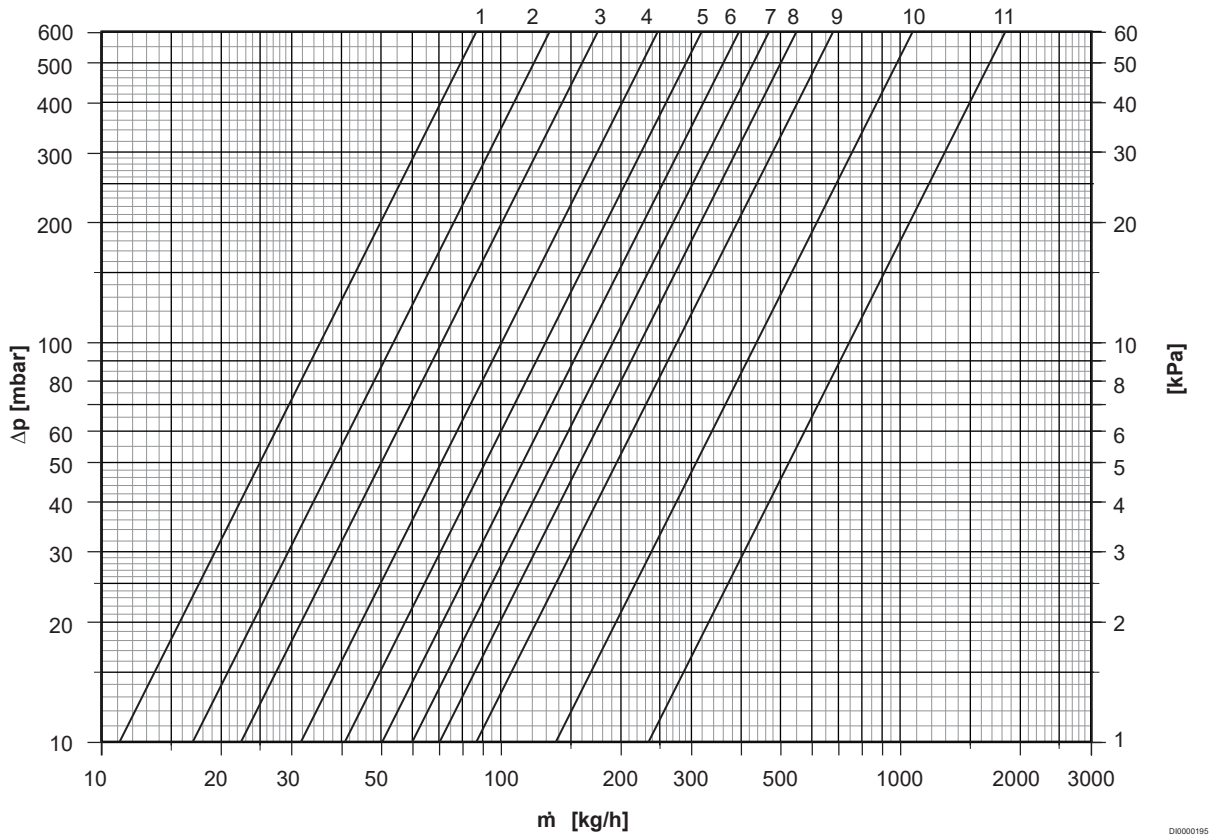
	2 - 5	6 - 9	10 - 14	15 - 19	20
	2	3	4	5	6

ZD0000077

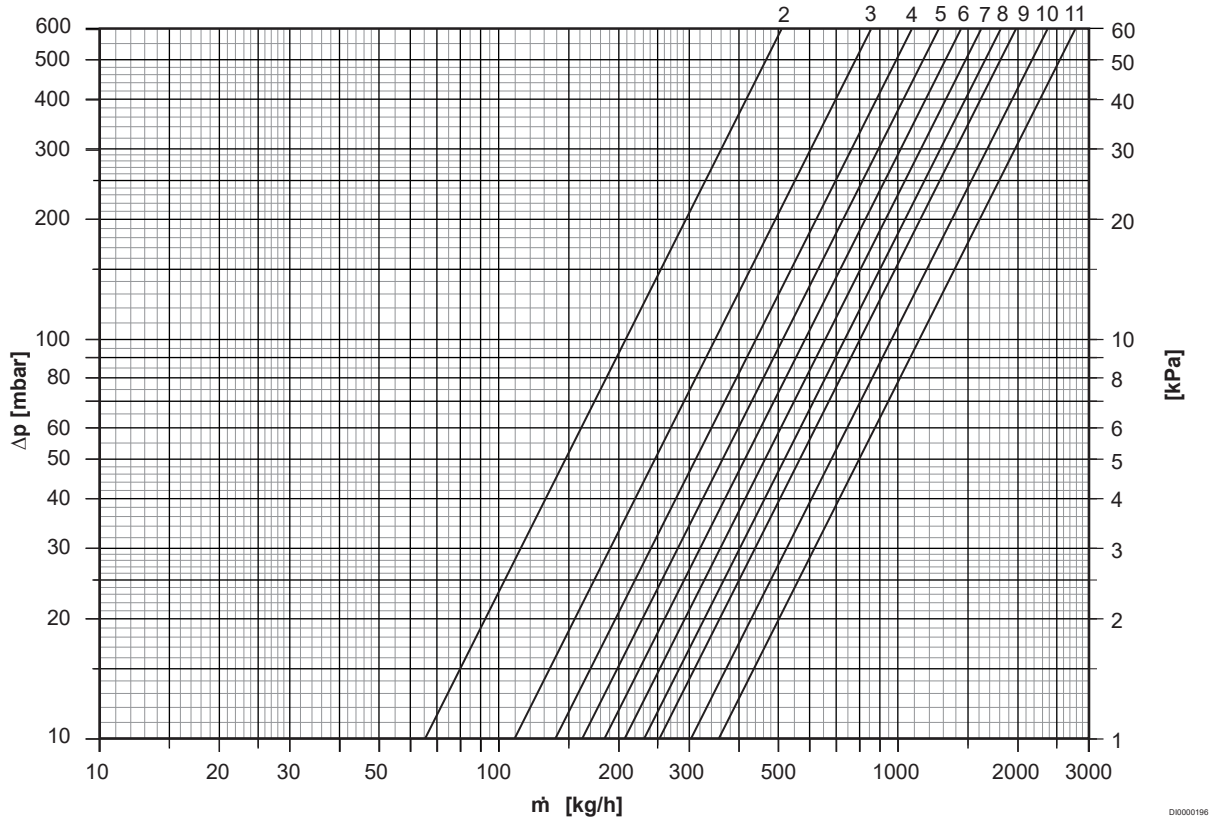
4.3 Pressure loss diagrams

G¾ Euro

25 mm



G1½



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