Wavin Tigris
Technical Handbook

Tigris family
one-fits-all

wavin
An Orbia business.

Contents

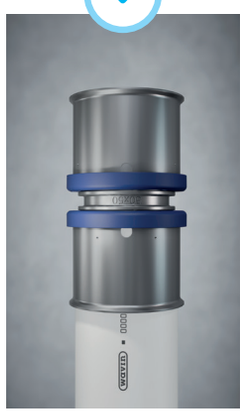
Wavin Tigris

Technical Handbook

This handbook presents the specific characteristics of individual products in the Tigris product family.
It describes their features and areas of application. Additionally, this handbook provides installation instructions, technical background information, as well as relevant standards and regulations.

The Ultimate-Flow Wavin Tigris product family at a glance

one pipe fits all

PPSU series		Brass series		
Radial Press-Fit		Radial Press-Fit		Axial Press
				
Wavin Tigris K5	**Wavin Tigris K1**	**Wavin Tigris M5**	**Wavin Tigris M1**	**Wavin Tigris MX**
16-40 mm	50-75 mm	14-40 mm	50-75 mm	16-32 mm

1. Introduction

System Description

The Wavin Tigris family offers one solution for every case. Depending on your preferred choice of material, the family offers Tigris K5 and Tigris M5 as a core line. Extended by Tigris K1 and Tigris M1, the Radial Press-Fit, in PPSU or brass, and Tigris MX, an Axial Press system with the ultimate flow, cover together a complete range of fittings up to 75 mm multi-layer composite pipes.

About PPSU

PPSU (Polyphenylsulfone) is a high technical performance plastic which is resistant to corrosion, encrustation and high temperatures (heat shape resistance > 200 °C, processing temperature 360°C).

It's extremely high notched impact strength and lack of sensitivity to stress cracks make the Tigris K5 and Tigris K1 fitting extremely robust and insensitive to impacts.

The performance of PPSU has already been proven over many years in aircraft engineering, medical sterilization technology, chemical plants and automotive engineering as well as in Wavin plumbing fittings. In addition all female-threaded fittings are reinforced with high quality threaded inserts to ensure an extremely robust performance. With leadfree DZR brass inserts, our PPSU fittings are extremely well suited for environments where the highest water quality standards are required. All brass inserts of Wavin PPSU fittings are made of lead-free DZR brass CW 724R, a UBA listed brass quality that is dezincification resistant (DZR) and lead-free.

About PVDF

PVDF (Polyvinylideenfluoride) is resistant to heavy loads in terms of tension, bending and pressure. It also has very good resistance to chemicals, is UV-resistant, self-extinguishing and can be used up to 150 °C.

About brass

The brass fittings are made from
- the UBA listed drinking water approved brass type CW 617N with low lead content (<2%),
- leadfree DZR brass CW 724R.

This widely accepted brass can be used for all applications, heating as well as potable water and like PPSU, it resists high temperatures and pressures and is extremely robust and insensitive to impacts.

2. Wavin Tigris family

One pipe - fits all

2.1. The one-pipe-fits-all Wavin Tigris product family

With Tigris, Wavin offers a complete program of pipe and fitting solutions for multi- layer composite pipe systems. The Tigris family has five fitting solutions that are all perfectly designed to offer the most reliable connection for the Wavin's multilayer composite pipe, dedicated to the requirements of each specific field of application.

The core of the fitting program is based on the reliable Radial Press-Fit technology, offering a complete PPSU line with Tigris K5 and Tigris K1 or brass line with Tigris M5 and Tigris M1. The fitting program is extended by the Tigris MX system - a new Axial Press system based on DZR leadfree brass.

All Tigris fitting lines fulfil the specific requirements for Hot& Cold water installations and radiator heating as well as underfloor heating systems. They meet all drinking water quality requirements and are physiologically harmless.

Being a real product family, all fittings fit to the same multilayer composite pipe, offering a 1-fits-all solution!

2.2. Tigris Multilayer pipe – key features

The Wavin multilayer composite pipes (MP) consist of either an internal layer of cross-linked polyethylene (PE-Xc) or temperature-resistant polyethylene (PE-RT Type II), an external protection layer (HD-PE or PE-RT Type II), and an intermediate butt-welded aluminium layer. These layers are uniformly bonded together, forming a five-layer pipe structure.

Multilayer composite pipes offer many advantages

- Dimensional stability, resistant to unwanted movement yet flexible to work with
- Limited linear thermal expansion, thanks to the aluminium layer
- Significant lower need of fittings due to ease of pipe bending
- Perfect for tight installation situations due to easy bending
- Pipe holds its shape after bending thanks to the aluminium layer
- Corrosion resistant, free of encrustation
- Diffusion-proof

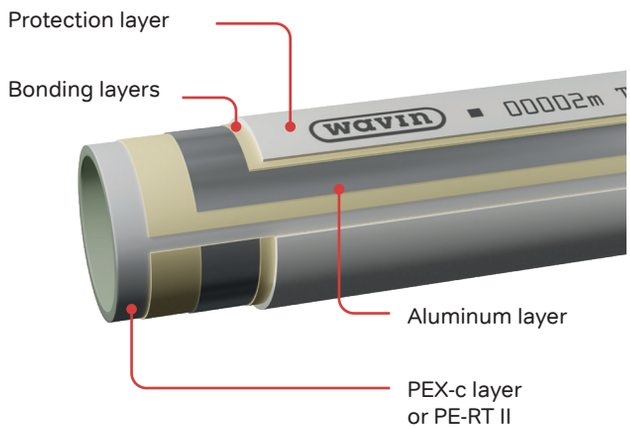


Fig. 1: Multilayer composite pipe structure.

Specific benefits of Wavin multilayer pipes

- Big inner diameter for an optimal flow performance
- Wide range of applications, including drinking water, heating and cooling systems, and pressurized air systems
- Dedicated product line for gas
- Suitable for wide variety of water quality
- High pressure, temperature and chemical resistance.
- Butt-weld aluminum layer; uniform thickness and resistance to peeling apart
- Physiologically harmless
- Low weight
- Quick and safe assembly
- On coils and straight lengths
- Pre-insulated or with protection pipe
- Easy to cut and easy to bend
- Broad range of dimensions (14 mm to 75 mm)

The Wavin multilayer composite pipes can be handled by a single installer. An optimal aluminium thickness means it can be bent by hand or supported by bending springs and bending pliers.

The Wavin multilayer composite pipes are classified by the kind of application according to ISO 21003. Please see chapter 2.3 Technical specifications MP Pipes for detailed information.

2. Wavin Tigris family

One pipe - fits all

2.2.1. The Wavin multilayer composite pipe for drinking water applications

The white coloured Wavin multilayer pipes can be applied for Hot&Cold water installation as well as heating systems. The pipes meet all drinking water quality requirements and are physiologically harmless. They also are oxygen tight and fulfil the requirements for low temperature radiator connections and underfloor heating systems.

Depending on the pipe dimension, they have an inner layer material in PEX-c or PE-RT type II, an external layer in PE-HD or PE-RT II with an aluminium layer in between connected by special bounding agents.

The Wavin multilayer composite pipe for drinking water applications fulfils the requirements according to ISO 21003 and carries amongst others DVGW, KIWA and KOMO certifications.

Please see chapter 2.3 on Technical specifications MP pipes for detailed information.

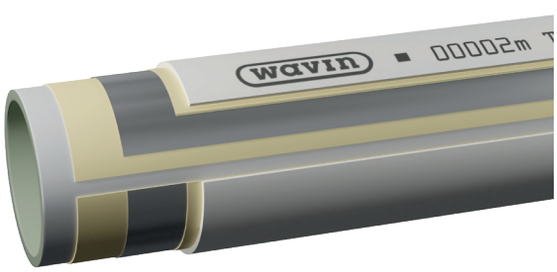


Fig. 2: Multilayer composite pipe for multiple applications.

2.2.2. The Wavin multilayer composite pipe for underfloor heating applications

The blue coloured Wavin multilayer pipes can be applied for radiator connection and underfloor heating. They are designed for lower temperature systems, are oxygen tight and fulfil the requirements for low temperature radiator connections and underfloor heating systems.

They have an inner layer material PE-RT type II, an external layer in PE-HD with an aluminium layer in between connected by special bounding agents.

The Wavin multilayer composite pipe for underfloor heating applications fulfils the requirements according to ISO 21003.

Please see chapter 2.3 on Technical specifications MP pipes for detailed information.

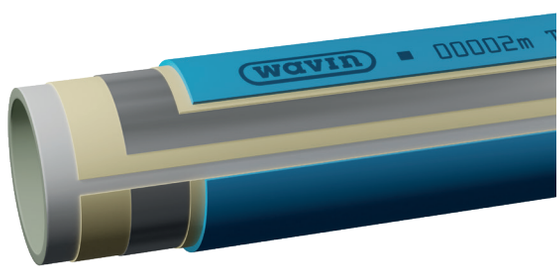


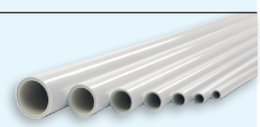
Fig. 3: Multilayer composite pipe for underfloor heating.

PEX-c is a reinforced physical (electron-beam) cross-linked polyethylene. Due to the cross-linking, the PE is not fusible and has a high thermal stability that especially predestines it for drinking water installations and high temperature radiator connections. The physical cross-linking ensures an equal spread of the links and an environmental and drinking water quality friendly cross-linking without any addition of chemicals. PEX-c is typically chosen when more extreme conditions are applied, like chemical or thermal disinfection.

PE-RT (Polyethylene of Raised Temperature Resistance) refers to a temperature-resistant polyethylene variant. The Wavin Tigris MP PE-RT pipes utilize PE-RT Type II material, which is fully standardized under ISO 22391 ("Plastics piping systems for hot and cold water installations") and engineered to meet equivalent performance classes and application requirements as cross-linked polyethylene (PE-X) systems complying with ISO 15875 ("Plastics piping systems for hot and cold installations - Cross-linked Polyethylene").

2.3. Technical specifications MP Pipes

Wavin multilayer composite pipes: Technical specifications

Range of application	Drinking water installation, radiator connections and underfloor heating	
Pipe colour	• White • Blue: Exclusively for underfloor heating (UFH) and radiator heating applications. • Yellow: Reserved for gas installations only.	
Pipe material	**Metal Plastic (MP) PEX-c pipe** Internal layer made of PEX-c (electron-beam crosslinked polyethylene), external layer made of PE with an aluminium layer between, connected by special bounding agents	**Metal Plastic (MP) PE-RT pipe** Internal layer made of PE-RT (raised temperature resistance polyethylene), external layer made of PE, with an aluminium layer between, connected by special bounding agents
Dimensions (mm)	14, 16, 20, 25, 26, 32, 40, 63	16, 20, 25, 75
Classification fire behaviour	DIN EN 13501: E DIN 4102: B2	DIN EN 13501: E DIN 4102: B2
Maximum operating pressure	10 bar	10 bar
Coefficient of thermal expansion	0,025 – 0,030 mm/m·K	-
Thermal conductivity	0,4 W/ m·K	-
Pipe roughness	0,002 mm	
Max. continuous operating temperature	70 °C	
Max. short term load	95 °C **	
Max. continuous operating pressure	10 bar (at 70 °C)	

** At max 100 hours in 50 years.

-

Table 1.

3. Tigris fitting

System description

3.1. The Radial Press-Fit system explained

Radial Press-Fit fittings are typically designed for making a fast, reliable and durable connection with multilayer pipes. The principle is based on deforming the metal cap of the fitting with a pressing tool which creates a tight sealing and mechanical connection at the same time in just one pressing. As the cap is deformed in a radial direction related to the pipe, it is called a Radial Press-Fit system.

Fig. 4: Wavin Tigris Radial Press-Fit pressing.

The Radial Press-Fit system offers a lot of benefits compared to alternative connection methods for piping.

It is a very fast way of making a durable, reliable connection; just cut the pipe, stick the fitting* on the pipe and press. Ready!

Because it is a predefined process and the Wavin fittings are designed to prevent every conceivable installation mistake, the result is a reliable and durable connection. In addition, Wavin Tigris fittings are designed and tested even beyond the high requirements for a 50-year lifetime simulation. The Wavin system warranty ensures a long and trouble-free lifetime.

*) depending on fitting type, see chapter 4- Installation Instructions

Wavin Tigris Radial Press-Fit fittings are subjected to constant internal quality controls and continuous external monitoring. They are certified by DVGW and tested according EN-ISO 21003.

The Radial Press-Fit system can cover a wide range of diameters, making it a suitable piping system for all kind of applications. Just small domestic housing project or big utility projects, risers and floor distribution, for heating as well as potable water systems.

Speed, reliability, variety: the Wavin Tigris Radial Press-Fit system covers it all.

3.2. The Wavin Axial Press Fit system explained

Wavin Tigris MX is the most recent member of the Tigris-family. Being part of the Tigris family, Tigris MX perfectly matches the one-pipe-fits all proposition. With just one pipe, every fitting from the Tigris family can be applied, whether it is Push-Fit, Radial press or now also Axial Press. Even combinations of the various fitting systems can be installed with all products of the Wavin Tigris family without the use of transitions between each other.

Tigris MX offers an maximum flow thanks to the straight bore which is one of the biggest bores on the market for Axial Press systems. Dead space is reduced to a minimum leading to an utmost hygiene for drinking water applications. But also, for heating applications the Ultimate-Flow concept shows advantages, such as the more efficient use of heat pumps due to the improved flow properties.

With an easy to expand pipe and sliding rings in a distinctive black carbon look made of PVDF that can be assembled from both sides, installing of an Axial Press system has never been easier. Moreover, calibrating and chamfering of the pipe is not necessary, which saves valuable time and eliminates installation mistakes.

Additionally, the leadfree DZR brass body is suitable for all markets around the globe. DZR material outstands and proofs itself as a corrosion free material which is the perfect choice for installation systems. In terms of complying with guidelines, but also with sustainability, leadfree material enables a safe drinking water in every way on a long term.

This makes Wavin Tigris MX the choice to work with when it comes to high performance in projects and a need for a failure-free, reliable, and durable connection.

Combined with the proven reliability of Tigris multilayer pipes, that have been successfully applied in many markets over decades, the Wavin Axial Press-system offers utmost reliability; it has even been tested beyond the high requirements for a 50-year lifetime simulation.

Finally, it fully profits from all benefits of the Tigris multilayer pipe; extreme big inner bore, the easy handling process, whether expanding, cutting, or bending! That is why the Wavin system warranty ensures a long and trouble-free lifetime.

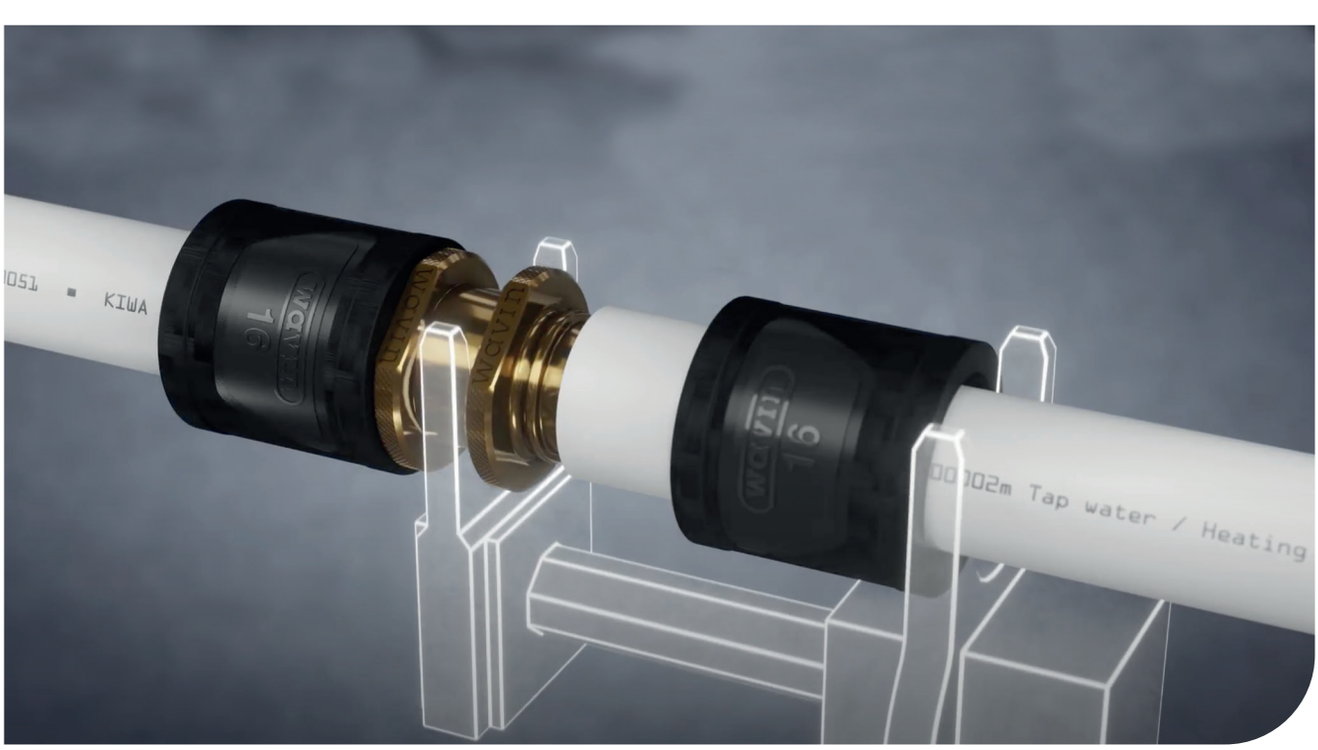


Fig. 5: Ultimate-Flow Tigris MX connection.

3. Tigris fitting

3.3. Product Feature Overview Tigris M5/K5/M1/K1/MX

The below overview gives a summary of the product features of the various Tigris designs, the body material, the dimensions and the pressing profile that can be used to create an utmost reliable installation. Below you will find an explanation of the icons that show the benefits of each feature.

					
	Wavin Tigris M5	**Wavin Tigris K5**	**Wavin Tigris M1**	**Wavin Tigris K1**	**Wavin Tigris MX**
ONE FITS ALL	✔	✔	✔	✔	✔
OPTI FLOW	✔	✔			✔
ULTIMATE FLOW					✔
ACOUSTIC LEAK ALERT	✔	✔			
DEFINED LEAK	✔	✔	✔	✔	
MULTI JAW	✔	✔			
IN 4SURE	✔	✔	✔	✔	
PIPE GRIP	✔	✔	✔	✔	
ULTRA SEAL	✔	✔	✔	✔	
EASYFIT	✔	✔	✔	✔	
Diameters	14-40	16-40	50-75	50-75	16-32
Body material	Brass	PPSU	Brass	PPSU	Brass
Press profile	U, Up, TH, H, B	U, Up, TH, H, B	U	U	Axial Press
Drinking Water Installation	✔	✔	✔	✔	✔
Heating Installation	✔	✔	✔	✔	✔
Compressed Air Installation	✔	✔	✔	✔	

*** Conditions for compressed air installation:**
› The system must be oil-free according to ISO 8573-1:2010 Class 1 or equipped with an upstream oil filter.
› The maximum operating pressure must not exceed 10 bar (fittings only in combination with Tigris composite pipe white).
› The operating temperature must be between 0°C and 40°C.

Table 2: Product feature overview.

ONE FITS ALL

One pipe fits all Tigris fittings

All the Tigris fittings can be used with the same Wavin pipes. Even if the Fitting-systems are different, all Wavin multilayer composite pipes fit.

OPTI FLOW

Increased inner bore for optimized flow

An increased inner bore leads to an optimization of the flow, by reducing the pressure loss as a result of less flow resistance.

ULTIMATE FLOW

Larger inner bore for minimized pressure loss

30% larger bore than common solutions on the market and designed so that stagnant water has no chance - for optimal hygienic requirements.

ACOUSTIC LEAK ALERT

Detect non-pressed fittings by a whistle

When the pipe is inserted in the fitting, but the installer forgot to press it, the connection will be leaking. When executing a pressure test with air, the fitting can easily be acoustically traced by a whistling sound.

DEFINED LEAK

Clear visual water leaking when sleeve is not pressed

When the pipe is inserted in the fitting, but the installer forgot to press it, the connection will be leaking. When executing a pressure test with water, the fitting can easily be visually traced as it is leaking water.

MULTI JAW

Fits multiple pressing jaw profiles: U, Up, TH, B, H

Designed to fit the most common jaw profiles; U, Up, H, TH and B profiles. No need to buy new equipment, thus easy to switch to the new Tigris 5 series without worrying about your system warranty.

IN4SURE™

Proper pipe position visible 360°

It is important to insert the pipe far enough to guaranty a tight sealing between pipe and fitting. A visual check proofs it is properly inserted.

PIPE GRIP

Pipe stays in position before pressing

When a pipe is properly inserted in the fitting, it should keep this position until the (fitting) cap is pressed. PipeGrip prevents undesired movements to ensure a reliable pressing.

ULTRA SEAL

Reliable O-ring sealing, tested beyond market standards

The reliability of the O-rings sealings is tested with a lifetime simulation test under extreme conditions. Tested to 110 ° C which is far above the required max temperature of 95 ° C.

EASYFIT

Hexagonal fitting connectors simplify the insertion process.

The fittings are designed to guide the pipe straight onto the fittings, ensuring that the O-rings are protected from damage during pipe insertion. The patented hexagonal fitting connectors allow for low-force insertion while ensuring a reliable connection.

3. Tigris fitting

3.4. Product features Tigris K5/M5

Based on the proven design of Tigris Radial Press-Fit technology, Wavin offers a rich range of fittings with the latest technology that lead to an outstanding reliable fitting with significant increase flow performance and the unique Acoustic Leak Alert technology. The fittings are equipped with a stainless-steel press sleeve, that gives additional strength and reliability to the system and that is designed for multiple pressing jaw systems. The Wavin Tigris K5/M5 portfolio is available in 16-40 mm.

OPTIFLOW

Reliability is a key requirement to ensure lifetime performance, but also reducing pressure loss to a minimum defines the quality and performance of the installation. Designed specifically to deliver optimal flow performance, the K5/M5-series of Wavin Tigris with OPTIFLOW have up to a 50% larger inner bore. This is especially relevant for the smaller pipe diameters where the impact of inner bore on pressure loss is the biggest. As a result, your customers will enjoy a higher total system performance. When it comes to optimal flow performance, Tigris K5 and Tigris M5 are the fittings of your choice.

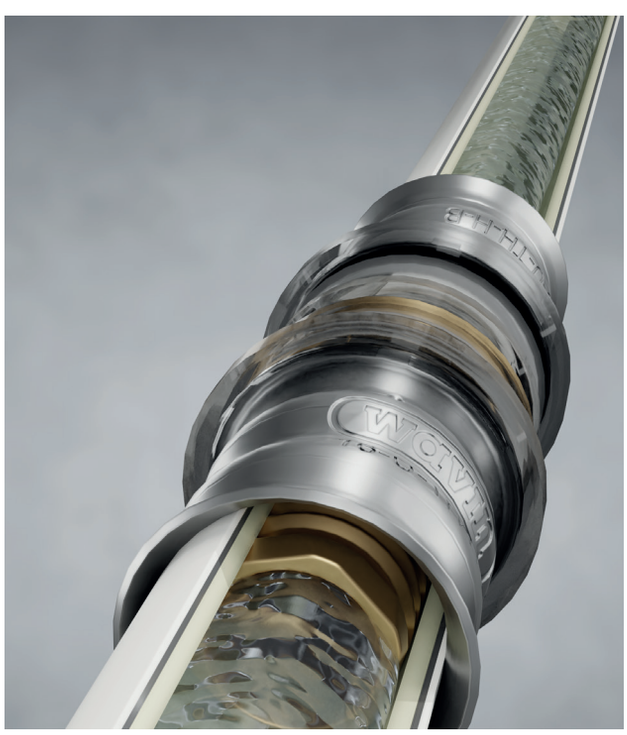


Fig. 6: OPTIFLOW.
Optimal flow performance.

ACOUSTIC LEAK ALERT-testing with air

From a hygiene perspective executing the pressure test with air instead of water might be preferable or even obligatory. However, with Defined Leak alone, an unpressed fitting might be hard to locate on an air test. Therefore Tigris M5 and Tigris K5 are equipped with **Acoustic Leak Alert**. When executing a pressure test with air, this feature enables installers to trace an entire system for leaks caused by connections that have not been pressed.

With ACOUSTIC LEAK ALERT any unpressed fitting emits a loud whistle, which makes locating of the unpressed fitting extremely easy. And, because unpressed fittings are detected so quickly, Tigris M5 and Tigris K5 fittings make testing with air an unbelievably attractive alternative.

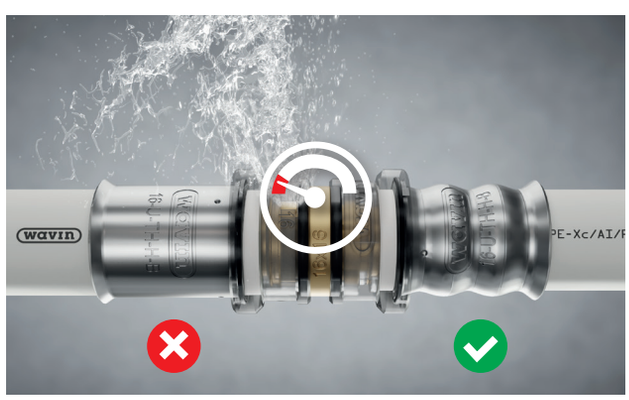


Fig. 7: DEFINED LEAK in the pressure test reveals with leaking water the unpressed fitting.

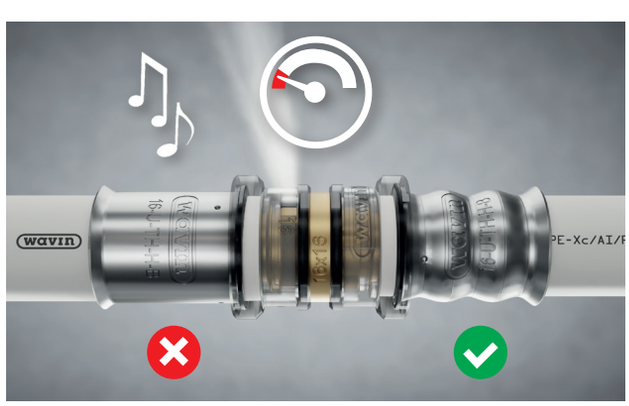


Fig. 8: ACOUSTIC LEAK ALERT. A loud whistle tone caused by the leaking air helps to trace the unpressed fitting.

Using air instead of water for pressure tests avoids stagnating water in the installation – impressively reducing Legionella risks. On top of that, testing with air prevents frost damage during winter months.

Wavin Tigris K5 and Wavin Tigris M5 featuring Acoustic Leak Alert still feature as well Defined Leak. This means no matter what is used, water or air, an unpressed fitting can always easily be found.

Leak prevention

Ensuring a reliable installation is the key aim for every installer and a hygienic system is essential for every drinking water application. To check if the installation is made leak tight there are two options: pressurize the installation with water or with air[2].

DEFINED LEAK-Testing with water

When the pressure test is executed with water, the Defined Leak feature guarantees that an accidentally forgotten unpressed connection is clearly exposed to the installer by visually leaking during the pressure test.

Fig. 9: DEFINED LEAK in the pressure test reveals with leaking water the unpressed fitting.

IN4SURE™

In order to make a reliable pressing, it is important that the pipe is properly inserted into the fitting. The IN4SURE™ feature offers a visual check if the pipe is inserted far enough. The transparent fixring of Tigris K5 and Tigris M5 offers a 360° visual check. This is extremely helpful in difficult access applications. When the pipe is visible, you are ready to press.

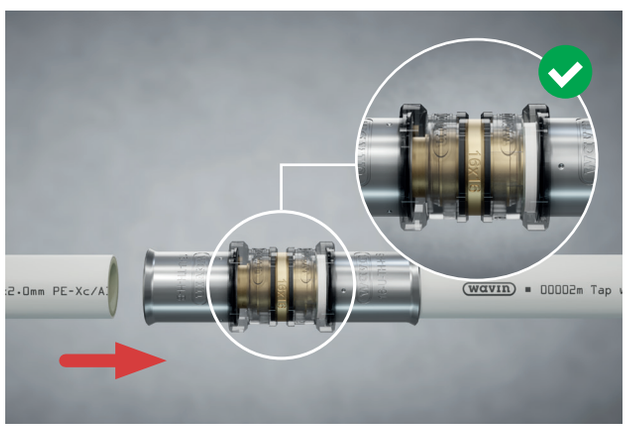


Fig. 10: IN4SURE™ helps to check if the pipe is inserted properly.

[2] Details about test procedures with air or water can be found in chapter 4 Completing the Installation.

[3] At high noise levels, long-term exposure may cause hearing damage and hearing protection is therefore recommended. Be aware that covering the fitting with (thermal) insulation can reduce the sound level.

3. Tigris fitting

MULTI JAW

With MULTI JAW, Wavin Tigris K5 and Wavin Tigris M5 guarantees secure connections regardless of the profile. You can use all of the most common jaw profiles to press the new Tigris K5 or Tigris M5 as they are compatible with U, Up, H, TH and B profiles. This eliminates the need to buy new equipment and makes it easy to switch to the new Tigris M5 or Tigris K5 without worrying about your system warranty.

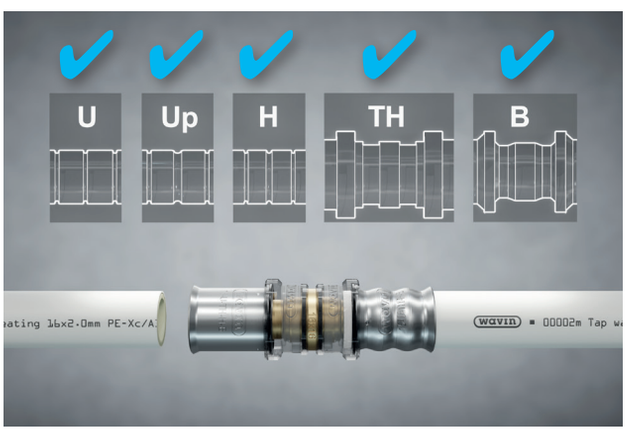


Fig. 11: MULTI JAW.
Pressing possible with the most common pressing profiles. Wavin System Warranty.

EASYFIT

The fittings are designed in a way that pipe is guided onto the sleeve in a straight way and that the O-rings are protected against damage during pipe insertion. The patented hexagonal sleeve-end enables low insertion force, but of course calibration is still allowed if you want to reduce insertion forces further. But if you forget, a reliable connection is still guaranteed.

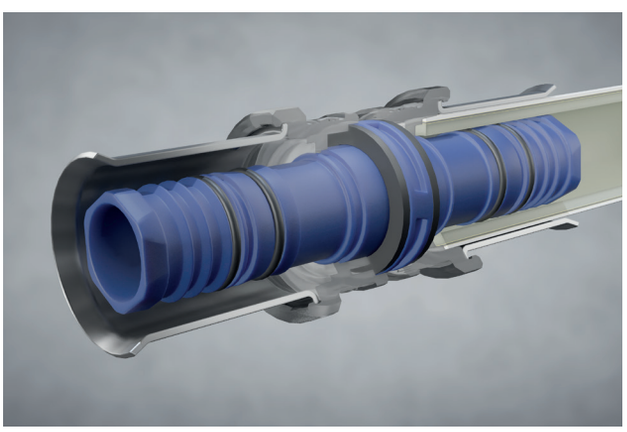


Fig. 12: EASYFIT. Pipe insertion without calibration.

Calibration not required

With the smaller diameters of the Wavin Tigris K5/M5 series it is no longer required to chamfer the pipe after cutting it on the desired length. Just cut the pipe square and insert the pipe into the fitting.

Nevertheless, as high insertion forces can occur for larger diameters of 25 mm and above, we recommend to calibrate.

Fig. 13: Chamfering recommended but not required at diameters up to 40mm for Tigris K5/M5.

ULTRASEAL

The radial press fittings have been designed to ensure a long lifetime, problem free operation and durable sealing. This is established by O-rings of the highest quality EPDM materials that resist high temperatures and have high chemical resistance. They have been exposed in the lifetime simulation test to extreme conditions that are even beyond the ISO standards in order to ensure the utmost reliable sealing possible; ULTRASEAL.

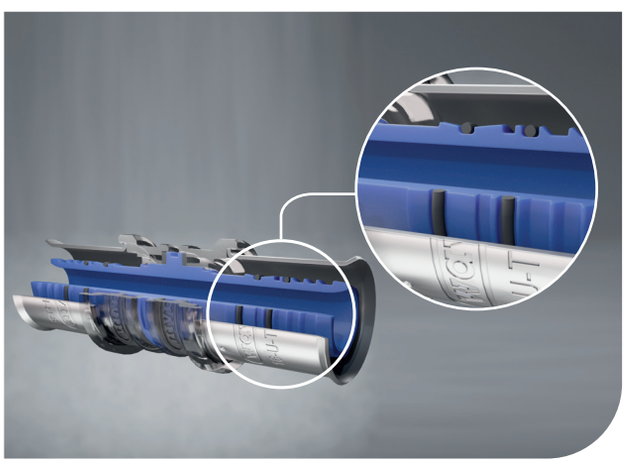


Fig. 14: ULTRASEAL. O-rings have been tested even beyond the ISO requirements for life test simulation.

PIPEGRIP

For a reliable pressing a proper pipe insertion is essential. To ensure that the pipe stays in place whilst not pressed, the caps on the fittings have small dents that firmly hold the fitting and pipe in position. They even hold a pipe weight up to 2 m length. This means that no additional hands are needed to keep the pipe in position and the free hand can be used to operate the pressing tool.

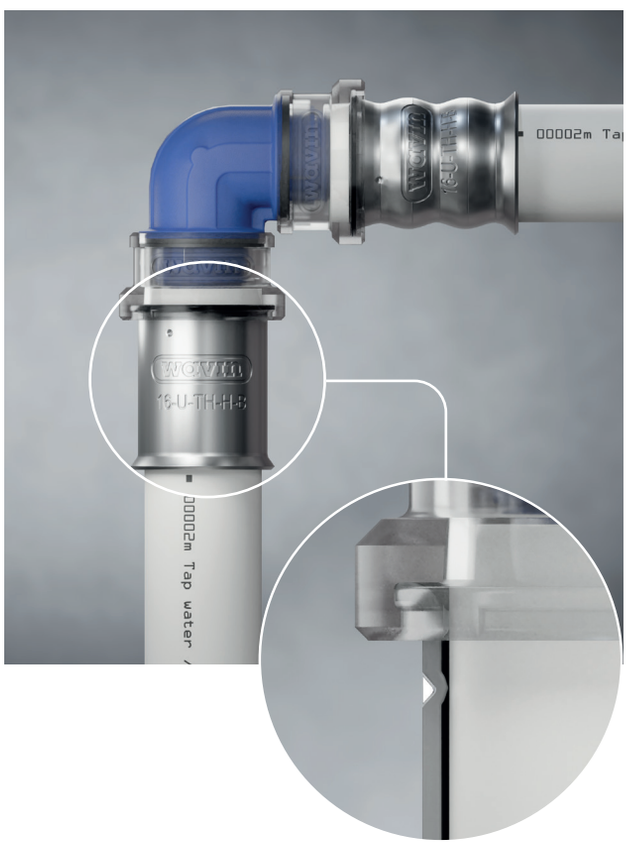


Fig. 15: PIPEGRIP. Firmly holds the pipe in position to have free hands for operating the pressing machine.

3. Tigris fitting

3.5. Product features Tigris K1/M1

The Tigris K1 and Tigris M1 fittings, with patented hexagonal head cross-section, are well known by their many years of proven reliability. The fittings are equipped with a stainless-steel press sleeve, that gives additional strength and reliability to the system. The Tigris K1/M1 fittings should be pressed with U-Profile only. The pipe must be calibrated before pushing into the fitting.

The fittings are suitable for Hot&Cold water applications and heating systems and are available in 50-75 mm.

IN4SURE™

In order to make a reliable pressing, it is important that the pipe is properly inserted into the fitting. The IN4SURE™ feature offers a visual check if the pipe is inserted far enough. The fittings have two observation windows, through which the insert depth of the pipe can be reliably checked before pressing. If the pipe is visible, a reliable pressing can be made.

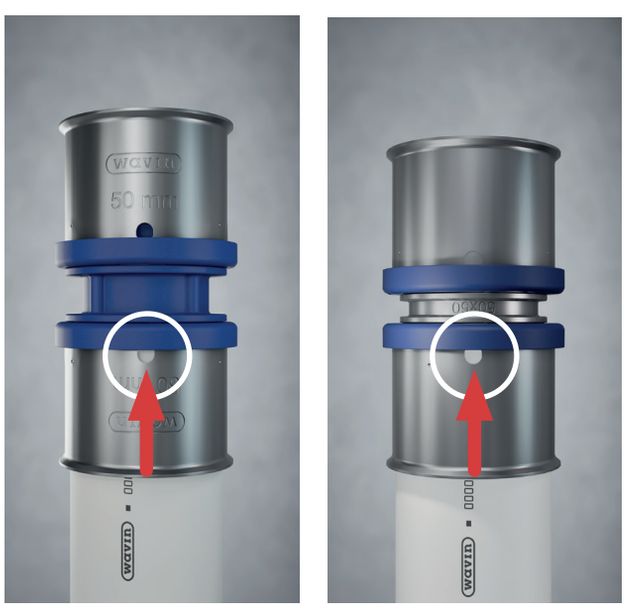


Fig. 16: IN4SURE™. Helps to check if the pipe is inserted properly.

EASYFIT

The patented hexagonal head cross-section has a positive impact on reducing the insertion forces which reduces the force required to insert the pipe. The sleeve is designed for an optimal guidance of the pipe during insertion, whilst eliminating the risk of damaging the O-rings during installation.

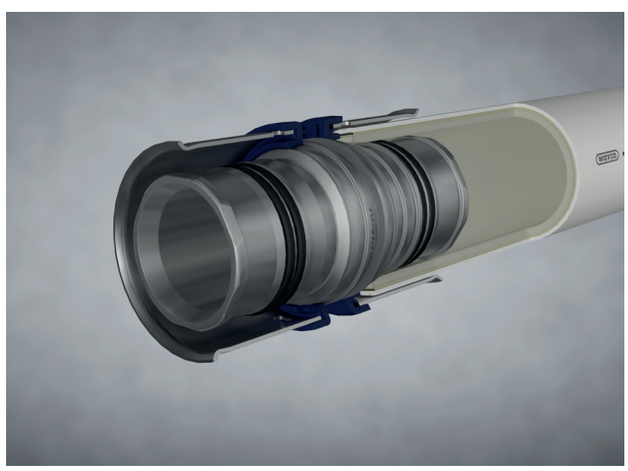


Fig. 17: Low insertion force thanks to the patented hexagonal sleeve-end.

DEFINED LEAK-Testing with water

When the pressure test is executed with water, the Defined Leak feature guarantees that an accidentally forgotten unpressed connection is clearly exposed to the installer by visually leaking during the pressure test.

Fig. 18: DEFINED LEAK in the pressure test reveals with leaking water the unpressed fitting.

PIPEGRIP

For a reliable pressing a proper pipe insertion is essential. To ensure that the pipe stays in place before being pressed, the caps on the fittings have small dents that firmly hold the fitting and pipe in position. They even hold a pipe weight up to 2 m length. This means that no additional hands are needed to keep the pipe in position and the free hand can be used to operate the pressing tool.

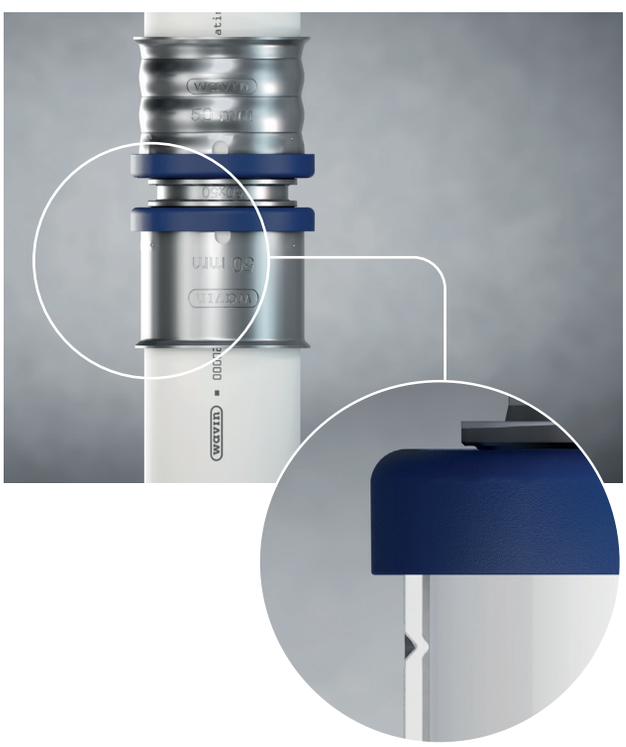


Fig. 19: PIPEGRIP. Firmly holds the pipe in position to have free hands for operating the pressing machine.

Besides these outstanding features, the fittings provide further advantages in practise:

- Possible to combine with Wavin Tigris K5, Wavin Tigris M5 and Tigris MX in one installation
- Dimensions from 50 mm to 75 mm to complete the Wavin MP range
- Quick and safe assembly
- Physiologically harmless

3. Tigris fitting

3.6. Product features Tigris MX

Based on decades of knowledge and experience, Wavin Tigris MX combines and extends the existing Wavin Tigris unique features: An easy-to-handle, high flow performance pipe, that allows this new generation of fittings to go one step further in the optimization of efficient water supply and reduced flow resistance.

The ultimate flow concept by Wavin allows an up to one third reduced pressure loss[1]. In addition to that, the one-fits-all technology allows users to combine several products of Wavin in one system. Wavin Tigris MX is available in the range of 16-32 mm.

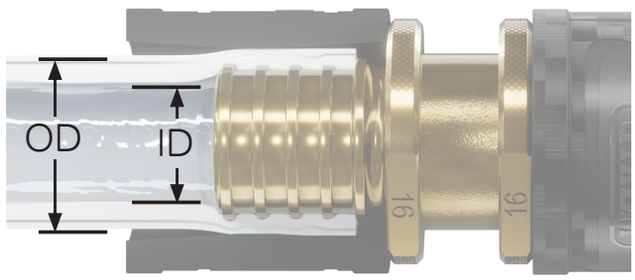


Fig. 20. Wavin Tigris MX

ULTIMATE FLOW

Wavin Tigris K5/M5 already has set new standards for Radial press fitting with the optimized flow thanks to the increased inner bore.

Wavin Tigris MX raises the bar even further. Elaborating on the big inner bore of the Tigris pipe, the straight pipe - fitting bore of the Axial press concept offer optimized solutions in situations with highest requirements in terms of pressure loss. With the improved flow performance of the bigger inner bore, the use of Tigris MX even enables to explain why pipe dimensions can reduce the project costs.
As mentioned above, the ultimate flow connects further advantages when it comes to drinking water and heating applications – the absence of dead space comes along with an improvement of hygienic properties of the system.

No stagnating water eliminates the risks of potential legionella growth and ensures safety for every user. In terms of heating applications, less flow resistance ensures the efficient use of heat pumps. Build safe and sustainable environments with Wavin Tigris MX!

Tool-Fit

The story of easy to install of Wavin Tigris MX continues in the use of tools. Wavin offers a wide range of manual and battery tools for reliable and fast installation. But on top, also the commonly used tools on the market can be used for expanding and sliding.

Only the expander heads that are dedicated for the Wavin multilayer pipes are customized. In that way, no new equipment is needed and a switch to the new Wavin Tigris MX system can easily be done without high investments in new tools!

Leak detection

When not assembled, leakages can be detected by pressure loss when pressurizing with water or air and can be detected visually with water or simply by noticing, when using MP pipes, that the sliding ring is not attached on the fitting – the high contrast between the two colors of pipe and sliding ring is also beneficial for that.

To ensure a safe and reliable connection, Wavin Tigris MX profits from a unique bigger first rib on the fitting, which makes sure, that after sliding no movement backwards can occur.

[1] In comparison to common solutions on the market.

3.7. Technical specifications Fittings

Technical specifications Wavin Tigris K5 and Tigris M5

	Wavin Tigris K5 (16-40 mm)	Wavin Tigris M5 (14-40 mm)
Fitting material	Polyphenylsulfone (PPSU body), press sleeve in stainless steel, threaded inserts: leadfree DZR brass (CW724R)	Brass body (CW 617N / CW724R), press sleeve in stainless steel
Fitting appearance	Blue fitting and transparent fixring	Brass-coloured body and transparent fixring
		
Max. short-term load	95°C (at max. 100 hours in 50 years)	
Max. constant operating pressure	10 bar at 70°C	
Operation only in accordance with ISO 21003 (see Table 10).		

Table 3: Technical specifications of Wavin Tigris K5 and Wavin Tigris M5.

Technical specifications Tigris K1 and Tigris M1

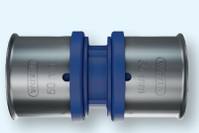
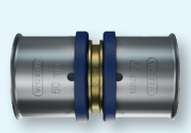
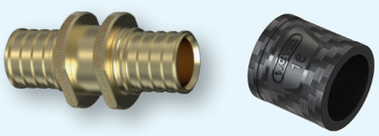
	Wavin Tigris K1 (50-75)	Wavin Tigris M1 (50-75)
Fitting material	Polyphenylsulfone (PPSU), press sleeve in stainless steel, threaded inserts: leadfree DZR brass (CW724R)	Brass (CW724R), press sleeve in stainless steel
Fitting appearance	Blue	Brass color
		
Max. short-term load	95°C (at max. 100 hours in 50 years)	
Max. constant operating pressure	10 bar at 70°C	
Operation only in accordance with ISO 21003 (see Table 10).		

Table 4: Technical specifications of Wavin Tigris K1 and Wavin Tigris M1.

Note: it is highly recommended to apply insulation to pipes that are exposed to continuous high operating temperatures to avoid energy loss and prevent blistering.

Technical specifications Wavin Tigris MX

	Wavin Tigris MX
Fitting material	Brass, leadfree (CW 724R)
Fitting appearance	Brass coloured body and black sliding ring 
Sliding ring material	PVDF
Sliding ring color	Black, structured
Sliding ring shape	Fit-optimized for dimension
Max. constant operating pressure	10 bar
Max. short-term load	95°C (at max. 100 hours in 50 years)

Operation only in accordance with ISO 21003 (see Table 10).

Table 5: Technical specifications of Wavin Tigris MX.

4. Installation

Instructions

This chapter will provide you a clear instruction how to store, handle and install the various Tigris products in a professional, reliable and efficient way.

After a quick guide to get started and informing you about some general guidelines, it will guide you in detail from the preparation to execution and to final testing of the finished installation.

Please read the instructions carefully, especially when working with Wavin Tigris products for the first time. This chapter will end by showing examples of the most common installation designs.

4.1. Overall installation instructions

The respective current codes of practice must be observed in the installation of the Wavin Systems Tigris K5, Tigris M5, Tigris K1, Tigris M1 and Tigris MX. These systems are to be assembled only by trained and qualified professionals and with appropriate tools only.

Wavin Tigris systems are constructed in accordance with the relevant codes of practice. The mountings used must be adequate for fixing the composite pipe in the respective nominal diameter. To reduce sound transfer and head loss mountings with a sound and temperature insulation insert are recommended.

The expected linear expansion based on maximum temperature feed and line length must be considered. A distinction is generally drawn between fixed points and flexible points as fixing methods. Fixed points divide the pipeline element into separate sections and provide stability. Flexible point fixings enable expansion and movement of the pipeline concerned.

4.2. A quick guide to get started

The next page overview gives you a quick guide to get easily started with installing the Wavin Tigris family products. In the chapters that follow you will find out all details that help you making a perfect installation.

Before starting the installation, always check pipes and fittings for dirt and internal damage to prevent an eventual negative impact on the reliability of the system.

4. Installation

4.3. General guidelines for handling and storage

Storage and handling

The Wavin system components are well protected in the original packaging. Nonetheless, all components (fittings and pipes) should be protected from mechanical and environmental damage.

Impairment due to ultraviolet radiation

Wavin multilayer composite pipes must be protected from direct, intense sunlight and ultraviolet (UV) radiation. This applies both for the storage of the pipes and for finished installation. Storage must therefore not take place in the open air. Suitable measures must be taken to protect finished systems and system components from the effects of UV rays.

Observe press and push-fit fitting assembly instructions

- Always cut the pipe to length at right angles
- Wavin Tigris K1, Wavin Tigris M1:
  Calibrate and chamfer the pipe end all round
- Push the pipe into the fitting to the stop
- Check the press or push-fit fitting observation window respectively the transparent fixring
- Press in the case of the press fittings
- See chapter 3 Detailed installation instructions for further details.

Potential equalisation

Building and electrical regulations, such as DIN VDE 0100-540 VDE 0100-540, demand potential equalisation between earth wires and “conductive“ water, wastewater and heating pipes. As Wavin Hot&Cold water systems do not represent conductive pipe systems, they cannot be used for potential equalisation and are accordingly not to be earthed. An approved electrician must check that the installation of Wavin Tigris K1/M1, Wavin Tigris MX and Wavin Tigris K5/M5 does not impair the existing electrical protective and earthing measures.

Installation temperature

Please check the information sheet of the tools. But in general should the installation temperature for Wavin pipe systems should not fall below -10°C. The operating temperatures of the new pressing machines with the Li-ion batteries from the Wavin range must be above -15°C not above 40°C. The optimum processing range for Wavin full plastic pipes and for Tigris MX is above 5°C. For MP pipes it is 10°C

Frost protection

When using Wavin Tigris with pipe networks that require protection from frost (e.g. cold water networks, brine pipes), we recommend the use of ethylene glycol (to protect from risk of freezing). Ethylene glycol can be used up to a maximum concentration of 35%. This concentration roughly corresponds to frost proofing of -22°C. Before using alternative frost protection additives, confirm the suitability/approval with your contact at Wavin.

Sealing

The assembly of a threaded connection must be in accordance with the local standards, like DIN 30660 and DIN EN 751-2. We strongly recommend the use of PTFE / Teflon Tape to seal the connection. Only hemp in combination with the tested Griffon Silpat, Unipak Paksalve and Neo-Fermit pastes are suitable for PPSU. Next to these, also Teflon (PTFE) tape and Loctite 5331 thread sealant can be used for K1/K5. Restrict the amount of hemp as too great a quantity can result in damage to the internal threads and cross-threading. When using hemp make sure that the thread tips remain visible. Check the local regulations about using hemp in drinking water installations.

Contact with substances containing solvents

Avoid direct contact of Wavin Hot&Cold Water Systems with solvents or construction materials containing solvents (such as paints, sprays, expanding foams, adhesives [as e.g. Armaflex 520]). Aggressive solvent can lead to negative impact on the plastic material. Because ammonium-chloride and nitrate containing media can cause crack corrosion, the used material and auxiliary materials as well as the surrounding environment must be free of this to avoid impact on the metal material.

Note

Specifically, chemical sealants and adhesives (e.g. 2-part adhesives) must not be used. Expanding foams produced on the basis of methacrylate, isocyanate and acrylate must not be used. Under unfavourable circumstances, aggressive chemicals that are present may cause damage to the plastic material. The Wavin systems do not require the use of any chemical substance or additional lubrication during installation. Cold welding agents as used for welding PVC protection foils for pipe insulations, which contain Acetone or Tetrahydrofuran (THF), must not be used.

Insulation

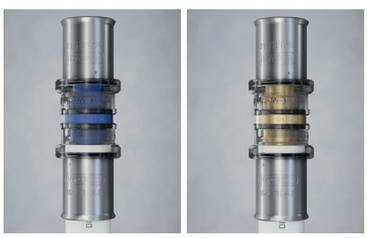
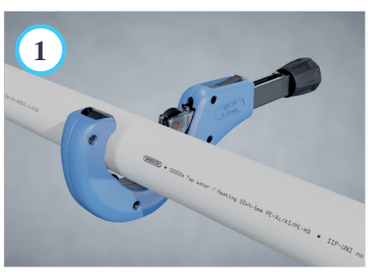
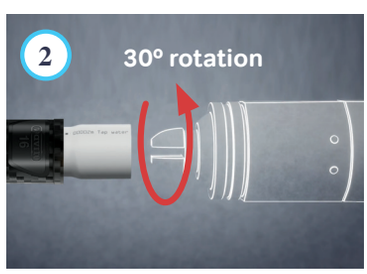
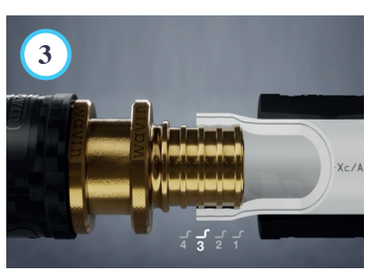
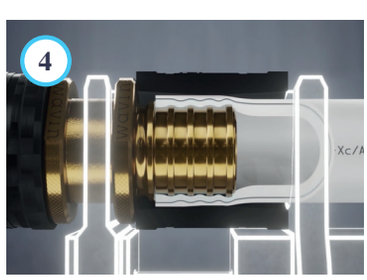
Pipes and connectors always have to be insulated according the local laws or regulations.

Water heaters, flow-type heaters, and fresh water stations

The white Wavin multilayer composite pipes are suitable for applications according ISO 10508 for drinking water applications according class 2 and heating applications according class 5 (see table in chapter Thermal Disinfection). Thermal and pressure overloads in the composite pipe network must be prevented through appropriate safety measures, including the use of suitably regulated equipment and monitoring equipment. The equipment hast to be approved as suitable for this application by the manufacturer.

4. Installation

Detailed installation instructions

Wavin Tigris K5 | M5 16 - 40 mm	Wavin Tigris K1 | M1 50 - 75 mm	Wavin Tigris MX 16 - 32 mm
		
		
		
		
		

* Optional, as high insertion forces can occur for larger diameters of 25 mm and above, we recommend to calibrate.

4.4. Making a radial press fit

1. Radial press fit preparation

Always use the right pipe cutter to ensure a proper cut. By using other tools, e.g. saws and other cutting tools not approved in this handbook by Wavin will affect the systems guarantee.

Pipe scissors can be used for the dimensions 16mm - 25mm*.
Pipe cutters can be used for the dimensions 32mm - 72mm..
Make sure the cut is always made perpendicular to the pipe.
Remove eventual remaining burrs or sharp edges.

* For Italy including 20 x 2.0, 26 mm, 14 mm for the Netherlands.

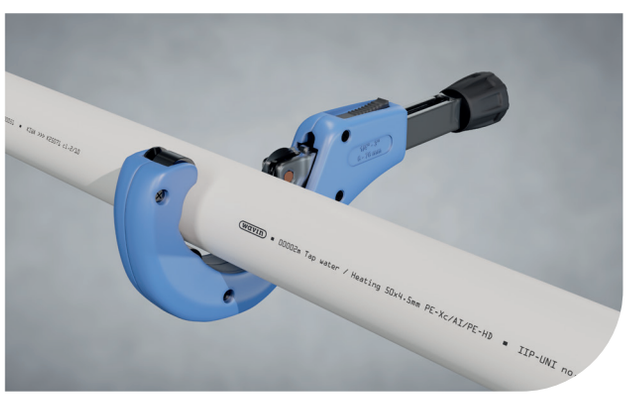


Fig. 21: Cutting the pipe.

2. Calibration and chamfering

For **Tigris K1/M1** calibration and chamfering is always required.
For **Tigris M5/K5** it is recommended, especially for 32 and 40 calibration is recommended to reduce push in forces.
Only use the original Wavin calibration tools. By using other calibration tools the system guarantee is affected.

- Dimensions* 16 – 25 mm: all-round chamfer of depth minimal 1 mm.
  Maximum battery or drilling machine rotation speed should be 500 rpm.
  Remove accumulated shavings from the calibrating pin.

- Dimensions 32 – 75 mm: all-round chamfer of depth minimal 2 mm.
  Do not use a battery or drilling machine for safety reasons.
  Careful: only use lowest RPM when using it.

* For Italy including 26 mm, 14 mm for the Netherlands.

4. Installation

3. Push in and check

Make sure the pipe is correctly inserted.

- Wavin Tigris K5 and Wavin Tigris M5: Push the pipe into the fitting until the stop (visible in fix ring window)
- Wavin Tigris K1 and Wavin Tigris M1: Push the pipe into the fitting until the stop (visible in cap window)

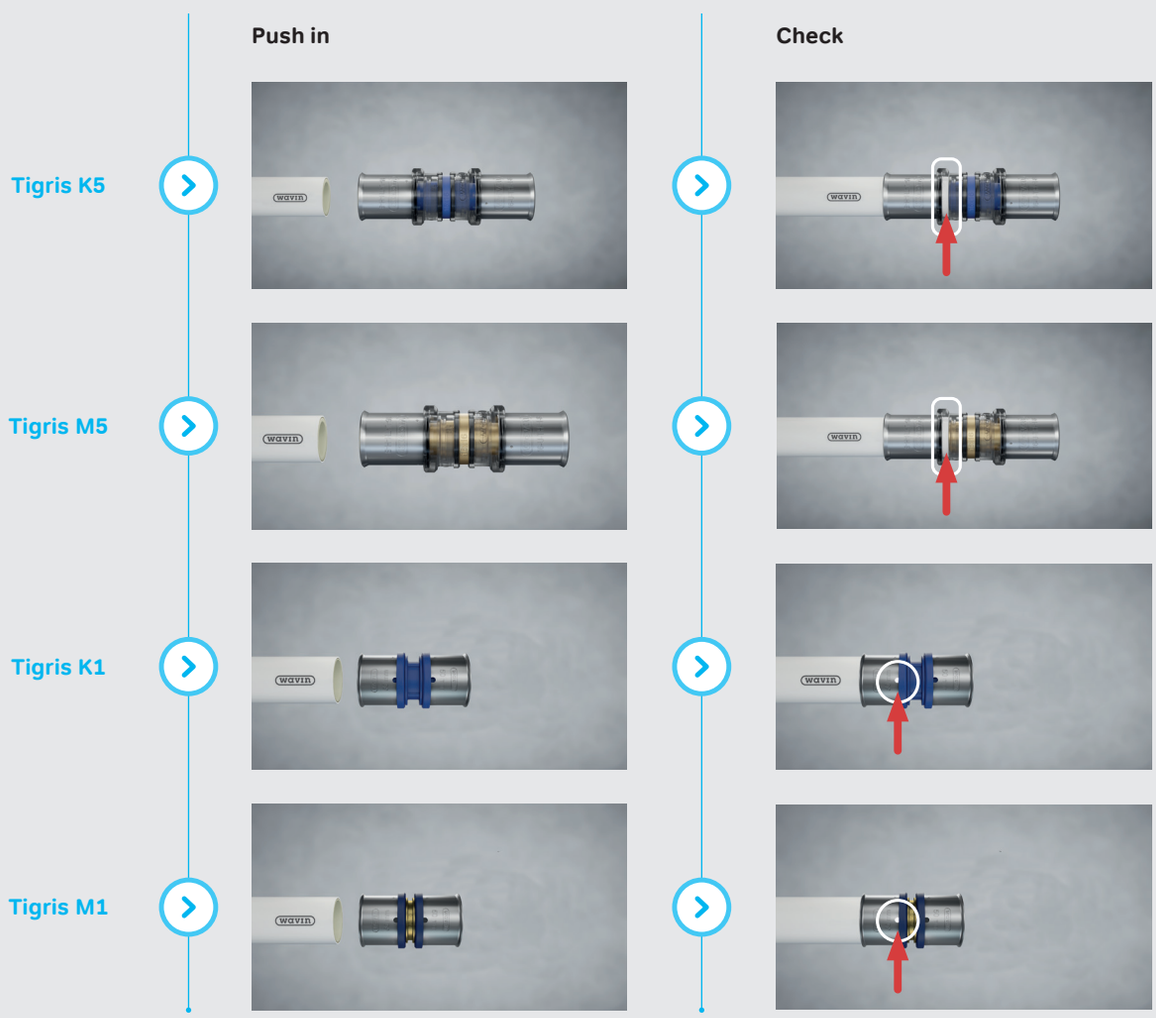


Fig. 22: Checking the correct pipe insertion.

4. Execute pressing

Radial press Systems Wavin Tigris K5/M5 and Wavin Tigris K1/M1: Always position the jaw perpendicularly between the guides of the cap and fixring. For Tigris K1/M1 only use U press profiles. For Tigris K5/M5 you can use U/Up/B/TH/T profiles, see details about the various cap positions in the diagram below. The pressing should only be performed once for each sleeve.

Multiple pressing Jaws

In general all Wavin Tigris Radial Press-Fit fittings (up to 75 mm) can be pressed with pressing jaws with the " U" profile. The Wavin Tigris K5 and Wavin Tigris M5 (16-40 mm) can be pressed with "U", "Up", " TH" ,"H" and "B" profile. Below gives the right positioning of the jaws on the fitting.

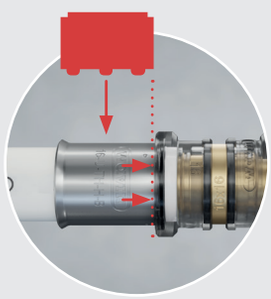
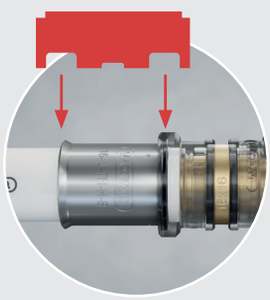
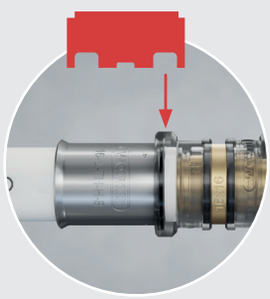
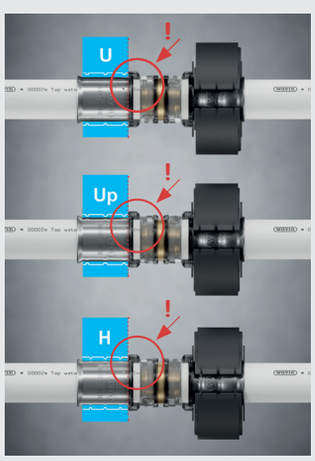
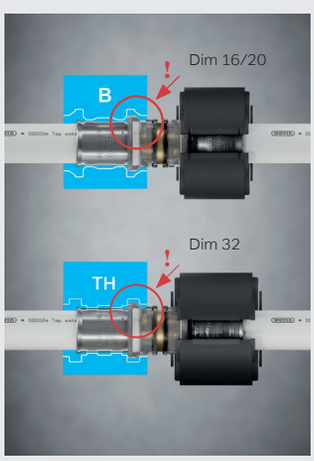
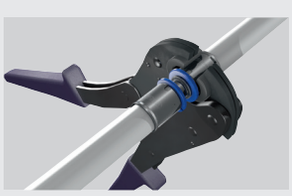
Positioning the pressing jaws with:	U/Up/H profiles 16 - 40 mm	TH/B profiles 16 - 20 mm	TH/B profiles 25 - 40 mm
			
• Tigris K5/M5: Multiple pressing jaws			
			
• Tigris K1/M1: Only use U-profile.	• The pressing jaws should cover the metal cap, in between the fix-ring and the metal cap rim. • Always use the **rim of the fix-ring** as end-stop for all diameters to position the pressing jaw on the metal cap.	One of the big grooves of the pressing jaws should always cover the fix-ring collar. • **For 16-20 mm**: one jaw-groove covers the fix-ring, the other jaw-groove covers the metal cap collar.	• **For 25-40**: Only the fix-ring is covered by the jaw-groove. The metal cap collar is not covered by the jaw-groove.

Fig. 23:
Positioning the pressing jaws on the fitting with Wavin Tigris K5 and Wavin Tigris M5.

4. Installation

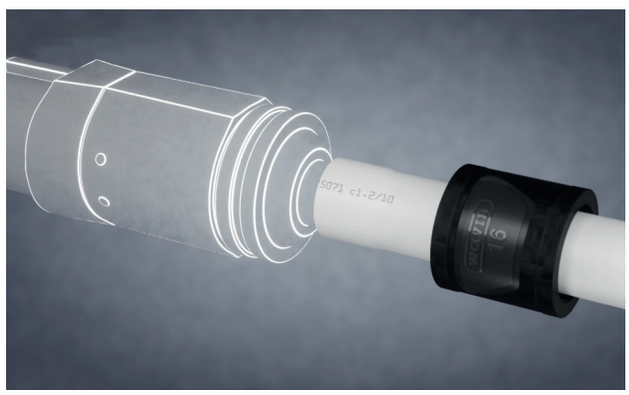
4.5. Making an axial press fit

To install Wavin Tigris MX, a few steps have to be followed as in the following instruction explained.

1. Preparation

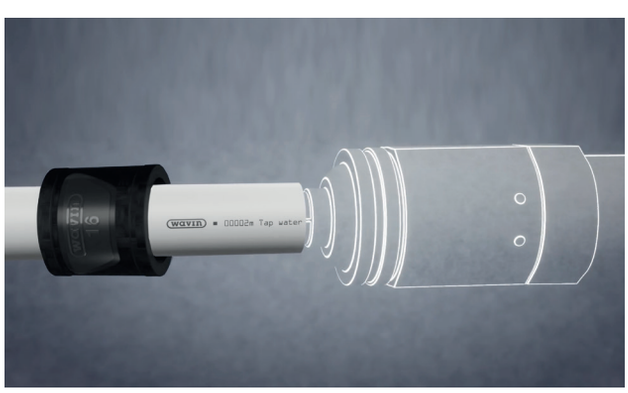
Always use the right pipe cutter to ensure a proper cut. By using other tools, e.g. saws and other cutting tools not approved in this handbook by Wavin will affect the systems guarantee.

Pipe scissors can be used for the dimensions 16mm - 25mm. Pipe cutters can be used for the dimensions 32mm - 72mm.. Make sure the cut is always made perpendicular to the pipe. Remove eventual remaining burrs or sharp edges.



2. Assembly

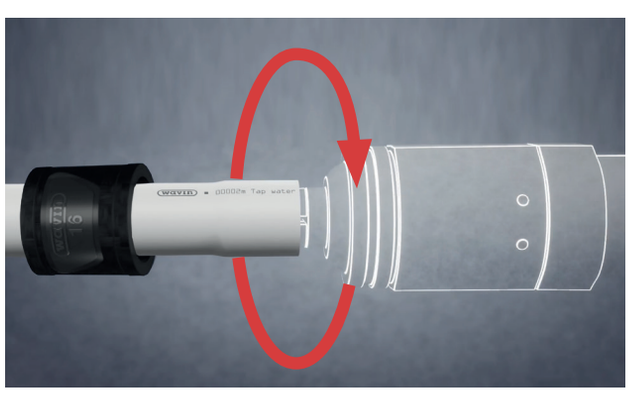
Put the sliding ring on the pipe first. Afterwards, stick the expander head in the pipe. In case one pipe shall be prepared at both sides, make sure to put two sliding rings on the pipe first.



3. First expansion

Expand the pipe the first time. Make sure to expand until the expanding process is completed.

Note Do not forget to put the sliding ring on the pipe before expanding.

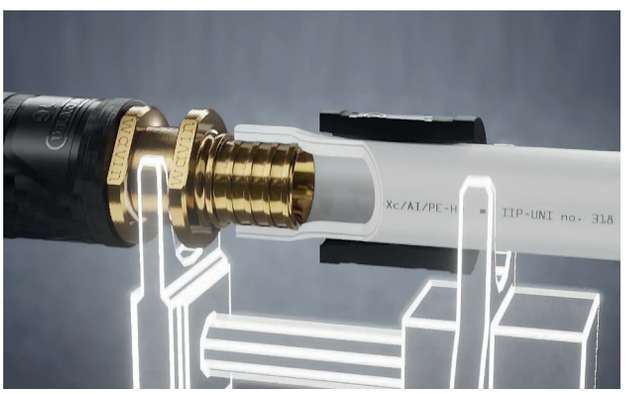


4. Second expansion

Following a 30-degree rotation of the pipe, proceed with the second expansion. Ensure that the expansion process continues until it reaches its end cycle for a complete expansion of the pipe.

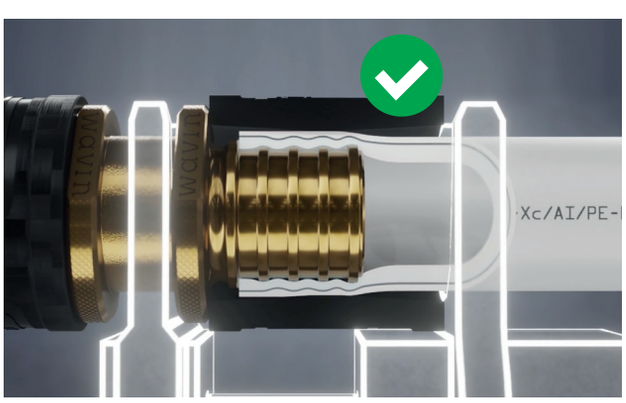
5. Push the pipe onto the fitting

Push the pipe over the third rib. To ensure that the expansion has been done correctly, ensure that the pipe covers the third rib of the fitting. The pipe will be pulled over the fourth rib during the sliding process.



6. Positioning of sliding forks

Before sliding the sliding ring onto the fitting, make sure that the sliding forks are positioned correctly. For that, one fork grabs the sliding ring, the other fork grabs the flange of the fitting sides.



7. Complete the connection

To finish the connection, push the sliding ring onto the fitting until it touches the flange. During this process, the pipe will be pulled over the fourth rib. The front rib on the fitting has a bigger diameter then the other ribs, this ensures a reliable connection and makes sure that no backward movement of the sliding ring can occur.

4. Installation

4.6. Pipe bending

By bending the pipe the demand of fittings needed for the installation can be reduced. The pipe is easy to bend: by hand, with the aid of the bending spring or using the Wavin bending pliers. Bending springs and bending pliers are preferred to be used to ensure the pipe is not kinked by accident. See the table below showing the bending radius overview.

Be aware that the installation shall be done in a tension-free way. Therefore, bending after pressing is not recommended and can lead to damages of the system.

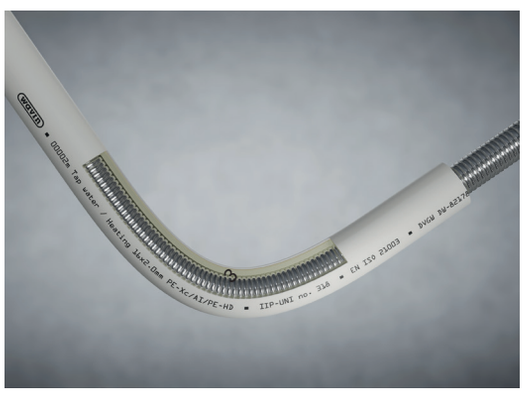


Fig. 24: Bending the pipe with a bending spring.

Measurement Dn x s mm	Bending radius By hand mm	Bending radius Bending spring mm	Bending radius Bending iron mm
14 x 2,0			
16 x 2,0	5 x ø ≈ 80	4 x ø ≈ 64	ca. 46
20 x 2,0	5 x ø ≈ 100	4 x ø ≈ 80	ca. 52
20 x 2,25	5 x ø ≈ 100	4 x ø ≈ 80	ca. 52
25 x 2,5	5 x ø ≈ 125	4 x ø ≈ 100	ca. 83
26 x 3,0	5 x ø ≈ 130	4 x ø ≈ 105	ca. 88

Table 6: Bending radius overview.

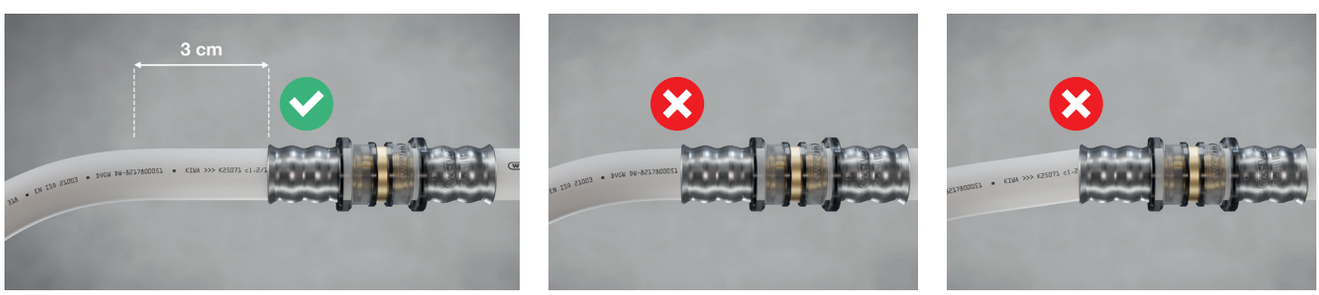


Fig. 25: Bending of the pipe directly at the fitting is not allowed. A minimum distance of 3 cm must be observed.

4.7. Wavin Tigris M5 transition to metal/copper

- Check the copper/metal pipe for damages or burrs. Remove damaged section or burs before continuing.
- Slide the press connection into the copper fitting and press according to the specifications of the copper fitting manufacturer. A minimum space of 5 mm must be observed between the soldered joint and outer edge of the copper fitting.
- Press the copper fitting on the pipe according to the instructions of the copper fitting supplier.
- Mount the Tigris pipe according to the Tigris M5 and Tigris K5 assembly steps described in this technical manual.

Attention: Do not solder, otherwise the sealing rings on the press transition to copper might be damaged.

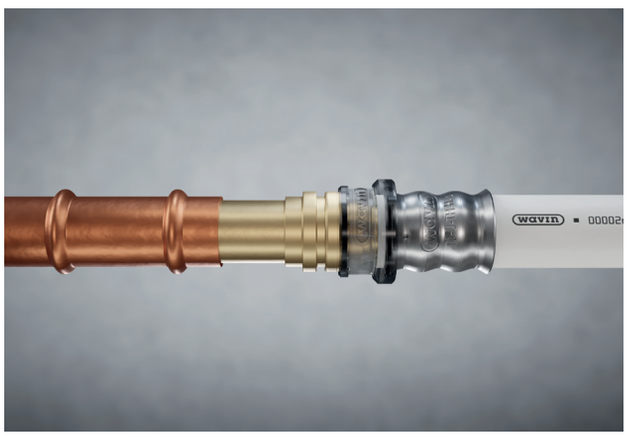


Fig. 26: Transfer coupler to metal and copper pipes with Wavin Tigris K5 and Wavin Tigris M5.

4.8. Wavin Tigris M5 Press transition to metal/copper

Preparations on the metallic connection side

Cut pipes at right angles using a roller pipe cutter or a fine-toothed metal saw suitable for the respective material. Avoid discoloration at all costs.

IMPORTANT: When processing stainless steel pipes, the cutting speed must be low enough to prevent sensitization of the stainless steel due to heating. Additionally, the saw blade or cutting wheel must not have been previously used for unalloyed ferrous materials.

- Carefully deburr the pipe end inside and outside using a suitable deburring tool (e.g., pipe deburrer or file). Thoroughly remove chips and deburring residues.
- Mark the insertion depth on the pipe with a waterproof pen.
- Check the sealing ring for correct fit, dirt, and damage.
- Then insert the pipe end or the outer press end of the press fitting into the fitting socket up to the stop with a slight rotating movement and gentle pressure.

Caution:
Do not solder or weld, as this may damage the sealing rings of the press transition due to heat transfer.

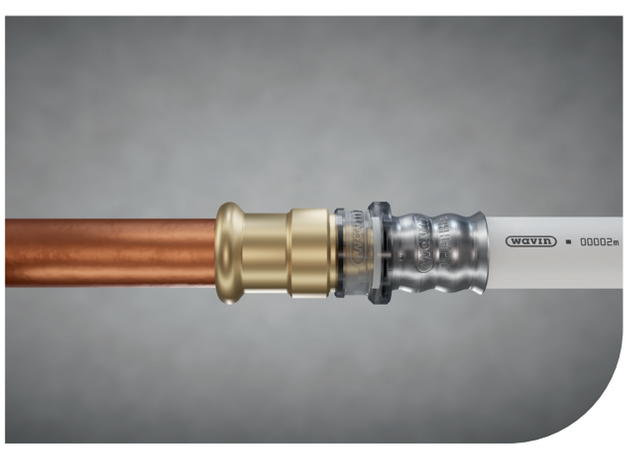


Fig. 27: Press connection transfer coupler to metal and copper pipes with Tigris M5.

4. Installation

Pressing

- For metallic pipe connections, press jaws and slings must have the original SA, M, or V profiles.
- Install Tigris multilayer composite pipe according to the assembly steps in the quick guide for Tigris K5/M5.

Caution:
Do not solder or weld, as this may damage the sealing rings of the press transition due to heat transfer.

Wall Clearance
The following minimum distance is required for fitting installation:

- 10 mm between fitting and wall.

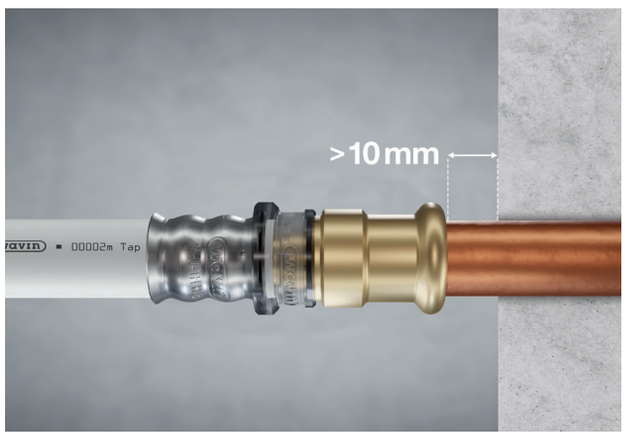


Fig. 28: Minimum distance between fitting and wall.

4.9. Tigris M5 Push-fit transition to copper

Preparations on the metallic connection side

- Cut copper pipe at right angles.
- Carefully deburr the copper pipe inside and outside and calibrate soft copper pipe.
- Check the transition coupling for cleanliness and correct positioning of sealing elements.
- Push the transition coupling onto the copper pipe as far as possible. Do not use oil or lubricant.
- Install Tigris multilayer composite pipe according to the assembly steps in the quick guide for Tigris K5/M5.

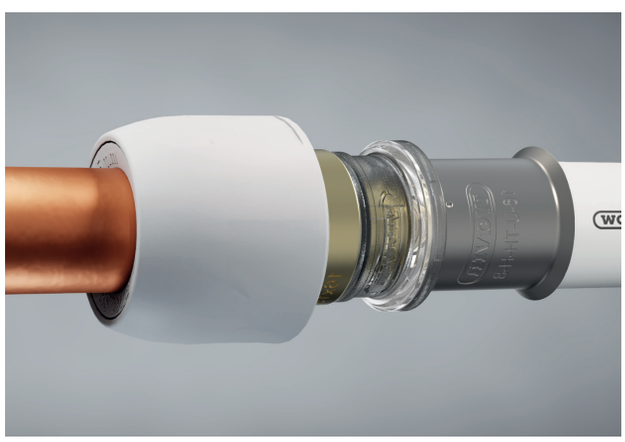
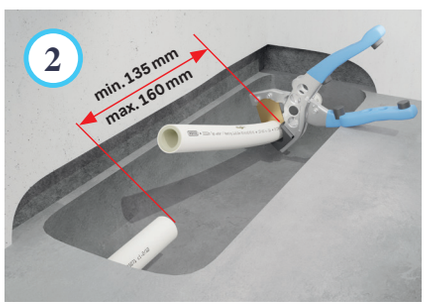


Fig. 29: Push-fit transition to copper for Tigris M5.

4.10. Repair Couplers

In case a damaged or leaking section of pipe is found in a finished installation, the affected pipe section can be replaced by using the Wavin Repair Coupler. Follow the below steps for a reliable installation.

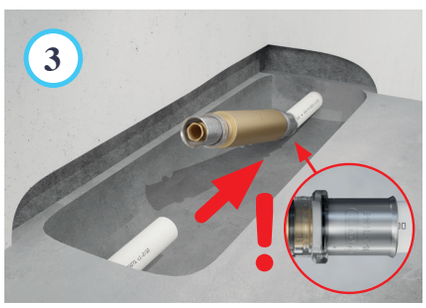
Reveal the area around the leaking part when the pipe is covered by e.g. plaster or concrete.



Cut away the pipe section that is damaged or leaking.

Note the minimum and maximum distance between both pipe ends, in order to guarantee a secure new connection.

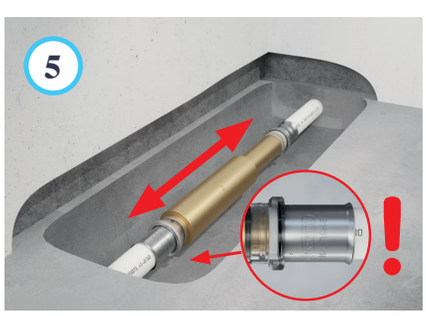
- **Minimum length 135 mm**
- **Maximum length 160 mm**



Make sure the pipe surface is completely smooth and clean.

Place one connector of the Wavin Repair Coupler on one of the free pipe ends. Check in the viewing window that the pipe is inserted correctly. (IN4SURE™)

Press the assembled connection.



Pull out the free end of the Wavin Repair Coupler and insert the other connector onto the remaining free pipe end.

Check in the viewing window that the pipe is inserted correctly. (IN4SURE™)

Press this second assembled connection.

Finally execute the regular pressure test, to make sure the installation is leak tight again.

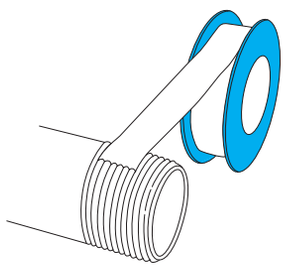
Fig. 30: Installation steps repair coupler.

4. Installation

4.11. Threaded fittings

To ensure a reliable connection to other pipe systems and other components of the installation standardized threaded connectors can be used.

A conical connection (Rp) should be made as follows:



- Cover the male thread with Wavin-approved sealing tape.
  Wrap Wavin-recommended PTFE sealing tape around the male thread 3 to 5 times by hand.
- Assemble the threaded connection in accordance with local standards, such as **DIN 30660 and DIN EN 751-2**.
- Always avoid tightening the connection all the way to the end of the thread, as this may cause leaks.
  If the fitting is unscrewed, the sealing tape must be reapplied to prevent leakage.
  A sealed and mounted fitting should never be turned back!

Wavin recommends using PTFE sealing tape to seal the connection. Alternatively, hemp may be used, but only in combination with an approved plastic sealing compound, such as **Fermit**. Use hemp sparingly, as excessive amounts can damage the threads or the fitting body. When applying hemp, ensure that the thread tips remain visible.

Always check local regulations regarding the use of hemp in drinking water installations.

Do not use sealing solvents in combination with Tigris K5 (PPSU) fittings. Many solvents can cause tensile stress in the PPSU body, which may lead to cracks and leakage.
Only use solvents that are listed in the approved chemical list in this handbook.

Tigris male threaded fittings with female flat seal counterparts
Do not use Tigris male threaded (Rp) fittings with flat-seal female threaded (G) screw connections. This combination can create excessive tensile stress in the fitting or seal, which may cause cracks and lead to leakage.

5. Completing the installation

Leak and pressure tests and flushing

5.1. Pressure tests (Defined Leak & Leak Alert)

After finalizing the installation, a leak- and pressure check should be executed. The tests can be executed with water or (clean) pressurized air. Be aware that depending on the circumstances, testing with water might require additional measures to prevent legionella caused by stagnated water afterwards.

Working with pressure always requires taking the necessary precautionary measures!

One of the causes of leakage can be an unpressed connection or wrongly pressed connection.

Wavin Tigris offers 2 time saving ways of easily tracing the pressed connections when executing a pressure test to safe time in the final pressure test that is required for installation release; Defined Leak or Acoustic Leak Alert.

5.2. Function check with water- Defined Leak

The Defined Leak test serves as an initial check to instantly trace unpressed connections when executing the installation function check. When the function check is carried out with water, the leak from unpressed connections is clearly visually identifiable by dripping water from the fitting. Press the fitting or replace a wrongly pressed fitting to restore the connection. Repeat the check until all malfunctioning fittings have been properly pressed.

It is advised to always start with carrying out a visual check on the connections (pressed/unpressed) to avoid any damage caused by leaking water.

After this initial check, the system can be pressurized according to the local required procedures to execute the pressure test. Below you find a summary of a common test procedure for testing with water. Please check your local regulations for local defined procedures in executing the pressure check with water.

5.3. Function check with air - Acoustic Leak Alert

The Acoustic Leak Alert test serves as an alternative check to instantly trace unpressed connections when executing the installation function check.

With Wavin Tigris K5 and Wavin Tigris M5 there is now an alternative way to check for unpressed connections with air pressure instead of water.

Testing with air instead of water can be beneficial for several reasons. There is no danger of frosted pipes or water damage, there is no potential legionella risk caused by stagnating water and it is a clean way of testing, that can be executed independently from available water supplies on building sites.

When the function check is carried out with air, the leak from unpressed connections is easily traceable by a loud acoustic whistle sound generated by the leaking connection. By just following the sound, the connection can be found and pressed or replaced, depending the cause of the leak. Repeat the check until all malfunctioning connections have been properly pressed.

After this initial check, the system can be pressurized according to the local required procedures to execute the pressure test. Below you find in a summarized way a common test. procedure for testing with air. Please check your local regulations for local defined procedures for executing the pressure check with air.

Fig. 31: Defined leak when testing with water.

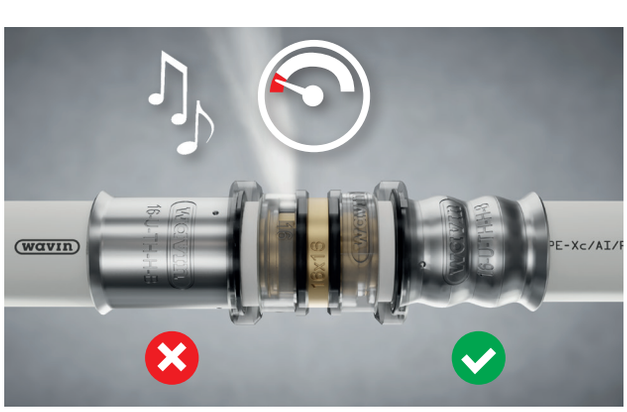


Fig. 32: Acoustic Leak Alert when testing with air.

5. Completing the installation

5.4. Protocol example – pressure test with water – Defined Leak

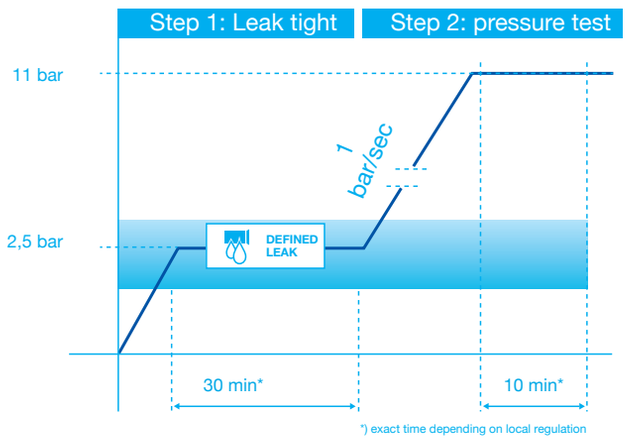


Fig. 33: Pressure test protocol when testing with water.

It is essential that a system pressure test is carried out in line with the relevant local regulations for plastic pipe systems used for drinking water or heating systems. Clean filtered drinking water should be used for the test.

If there are no clear local regulations available then Wavin recommends to use the testing procedures according to DIN 1998 Part 2. The main requirements of the test conditions, including records to be kept are summarised below.

Due to the risk of high pressures, it is common and recommended to execute the water pressure test in 2 steps. A practical and safe method is described in the German (BTGA 3002) as well as the Dutch (WB 2.3) testing procedures. These procedures distinguish the following 2 steps:

1) check connections on leak tightness
2) check connections on pressure resistance

For step 1 the system is stepwise pressurized up to approx. 2,5 bar (WB 2.3) and set for a defined time frame (minimum 10 min for WB 2.3). The pressure on the system is noted at the start and the end of this period. Differences between the initial installation pressure and the pressure after the defined time indicate if the pressure test has been executed successfully (no pressure drop) or if there are leaks (pressure drop).

Wavin Defined Leak has been designed to instantly indicate leaking fittings at this stage of the process. This means that malfunctioning connections can instantly and safe be discovered in a visual way by looking for the dripping fitting. This saves valuable time in diagnosing and tracing a malfunction.

For step 2 the system is pressurized on 1,1 times the maximum working pressure (normally 10 bar) , this means a test pressure of 11 bar. Again the pressure on the system is noted at the begin and the end of the defined time frame (minimum 10 min for WB 2.3).

Differences between initial pressure and final pressure after the defined time indicate if the pressure test has been executed successfully.

Be aware that SAFETY PRECAUTION MEASURES are taken when applying high pressures on the piping system.
The results should be recorded and signed for.

5.5. Protocol example – pressure test with air – Acoustic Leak Alert

The Acoustic Leak Alert test serves as an alternative check to instantly trace unpressed connections when executing the installation function check.

With Wavin Tigris K5 and Wavin Tigris M5 there is now an alternative way to check for unpressed connections with air pressure instead of water.

Testing with air instead of water can be beneficial for several reasons. There is no danger of frosted pipes or water damage, there is no potential legionella risk caused by stagnating water and it is a clean way of testing, that can be executed independently from available water supplies on building sites. When the function check is carried out with air, the leak from unpressed connections is easily traceable by a loud acoustic whistle sound generated by the leaking connection.

By just following the sound, the connection can be found and pressed or replaced, depending the cause of the leak. Repeat the check until all malfunctioning connections have been properly pressed. After this initial check, the system can be pressurized according to the local required procedures to execute the pressure test.

Below you find in a summarized way a common test. procedure for testing with air. Please check your local regulations for local defined procedures for executing the pressure check with air.

Always execute tests according to local legislation or standard. Be aware that Acoustic Leak Alert is just an aid to rapidly find the leaking fitting. It does NOT replace the required leak- and pressure test.

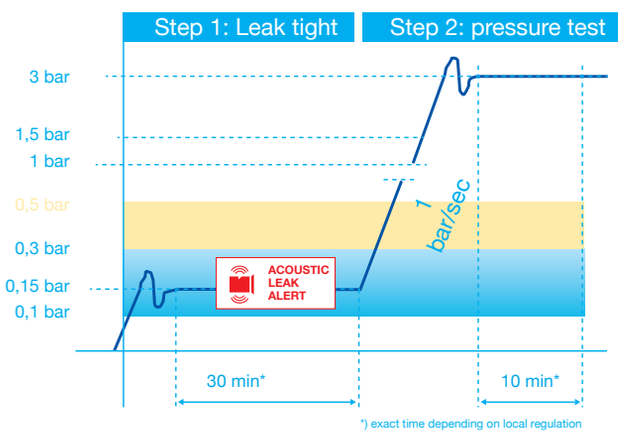


Fig. 34: Pressure test protocol when testing with air.

Due to the risk of high pressures, it is common and recommended to execute the air pressure test in 2 steps. A practical and save method is described in the German (BTGA 3002) as well as the Dutch (WB 2.3) testing procedures. These procedures distinguish the following 2 steps:

1) check connections on leak tightness
2) check connections on pressure resistance

For step 1 the system is pressurized at approx. 0,15 bar for a defined time frame (minimal 30 min for BTGA 3002). The pressure on the system is noted at the start and the end of the period. Differences between the initial installation pressure and the pressure after the defined time indicate if the pressure test has been executed successfully.

Wavin Acoustic Leak Alert has been designed to easily indicate leaking fittings at this stage of the process. If a pressure drop is found, leaking fittings can instantly and safely be discovered by an acoustic signal. By pressurizing the system starting from 0,15 bar up to 0,3 bar, with a maximum of 0,5 bar(for safety), the leaking fitting will generate a clear and loud whistle. This saves valuable time in diagnosing and tracing a malfunction.

This feature is available for Wavin Tigris M5 and Wavin Tigris K5 only. In case of a mixture of Wavin Tigris M1, M5, K1 and K5 fitting, or with a mixture of Wavin Tigris MX, it is advised to execute the pressure test with water.

For step 2 the system is pressurized, depending of the pipe OD, with 3.0 bar (≤ DN/OD 63 mm) or 1,0 bar (63mm > DN/OD < 110 mm.). Again, the pressure on the system is noted at the begin and the end of the defined time frame (minimal 30 min for BTGA 3002).

Differences between initial pressure and final pressure after the defined time indicate if the pressure test has been executed successfully.

Be aware that SAFETY PRECAUTION MEASURES are taken when applying high pressures on the system. The results should be recorded and signed for.

Below is an indicative schedule of the leak test procedure as described above.

Always execute tests according to local legislation or standard. Be aware that Acoustic Leak Alert is just an aid to rapidly find the leaking fitting. It does NOT replace the required leak- and pressure test.

5. Completing the installation

5.6. Initial operation and handover

According to DIN 1988-2/EN 806-4, the installer of the system must prepare relevant handover and acceptance logs. The system operator must be instructed with respect to the operation of the tap water system created. It is recommended that the instruction being completed is confirmed in writing.

Depending on the scale of the system, the presentation of written operating instructions is advised.

5.7. Usage of the Wavin Tigris pressure test plug

The Wavin Tigris pressure test plug is screwed on the pipe that shall be tested. The pipe must completely fill the check window. After the execution of the pressure test, the pressure test plug has to be unscrewed again. The area where the pressure test plug was screwed on the pipe (thread cuts are visible) must be cut off before further processing.

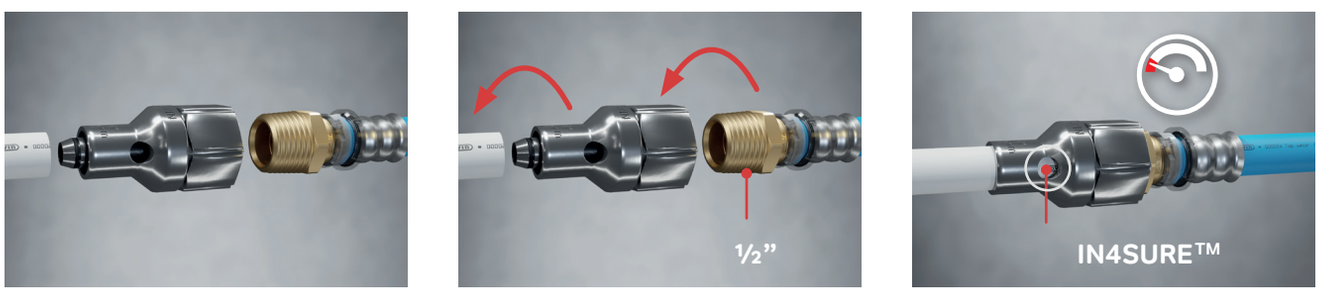


Fig. 35: Pressure check with coupler: 16 mm - 20 mm - 25 mm.

5.8. Protocol pressure test for drinking water installations (if no local test regulation available)

Example protocol pressure test drinking water installations - testing with water

(Based on test protocol from BTGA Rule 5.001; pressure test with water)

Building project: _____

Clients represented by: _____

Contractor represented by: _____

Pipe system material: _____

Connection type: _____

System operating pressure: _____ bar

Ambient temperature: _____ °C test medium: _____ °C Δt: _____ K

The drinking water system has been tested as ○ total installation ○ in _____ sections

Designation of the subsection: _____

Subsection Nr _____ from total of _____ subsections.

○ The filling water is filtered, and the line system is fully vented

All lines were sealed with metal plugs, caps, blanking plates or blind flanges.
Appliances, pressure tanks or drinking water heater were disconnected from the lines.
A visual inspection of all pipe connections to proper execution has taken place

○ **Metal, multilayer composite and PVC pipes**
○ **Plastic pipes made of PE, PP, PE-X, PB and therewith combined pipes from multilayer and metal**

1) If Δ t > 10 K, 30 minutes wait time after application of the system pressure, before actual testing. If Δ t <10 K go to step 2
2) Apply the actual test pressure of min. 1.1 times (11 bar) of the maximum allowable working pressure (10 bar according to DIN EN 806-2). Test time: 30 min.
3) Reduce the pressure to 0.5 times (5.5 bar) of the initial test pressure and implement a visual inspection. Test Time: 30 Min.
4) Evaluation: During the test period no pressure drop occurred (Δp = 0). Leaks are not present.

The pipe system is: ○ **tight** ○ **leaking**

Client signature/stamp _____

Place, date_____ Contractor signature/stamp _____

5. Completing the installation

Example protocol pressure test drinking water installations - testing with air

(Based on test protocol from BTGA Rule 5.001; pressure test with air or inert gasses)

Building project: _____

Clients represented by: _____

Contractor represented by: _____

Pipe system material: _____

Connection type: _____

System operating pressure: _____ bar

Ambient temperature: _____ °C test medium: _____ °C Δt: _____ K

The drinking water system has been tested as ○ total installation ○ in _____ sections

Designation of the subsection: _____

Subsection Nr _____ from total of _____ subsections.

○ The filling water is filtered, and the line system is fully vented

All lines were sealed with metal plugs, caps, blanking plates or blind flanges.
Appliances, pressure tanks or drinking water heater were disconnected from the lines.
A visual inspection of all pipe connections to proper execution has taken place

○ **Metal, multilayer composite and PVC pipes**
○ **Plastic pipes made of PE, PP, PE-X, PB and therewith combined pipes from multilayer and metal**

5) If Δ t > 10 K, 30 minutes wait time after application of the system pressure, before actual testing. If Δ t <10 K go to step 2
6) Apply the actual test pressure of min. 1.3 times of the maximum allowable working pressure
7) Test Time: 120 Min.
8) Evaluation: During the test period no pressure drop occurred (Δp = 0). Leaks are not present.

The pipe system is: ○ **tight** ○ **leaking**

Client signature/stamp _____

Place, date_____ Contractor signature/stamp _____

5.9. Pressure test for radiator installations in accordance with DIN 18380 (if no local test regulation available)

Example protocol pressure test heating installations - testing with water

(Based on test protocol from BTGA Rule 3.002; pressure test with water)

Building project: _____

Clients represented by: _____

Contractor represented by: _____

Pipe system material: _____

Connection type: _____

System operating pressure: _____ bar ambient temperature: _____ °C test medium: _____ °C

Test medium ○ oil-free compressed air ○ Nitrogen ○ CO_2 ○ Other_____

The drinking water system has been tested as ○ total installation ○ in _____ sections

Designation of the subsection: _____

Subsection Nr _____ from total of _____ subsections.

All lines were sealed with metal plugs, caps, blanking plates or blind flanges.
Appliances, pressure tanks or drinking water heater were disconnected from the lines.
A visual inspection of all pipe connections to proper execution has taken place

○ **Leak testing**

Test pressure 150 mbar
Test time to 100 Liter of tap volume at least 30 minutes.
Test time to be increased by 10 minutes for each additional 100 liters of tap volume.

Tap volume _____ Liter **Test time _____ min**

Temperature compensation and steady-state in case of **plastic materials** is awaited, after which the test period begins.

○ During the test period no pressure drop was detected

○ **Load test with increased pressure**

Test pressure ≤ DN 50 max. 3 bar > DN 50 max. 1 bar
Test time 10 min. (Deviating test time: _____ min)

Temperature compensation and steady-state in case of plastic materials is awaited, after which the test period begins

○ During the test period no pressure drop was detected

The pipe system is: ○ **tight** ○ **leaking**

Client signature/stamp _____

Place, date_____ Contractor signature/stamp _____

5. Completing the installation

Example protocol pressure test heating installations- testing with air

(Based on test protocol from BTGA Regel 3.002; pressure test with air or inert gasses)

Building project: _____

Clients represented by: _____

Contractor represented by: _____

Pipe system material: _____

Connection type: _____

System operating pressure: _____ bar ambient temperature: _____ °C test medium: _____ °C

Test medium ○ oil-free compressed air ○ Nitrogen ○ CO_2 ○ Other_____

The drinking water system has been tested as ○ total installation ○ in _____ sections

Designation of the subsection: _____

Subsection Nr _____ from total of _____ subsections.

All lines were sealed with metal plugs, caps, blanking plates or blind flanges.
Appliances, pressure tanks or drinking water heater were disconnected from the lines.
A visual inspection of all pipe connections to proper execution has taken place

Note:
The Contractor shall subject the system after installation and before closing the wall slots, wall and ceiling openings and, where appropriate before applying the screed or other coverage of a pressure test. When pressure testing, manufacturer's instructions of the tested components must be observed.

○ **Leak testing**

Test pressure 150 mbar
Test time to 100 Liter of tap volume at least 30 minutes.
Test time to be increased by 10 minutes for each additional 100 liters of tap volume.

Tap volume _____ Liter **Test time _____ min**

Temperature compensation and steady-state in case of **plastic materials** is awaited, after which the test period begins.

○ During the test period no pressure drop was detected

○ **Load test with increased pressure**

Test pressure ≤ DN 50 max. 3 bar > DN 50 max. 1 bar
Test time 10 min. (Deviating test time: _____ min)

Temperature compensation and steady-state in case of plastic materials is awaited, after which the test period begins

○ During the test period no pressure drop was detected

The pipe system is: ○ **tight** ○ **leaking**

Client signature/stamp _____

Place, date_____ Contractor signature/stamp _____

6. Installation design guidelines

6.1. Linear expansion and fixing

The respective current codes of practice must be observed in the installation of Wavin Tigris K5, Tigris M5, Tigris K1, Tigris M1 and Tigris MX Hot&Cold water systems. These systems are to be assembled by trained and qualified professionals and with the appropriate tools only.

Wavin Tigris K5, Tigris M5, Tigris K1, Tigris M1 and Tigris MX Hot&Cold Water Systems are constructed in accordance with the relevant codes of practice.

The mountings used must be adequate for fixing the composite pipe in the respective nominal diameter. Fixing systems with a sound insulation insert are recommended. The expected linear expansion based on maximum temperature feed and line length must be taken into account.

A distinction is generally drawn between fixed points and floating points as fixing methods. Fixed points divide the pipeline element into separate sections. In the case of straight pipe routes, a fixed point is to be applied at the mid-point. No fixed points should be applied directly at fittings that are used for a change of direction. Sufficient stability of the fixed points is required in order to effectively absorb the expansion forces occurring. A short distance to the ceiling must be observed. Vertical lines, such as risers, can generally be installed only with fixed point clips. Here, fixing should be in front of or behind each storey branch. By contrast, floating point fixings guarantee expansion and movement of the pipeline concerned.

For more information about this, please refer to the next chapter.

Use metal clamps with a rubber inlayer to prevent construction born sound. This allows also some of movement without large tension. Do not attach Tigris pipe systems to other piping systems, e.g. soil & waste systems.

6.2. Consideration of thermally induced linear expansion

All pipe materials expand on heating and contract on cooling. In the case of the piping for tap water systems (particularly with heated tap water) and heating pipes, the temperature-based linear expansion of the materials must always be considered.

The temperature difference and pipe length constructed determine the length change. For assembly, the movement possibilities for each direction change must be considered.

Irrespective of the pipe size, the coefficient of expansion of Wavin multilayer composite pipes is 0.025 – 0.030 mm/m·K. The length changes of Wavin multilayer composite pipes as expected in operation with different pipe lengths and temperature differences can be determined from the following diagram.

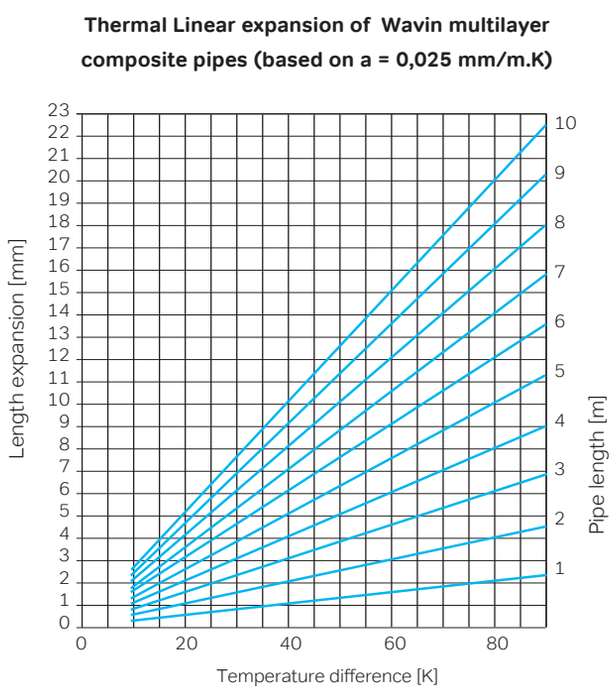


Fig. 36: Thermal Linear expansion.

6. Installation design guidelines

The length changes can likewise be calculated using the following formula

	$\Delta l = \alpha \times l \times \Delta\vartheta$ Δl = Length expansion (mm) α = Coefficiënt of length expansion (mm/m.K) l = Pipeline length (m) $\Delta\vartheta$ = Temperature difference (K)
Sample calculation: **Given:**	Wavin Tigris multilayer-pipe for hot water application Pipe length (l) 12 m Lowest ambient temperature 10 °C Mediumtemperature 60 °C
Sought:	Minimum length expansion under operating conditions $\Delta l = \alpha \times l \times \Delta\vartheta$ 60 K - 10 K = 50 K dT= 0,025 mm/m*K x 12 m x 50 K = 15 mm
Result:	Maximum length expansion under operating conditions = 15 mm

Table 6: Calculation example length change.

6.3. Absorption of length changes by bending joints

In the case of a change of direction, the thermal length expansion of a pipeline can often be offset within the pipe layout by bending joints and expansion U-bends. The length of the bending joint can be determined by calculation or taken from the diagram below.

Key:

L_B = Length of the bending joint [mm]
d = External pipe diameter [mm]
ΔL = Length change [mm]
C = Material-dependent constant for Wavin multilayer composite pipe (= 30)

$$L_B = C\sqrt{(d*\Delta L)}$$

Given:	Length change Δl = 20 mm Pipe diameter d = 25 x 2,5 mm Constant c for Tigris = 30
Sought:	Length of the bending joints L_B
Result:	650 mm, from diagram above

See figure 37 for calculation example.

Table 7: Calculation example length bending joints.

Bending joint classification Wavin multilayer composite pipe

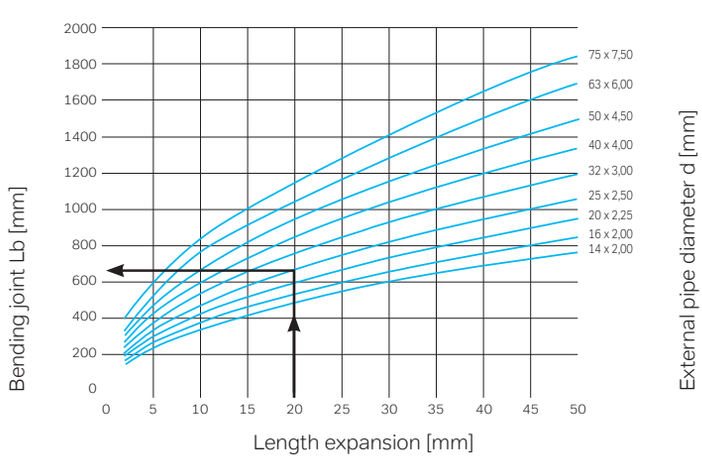
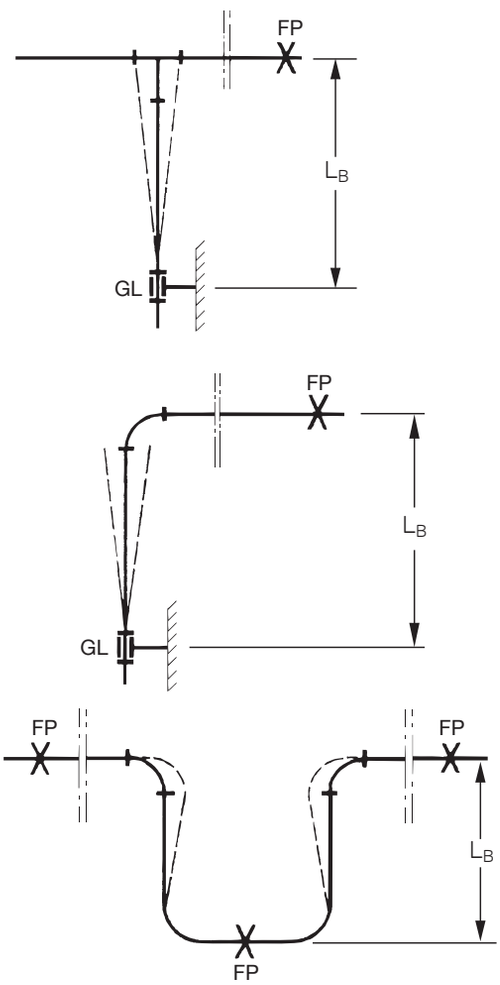


Fig. 37: Bending joint classification of Wavin multilayer composite pipes.



FP = Fixed point
GL = Flexible point
L_B = Fixing interval

Fig. 38: Flexible and fixed point mounting (see also table 8).

6.4. Fixing intervals

Pipelines on a supporting base must be fixed in accordance with DIN 18560-2: 4.1, EN 13813-01. The number of fixing components is essentially dependent on the piping in the respective construction project. As the calculation basis with straight piping, a fixing component can be attached at approx. 1 m pipe length. In the areas of diversion, at least two fixing components are to be affixed (before and after the diversion curve).

Dimension (mm)	Fixing interval L_B (m)
16 x 2,0	1,00
20 x 2,25	1,20
25 x 2,5	1,50
32 x 3,0	1,50
40 x 4,0	1,80
50 x 4,5	1,80
63 x 6,0	2,00
75 x 7,5	2,20

Table 8: Pipe clamp intervals for Wavin multilayer composite pipes installed in exposed locations.

The type and intervals of the fixings are dependent on pressure, temperature, medium and installation situation. The pipe fixings must be properly designed according to the total mass (pipe weight + weight of the water + weight of the insulation), in accordance with the recognised codes of practice. See below table for pipe masses.

Dimension mm	Pipe mass kg/m	Pipe mass + water kg/m	Pipe mass + water + Iso 9 mm kg/m	Pipe mass + water + Iso 13 mm kg/m
16 x 2,00	0,095	0,202	0,232	0,250
20 x 2,25	0,138	0,330	0,364	0,384
25 x 2,50	0,220	0,558	0,596	0,620
32 x 3,00	0,340	0,942	0,988	1,012
40 x 4,00	0,605	1,605	–	–
50 x 4,50	0,840	2,480	–	–
63 x 6,0	1,340	3,380	-	-
75 x 7,5	2,140	4,967	-	-

Table 9: Pipe masses.

6. Installation design guidelines

6.5. Concealed installations

6.5.1. Pipes in screed or concrete

Due to the relatively low expansion forces, no compensation measures are required in the case of direct embedding of the pipes. Because of the slight plastic malleability of Wavin multilayer composite pipes, the length changes are absorbed by the pipe wall. Moreover, the respective local regulations describing the minimum requirements regarding energy use of new and renovated buildings (e.g. GEG) and impact noise insulation must be observed.

Protection against corrosion

When fittings are exposed to aggressive media, like chlorides, ammonia, base environments with PH >12,5, fittings must be protected against corrosion by a sufficient covering, like protection tape (eg Denso).

When build into screed, concrete or plaster above conditions have to be considered and when applicable, protective measures must be taken. This only counts for Wavin Tigris M1/M5 and Wavin Tigris MX fittings.

6.5.2. Pipes in the floor construction

As multilayer composite pipes can move axially within the insulation with low resistance, the expected length changes must be absorbed. Right angle diversions in the insulating layer must be arranged such that length changes that occur in the respective sections are absorbed by the insulation thickness in the curve area.

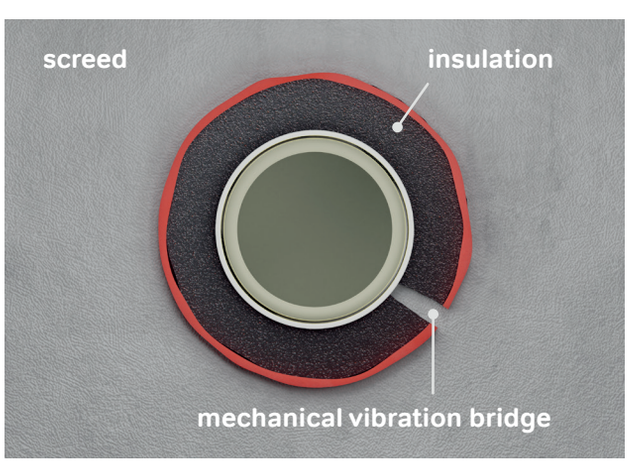


Fig 39: Mechanical vibration transmission through defective pipe insulation.

Wavin Hot&Cold Water Systems already laid on the floor are exposed to many potential impacts on site during the construction phase, from scaffolding, ladders or other objects. Therefore caution must be exercised to prevent damage to the pipe/fitting or even the insulation. Before installing further floor construction, a check should therefore be conducted for damage. Any damage to the pipe insulation should be repaired in all cases in order to avoid the risk of the formation of impact noise bridges or reduced sound insulation.

Causes of damage in floating screeds are often due to several pipe strings being installed under the screed plate.

The following principles should be observed when installing pipe strings in the floor construction:

- Use heat and sound insulated pipelines
- Use sound insulated pipe fixing
- Avoid pipe crossings as much as possible
- Install pipelines parallel to walls
- Apply perpendicular junctions of pipelines into neighbouring walls
- Reduce width of the pipe string to a maximum of 120 mm
- Minimum distance between pipelines and walls:
  - 200 mm in corridors
  - 500 mm in the living area
- For piping through screed expansion joints corrugated tube or alternatively 6 mm pipe insulation should be applied.
- Fittings exposed to aggressive media or constantly exposed to moisture must be protected against corrosion by a sufficient covering

6.5.3. Pipelines installed under plaster

Depending on the wall construction and masonry strength, there is a risk that the expansion forces from a multilayer composite pipe that is plastered-in directly, could cause damage to the wall. Multilayer composite pipes under plaster should therefore be installed with insulation. This pipe insulation must be able to absorb expected length changes due to heat.

In the case of pipelines under plaster for which there is no need for heat insulation, we recommend the use of the Wavin multilayer composite pipe in black protective tube (see product portfolio).

All pipes and fittings installed under plaster must be protected from direct contact with all building materials (such as masonry, plaster, cement, screed, tile adhesive) as detailed above.

6.5.4. Pipelines installed in exposed locations

Pipelines installed in exposed locations (e.g. basement pipes, risers etc.) are fixed depending on the structural conditions and the recognised codes of practice. As appropriate, thermal length changes must be considered with the arrangement of bending joints in conjunction with fixed points and flexible points as described in the previous chapter - Linear expansion and fixing.

6. Installation design guidelines

6.6. Installation examples

6.6.1. Installation variants for drinking water

In this chapter you find four core installation examples of Tigris solutions in different situations. The right type of configuration will depend on the specific application area.

6.6.1.1. Single Tee installation

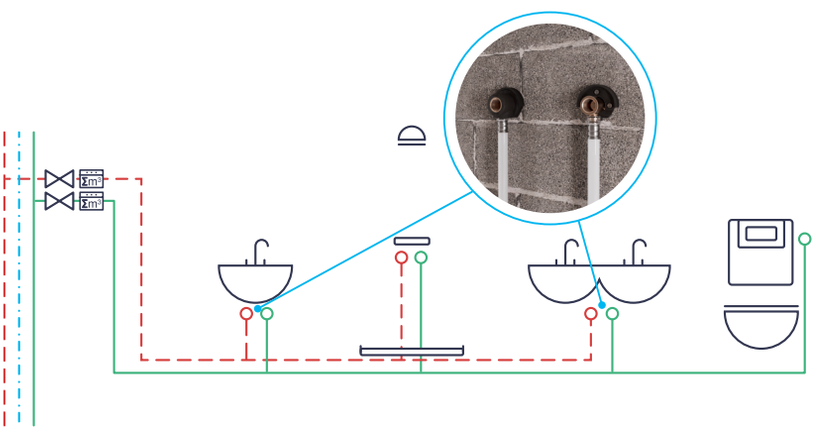


Fig. 40: Single Tee installation.

This type of installation should be used only when supplying to regularly and frequently used taps and fittings. Regularly and frequently here means “daily”. Tee connections result in single supply lines in which the drinking water can stagnate if it is not used.

Advantages:

- Simple piping
- Quick to install
- Less piping used

Wall flanges

	K5	M5 short	M5 long	MX short	MX long
	 wall flange	 wall flange short	 wall flange long	 wall flange short	 wall flange long
Single					
Exposed fixtures					

Table 10: Materials of Single Tee installation example.

6.6.1.2. In series installation

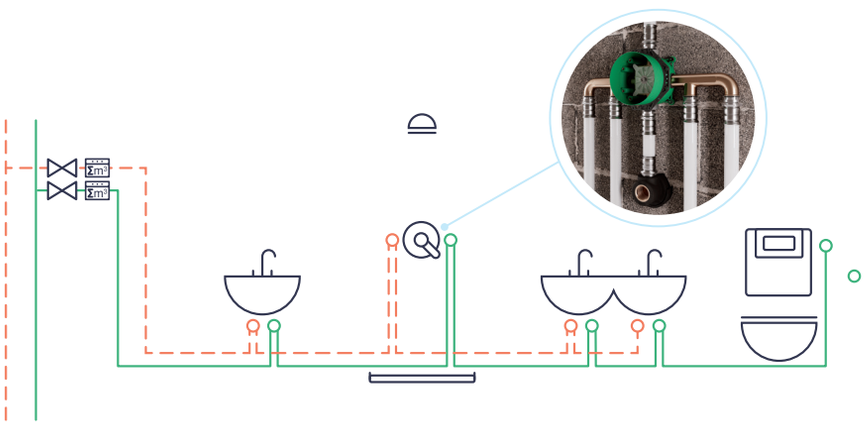


Fig. 41: In series installation.

In-series installation is suited to multi-storey installation with upstream water meters. The pipe is routed from one tapping point directly to the next. In-series installation is suited to multi-storey installation with upstream water meters. The pipe is routed from one tapping point directly to the next, using double connections. The tapping points are supplied by a common pipe. It should be ensured that the most frequently used fixture appears at the end of the in-series installation. WC flushing systems that can be set with a continuous, timed flush are available. These ensure that the entire cold-water piping on each storey is flushed, even when not in continuous use, for example in hotels. If required, flush valves for hot water piping are also available, with which a continuous, timed flush can be set.

Advantages:

- Simple piping
- No joints in screed
- Time-saving, quick installation
- Even pressure and heat distribution
- Low stagnation volume
- Rapid water exchange

Wall flanges

K5	M5 short	M5 long	MX short	MX long	K5	M5	MX	M5
								
wall flange	wall flange short	wall flange long	wall flange long	wall flange long	double wall flange 90°	double wall flange	double wall flange	connector
Single								
Exposed fixtures								

Table 11: Materials of In-series installation example.

6. Installation design guidelines

6.6.1.3. Loop installation

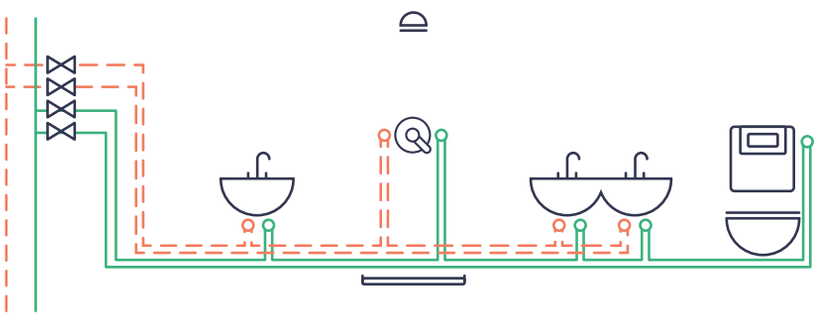


Fig. 42: Loop installation.

The loop installation illustrated here is suited to multi-storey installation with upstream water meters. The pipe is routed from one tapping point directly to the next using double connections. The piping then runs from the last consumer back to the storey connection point.

Advantages:

- Low pressure loss values (reduced by 50%)
- Greater distances for tapping are possible
- Significantly more tapping points can be connected with the same pipe diameter
- Even pressure and heat distribution
- Optimum water exchange with just one consumer's use
- Low stagnation times

Loop installations with continuous hot water circulation should be sufficiently insulated.
The continuous maximal hot water temperature should be limited to 70 °C, according to ISO 21003.

Wall flanges

K5	M5	MX	M5
			
double wall flange 90°	double wall flange	double wall flange	connector
Single			
Exposed fixtures			

Table 12: Materials of loop installation example.

6.6.1.4. Loop installation with circulation connection

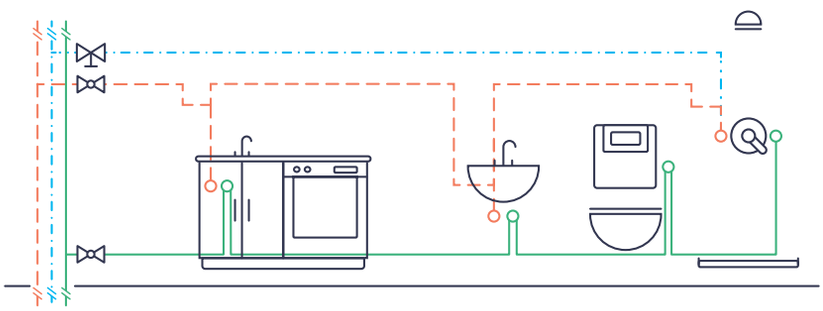


Fig. 43: Loop installation with circulation connection.

This type of loop installation is suitable for multi-storey instal¬lations without upstream water meters. The pipe is guided from one tapping point directly to the next using double connections. The piping then runs from the last cold water consumer back to the storey connection point. The hot water pipe is guided from the last fixture as a circulation pipe back to the storey connection point.

Advantages:

- Lower pressure loss values for cold water section
- All hot water tapping points feature a circulation connection. Even hot water temperature distribution
- Optimum water exchange even when only one fixture is used
- Low stagnation times
- No legionella growth in the hot water tapping points
- Hydraulic alignment of the circulation piping

Loop installations with continuous hot water circulation should be sufficiently insulated. The continuous maximal hot water temperature should be limited to 70 °C, according to ISO 21003.

Wall flanges

K5	M5	MX	M5
			
double wall flange 90°	double wall flange	double wall flange	connector
Single			
Exposed fixtures			

Table 13: Materials of loop installation with circulation example.

6. Installation design guidelines

6.6.2. Heating installation Variants

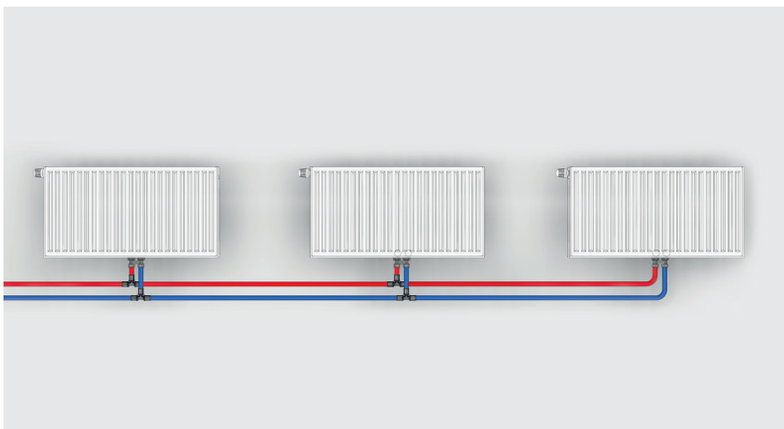


Fig. 44: Double pipe radiator heating.

In this chapter you find the most common examples of Tigris radiator solutions.

1. Double pipe heating

The “standard variant” – recognized, tried and tested
Economically sensible terms and conditions of service
Because of the total length of the pipe network resulting in pressure loss, a pressure loss of 100 to 200 Pa/m can be calculated in consideration of additional individual resistances (e.g. valves).

The advantages:
- Even temperature of all radiators (= source of well being)
- Recognised system for recording heating costs
- Suitable for skirting boards

2. Double pipe heating with central manifold

The “spaghetti system” – optimal assembly and comfort
Economically sensible terms and conditions of service
Because of the short connection pipes from the manifold to the individual radiators, a pressure loss of 240 to 400 Pa/m can be calculated in consideration of additional individual resistances (e.g. valves).

The advantages:
- Only one pipe dimension from the manifold
- No connecting points in the floor area
- Each radiator feed line can be operated autonomously.
- No circulation in the pipe system in case of radiator stoppage (energy saving)

3. Single pipe heating

The “saving variant” – quick and inexpensive

Economically sensible terms and conditions of service
Because of the total length of the main line resulting in pressure loss in the case of single pipe heating, a pressure loss of 100 to 200 Pa/m should be expected in consideration of additional individual resistances (sub-pipes branching off of the main line or z values of 4-way valves).

With the use of 4-way valves:

- No connecting points in the floor area
- Extremely quick installation
- Only one pipe dimension from the line connection

6.6.3. Radiator connection: installation Variants

The Wavin Tigris K5/M5 systems offer many options for the connection of standard compact and valve radiators in the single pipe and double pipe system. The following diagrams show the most popular connection variants. In all cases, the insulation must be taken into account in accordance with the energy saving regulation.

6.6.3.1. Compact Radiators

Pipe connection from the wall by means of Eurocone screw connections.

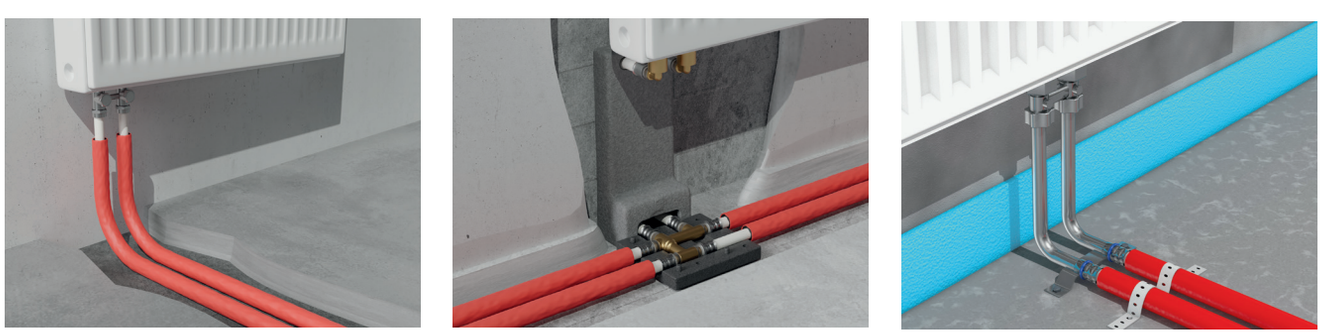
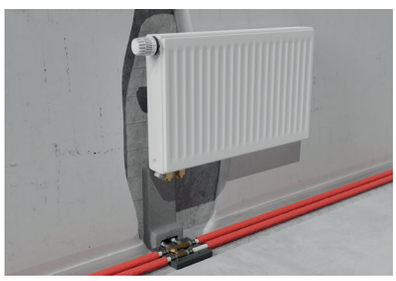


Fig. 45: Radiator installation examples with “Eurocone” screw connection.

6. Installation design guidelines

6.6.3.2. Valve Radiators

Pipe connection from the wall by means of radiator connecting block and IT “Eurocone” screw connections and the use of a junction fitting.



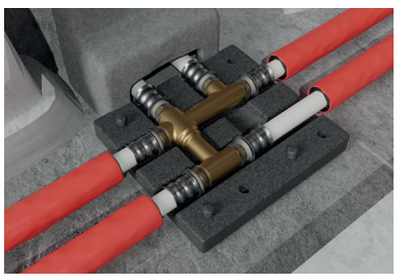


Fig. 46: Radiator installation examples with crossfitting block.

Pipe connection from the floor by means of Tigris M1 angle connecting pipes.

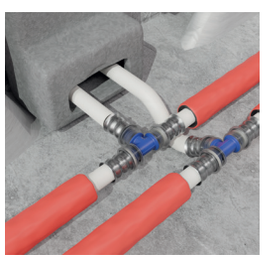


Fig. 47: Radiator installation examples with angle connection pipes.

Remark:
Always protect fittings from corrosion when immersed in concrete.

Materials for sample installation

Tigris M5 Elbow radiator

Dimension	Article Nr.
16/300	4064239

Tigris M5 Tee radiator

Dimension	Article Nr.
16x 15/300	4064240
20x 15/300	4064241

Tigris M5 Cross Fitting

Dimension	Article Nr.
16x15/230	4064242

Tigris M5 Radiator Mounting Valve Floor

Dimension	Article Nr.
16x15/330	4064243

Radiator Connection Block

Type	Article Nr.
16	4013510

Radiator Connection Block Vario

Type	Article Nr.
Vario	4024556

Tigris M5 Intersection Fitting

Dimension	Article Nr.
16 x 16 x 16	4067720
16 x 20 x 16	4067721
20 x 16 x 16	4067722
20 x 16 x 20	4067723
20 x 20 x 16	4067724
20 x 20 x 20	4067725

Tigris M1 Connection Fittings
› IG „EURO-KONUS“

Type	Article Nr.
Vario	4024556

7. Operating conditions

7.1. Operating conditions

The operating conditions for Wavin multilayer pipes and fittings should be followed according to ISO 21003-1:2008 (E), see table below.

Operating conditions

Application class	**Design temperature** T_D °C	**Time**[b] **at** T_D years	T_{max} °C	**Time at** T_{max} years	T_{mal} °C	**Time at** T_{mal} h	**Typical field of application**
1[a]	60	49	80	1	95	100	Hot water supply (60 °C)
2[a]	70	49	80	1	95	100	Hot water supply (70 °C)
4[b]	20 plus cumulative 40 plus cumulative 60	2,5 20 25	70	2,5	100	100	Underfloor heating and low-temperature radiators
5[b]	20 plus cumulative 60 plus cumulative 80	14 25 10	90	1	100	100	High-temperature radiators

Note: For values of T_D, T_{max} and T_{mal} in excess of those in the table, this international Standard does not apply.

T_D = temperature the pipe system is designed for
T_{max} = maximum temperature permitted for a short time
T_{mal} = highest possible temperature that may be reached in the event of the fault "mal" (maximum 100 hours in 50 years)
a = a country/ state can select either class 1 or class 2 according to its national provisions
b = if there is more than one operating temperature for the operating duration and the associated temperature for an application classes, the corresponding operating duration times should be added. "Plus cumulative" in the table implies a temperature group for the temperature given for an operating period (e.g. the temperature group for a period of 50 years for class 5 is made up as follows: 20 °C over 14 years, followed by 60 °C over 25 years, followed by 80 °C over 10 years, follwed by 90 °C over 1 year, folowed by 100 °C over 100 hours)
c = only permitted if the fault temaperature cannot exceed 65 °C

Table 14: Operating conditions according ISO 21003.

7. Operating conditions

7.2. Flow performance

The performance of the installation is related to the pressure loss in the system and the final water flow at the tap point. One of the causes of pressure loss in the systems is related to internal diameters of pipe as well as inner bore of the fitting. The impact of the inner bore (reduction) versus pipe inside diameter is stronger for smaller diameters than with bigger diameters.

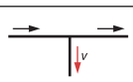
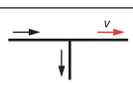
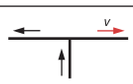
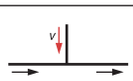
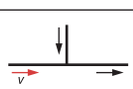
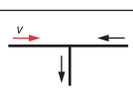
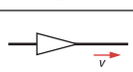
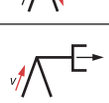
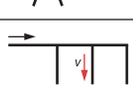
With Tigris M5 and Tigris K5, covering the fitting range up to 40 mm, the increase of the bore diameter has significantly contributed to an improvement of flow performance. That's what we call Optiflow.

Tigris MX offers the feature of an ultimate flow which has with the 30% larger inner bore than common solutions on the market and with that at well a minimized pressure loss.

In the next overview the Zeta values of the various fittings and diameters can be found.

7.2.1. Zeta values Wavin Tigris M5 & M1

A water velocity of 2 m/s has been used for the calculation:

Nr.	Abbreviation according to DVGW W 575	Graphic symbol according to DVGW W 575 [1)]	Zeta value ξ							
			Tigris M5					Tigris M1		
			DN 12	DN 15	DN 20	DN 25	DN 32	DN 40	DN 50	DN 65
			pipe diameter d_a mm							
			16	20	25	32	40	50	63	75
1	TA		7,8	5,4	3,9	3,2	3,1	4,8	4,6	4,4
2	TD		2,5	1,4	0,8	0,6	0,5	2,9	2,7	2,5
3	TG		7	5	4,1	2,7	3,1	4,8	4,6	4,4
4	TVA		13,4	9,3	8,1	5,4	7,1	6,5	5,5	4,6
5	TVD		27,4	19,3	7,1	5,5	16,8	15,1	15,0	14,8
6	TVG		18,9	11,7	12,8	9,8	9,3	9,3	8,3	7,2
7	W90		6,4	5,4	3,7	3	3,1	3,9	4,2	4,4
8	W45		/	/	/	/	0,9	0,9	0,9	0,8
9	RED		2,6	0,8	0,7	0,9	0,7	0,6	/	/
10	WS		6,3	6,1	/	/	/	/	/	/
11	WSD		9	6	3,8	/	/	/	/	/
12	WSA		7,1	12,2	9,8	/	/	/	/	/
13	STV		/	/	/	/	/	/	/	/
14	K		2,2	1,1	0,8	0,9	0,9	0,7	0,7	0,6

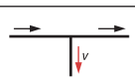
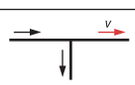
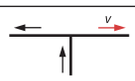
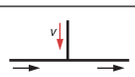
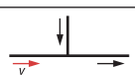
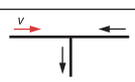
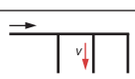
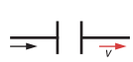
Remark: The Zeta values of Tigris K1, Tigris K5, Tigris M1, Tigris M5 and Tigris MX can by exception deviate of the values mentioned in the above table according to DIN 1988- part 300. On request, the specific values can be submitted. The values in the table are the measured values for Tigris M5. These values might only be used indicatively for Tigris K5.

Table 15: Zeta values Wavin Tigris M5 and Wavin Tigris M1 and equivalent pipe lengths.

7. Operating conditions

7.2.2. Zeta values Wavin Tigris K5 & K1

A water velocity of 2 m/s has been used for the calculation:

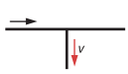
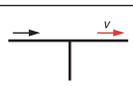
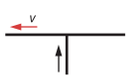
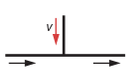
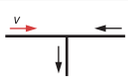
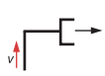
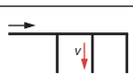
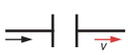
			Zeta value ξ							
			Tigris K5					Tigris K1		
Nr.	Abbreviation according to DVGW W 575	Graphic symbol according to DVGW W 575 [1)]	DN 12	DN 15	DN 20	DN 25	DN 32	DN 40	DN 50	DN 65
			pipe diameter d_a mm							
			16	20	25	32	40	50	63	75
1	TA		6,9	5,0	4,8	4,6	4,6	5,1	5,1	4,9
2	TD		2,4	1,4	1,1	0,6	0,8	3,6	3,4	3,1
3	TG		7,9	5,1	5,0	4,6	4,6	5,1	5,1	4,9
4	TVA		12,4	8,6	8,6	7,6	10,0	7,0	7,1	6,8
5	TVD		25,3	17,5	9,6	8,8	21,4	15,9	15,9	15,3
6	TVG		17,1	11,5	10,1	10,4	14,7	9,9	8,9	7,8
7	W90		7,0	5,0	5,0	4,0	4,5	4,0	4,5	4,2
8	W45		/	/	2,1	1,7	1,7	3,0	3,0	2,9
9	RED		1,8	1,0	0,7	0,9	0,7	0,9	/	/
10	WS		5,5	5,5	/	/	/	/	/	/
11	WSD		9,0	6,0	/	/	/	/	/	/
12	WSA		6,9	5,3	/	/	/	/	/	/
13	STV		/	/	/	/	/	/	/	/
14	K		2,3	1,3	0,8	0,3	0,4	0,8	0,8	0,8

Remark: The Zeta values of Tigris K1, Tigris K5, Tigris M1, Tigris M5 and Tigris MX can by exception deviate of the values mentioned in the above table according to DIN 1988- part 300. On request, the specific values can be submitted.

Table 16: Zeta values Wavin Tigris K5 and Wavin Tigris K1 and equivalent pipe lengths according to DIN 1988- part 300.

7.2.3. Zeta values Wavin Tigris MX

A water velocity of 2 m/s has been used for the calculation of equivalent pipe lengths:

Nr.	Designation according to DVGW W 575	Graphic symbol according to DVGW W 575 [1)]	Zeta value ξ Tigris MX			
			DN 16	DN 20	DN 25	DN32
			pipe diameter d_a mm			
			16	20	25	32
1	TA		2,0	2,0	1,8	1,5
2	TD		0,3	0,1	0,2	0,2
3	TG		2,0	1,7	1,7	1,4
4	TVA		3,6	2,5	2,9	2,2
5	TVD		8,0	4,9	5,5	4,2
6	TVG		6,5	4,8	4,2	3,3
7	W90		1,9	1,9	1,6	1,4
8	W45		/	/	0,7	0,4
9	RED		/	0,7	0,4	0,5
10	WS		2,9	2,8	/	/
11	WSD		1,4	2,3	/	/
12	WSA		2,5	2,6	/	/
13	STV		/	/	/	/
14	K		0,1	0,2	0,2	0,1

Remark: The Zeta values of Tigris K1, Tigris K5, Tigris M1, Tigris M5 and Tigris MX can by exception deviate of the values mentioned in the above table according to DIN 1988- part 300. On request, the specific values can be submitted.

Table 17: Zeta values Wavin Tigris K5, Tigris MX and Wavin Tigris M5 and equivalent pipe lengths.

7. Operating conditions

7.2.4. Pressure loss in pipes for drinking water applications

Dimensions 16-25 mm

The design and calculation of the required pipe diameter can be done in accordance with the relevant technical design rules, determined by the amount of heat to be transported and the applicable pressure losses in the pipe network.

The pressure loss in a pipe network is caused by the pipe friction for the selected pipe diameter and the sum of individual resistances such as angles, tees, radiators.

Drinking water, nominal dimensions 16-25 mm

Normal dimension (V/I)	16 x 2 mm 12 mm 0,11 l/m		20 x 2,25 mm 15,5 mm 0,19 l/m		25 x 2,5 mm 20 mm 0,31 l/m	
Vs l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s
0,01	0,24	0,12				
0,02	0,80	0,19	0,24	0,15		
0,03	1,39	0,29	0,49	0,18		
0,04	2,26	0,37	0,77	0,23	0,26	0,18
0,05	3,40	0,45	0,98	0,26	0,29	0,20
0,06	4,43	0,55	1,29	0,31	0,34	0,22
0,07	5,80	0,63	1,84	0,39	0,52	0,24
0,08	7,40	0,73	2,25	0,45	0,74	0,26
0,09	8,90	0,82	2,38	0,50	0,84	0,30
0,10	10,81	0,91	3,31	0,54	0,99	0,33
0,15	22,00	1,35	6,51	0,81	2,00	0,49
0,20	37,40	1,81	11,01	1,10	3,30	0,65
0,25	61,24	2,44	15,48	1,31	4,40	0,79
0,30	81,29	2,87	23,70	1,63	6,47	0,97
0,35	104,30	3,34	28,94	1,83	8,35	1,10
0,40	131,80	3,73	41,05	2,17	10,47	1,29
0,45	157,80	4,43	44,04	2,34	13,40	1,44
0,50	191,20	4,84	54,03	2,71	15,70	1,58
0,55	229,40	5,11	71,02	2,96	19,34	1,79
0,60	261,30	5,52	79,60	3,24	21,99	1,94
0,65	299,70	5,91	91,10	3,51	25,30	2,09
0,70	333,76	6,41	99,90	3,77	29,01	2,22
0,75	378,13	6,85	115,40	4,00	33,40	2,41
0,80	425,31	7,26	122,30	4,19	35,70	2,51
0,85			137,20	4,46	39,90	2,67
0,90			154,70	4,80	43,15	2,73
0,95			171,50	5,10	49,10	3,04
1,00			190,40	5,33	52,80	3,11
1,05			208,30	5,60	63,01	3,38
1,10			217,90	5,87	67,40	3,53
1,15			229,40	5,99	70,01	3,70
1,20			243,60	6,27	74,40	3,85
1,25			281,10	6,70	77,20	4,10
1,30			299,40	6,99	81,03	4,32
1,35					86,21	4,50
1,40					99,13	4,62
1,45					101,90	4,84
1,50					103,80	4,99

Table 18: Pressure loss in Wavin Tigris multilayer pipes in the drinking water installation.

Drinking water, nominal dimensions 32-50 mm

Normal dimension (V/l)	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 41 mm 1,32 l/m	
Vs l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s
0,07	0,21	0,13				
0,08	0,24	0,14				
0,09	0,26	0,16				
0,10	0,31	0,19				
0,15	0,58	0,27	0,27	0,19		
0,20	1,10	0,41	0,35	0,27		
0,25	1,31	0,48	0,55	0,31	0,19	0,18
0,30	1,80	0,56	0,70	0,38	0,25	0,23
0,35	2,51	0,68	0,88	0,42	0,31	0,27
0,40	3,10	0,76	1,14	0,49	0,36	0,32
0,45	3,65	0,85	1,35	0,54	0,45	0,33
0,50	4,45	0,95	1,67	0,60	0,54	0,38
0,55	5,20	1,03	1,99	0,69	0,63	0,41
0,60	6,21	1,14	2,32	0,77	0,70	0,45
0,65	7,01	1,22	2,34	0,81	0,82	0,51
0,70	7,99	1,29	2,99	0,84	0,95	0,55
0,75	9,05	1,40	3,38	0,90	1,08	0,57
0,80	10,64	1,53	3,77	0,97	1,17	0,60
0,85	11,17	1,59	4,38	1,06	0,27	0,62
0,90	13,25	1,72	4,73	1,13	1,43	0,65
0,95	13,73	1,78	5,24	1,19	1,66	0,72
1,00	15,11	1,87	5,65	1,25	1,77	0,79
1,10	18,14	2,06	6,73	1,38	2,07	0,84
1,20	20,99	2,25	7,77	1,47	2,35	0,87
1,30	24,40	2,44	9,04	1,65	2,72	0,96
1,40	27,47	2,65	10,31	1,78	3,16	1,05
1,50	31,20	2,83	11,67	1,91	3,59	1,16
1,60	35,90	3,09	12,98	1,97	4,02	1,24
1,70	39,99	3,21	14,37	2,09	4,61	1,41
1,80	43,71	3,41	16,09	2,26	5,01	1,49
1,90	46,98	3,55	17,57	2,35	5,45	1,65
2,00	54,20	3,81	19,31	2,47	5,99	1,72
2,20	69,27	4,22	23,11	2,78	7,02	1,81
2,40	78,00	4,61	27,01	3,01	8,25	1,89
2,60	87,20	4,94	31,02	3,29	9,45	2,04
2,80	93,34	5,04	35,19	3,46	10,91	2,21
3,00	121,30	3,31	40,04	3,78	12,25	2,31
3,20			45,57	3,99	13,55	2,56
3,40			50,88	4,06	14,48	2,74
3,60			56,17	4,51	18,02	2,99
4,00			66,87	4,94	20,54	3,14
4,20			71,14	5,23	21,74	3,29
4,40			79,14	5,41	23,08	3,47
4,60			85,77	5,66	27,25	3,71
4,80			93,23	5,91	28,88	3,88
5,00			107,12	6,13	30,67	3,89
5,20					32,19	4,02
5,40					33,33	4,08
5,60					34,12	4,12
5,80					39,68	4,33
6,00					43,44	4,56

Drinking water, nominal dimensions 63-75 mm

Normal dimension (V/l)	63 x 6,0 mm 51 mm		75 x 7,5 mm 60 mm	
Vs l/s	R mbar/m	v m/s	R mbar/m	v m/s
1,00	0,63	0,50	0,27	0,35
1,10	0,74	0,55	0,31	0,39
1,20	0,89	0,59	0,37	0,42
1,30	1,13	0,63	0,42	0,46
1,40	1,21	0,68	0,48	0,50
1,50	1,26	0,75	0,54	0,53
1,60	1,49	0,78	0,61	0,57
1,70	1,60	0,82	0,68	0,60
1,80	1,76	0,89	0,75	0,64
1,90	1,92	0,95	0,83	0,67
2,00	2,10	1,00	0,90	0,71
2,20	2,60	1,12	1,07	0,78
2,40	2,80	1,20	1,25	0,85
2,60	3,20	1,26	1,44	0,92
2,80	3,60	1,35	1,65	0,99
3,00	4,30	1,48	1,86	1,06
3,20	4,90	1,60	2,09	1,13
3,40	5,60	1,70	2,33	1,20
3,60	6,60	1,85	2,58	1,27
4,00	7,20	2,00	3,12	1,41
4,20	8,00	2,10	3,40	1,49
4,40	9,00	2,20	3,70	1,56
4,60	9,40	2,30	4,01	1,63
4,80	9,70	2,40	4,33	1,70
5,00	10,80	2,50	4,66	1,77
5,20	11,00	2,58	5,00	1,84
5,40	11,60	2,62	5,35	1,91
5,60	12,40	2,73	5,71	1,98
5,80	13,80	2,85	6,09	2,05
6,00	15,00	2,94	6,47	2,12
6,25			6,96	2,21
6,50			7,48	2,30
6,75			8,01	2,39
7,00			8,55	2,48
7,25			9,11	2,56
7,50			9,69	2,65
7,75			10,28	2,74
8,00			10,89	2,83
8,50			12,16	3,01
9,00			13,49	3,18
9,50			14,89	3,36
10,00			16,34	3,54

7. Operating conditions

7.2.5. Pressure loss in heating systems

Dimensioning heating systems

For Wavin multilayer composite pipes installed with Tigris K1, Tigris K5, Tigris M1, Tigris M5 and Tigris MX fittings, the aluminum layer guarantees tightness against oxygen diffusion and thus meets the requirements of DIN 4726 (hot water, underfloor heating and central heating) in terms of oxygen tightness.

This makes the Wavin Tigris connection system particularly suitable for these heating applications.

The design and calculation of the required pipe diameter can be done in accordance with the relevant technical design rules, determined by the amount of heat to be transported and the applicable pressure losses in the pipe network.

The pressure loss in a pipe network is caused by the pipe friction for the selected pipe diameter and the sum of individual resistances such as angles, tees, radiators.

Connection angle

The pipe friction losses of Wavin Tigris pipes can be found on the tables on the next pages. By selecting an inlet/return temperature difference of 10, 15 or 20 K, the pressure loss in Pa/m as well as the speed can be determined directly.

Formulas:
Sum of individual pressure losses:

$Z = \Sigma \zeta \frac{v^2 \cdot p}{2}$ [Pa]

ζ = Pressure loss Coefficient (Zeta value)
p = Density (kg/m^3)
v = Velocity (m/s)

Total pressure loss:

$\Delta pg = R \cdot l + Z + \Delta p_V$ [Pa]
R = Pressure loss in pipe (Pa/m)
l = pipe length (m)
Z = individual pressure loss
Δp_V = Pressure loss heating valve (Pa)

Heating medium mass flow:

$m = \frac{QHK}{\Delta t.C}$ [kg/h]

Q_{HK} = heat quantity heating circuit (W)
Δt = Temperature difference inlet/return (K)
C = specific heat capacity water
= (1,163 Wh/kg · K)

Pressure loss in multi layer pipes for heating systems

Dimensions 16-32 mm

Mass flow kg/h	Heatperformance W			Pipe dimensions mm			
				16 x 20 d_i = 12		20 x 2,25 d_i = 15,5	
	with a delta of (K)			Pressure loss R (Pa/m) + Velocity v (m/s)			
	10	15	20	R	v	R	v
8,59	100	150	200	1	0,02		
12,89	150	425	300	3	0,03		
17,19	200	300	400	5	0,04		
21,49	250	375	500	8	0,05		
25,79	300	450	600	10	0,06		
30,09	350	525	700	13	0,09		
34,39	400	600	800	16	0,10		
38,69	450	675	900	19	0,11		
42,99	500	750	1000	22	0,12		
51,59	600	900	1200	30	0,13		
60,18	700	1050	1400	35	0,14		
68,78	800	1200	1600	50	0,16		
77,38	900	1375	1800	61	0,20		
85,98	1000	1500	2000	66	0,21	11	0,10
94,58	1100	1650	2200	81	0,23	18	0,12
103,18	1200	1800	2400	93	0,26	25	0,14
111,76	1300	1950	2600	111	0,29	31	0,16
120,36	1400	2100	2800	119	0,30	38	018
128,96	1500	2250	3000	144	0,33	46	0,20
137,56	1600	2400	3200	156	0,35	51	0,22
146,16	1700	2550	3400	177	0,38	58	0,24
154,76	1800	2700	3600	190	0,39	63	0,25
171,96	2000	3000	4000	225	0,43	70	0,27
180,57	2100	3150	4200	247	0,44	79	0,28
189,17	2200	3300	4400	268	0,46	86	0,29
197,76	2300	3450	4600	289	0,49	93	0,30
206,36	2400	3600	4800	320	0,52	98	0,31
214,96	2500	3750	5000	345	0,56	103	0,32
223,56	2600	3900	5200	353	0,58	107	0,34
232,16	2700	4050	5400	365	0,61	112	0,,35
240,76	2800	4200	5600	422	0,63	121	0,37
249,36	2900	4350	5800	453	0,65	130	0,39
257,95	3000	4500	6000	471	0,67	140	0,40
266,55	3100	4650	6200	506	0,69	152	0,42
275,15	3200	4800	6400	545	0,71	161	0,43
283,75	3300	4950	6600	587	0,74	167	0,45
292,35	3400	5100	6800	603	0,76	175	0,46
300,94	3500	5250	7000	625	0,77	185	0,47
309,54	3600	5400	7200	663	0,79	199	0,48
318,14	3700	5550	7400	696	0,82	211	0,50
326,74	3800	5700	7600	732	0,83	218	0,51
335,34	3900	5850	7800	765	0,86	226	0,53
343,93	4000	6000	8000	781	0,88	235	0,54
386,93	4500	6250	9000	966	0,98	277	0,61
408,43	4750	7125	9500	1088	1,04	304	0,63
429,92	5000	7500	10000	1067	1,11	351	0,66
451,42	5250	7875	10500			374	0,70
472,91	5500	8250	11000			409	0,72
494,41	5750	8625	11500			439	0,75
515,90	6000	9000	12000			470	0,78
537,40	6250	9375	12500			512	0,83
558,90	6500	9750	13000			545	0,85
580,40	6750	10125	13500			581	0,88
601,89	7000	10500	14000			619	0,91
623,39	7250	10875	14500			666	096
644,88	7500	11250	15000			699	0,98
666,38	7750	11625	15500			744	1,01
687,87	8000	12000	16000			786	1,04
709,37	8250	12375	16500			829	1,08
730,87	8500	12750	17000			887	1,11
773,86	9000	13500	18000			987	1,17
795,36	9250	13875	18500			1019	1,21

Table 19: Mass flow, heat performance and pressure loss for Wavin Tigris multilayer pipes.

7. Operating conditions

Mass flow kg/h	Heatperformance W			Pipe dimensions mm			
				25 x 2,5 d_i = 20		32 x 3,0 d_i = 26	
	with a delta of (K)			Pressure loss R (Pa/m) + Velocity v (m/s)			
	10	15	20	R	v	R	v
171,96	2000	3000	4000	21	0,15		
189,17	2200	3300	4400	25	0,17		
206,36	2400	3600	4800	29	0,18		
214,96	2500	3750	5000	30	0,19		
232,16	2700	4050	5400	34	0,21		
249,36	2900	4350	5800	38	0,22		
257,95	3000	4500	6000	41	0,24	12	0,150
275,15	3200	4800	6400	45	0,25	13	0,156
292,35	3400	5100	6800	51	0,26	15	0,165
300,95	3500	5250	7000	54	0,27	16	0,170
318,14	3700	5550	7400	60	0,29	17	0,176
335,34	3900	5850	7800	66	0,30	19	0,185
343,94	4000	6000	8000	69	0,31	20	0,190
365,43	4250	6375	8500	77	0,33	22	0,200
386,93	4500	6750	9000	85	0,35	24	0,210
408,43	4750	7125	9500	93	0,37	26	0,220
429,92	5000	7500	10000	102	0,39	29	0,230
451,42	5250	7875	10500	108	0,42	32	0,240
472,91	5500	8250	11000	120	0,44	35	0,250
494,41	5750	8625	11500	130	0,46	38	0,260
515,91	6000	9000	12000	140	0,47	41	0,280
537,40	6250	9375	12500	150	0,48	44	0,290
558,90	6500	9750	13000	160	0,50	47	0,300
580,40	6750	10125	13500	171	0,52	50	0,310
601,89	7000	10500	14000	183	0,54	53	0,320
623,39	7250	10875	14500	194	0,56	56	0,330
644,88	7500	11250	15000	206	0,58	59	0,340
666,38	7750	11625	15500	218	0,61	62	0,370
687,88	8000	12000	16000	231	0,63	66	0,380
709,37	8250	12375	16500	244	0,65	70	0,390
730,87	8500	12750	17000	257	0,68	74	0,400
752,36	8750	13125	17500	270	0,70	78	0,410
773,86	9000	13500	18000	284	0,71	82	0,420
795,36	9250	13875	18500	297	0,71	86	0,430
816,85	9500	14250	19000	312	0,72	90	0,440
838,35	9750	14625	19500	327	0,74	94	0,450
859,85	10000	15000	20000	343	0,76	98	0,460
881,34	10250	15375	20500	357	0,78	102	0,470
902,84	10500	15750	21000	374	0,79	107	0,480
924,34	10750	16125	21500	390	0,83	112	0,490
945,83	11000	16500	22000	406	0,84	116	0,500
967,33	11250	16875	22500	422	0,85	121	0,520
988,83	11500	17250	23000	439	0,87	126	0,530
1010,32	11750	17625	23500	456	0,93	131	0,540
1031,82	12000	18000	24000	473	0,94	136	0,550
1053,31	12250	18375	24500	490	0,95	141	0,560
1074,81	12500	18750	25000	508	0,98	146	0,570
1096,31	12750	19125	25500	526	0,99	151	0,580
1117,80	13000	19500	26000	544	1,02	156	0,600
1139,29	13250	19875	26500	562	1,04	161	0,61
1160,79	13500	20250	27000	580	1,05	167	0,62
1182,28	13750	20625	27500	598	1,07	172	0,63
1203,78	14000	21000	28000	616	1,10	177	0,65
1225,27	14250	21375	28500	634	1,11	183	0,66
1246,77	14500	21750	29000	653	1,12	189	0,67
1289,76	15000	22500	30000	672	1,13	201	0,69

Mass flow kg/h	Heatperformance W			Pipe dimensions mm			
				25 x 2,5 d_i = 20		32 x 3,0 d_i = 26	
	with a delta of (K)			Pressure loss R (Pa/m) + Velocity v (m/s)			
	10	15	20	R	v	R	v
1332,76	15500	23250	31000			213	0,71
1375,75	16000	24000	32000			225	0,73
1418,74	16500	24750	33000			237	0,76
1461,73	17000	25500	34000			250	0,79
1504,73	17500	26250	35000			261	0,81
1547,72	18000	27000	36000			277	0,84
1590,71	18500	27750	37000			291	0,86
1633,70	19000	28500	38000			305	0,88
1676,69	19500	29250	39000			319	0,90
1719,69	20000	30000	40000			334	0,92
1762,68	20500	30750	41000			349	0,94
1805,67	21000	31500	42000			364	0,96
1848,66	21500	32250	43000			380	0,99
1891,65	22000	33000	44000			396	1,02

Table 19: Mass flow, heat performance and pressure loss for Wavin Tigris multilayer pipes.

Pressure loss in multi layer pipes for heating systems

Dimensions 40-75 mm

Mass flow kg/h	Heatperformance W			Pipe dimensions mm							
				40x4,0 d_i = 32		50 x 4,5 d_i = 41		63 x 6,0 d_i = 51		75 x 7,5 d_i = 60	
	with a delta of (K)			Pressure loss R (Pa/m) + Velocity v (m/s)							
	10	15	20	R	v	R	v	R	v	R	v
859,84	10000	15000	20000	37	0,30	12	0,19	4	0,13	2	0,09
945,82	11000	16500	22000	44	0,33	14	0,21	5	0,14	3	0,09
1031,81	12000	18000	24000	52	0,36	16	0,23	6	0,15	3	0,10
1117,79	13000	19500	26000	59	0,39	18	0,25	7	0,16	4	0,11
1203,78	14000	21000	28000	67	0,42	21	0,27	8	0,17	4	0,12
1289,76	15000	22500	30000	75	0,45	24	0,29	9	0,18	4	0,13
1375,75	16000	24000	32000	84	0,48	27	0,30	10	0,19	5	0,14
1461,73	17000	25500	34000	94	0,51	30	0,32	11	0,21	6	0,15
1547,72	18000	17000	36000	104	0,54	33	0,34	12	0,22	6	0,16
1633,70	19000	28500	38000	114	0,58	36	0,36	13	0,23	7	0,16
1719,69	20000	30000	40000	124	0,62	39	0,38	14	0,24	7	0,17
1805,67	21000	31500	42000	136	0,65	42	0,39	15	0,25	8	0,18
1891,65	22000	33000	44000	148	0,68	45	0,41	16	0,26	9	0,19
1977,64	23000	34500	46000	160	0,71	49	0,43	18	0,27	9	0,20
2063,62	24000	36000	48000	172	0,74	53	0,45	20	0,29	10	0,21
2149,61	25000	37500	50000	185	0,77	57	0,47	21	0,30	11	0,22
2235,59	26000	39000	52000	199	0,80	61	0,49	22	0,31	12	0,22
2321,58	27000	40500	54000	213	0,83	65	0,50	24	0,32	12	0,23
2407,56	28000	42000	56000	227	0,86	69	0,52	25	0,33	13	0,24
2493,55	29000	43500	58000	241	0,89	74	0,54	26	0,34	14	0,25
2579,53	30000	45000	60000	255	0,92	79	0,56	27	0,35	15	0,26
2665,52	31000	46500	62000	271	0,95	83	0,58	29	0,36	16	0,27
2751,50	32000	48000	64000	287	0,98	88	0,60	33	0,38	17	0,28
2837,48	33000	49500	66000	303	1,01	93	0,62	34	0,39	18	0,28
2923,47	34000	51000	68000	319	1,04	98	0,64	35	0,40	19	0,29
3009,45	35000	52500	70000	335	1,07	103	0,66	37	0,41	19	0,30
3095,44	36000	54000	72000	353	1,10	108	0,67	38	0,42	20	0,31
3181,42	37000	55500	74000	371	1,13	113	0,69	40	0,44	21	0,32
3267,41	38000	57000	76000	389	1,16	119	0,71	44	0,45	22	0,33
3353,39	39000	58500	78000	407	1,19	125	0,73	46	0,46	24	0,34
3439,38	40000	60000	80000	426	1,22	131	0,75	47	0,47	25	0,34
3525,36	41000	61500	82000	446	1,25	137	0,77	49	0,48	26	0,35
3611,34	42000	63000	84000	465	1,28	143	0,78	52	0,50	27	0,36
3697,33	43000	64500	86000	485	1,31	149	0,80	54	0,51	28	0,37
3783,31	44000	66000	88000	505	1,34	155	0,82	56	0,52	29	0,38
3869,30	45000	67500	90000	525	1,37	161	0,84	58	0,53	30	0,39
3955,28	46000	69000	92000	546	1,40	167	0,85	59	0,55	31	0,40
4041,27	47000	70500	94000	568	1,43	173	0,87	63	0,56	33	0,41
4127,25	48000	72000	96000	590	1,46	180	0,89	64	0,57	34	0,41
4213,24	49000	73500	98000	612	1,49	187	0,91	66	0,58	35	0,42
4299,22	50000	75000	100000	634	1,52	194	0,93	69	0,59	36	0,43
4406,70	51250	76875	102500	663	1,55	203	0,95	74	0,61	38	0,44
4514,18	52500	78750	105000	693	1,59	212	0,97	78	0,63	40	0,45
4621,66	53750	80625	107500	722	1,63	221	0,99	80	0,65	41	0,46
4729,14	55000	82500	110000	752	1,67	230	1,02	84	0,66	43	0,47
4836,62	56250	84375	112500	784	1,71	239	1,04	86	0,67	45	0,48
4944,11	57500	86250	115000	816	1,75	248	1,06	90	0,69	47	0,50
5051,59	58750	88125	117500	848	1,79	258	1,09	93	0,70	48	0,51
5159,07	60000	90000	120000	880	1,83	268	1,12	96	0,72	50	0,52
5374,03	62500	93750	125000	948	1,90	289	1,16	100	0,75	54	0,54
5588,99	65000	97500	130000	1016	1,98	310	1,21	112	0,78	58	0,56

Table 19: Mass flow, heat performance and pressure loss for Wavin Tigris multilayer pipes.

7. Operating conditions

Mass flow kg/h	Heatperformance W			Pipe dimensions mm							
				40x4,0 d_i = 32		50 x 4,5 d_i = 41		63 x 6,0 d_i = 51		75 x 7,5 d_i = 60	
	with a delta of (K)			Pressure loss R (Pa/m) + Velocity v (m/s)							
	10	15	20	R	v	R	v	R	v	R	v
5803,95	67500	101250	135000			332	1,25	119	0,80	62	0,58
6018,91	70000	105000	140000			354	1,30	125	0,82	66	0,60
6448,83	75000	112500	150000			400	1,39	145	0,90	74	0,65
6878,76	80000	120000	160000			449	1,48	161	0,94	83	0,69
7308,68	85000	127500	170000			501	1,58	182	1,02	93	0,73
7738,60	90000	135000	180000			555	1,67	198	1,08	103	0,78
8168,52	95000	142500	190000			610	1,76	218	1,12	113	0,82
8598,45	100000	150000	200000			671	1,85	242	1,20	124	0,86
9028,37	105000	157500	210000			733	1,95	260	1,23	135	0,91
9458,29	110000	165000	220000			797	2,04	288	1,40	147	0,95
9888,22	115000	172500	230000					309	1,37	159	0,99
10318,14	120000	180000	240000					336	1,40	172	1,03
10748,06	125000	187500	250000					361	1,49	185	1,08
11177,99	130000	195000	260000							198	1,12
11607,91	135000	202500	270000							212	1,16
12037,83	140000	210000	280000							226	1,21
12467,76	145000	217500	290000							241	1,25
12897,68	150000	225000	300000							256	1,29
13327,60	155000	232500	310000							271	1,34
13757,52	160000	240000	320000							287	1,38
14187,45	165000	247500	330000							304	1,42

Table 19: Mass flow, heat performance and pressure loss for Wavin Tigris multilayer pipes.

8. Pressing tools

8.1. Pressing Tools

In this chapter all details can be found on the tools that should be used for Wavin Tigris applications. Use the proper tools to ensure a Wavin System warranty.

8.1.1. Wavin pressing jaws and alternative brand pressing profiles

External certification in accordance with DIN EN ISO 21003-3 and 5:2008-11 is carried out exclusively on the basis of press joints created using Wavin Tigris fittings and pipes and Wavin press tools and jaws with the approved profiles.

The following pressing profiles are released for Wavin Tigris with system warranty:

- Wavin Tigris K5, Wavin Tigris M5 allow the following pressing profiles: U, Up, TH, H, B

  They cover the diameter ranges
  14, 16, 20, 25, 26, 32, 40* mm
  *) not available for B

- Wavin Tigris K1 and Wavin Tigris M1 allow the following pressing profile: U

  They cover the diameter ranges
  50, 63, 75 mm

If a different press tool is used, it must meet the minimum requirements listed below (e.g. linear thrust of 30 – 34 kN, use a suitable pressing jaw fixture etc) and must be technically flawless. This means it must be serviced and maintained according to the manufacturer's specifications.

For the purpose of liability and security, we recommend contacting the respective manufacturer for proof of suitability. In the event that a complaint is made and the damage can be traced back to an unsuitable press tool from a different manufacturer, Wavin shall carry no responsibility or liability.

For the correct way of positioning the pressing jaws, see chapter 4 Installation - execute pressings.

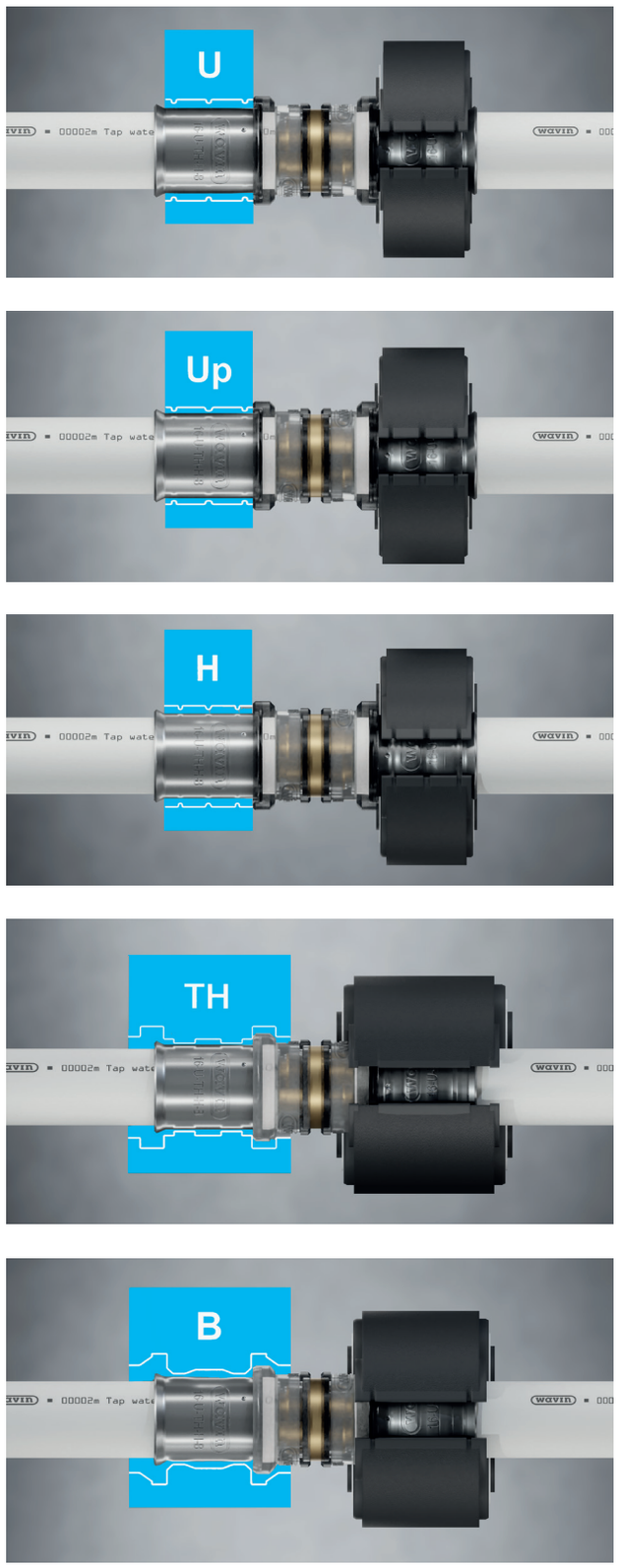


Fig. 48: Released pressing profiles for Tigris K5/M5.

8. Pressing tools

The press tools must meet the following requirements:

- The press tool must be operated and serviced according to the respective manufacturer guidelines. The Wavin assembly guidelines must be complied with.
- The “mini” press (14 - 32 mm) must provide a linear thrust of at least 19 +2 kN, for 16 – 40 mm.
- The “cordless” press (16 -75 mm) must provide a linear thrust of at least 32 +/-2 KN.
- The bolt geometry of the press tool must be suitable for the Wavin pressing jaws.

To check the compatibility of Wavin Tigris K1/M1 & Tigris K5/M5 pressing jaws with alternative brand press tools, please see table 21 in chapter 4.3.3

To check the compatibility of Wavin Tigris K1/M1 & Tigris K5/M5 pressing jaws with alternative brand press tools, please see table 22 chapter 4.3.3

8.1.2. Cordless and electric press tools

Wavin press-tools are supplied to the highest quality and manufacturing standards. Under correct operation and when all the necessary device inspections are carried out at regular intervals, the press tool warranty runs for 24 months from the despatch date or for 10.000 pressing operations whichever is sooner. Please refer to the respective press tool operating instructions for further details on operation and maintenance. The warranty is activated from the day of despatch from Wavin.

Fig. 49: Wavin pressing tool and pressing jaws.

The warranty does not cover any damage caused by improper handling or failure to observe the operating instructions or use with pipes or fittings not supplied by Wavin. Warranty services may be provided by the manufacturer only. Claims shall only be accepted if the device is supplied to the manufacturer fully intact, fully documented and with no interventions.

Inspection and service

The reliable performance of the press tool is dependent on careful handling. This is an important requirement for the tool to ensure long-lasting joints. The device requires regular service and maintenance. For any fault or fault message check in the manual included with the tool.

Only a clean and operational press tool can ensure a long-lasting sealed joint. The pressing jaws must only be used for their intended purpose of pressing Wavin Tigris fittings and should only be replaced by a qualified technicians.

8.1.3. Overview of compatible press tools

Table 20 shows the compatibility overview of Wavin Tigris K5/M5 & K1/M1 fittings with permitted press jaw profiles and alternative brand electrical and battery press tools. This table only lists “compatible devices” with a pressing force of 32 kN (± 2 kN) and 40 mm piston stroke.

Table 21 shows the compatibility overview of Wavin Tigris K5/M5 fittings with permitted press jaw profiles and mini press tools from alternative brands. This table only lists “compatible devices” with a pressing force of 19 kN (+ 2 kN) and only combinations of a single brand. The press jaws are intended for the mini press tool according to the manufacturer's specifications.

Table 22 shows the compatibility overview of tools that can be used for the Wavin Axial press system Tigris MX. The use of tools or tool combinations other than those stated in the overview in table 22 is at your own risk and excludes any liability on the part of Wavin. Release of other combinations only after written approval from Wavin.

Released Power pressing tools 32 kN [1)]

			Wavin Tigris K5	Wavin Tigris M5	Wavin Tigris K1	Wavin Tigris M1
Brand	**Type**	**Force**	**16 – 40**	**14[3)] – 40**	**50-75**	**50-75**
Wavin	ACO 203	32 kN	✓	✓	✓	✓
	ECO 203	32 kN	✓	✓	✓	✓
Novopress	ACO 203	32 kN	✓	✓	✓	✓
	ECO 203	32 kN	✓	✓	✓	✓
Klauke	MAP 232CFM	32 kN	✓	✓	✓	✓
	UAP 332CFM	32 kN	✓	✓	✓	✓
Hilti	NPR 32-A	32 kN	✓	✓	✓	✓
	NPR 32-P-22	32 kN	✓	✓	✓	✓
REMS	Akku-Press 22V ACC	32 kN	✓	✓	✓	✓
	Power-Press ACC	32 kN	✓	✓	✓	✓
Ridgid	RP340	32 kN	✓	✓	✓	✓
Rothenberger	ROMAX 3000	32 kN	✓	✓	✓	✓
	ROMAX 4000	32 kN	✓	✓	✓	✓
Released pressing profiles [2)]			U,Up,TH,H,B	U,Up,TH,H,B	U	U

Notes: 1) All press tools and jaws mentioned in the list have been tested and released at the laboratory of Wavin T&I. The release is based on he minimum press force that the press tool always must be able to deliver according to the tool supplier and on d90 measurements. It should be noted that this can only be guaranteed if the press tool has been serviced within the maintenance interval by the supplier or by a certified service station.

The press machines are intended exclusively for use with press jaws manufactured from the same supplier. No guarantee can be given when the pressing machine supplier and the pressing jaws supplier are mixed.

All work with the mentioned tools that does not correspond to proper use may lead to damage to the press device, the accessories or the pipes. Leaks and/or injury may result. Proper use also includes compliance with the Operating Manual of the press tools, adherence to the inspection and maintenance conditions as well as compliance with the latest versions of all relevant safety regulations. Modifying the tool in any manner may result in personal injury and voidance of the tool's warranty and also in incomplete/wrong pressings.

2) As far as the pressing profile is available in the specific dimension. B- & H-profile up to 32 mm only. Propress U-pressing jaws are released for above mentioned Wavin/ Novopress pressing tools.

3) 14 mm: Wavin/ Novopress, REMS: U, TH. All others: U only.

Table 20: Power pressing tools (32 kN).

8. Pressing tools

Releases Mini pressing tools 19KN [1)]

			Wavin Tigris K5/ Tigris M5 [3)] 16-40				
			Released pressing profiles [2)]				
Brand	**Type**	**Force**	**U**	**Up**	**TH**	**H**	**B**
Wavin	ACO 103	19 kN	✓	✓	✓	✓	✓
Novopress	ACO 103	19 kN	✓	✓	✓	✓	✓
REMS/ROLLER	Mini-Press S22V ACC	22kN	✓	✓	✓	✓	✓
	Mini -Press 22V ACC	22 kN	✓	✓	✓	✓	✓
	Mini- Press ACC	22 kN	✓	✓	✓	✓	✓
Klauke	MAP215CFM [4)]	15kN	✓	✓	✓	✓	
	MAP219CFM	19 kN	✓	✓	✓	✓	
Hilti	NPR19-A	19 kN	✓	✓	✓		
Ridgid	RP 219	19 kN	✓	✓	✓	✓	
Rothenberger	ROMAX Compact	19kN	✓	✓	✓		
	ROMAX Compact III	19kN	✓	✓	✓		

Notes: 1) All press tools and jaws mentioned in the list have been tested and released at the laboratory of Wavin T&I. The release is based on he minimum press force that the press tool always must be able to deliver according to the tool supplier and on d90 measurements. It should be noted that this can only be guaranteed if the press tool has been serviced within the maintenance interval by the supplier or by a certified service station.

The press machines are intended exclusively for use with press jaws manufactured from the same supplier. No guarantee can be given when the pressing machine supplier and the pressing jaws supplier are mixed.

All work with the mentioned tools that does not correspond to proper use may lead to damage to the press device, the accessories or the pipes. Leaks and/or injury may result. Proper use also includes compliance with the Operating Manual of the press tools, adherence to the inspection and maintenance conditions as well as compliance with the latest versions of all relevant safety regulations. Modifying the tool in any manner may result in personal injury and voidance of the tool's warranty and also in incomplete/wrong pressings.

2) As far as the pressing profile is available in the specific dimension. B- & H-profile up to 32 mm only. Propress U-pressing jaws are released for above mentioned Wavin/Novopress pressing tools.

3) Tigris M5 also 14 mm: Wavin/ Novopress ,REMS: U, TH. Klauke: U only.

4) MAP 215- max 32 mm.

Table 21: Mini pressing tools (19 kN).

Released Mini pressing tools 19 kN [1)]

			Wavin Tigris MX 16-32	
Brand	**Type**	**Force**	**Expander Tool**	**Slinding / press tool**
Wavin	Tigris MX combi tool 216BT	16kN	✓ 1)	✓ 2)
	Tigris MX expander tool 216BT	16kN	✓ 1)	
	Hand pressing tool	N/A		✓ 3)
Klauke	Combi tool 216BT	16kN	✓ 1)	✓ 2)
	Expander tool 216BT	16kN	✓ 1)	
Novopress	AXI 102 (18°)	19 kN	✓ 1)	
	AAP 102/ 47547	19 kN		✓ 4)
REMS	Ax Press 25	20 kN		✓ 4)
Rothenberger	ROCAM EPT PE-X	N/A	✓ 1)	
REHAU	A-One	14,5 kN	✓ 1)	✓ 4)
	A-3	18 kN		✓ 4)
	Rautool Qc	16,5 kN	✓ 1)	
	Rautool A light 2	18kN		✓ 4)

Notes: 1) Only with dedicated Wavin Expander heads with blocking mechanism
2) Only with dedicated Wavin Sliding forks for combitool
3)The manual tool requires special slider forks for the manual tool (MT)
4) Suitable in combination with Rehau sliding forks

All work with the mentioned tools that does not correspond to proper use may lead to damage to the press device, the accessories or the pipes. Leaks and/or injury may result. Proper use also includes compliance with the Operating Manual of the press tools, adherence to the inspection and maintenance conditions as well as compliance with the latest versions of all relevant safety regulations. Modifying the tool in any manner may result in personal injury and voidance of the tool's warranty and also in incomplete/wrong pressings.

Table 22: Wavin expanding handtool.

Damage report / check list

Customer:

Street:

City / Postcode / Country:

Telephone / Fax:

E-mail:

Contact person:

Responsible Wavin distributor or agent (supplier):

Please find enclosed:

ACO 102 cordless press tool	○	delivered with:	case ○
ACO 103 cordless press tool	○		battery ○
ACO 202 cordless press tool	○		charging unit ○
ACO 203 cordless press tool	○		
ECO 202 electric press tool	○		
ECO 203 electric press tool	○		

Other tools: _____ Pressing jaw ○ _____

(please indicate number and dimension) _____ | _____

Tool number: _____

The tool has been sent for: Repair ○ Service ○ Inspection ○

In the event of repair, please specify the reason:	○
Tool is losing oil	○
Faulty piston	○
Press procedure not correctly ended	○
Tool does not generate pressure	○
Housing broken	○
Faulty motor	○
Pressing jaw mount cracked	○
Faulty switch	○
Battery does not work	○
Charging unit does not work	○

Other complaints:

Price quotation requested? Yes ○ No ○

Date, Location _____ Signature _____

9. Certifications

Tigris M1/M5 and Tigris K1/K5

Approval/ Quality Mark	Country
VA + GDV	Denmark
ATG	Belgium
NF	France
IIP-UNI	Italy
WRAS	United Kingdom
KOMO / KIWA	Netherlands

Approval/ Quality Mark	Country
B-Mark	Poland
STF	Finland
DVGW	Germany
RISE	Sweden
SINTEF	Norway

Wavin Tigris MX system holds the following certification:

Mark	Country
• B-Mark	Poland
• KOMO/KIWA	Netherlands
• IPP	Italy
• DVGW	Germany

10. Use of chemicals

10.1. Disinfection of drinking water pipelines

The Wavin multilayer composite pipes are designed for use in the drinking water installation and certified accordingly, so that they can be used without any problems and a hygienically flawless installation can be established.

Disinfection measures are therefore normally not necessary. If, however, there is a compelling necessity due to a case of contamination, this is to be considered as an immediate emergency measure to return the installation to a serviceable condition.

The actual cause of the contamination (faulty operation, structural defects) must be rectified. Frequently recurring disinfections to maintain the serviceability of the installation must be avoided and do not correspond to the state of the art. If these are necessary, rehabilitation is to be preferred to installation. Frequent disinfections have a negative influence on the service life of an installation.

10.2. Thermal Disinfection

Usually conditions and parameters for thermal disinfection of drinking water systems foresee that “each tapping point must be exposed to at least 70 °C for at least 3 minutes when the outlet is open. Therefore, the water in the DHW heater must be heated above 70 °C. Temperature and duration are to be observed at all times. The outlet temperature must be “checked” at each tapping point.” (According DVGW Worksheet W551).

Disinfection of the Wavin Tigris multilayer composite pipes is possible using the method described. Classification of operating conditions according to ISO 10508 must be observed.

The Wavin installation pipe systems are designed for drinking water installations according to application class 2 and for heating installations suitable according to application class 5.

10.3. Chemical Disinfection

In general, the Wavin Tigris pipe can be disinfected chemically but certain aspects shall be taken into consideration. Especially long duration applications could have an impact on the life-time applications have impact on the life-time expectations of the system. For further information please contact your technical advisor at Wavin.

By following the rules of DVGW Code of Practice W 291 the implementation of chemical disinfection measures is regulated. The parameters described there such as active substances, concentrations, maximum temperatures and duration of application must be observed. The Wavin Tigris multilayer composite pipe can be disinfected with the disinfectants described in the worksheet, but the dosages of the chemicals must not be exceeded.

10.4. List of allowed chemicals

The following chemicals have been tested and have been released for operation with the Wavin Tigris MP systems. See table 23.

Products	Wavin MP pipe	Wavin Tigris M1 / M5	Wavin Tigris K1 / K5	Wavin Tigris MX
Ethylene glycol/propylene glycol < 35%	✔	✔	✔	✔
Teflon / PTFE tape	✔	✔	✔	✔
Neo- Fermit-paste + Hemp	✔	✔	✔	✔
Griffon Silpat	✔	✔	✔	✔
Loctite 5331	✔	✔	✔	✔
Bode silicone oil	✔	✔	✔	✔
Unipak Paksalve	✔	✔	✔	✔
Loctide 55	✔	✔	✖	✔
Loctite 542	✔	✔	✖	✔
Tangit Uni-lock	✔	✔	✖	✔
Würth sealing material	✔	✔	✖	✔
Rocol Rapidseal	✔	✔	✖	✔
Griffon Kolmat Flon- 100 fluid for PTDE	✔	✔	✖	✔
Unipak Uniflon fluid for PTFR wire	✔	✔	✖	✔
Armaflex SF 990	✔	✔	✔	✔
Paints, sprays, (2-part) adhesives [as e.g. Armaflex 520]	✔	✔	✖	✔
Cold welding agents contain Acetone or Tetrahydrofuran (THF)	✔	✔	✖	✔
Air pressurized system, based on oil free systems according to ISO 8573-1, class 1	✔	✔	✔	✔
Demineralized/deionized osmosis water	✔	✖	✔1)	✖
Sodium hydroxide < 0,5%	✔	✔	✔	✔
Tolyltriazole < 0,5%	✔	✔	✔	✔

Application of solvents containing stress corrosion cracking media, like ammonium- chloride and nitrate must be avoided.

1) female thread connectors excluded

Table 23: Overview of allowed chemicals.

Disinfectant	Max. concentration	Max. temperature	Max. time	Max. number of cycles*
Chlordioxid ClO_2	6 ppm as ClO_2	< 23 C	12 h	5
Hypochlorite Cl_2	50 ppm as Cl_2	< 23° C	12 h	5
Hydrogen peroxide H_2O_2	150 ppm	< 23° C	12 h	5
Potassium Permanganate $KMnO_4$	12 ppm	< 23° C	12 h	5

Above overview is just a short list. Please contact your local sales representative In case of doubts.

* Based on a desired lifetime of 50 years

Table 24: Overview of disinfectant chemicals.

11. Warranty

11.1. Limited warranty

The Products are warranted to be free from defects in materials and workmanship under normal use in hot and cold potable water installations, heating and cooling installations and oil-free pressurized air installations, for a period of [ten] years from the date of purchase (the "Warranty"). In order for this Warranty to apply, the Products must be handled, stored, and installed in accordance with the instructions provided in this product booklet. As set forth more fully in Section 7.5 of our Terms and Conditions of Sale (which is incorporated by reference), this Warranty does not cover any damage caused by improper handling, storage, shipping, or installation of the Products (including installation in any applications other than in hot and cold potable water installations, heating and cooling installations or oil-free pressurized air installations).

Claims under this Warranty must be made in writing and submitted to Seller promptly after the defect is discovered and, in any event, within [ten] years of the date of purchase. In order to make a claim under this Warranty, any Product alleged to be defective must be made available to Seller for inspection, verification, and testing.

If Seller confirms that the Product is defective, the exclusive remedy for breach of this Warranty is limited to (1) replacement of the defective product, or (2) refund of the purchase price. Seller shall have no liability for the cost of removal or reinstallation with respect to any replaced Product. The election of said remedies will be determined by Seller in its sole discretion and shall be considered final disposition.

To the extent that this Warranty conflicts with our Terms and Conditions of Sale, the terms of this Warranty shall prevail. This Warranty may only be modified or altered in a writing signed by Seller's representative.

Limitation of liability

FOR THE AVOIDANCE OF DOUBT, SELLER'S LIABILITY FOR ANY AND ALL LOSS OR DAMAGE, HOWSOEVER ARISING AND UNDER ANY LEGAL OR EQUITABLE THEORY (INCLUDING WITHOUT LIMITATION BREACH OF CONTRACT; BREACH OF WARRANTY; COMMON LAW, EQUITABLE, OR CONTRACT INDEMNITY; NEGLIGENCE; OR TORT) SHALL BE STRICTLY LIMITED TO THE PURCHASE PRICE OF THE PRODUCT.

ALL IMPLIED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED. THIS LIMITED EXPRESS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, GUARANTEES, AND AGREEMENTS. SELLER EXCLUDES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND/ OR WARRANTY OF NON-INFRINGEMENT. SELLER NEITHER ASSSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR SELLER ANY OTHER OBLIGATION OR LIABILITY IN CONNECTION WITH THE PRODUCTS. IN NO EVENT SHALL SELLER BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES.

Choice of law an venue

This Warranty shall be governed by and construed in accordance with the laws of the jurisdiction in which the Seller is incorporated, excluding in any case conflict of law rules. The Parties acknowledge and agree that the applicability of the United Nations Convention on Contracts for the International Sale of Goods (often referred to as the Vienna Sales Convention) is expressly excluded.

Any disputes related to the Products, or this Warranty will be resolved exclusively by the competent courts of the state in which Seller is incorporated, and you and Seller consent to personal jurisdiction in those courts

11.2. Warranty

Please use the opportunity to gain a 10-year warranty on the Wavin Hot & Cold systems installed in your building project.

It is a condition for the issuing of the 10-year warranty that evidence is provided that the Wavin Products are installed according to the Wavin installation guidelines, the applicable legislation and regulations and all demands of the latest technical knowledge and the requirements of good and sound craftsmanship. Furthermore, your project must be registered at Wavin through the official 10-year warranty form.

Additional conditions are mentioned below:

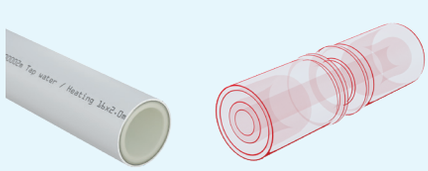
1. Your project must be registered, and you must have installed a Wavin system for which Wavin can provide the 10-year warranty
2. The installation must have been completed within the last 3 months and the installed Wavin products have been installed within 12 months after delivery
3. The completed, signed and stamped “Registration for 10-year warranty form” must be promptly mailed to:

---

4. In a few days you will receive the original 10-year warranty by mail.

Please bear in mind that it is not possible to receive this warranty for individual Wavin products. For Hot & Cold applications both the pipes and the fittings comprising the complete installation have to originate from Wavin. For Underfloor Heating applications the pipes, manifolds and insulation panels have to originate from Wavin if applicable. In case the Wavin products are installed in combination with products from other suppliers which are also available at Wavin, the warranty cannot be supplied or if already supplied it loses its validity.

Wavin pipe
+ Wavin Fitting
=
Wavin System Warranty

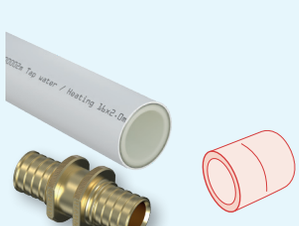


Wavin pipe
+ Other Fitting
=
NO Wavin System Warranty

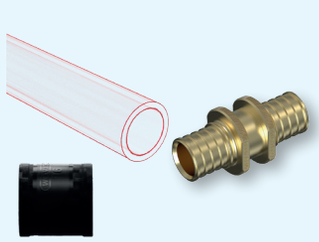
Other pipe
+ Wavin Fitting
=
NO Wavin System Warranty

Wavin pipe
+ Wavin MX Fitting
+ Wavin Sliding ring
=
Wavin System Warranty

Wavin pipe
+ Other Fitting
+ Wavin Sliding ring
=
NO Wavin System Warranty



Wavin pipe
+ Wavin Fitting
+ Other Sliding ring
=
NO Wavin System Warranty



Other pipe
+ Wavin Fitting
+ Wavin Sliding ring
=
NO Wavin System Warranty

11. Warranty

Registration for 10-Year Warranty Form

Building project*

Name, property _____

Street _____

Postcode, town/city _____

Installer*

Company _____

Street _____

Postcode, town/city _____

Planner

Company _____ Postcode, town/city _____

Architect

Company _____ Postcode, town/city _____

Distributor

Company _____ Postcode, town/city _____

Type of property*

- ○ Single family home
- ○ School
- ○ Home for the elderly
- ○ Multi-residential unit
- ○ Factory building
- ○ Residential complex
- ○ Bank
- ○ Place of Worship
- ○ Office/administrative building
- ○ Sports hall
- ○ Food outlet
- ○ Public building
- ○ Hospital
- ○ Museum
- ○ Store/shop
- ○ Doctor's practice
- ○ Swimming pool
- ○ Other

*Mandatory fields

System(s)*

Quantity _____

Please specify the system for which the declaration of liability should be issued.

_____

_____

Required supporting documents (minimum of 1)*

- ○ Copy of invoice _____
- ○ _____
- ○ _____

Installation and commissioning*

- ○ System ready for use on _____
- ○ Pressure test completed* on _____ ○ No faults present
- ○ Heating function checked on _____ ○ No faults present

The system has been installed, checked and commissioned in accordance with the Wavin planning specifications, installation instructions and operating instructions.

_____

Signature and stamp of the specialist company

_____

Signature of building owner

_____

By signing this document the installer accepts the applicability of the General Terms of Sale and Delivery of Wavin as published at www.wavin.com .

*Mandatory fields

12. Product portfolio

12.1. Product portfolio Wavin Tigris M5

Wavin Tigris M5 (14-40mm)

Coupler

Coupler reduced

Coupler PEX

Connector female

Connector male

Screw connector female

Connector Push Fit

Elbow

Elbow 45°

Elbow male

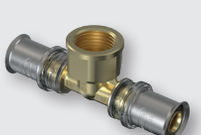
Elbow female

Elbow screw connector

Tee

Tee reduced

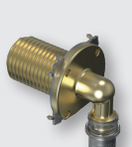
Tee male



Tee female

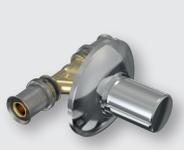
Wall plate

Terminal connector



Wall passage

Tee wall

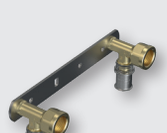


Valve

Wall plate double

U-connector 90°

Double wall passage



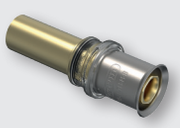
Wall plate sets

Wavin Tigris M5 (14-40mm)

Connector toilet

Elbow toilet

Tee toilet



Coupler metal

Elbow metal

Repair coupler

Ratiator wall

Radiator floor

Elbow radiator

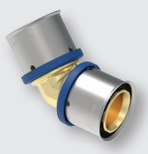
Tee radiator

Cross fitting

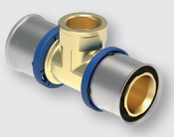
12. Product portfolio

12.2. Product portfolio Wavin Tigris M1

Wavin Tigris M1 (50-75mm)



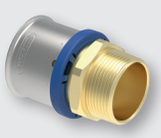
M1 Elbow
50 45



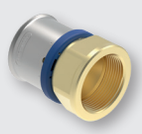
Tigris M1 Tee
Female 50x1x50

M1 Coupler 50

M1 Coupler
Reduced 50x40



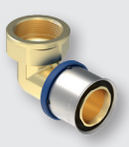
M1 Connector
Male 50x1.5



M1 Connector
Female 50

Tigris M1 Elbow
Male 50x1.5

M1 Elbow
50



Tigris M1 Elbow
Female 50x0.5

M1 Tee
50

M1 Tee
50x40x50

12.3. Product portfolio Wavin Tigris K5

Wavin Tigris K5 (16-40mm)

Coupler

Coupler reduced

End plug

Connector female

Connector male

Manifold male

Manifold female

Elbow

Elbow 45°

Elbow male

Elbow female

Connector toilet

Tee

Tee reduced

Tee female

Wall plate

Wall plate double

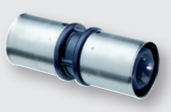
Elbow wallbox

12. Product portfolio

12.4. Product portfolio Wavin Tigris K1

Wavin Tigris K1 (50-75mm)

Connector male



Coupler

Coupler reduced

Elbow 45

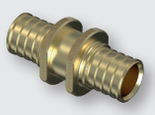
Elbow 90

Tee

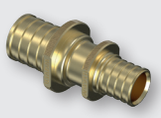
Tee reduced

12.5. Product portfolio Wavin Tigris MX

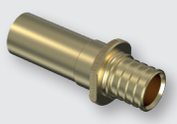
Wavin Tigris MX



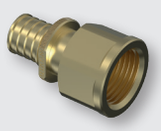
Coupler



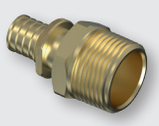
Coupler reduced



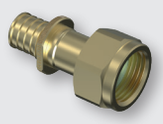
Coupler metal



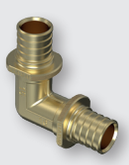
Connector female



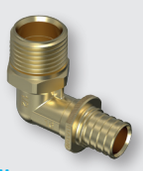
Connector male



Screw connector female

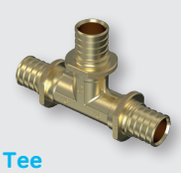


Elbow



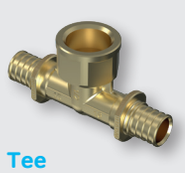
Elbow male

Elbow female



Tee

Tee reduced



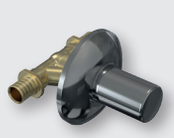
Tee female

Wall flange female

Double Wall flange female

End Plug

Terminal connector



Valve

Wall plate sets

Sliding ring

Notes

Notes

Discover our broad portfolio at wavin.com

- Drinking water distribution
- Waste water drainage
- Indoor climate solutions
- Urban climate resilience solutions

orbia

Building & Infrastructure

wavin

Wavin is part of Orbia, a community of companies working together to tackle some of the world's most complex challenges. We are bound by a common purpose: To Advance Life Around the World.

Orbia's Building and Infrastructure business Wavin is an innovative solutions provider for the global building and infrastructure industry. Backed by more than 60 years of product development experience, Wavin is advancing life around the world by building healthy, sustainable environments for global citizens. Whether it's to improve the distribution of clean drinking water, to make sanitation accessible for everyone, to create climate resilient cities, or to design comfortable living spaces, Wavin collaborates with municipal leaders, engineers, contractors, and installers to help future-proof communities, buildings and homes. Wavin has 12,000+ employees around 65 production sites worldwide, serving over 80 countries through a global sales and distribution network.

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