March 2025 | Technical Handbook

Pex Pipe System

Wavin A-Pex & SuperPEX

Cold expansion and crimp pipes for potable plumbing

wavin

An Orbia business.

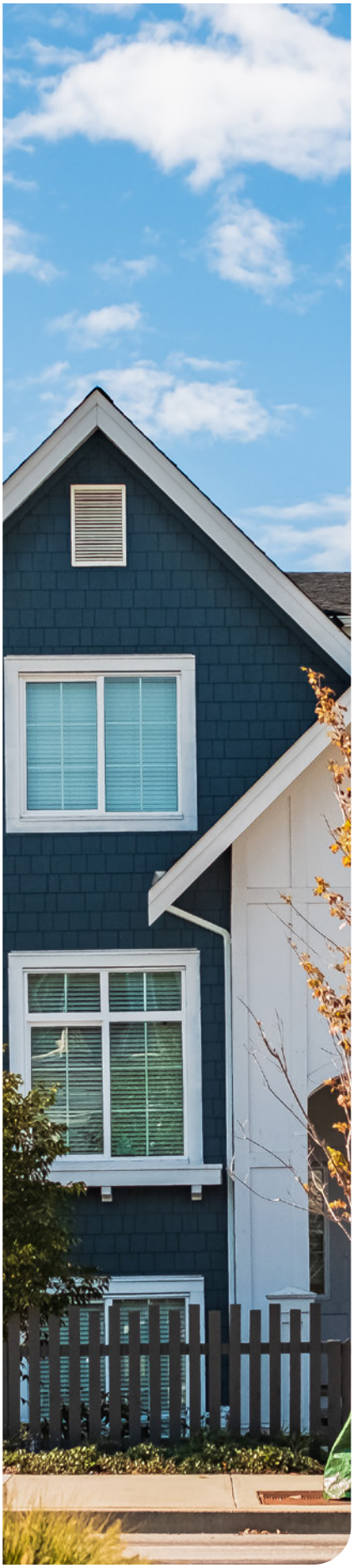
Introduction

This guide aims to acquaint plumbing professionals with the **Wavin A-Pex** pipe and expansion fitting connection, the **Wavin SuperPEX** pipe and crimp fitting connection, along with their recommended installation method. Wavin Pex pipes and fittings present numerous advantages over rigid pipe systems, including superior flexibility and the reduction of required fittings.

Global leader in plastic pipes & fittings since 1955

Wavin is a leading supplier and manufacturer of plastic pipes and fittings for plumbing, waste and sewer systems, roof drainage, stormwater management, smart water management solutions, water reuse systems, and underfloor heating.

Backed by more than 60 years of product development experience, Wavin (pronounced “wah-vin”) advances life around the world by building healthy, sustainable environments for people everywhere.



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Who we are

- Wavin is an innovative solution provider for the building and infrastructure industry across multiple continents. Backed by 60+ years of expertise, we are geared up to tackle some of the world's biggest challenges around: water supply, sanitation, climate-resilient cities and building performance.

- At Wavin, we focus on creating positive change in the world and our passion is building livable and loveable places. We engage and collaborate with city leaders, engineers, planners and installers to help make cities future-proof and buildings comfortable and energy-efficient.

- As a leading supplier of plastic systems and solutions, we connect customers to better solutions for above and below ground projects in the following application areas: water management, heating and cooling, water and gas distribution, waste water drainage and datacom. Wavin headquarters are located in Amsterdam, the Netherlands.

- Wavin is part of Orbia, a community of companies bound together by a shared purpose: to advance life around the world. Wavin has 12'000+ employees in 40+ countries worldwide and operates under brands like Wavin, Amanco, Plastigama and Pavco.

Our purpose

Building healthy, sustainable environments

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, Orbia Wavin is advancing life around the world by building healthy, sustainable environments for global citizens.

There are four pillars driving our sustainability journey, selected to reflect where we can contribute to the United Nation's published Sustainable Development Goals. These pillars form the foundation of our purpose: to build healthy, sustainable environments.

While we build and create value through our products and services, we do so in a mindful way – by using as much recycled material as possible, reducing energy consumption and waste, and keeping a close eye on our footprint. In other words, doing our utmost to create a sustainable future.

Our purpose drivers

We deliver innovative products, systems and services that create:

Safe and efficient water supply

Because today about 30% of all water pumped through pipe systems is lost due to leakages.

Better sanitation and hygiene

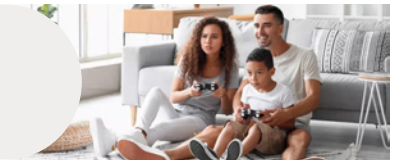
Because approximately 50% of the people in the developing world live without improved sanitation.

Climate resilient cities

Because we are experiencing 30% heavier rainfall due to climate change, and in parallel have long dry periods with too little water and heat stress.

Better building performance

Because around 40% of all the energy is consumed in buildings.



Building Better Since 1955

For years, metal pipes have been the go-to choice for plumbing professionals everywhere. Now, it's time for a fresh, forward-thinking solution that makes the job quick and easy. Wavin's plastic piping solutions have been trusted worldwide since 1955, delivering excellence and innovation for today and tomorrow. Say goodbye to heavy, rusty metal and hello to lighter, flexible, and reliable plastic PEX pipes. Embrace **Generation PEX** for a faster, easier, and more reliable solution you can count on!

Plastic is Affordable and Durable

Plastic pipes are the answer for affordability, durability, and safe plumbing systems. They are lighter, can be easily and quickly installed, are corrosion-resistant and have a long service life.

All metal pipes are ridged materials, which requires couplers in the installation to change direction to cross a corner or to go from wall to ceiling or floor. This makes these systems less flexible—meaning more expensive—to install.

Lifecycle analysis of PEX pipes in residential construction reveals that **using PEX reduces construction costs by 63% .**[1]

Furthermore, copper pipes have challenges in distributing drinking water. They are prone to deposits, one reason why copper pipes are mainly used for heating distribution.

Most importantly, plastic piping systems have no adverse effect on water quality.

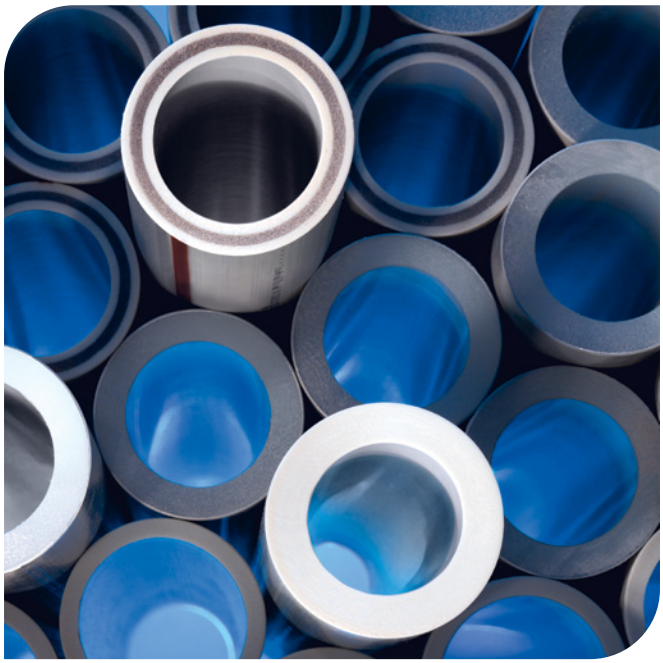
Plastic is more Sustainable

The environmental impact of plastic pipes are highly debated. However, plastic pipes have a low carbon footprint in their manufacturing, shipping, and recyclability lifecycle.

Copper, by contrast, has a more significant negative environmental impact. PEX piping significantly reduces CO2 emissions over its lifecycle: **42% less CO^2 emissions** vs. copper, according to a lifecycle analysis by the Plastic Pipe Institute .

Part of that lifecycle benefit comes from plastic pipe's lighter weight. For every plastic pressure pipe that weighs one pound, its metal counterpart weighs four pounds. Plastic pipes cost less to ship and require less effort to load, in addition to their lighter environmental impact.

For more information, the Plastic Pipe Institute offers this helpful "A Greener Infrastructure" guide.



[1] Source: Plastic Pipe Institute Lifecycle Analysis that followed ISO Standard 14040 methodology.

Wavin Plastic Pipes: The Better Choice

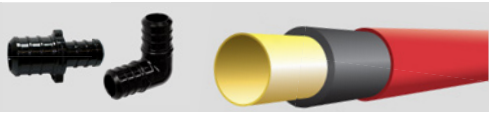
Wavin's plastic pipes — PVC, CPVC, PEX, and PP-RCT— are used in projects all over the world. Trusted since 1955, Wavin has the plastic pipe innovation and expertise you can rely on to deliver excellence.

Wavin A-Pex

Wavin's A-Pex offering is truly the apex of advanced PEX piping, with an industry-leading 25-year warranty on the system. Ideal for colder temperatures, Wavin A-Pex is pressure-resistant to mitigate the risk of burst pipes during frigid winters. Its flexibility makes it Ideal in multifamily residential, industrial, commercial, and high-rise, applications.

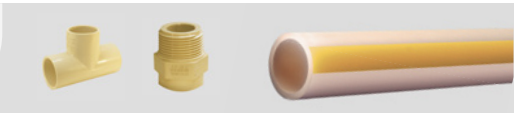
The Wavin A-Pex pipe is versatile offering connections that can be made through expansion and crimping to accommodate the user's preference and comfort level.

Wavin SuperPex



Our multilayer Wavin SuperPEX pipe's flexibility makes installation simple and worry-free. It has the highest rating in chlorine resistance in the most demanding conditions, such as hot water domestic continuous recirculation. With two layers of defense, Wavin SuperPEX also has the highest UV resistance rating of all PEX offerings: 180 days, compared to standard PEX plastic pipe, which has a maximum exposure of 30 days. This means more flexibility in storage and on the job site.

Wavin Bow FlowGuard® Gold CPVC



This high-temperature pressure piping for potable water is designed for residential/commercial hot and cold water pressure applications. It is the only complete CPVC pipe and fittings system made from materials that are pressure-rated by the Plastic Pipe Institute. Wavin Bow FlowGuard Gold CPVC has up to 92% higher sustained pressure resistance at elevated temperatures than other CPVC brands and up to 80% higher resistance to impact fracture.
Source: Lubrizol Advanced Materials, Inc.

Wavin Schedule 40 PVC

This piping is typically used for transporting potable water, but it is also a good choice for distributing other pressurized liquids, provided they are chemically compatible with PVC. It is intended for places where the liquid temperature does not exceed 140° F, such as residential buildings, high-rise buildings, offices, commercial buildings, hospitals, hotels, and semi-industrial environments.

Wavin Schedule 40 PVC is resistant to oxidation and corrosion, non-toxic, and odorless. Smooth interior walls mean low frictional loss, and the pipe's light weight makes it easy to install using solvent weld.

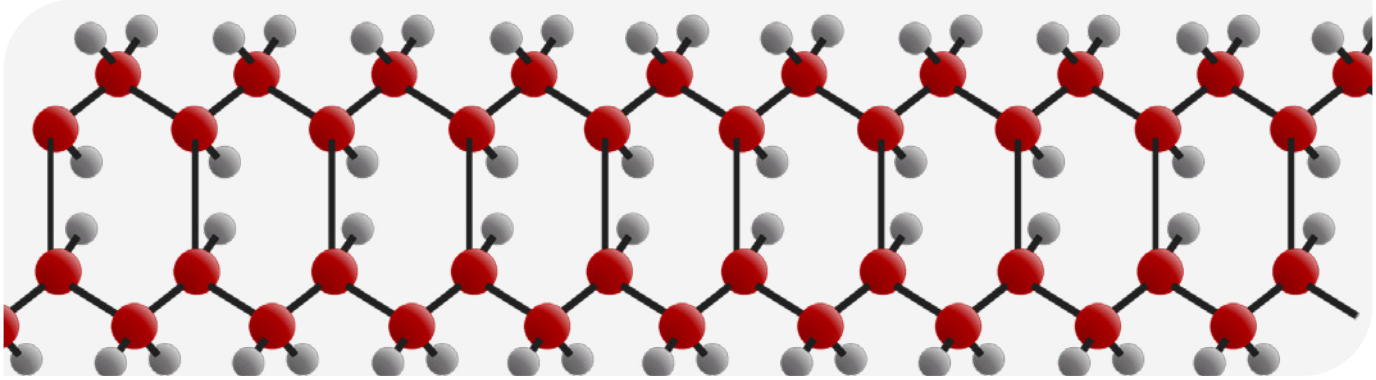
Wavin PP-RCT Basalt

The basalt fiber in the middle layer of our PP-RCT pipe ensures a better-performing, lightweight pipe with high corrosion resistance. It is more environmentally friendly than glass fiber-filled polymer alternatives. It can be used in a wide range of high-pressure applications with the lowest lead fittings content. The Wavin PP-RCT pipe is connected by hot fusion and becomes one continuous piece. Perfect for HVAC and potable water applications.

General Product Information on PEX

PEX Overview

PEX (cross-linked polyethylene) is a material made from high-density polyethylene (HDPE) molecules that are permanently bonded through a process called crosslinking. This process creates a “semi-thermoset” polymer, providing PEX with enhanced long-term stability and durability.



Types of PEX

The crosslinking process in PEX production involves chemically bonding polymer chains into a three-dimensional network, significantly improving the material’s properties. There are three primary methods of crosslinking:

- **PEX-a (Peroxide Method)**
  Crosslinking is initiated by heating HDPE with peroxide compounds, resulting in a uniform and flexible product.
- **PEX-b (Silane Method)**
  Crosslinking occurs through a chemical reaction between polyethylene molecules and silane compounds during the extrusion process.
- **PEX-c (Electron Beam Method)**
  High-energy electron beams are used to break polymer chains, inducing crosslinking without the use of additional chemicals.

These methods offer increased strength, flexibility, and resistance to temperature and chemical degradation, making PEX pipes versatile for plumbing and heating systems

The PEX related standards do not differentiate in strength between the different crosslinking techniques.

However, the level of crosslinking differ between the various types:

PEX-a	Peroxide Crosslinking	Cross-Linking Level ≥ **70%**
PEX-b	Silane Crosslinking	Cross-Linking Level ≥ **65%**
PEX-c	Radiation Crosslinking	Cross-Linking Level ≥ **60%**

PEX-a pipes and Cold Expansion Connections.

Cold expansion connection refers to a method of connecting PEX-a pipe using a specialized fitting, expansion ring and tool to expand the tubing, allowing the fitting to be inserted. As the pipe and ring contracts to its original size, it forms a tight, secure seal without the need for clamps or crimp rings.

How It Works:

An expansion ring is placed over the end of the PEX-A pipe, and a specialized tool is used to slightly expand both the ring and the pipe. This allows the fitting to be inserted. Once the tool is removed, the pipe and ring contract back to their original size, forming a strong, secure connection.

*PEX-a pipes are also suitable for crimp connections

PEX-b pipes and Crimp Connections

Crimp connections are a method for joining PEX-b (or PEX-a) pipes and fittings that involves sliding a metal crimp ring onto the tubing, inserting the fitting, and using a specialized crimping tool to tightly compress the ring around the fitting. This creates a secure, leak-proof connection by firmly holding the fitting in place.

How It Works:

The crimp ring is slid onto the tube, leave a small gap, insert the fitting and place the jaws of the tool over the crimp ring. Fully close the jaws to compress the crimp ring for a strong connection.

Pex Features & Benefits

Easy Installation:
PEX pipes use mechanical connections, so there's no need for soldering, open flames, or chemicals. Their flexibility allows them to navigate around obstacles easily, and incorporating manifolds can further streamline the installation process and enhance performance.

Corrosion Resistance:
PEX pipes do not pit or corrode.

Scaling Resistance:
Their smooth inner walls and chemical properties result in a resistance to mineral build-up.

Cost Efficiency:
Installing PEX systems requires less labor and can enhance overall system performance.

Variety of Sizes:
PEX pipes come in large range of diameters to suit different needs.

Energy Efficiency:
PEX pipes reduce heat loss through their walls.

Freeze Resistance:
In most cases, PEX pipes can handle freezing and thawing of water without damage.

Water Conservation:
Well-designed PEX systems can minimize the time it takes for hot water to reach the faucet.

Environmentally Friendly:
PEX is made from inert materials and doesn't release volatile organic compounds (VOCs).

Certifications:
PEX pipes and fittings are required to meet stringent performance standards.

Applications

PEX piping can be used in a wide variety of applications in residential construction. This Design Guide is focused on the design and installation of PEX hot and cold potablewater supply systems, which can be used for both new construction and remodeling or retrofit projects.

Industrial

Commercial

High-Rise

Multi-Family Residential Facilities

Standards

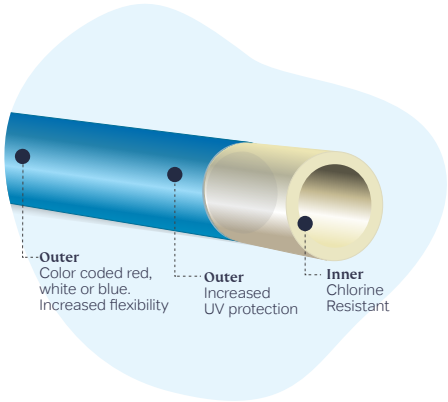
Wavin A-Pex (PEX-a)

Wavin A-Pex duolayer tubing is manufactured for use in hot and cold potable water distribution including industrial, commercial, high-rise and multi-family residential facilities.

PEX-a is commonly linked with the **cold expansion connection method**.

In this process, a special tool expands the pipe and expansion ring to an inner diameter that allows the fitting to be inserted. Once the fitting is in place, the pipe and expansion ring contract back around the fitting, leveraging the relaxation properties of PEX-a to create a tight, durable connection.

However, Wavin A-Pex pipes can also be connected using crimp fittings, a method frequently used in PEX-b pipe systems.



Features and benefits Wavin A-Pex pipes

Wavin A-Pex pipes

- Wavin A-Pex pipes are produced in the following sizes (external pipe diameter is shown):
  ½", ¾", 1", 1 ¼", 1 ½", 2"
- They are available in coils with length variations from 100 ft, 300ft to 500ft or in 20 ft straight lengths

- Pipes come with full color outer layer in white, blue or red for sizes ½" , ¾" and 1". The range 1 ½", 1 ¾" and 2" are available with white outer layer.

Benefits of Wavin A-Pex Duolayer pipes

Offers superior flexibility, making it easy to install and service.

Reduces noise caused by water hammer, resulting in a quieter system compared to copper.

Resists corrosion and scale buildup, enhancing plumbing system performance.

Requires fewer fittings, reducing total installation costs.

Features fewer joints, minimizing the likelihood of callbacks.

Allows faster pressure testing without waiting for glue to dry or joints to cool.

Benefits of Expansion Fittings

- Reliable Connections: The expansion ring and pipe must be expanded to ensure a proper connection, preventing missed fittings.

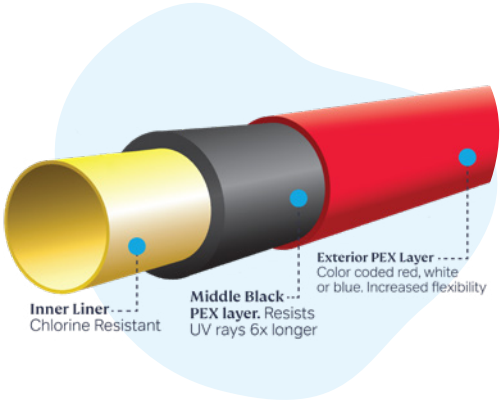
- Material Options: Choose from Wavin fittings made of polymer or lead-free brass to suit your needs.

- Approved tools: only use Milwaukee expansion tools approved for making expansion joints

Wavin SuperPEX (PEX-b)

Wavin's SuperPEX is an advanced three-layered PEX-b tubing designed to combine flexibility for effortless installation with unparalleled UV protection. Engineered specifically for hot and cold potable water distribution in industrial, commercial, high-rise, and multi-family residential settings, SuperPEX can also be used as a durable underground water service pipe.

PEX-b pipes are joined by **crimp connections**



Features and benefits SuperPEX pipes

Wavin SuperPEX Pipes

- Wavin SuperPEX pipes are produced in the following sizes (external pipe diameter is shown): ⅜", ½", ¾" and 1" nominal sizes.
- Available in coils and in straight lengths.
- The tubing is made to CTS (Copper Tube Size) outside dimensions and an SDR (Standard Dimension Ratio) of 9.
- Red, white and blue colors available.

Benefits of SuperPEX Triplelayer pipes

- High resistance to chlorine in most demanding conditions (hot water domestic continuous recirculation)
- Provides long term protection against chlorine degradation
- Highest UV resistance; offers two layers of defence against damaging UV Rays rated 180 days
- Flexibility of the material makes installation easy.

Benefits of Crimp Fittings

- Easy to install- fast join method- no waiting time after crimping.
- Material Options: Choose from Wavin fittings made of polymer or lead-free brass to suit your needs.

Standards and Certifications

Wavin A-Pex (PEX-a)

Standards

The Wavin A-Pex system (pipe and fitting) is designed certified to the following standards:

Pipes

- CSA B137.5
- ASTM F876
- ASTM F877

Compatible Fittings

- ASTM F1960; ASTM F1807; ASTM F2159

Listings/ certifications

Listee holder, Wavin USA Inc.

- NSF 14; NSF 61; cNSF®us pw

The tubing also has listings with:

- *ICC Evaluation Service product certificate PMG-1559
- *CAN/ULC -S102.2
- *ASTM E84
- For detailed information, please refer to: *ICC -ES PMG-1559

Chlorine resistance and UV protection: Chlorine, UV, and Hydrostatic Design Stress (HDS) rating of pipe: PEX material designation code **PEX 5206.**

Model Plumbing Codes

CODE ACCEPTANCE OF PEX SYSTEMS PEX plumbing systems are approved by all major building codes, including (but not limited to) the:

- International Residential Code
- International Plumbing Code
- National Standard Plumbing Code
- Uniform Plumbing Code
- National Plumbing Code of Canada

Wavin SuperPEX (PEX-b)

Standards

The SuperPEX system (pipe and fitting) is designed certified to the following standards:

Pipes

- CSA B137.5
- ASTM F876
- ASTM F877
- AWWA C904

Compatible Fittings

- ASTM F1807; ASTM F2159

Listings/ certifications

Listee holder, Bow Plumbing Group Inc.

- NSF 14; NSF 61; cNSF®us pw
- HUD (MR1293g)

The tubing also has listings with:

- ULC to CAN/ULC S101, design #'s M516, J900, W316 and W458.
- UL to UL 263, design #'s K917, L588, U383 and V461.
- *NSF to CAN/ULC S102.2.
- *NSF to ASTM E84

For detailed information, please refer to: *https://info.nsf.org/certified/plumbing

Chlorine resistance and UV protection: Chlorine, UV, and Hydrostatic Design Stress (HDS) rating of pipe: PEX material designation code **PEX 5306**.

Model Plumbing Codes

CODE ACCEPTANCE OF PEX SYSTEMS PEX plumbing systems are approved by all major building codes, including (but not limited to) the:

- International Residential Code
- International Plumbing Code
- National Standard Plumbing Code
- Uniform Plumbing Code
- National Plumbing Code of Canada

List of applicable standards

- **ASTM - F877** Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
- **ASTM - F876** Standard Specification for Cross-linked Polyethylene (PEX) Piping
- **CAN/CSA B137.5** Crosslinked Polyethylene (PEX) Piping Systems for Pressure Applications
- **ASTM- F1960** Standard Specification for **Cold Expansion Fittings** with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Piping
- **ASTM-F1807** Standard Specification for **Metal Insert Fittings** Utilizing a **Copper Crimp Ring, or Alternate Stainless Steel Clamps**
- **ASTM-F2159** Standard Specification for **Plastic Insert Fittings** Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps
- **ASTM F2023** Standard Test Method for Evaluating the **Oxidative Resistance** of Crosslinked Polyethylene (PEX) Tubing and Systems to Chlorinated Hot Water ➻ class 5
- **ASTM F2657** Standard Test Method for **Outdoor Weathering Exposure** of Crosslinkedb Polyethylene (PEX) Tubing
- **NSF14/NSF/ANSI 14** Plastics Piping Systems Components and Related Materials (DZR materials)
- **NSF/ANSI/CAN 61** Drinking Water System Components — Health Effects (eg leadfree materials)
- **NSF/ANSI/CAN 372** Drinking Water System Components – (leadfree)

Technical Information

This technical information pertains to the Wavin **Pex plumbing systems**, the assembly and use of the PEX-a reinforcing ring with Wavin PEX-a Pipe, and the crimp connections of PEx-a and PEX-b pipes, intended for hot and cold-water potable distribution systems. It is imperative that individuals using this guide are experienced and appropriately licensed contractors familiar with the principles and practices of installing hot and cold-water potable distribution systems.

This guide serves to demonstrate the proper assembly method and installation recommendations for the Wavin Pex plumbing system. Contractors must verify that the technical information provided in this guide aligns with local codes and regulations. Any conflicts with code requirements or industry standards should be addressed by consulting the Wavin distributor and relevant building authorities. Wavin is not liable for installation practices that deviate from this installation guide or are not acceptable practices within the mechanical trades.

Before starting the installation process, it is essential to review the Wavin Pex Limited Warranty, available at the end of this handbook, on the company's website or through authorized distributors. Proper installation is the responsibility of the contractor, who should refer to the Wavin Technical Guidelines for comprehensive instructions and updates.

Safety precautions outlined in this guide are critical. Trained personnel should conduct installations, adhering to safety guidelines provided for PEX-a and PEX-b tool manufacturers. Failure to follow safety procedures may result in serious injury. Always exercise caution and keep all body parts clear of machinery during operation.

Essentials

Wavin A-Pex Material:

- Crosslinked polyethylene,
- PEX Peroxide Method (PEX-a), PEX 5206

Wavin SuperPEX Material:

- Crosslinked polyethylene,
- PEX Silane Method (PEX-b), PEX 5306

Continuous working pressure:

- 690 kPa - 82ºC / 100 psi @ 180ºF
- 1103 kPa - 23ºC / 160 psi @ 73ºF

Chlorinated Potable Water:

- 550 kPa - 60ºC / 80 psi @ 140ºF

Caution: do not use pipe when chlorine dioxide is present in the water treatment system as it might significantly reduce the lifetime.

General Specifications

Pipe Dimensions

Nominal tubing size (in)	Outer Diameter (in)	Outer Diameter Tolerance (in)	Minimum Wall thickness (in)	Thickness Tolerance (in)
⅜"	0.500	±0.003	0.070	+0.010
½"	0.625	±0.004	0.070	+0.010
¾"	0.875	±0.004	0.097	+0.010
1"	1.125	±0.005	0.125	+0.013
1¼"	1.375	±0.005	0.153	+0.015
1½"	1.625	±0.006	0.181	+0.019
2"	2.125	±0.006	0.236	+0.024

Weights and Capacities of PEX Pipe (per 100 ft)

Nominal tubing size (in)	Weigth Empty (lbs)	Weigth Full (lbs)	Capacity (US.gal)
⅜"	4.20	8.4	0.50
½"	5.2	13.2	1.0
¾"	10.2	26	1.9
1"	17	43	3.2
1¼"	25	64.3	4.7
1½"	35.6	89.8	6.5
2"	60.7	153.5	11.1

Hydraulic loss -Metal insert Fittings

Fitting Equivalent Length of Pipe (ft)

Fitting Type	3/8"	1/2"	3/4"	1"
Coupling	2.9	2	0.6	1.3
Adapter	2	2	1	1
Elbow 90	9.2	9.4	9.4	10
Tee-Branch	9.4	10.4	8.9	11
Tee-Run	2.9	2.4	1.9	2.3

Hydraulic loss -Poly Alloy insert Fittings

Fitting Equivalent Length of Pipe (ft)

Fitting Type	1/2"	3/4"	1"
Coupling	7.1	4.8	4.5
Elbow 90	16.5	17.4	18
Tee- Branch	17.9	17.7	17
Tee - Run	7.2	6.6	6

Hydraulic Performance & Friction Losses

Below tables show the calculate pressure loss, based on the Hazen Williams formula. Tube inside diameters are based on the average inner diameters following the ASTM 876 values,

Hazen Williams (Pressure Loss)

$$F = 4.52 \frac{Q^{1.85}}{C^{1.85} \cdot d^{4.87}}$$

Where:

- F = Friction loss (psi/ft)
- Q = Flow rate [gal (U.S.) / min]
- C = Hazen Williams friction factor (150 for PEX)
- d = tube inside diameter (inches)

Pressure loss and velocity versus flow rate

Tubing	3/8"		1/2"		3/4"		1"		1 1/4"		1 1/2"		2"	
Flow Rate	Velocity	F.Loss	Velocity	F.Loss	Velocity	F.Loss	Velocity	F.Loss	Velocity	F.Loss	Velocity	F.Loss	Velocity	F.Loss
(U.S. GPM)	(ft/s)	(psi/100 ft)	(ft/s)	(psi/100 ft)	(ft/s)	(psi/100 ft)	(ft/s)	(psi/100 ft)	(ft/s)	(psi/100 ft)	(ft/s)	(psi/100 ft)	(ft/s)	(psi/100 ft)
1	3.33	7	1.81	1.6	0.96	0.3	0.55	0.1	0.37	0.0	0.26	0.0	0.15	0.0
2	6.67	25.4	3.62	5.8	1.81	1.1	1.1	0.3	0.74	0.1	0.53	0.1	0.31	0.0
3	10	53.9	5.43	12.2	2.72	2.3	1.65	0.7	1.1	0.3	0.79	0.1	0.46	0.0
4			7.24	20.8	3.63	3.9	2.19	1.1	1.47	0.4	1.06	0.2	0.62	0.1
5			9.05	31.4	4.54	5.8	2.74	1.7	1.84	0.6	1.32	0.3	0.77	0.1
6			10.86	44.0	5.44	8.2	3.29	2.4	2.21	0.9	1.58	0.4	0.92	0.1
7					6.35	10.9	3.84	3.2	2.57	1.2	1.85	0.5	1.08	0.1
8					7.26	13.9	4.39	4.1	2.94	1.5	2.11	0.7	1.23	0.2
9					8.17	17.3	4.94	5.1	3.31	1.9	2.38	0.9	1.39	0.2
10					9.07	21.0	5.48	6.2	3.68	2.3	2.64	1.0	1.54	0.3
11					9.98	25.1	6.03	7.4	4.04	2.8	2.9	1.2	1.69	0.3
12					10.89	29.5	6.58	8.7	4.41	3.3	3.17	1.5	1.85	0.4
13							7.13	10.1	4.78	3.8	3.43	1.7	2	0.5
14							7.68	11.6	5.15	4.3	3.7	1.9	2.16	0.5
15							8.23	13.2	5.52	4.9	3.96	2.2	2.31	0.6
16							8.78	14.8	5.88	5.6	4.22	2.5	2.46	0.7
17							9.33	16.6	6.25	6.2	4.49	2.8	2.62	0.7
18							9.87	18.4	6.62	6.9	4.75	3.1	2.77	0.8
19							10.42	20.4	6.99	7.7	5.02	3.4	2.92	0.9
20									7.35	8.4	5.28	3.8	3.08	1.0
25									9.19	12.7	6.6	5.7	3.85	1.5
30									11.03	17.8	7.92	7.9	4.62	2.1
35											9.24	10.6	5.39	2.8
40											10.65	13.5	6.16	3.6
45											11.88	16.8	6.93	4.5
50												20.4	7.7	5.5
55												24.4	8.47	6.6
60												28.7	9.24	7.7
65												33.2	10.01	8.9
70												38.1	10.78	10.3
75												43.3	11.55	11.6

Note: maximum velocity to control water hammer. Tubing manufactured per ASTM F 876/F 877

Hydrostatic Design Stresses and Pressure Ratings for SDR 9 PEX Tubing for Water at Different Temperatures

Rated Temperature		Hydrostatic Design Stress		Pressure Rating for Water	
°F	°C	psi	(Mpa)	psi	(Mpa)
73	23	630	(4.34)	160	(1.10)
180	82	400	(2.76)	100	(0.69)
200	93	315	(2.17)	80	(0.55)

Values according ASTM F 876

Heating Capacity

The specific heat capacity of water is approximately 1 BTU / lb. • °F , equal to (500 BTU / gal (U.S.) °F or 4184 J/Kg/K. This means, to raise 1 pound of water through 1 °F , it requires 1 BTU (British Thermal Unit). Similar, to raise 1 kg of water with 1 °C it requires an energy of 4.18 Joule.

Thermal Conductivity

R = r2•ln(r2/r1)/k

Where:

r1 = inside radius (in.)

r2 = outside radius (in.)

k = thermal conductivity (BTU•in)/(ft2•hr•°F)

ln = natural logarithm

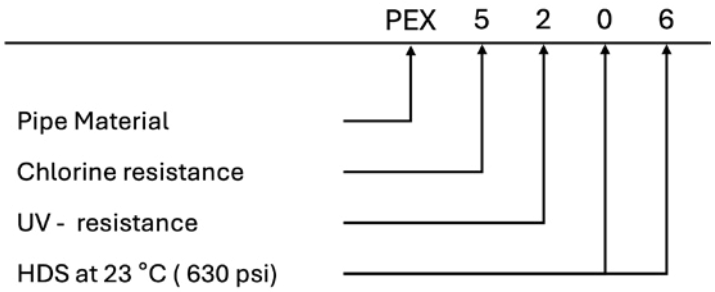
for PEX; k= 2.86

Tubing Size:	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
R-Value	0.028	0.038	0.049	0.06	0.072	0.093

Conversions		
Imperial	Metric	Alternative
1 inch	= 2.54 cm	= 25.4 mm
1 foot	=0.305 m	
1 lb.	= 454 g	
1 psi	= 6.89 kPa	= 2.31ft H20
1 Btu/hr	= 0.293 W	
1 gal (U.S.)	= 3.79 L	= 0.832 gal (Imp)

Pipe marking: Chlorine resistance, UV resistance and Hydrostatic Design Stress (HDS)

Markings below can be found on the pipes and provide information about chlorine and UV resistance and Hydrostatic Design Stress



Chlorine marking

The first digit on the material designation code is the Chlorine-resistance of the pipe.

Material designation code:

1 2 0 6 Chlorine resistance: 25% @ 140 °F and 75% @ 73 °F and both at 80 psi

3 2 0 6 Chlorine resistance: 50% @ 140 °F and 50% @ 73 °F and both at 80 psi

5 2 0 6 Chlorine resistance: 100%@ 140 °F and 80 psi

UV-resistance marking

The second digit on the material designation code is the UV-resistance of the pipe.

Material designation code:

5 **1** 0 6 UV resistance: 1 month

5 **2** 0 6 UV resistance: 3 months

5 **3** 0 6 UV resistance: 6 months

Chlorinated Potable Water

The Wavin Pex pipes meet the ASTM F876 oxidative resistance requirements when tested to ASTM F2023. The pipe meets a material designation code of 5. By utilizing reverse osmosis-purified water complemented by a controlled concentration of free chlorine, measured at 4.3 +/- 0.3 ppm (4.3 mg/L), and adjusted the pH to 6.8 +/- 0.2. This meticulous preparation ensures the attainment of an oxidative reduction potential (ORP) of 825 mV or higher, aligning precisely with the specified requirements of the ASTM F 2023.

Temperature rating in chlorinated potable water is 140 °F @ 80 psi (Additionally, Wavin A-Pex is resistant to chloramine found in portable water systems)

Caution: do not use PEX products when chlorine dioxide is present in the water treatment system as it might significantly reduce the lifetime

Hydrostatic Design Stress (HDS)

The last digits (06) on the material designation code refer to the hydrostatic design stress.

This refers to the maximum hoop stress and relates to the internal hydrostatic pressure that can be applied without causing failure, which is 630 psi at 23 °C for PEX.

Connecting Pex Pipes

Only expansion fittings certified to ASTM F1960 and crimp fittings meeting ASTM F1807 and ASTM F2159 standards are approved for use with PEX-A pipe. For a secure and reliable joint, always use pipe cutters to make a clean, square cut to the required length. Rough or uneven cuts can compromise the integrity of the connection.

Cold Expansion

Step 1: Utilize pipe cutters to make a precise square cut of the pipe to the desired length. Any rough or uneven cuts may compromise the integrity of the joint.

Step 2: Slide the expansion ring over the PEX tubing until it extends no more than 1/8 inch beyond the tubing's end or until the stop on the ring (if present) touches the tubing.

Step 3: Using an approved manual or cordless expansion tool, insert the tool into the PEX pipe and expand it. Each pipe size requires a specific expander head, so verify that it matches the pipe size before proceeding. The number of expansions required depends on the tubing size see the expansion table below

Step 4: Once the tubing is expanded, insert the fitting until it reaches the shoulder, allowing the PEX to contract securely around the fitting. Within several seconds, the tubing will secure around the fitting, and your connection is made and ready for use.

General Wavin PEX-A Connection Tips

If the fitting does not slide into the pipe all the way to the stop, promptly remove it from the piping and perform one final expansion of the tube.

Table below provides the recommended number of expansions. The actual number of expansions may vary based on experience, technique, and weather conditions. In certain circumstances, fewer expansions may suffice. The correct number of expansions ensures a snug fit between the piping and the fitting shoulder

Milwaukee PEX expansion tools @ Room Temperature 73.4ºF (23ºC)				
Pipe Size	M12 with standard heads (2432)	With RAPID SEAL™ heads (2532)	M18 (2632)	M18FUEL 2" (2932)
½"	7-8	5-8	9	7-9
¾"	11-12	7-12	10	9-11
1"	17-18	12-18	19	12-13(or 7-8H)

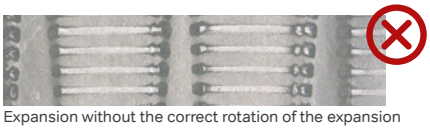
Ensure the Wavin PEX-A ring rests securely against the fitting shoulder. If there is more than 1/16" (1 mm) between the ring and the shoulder of the fitting, replace the connection. Square cut the piping 2" away from the fitting for ⅜" to 1" pipe, 3" away for 1¼" to 2" pipe.

Correct Expansion

During the expansion of the pipe, the expansion head rotates in order to create a smooth and equal expansion. A correct expansion can be recognized by overlapping tooling imprints on the inside of the expanded pipe. If the imprints do not overlap, the expansion tool did not rotate properly

On the right side there are some examples of expansions of the pipe where the tool has and has not correctly rotated and what the pipe should look like when expanded correctly.

Expansion with correct rotation of expansion tool- overlapping imprints



Expansion without the correct rotation of the expansion tool- non overlapping imprints

Reuse

Removal of mounted fittings from pipes for reuse purposes is limited possible and requires your special attention and should be avoided in the occasions as described below to avoid unreliable connections.

- Wavin PEX-A brass fittings CAN be reused unless the rib area has been damaged during removal.
- Wavin PEX-A pipes expanded area CANNOT be reused. The expanded section must be cut off and the virgin pipe end must be expanded again.
- Wavin PEX-A polymer fittings CANNOT be reused and should be discarded immediately.
- Wavin PEX-A compression sleeves CANNOT be reused and should be discarded immediately.

NOTE: DO NOT cut the Wavin PEX-A compression sleeve from the finished joint.

NOTE: DO NOT cut Wavin PEX-A pipe from the fitting.

Crimp Connections

- Ensure that fittings and rings to be used are identified as being for use with PEX tubing.
- Cut tubing squarely, remove burrs, and slip the crimp ring on the tube.

- Insert a PEX fitting into tube up to the fitting shoulder and position the crimp ring 1/8” to 1/4” from end of pipe. To prevent ring from moving, squeeze the ring slightly with your fingers or a pair of pliers.

- Center the crimping tool exactly over the ring, and keeping both the ring and the tool square with the tube, close the tool completely.

- Check each crimped ring with the proper gauge. Slip gauge squarely over the crimped ring. Check in at least two positions. The “GO” portion of the gauge should slip over the ring. If not, the ring is under crimped. For gauges with “NO-GO” dimensions, the “NO-GO” gauge should not slip over the ring.

Go

No-Go

- Joints that do not pass the gauge check must be cut out and replaced. DO NOT RECRIMP (Double Crimp) THE SAME FITTING

Incorrect Connection

The following are some examples of improper connections that may result in improper sealing and potential for leaks.

- Ring crimped over the end of tube
- Tool not fully closed or ring not fully covered
- Tool not centered on ring
- Tube not cut squarely
- Ring too far from tube end

Tools and Rings

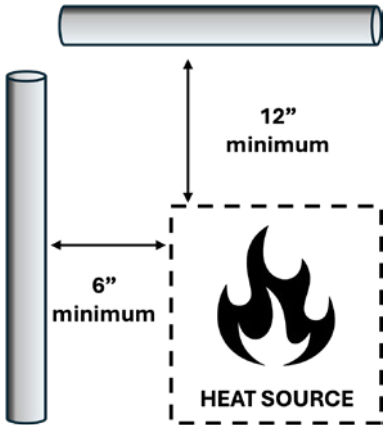
- Use tools available from Wavin. All tools must make a full-circle crimp.
- Check tool adjustment daily, and readjust as necessary.
- Use only copper crimp rings intended for PEX.

Installation Best Practices

General Installation

Review all limitations on the **Wavin Pex Pipes and fittings system** you have selected to use before proceeding.

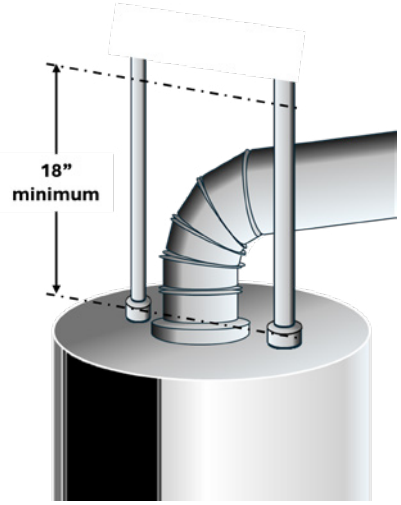
Keep pipe a minimum of 12” vertically or 6” horizontally from sources of high heat, such as recessed light fixtures, flue gas vents, or heating appliances.



Wavin permits the use of Wavin A-PEX and SuperPEX when connected to instantaneous water heaters or other hot water producing devices. However, consult the water heater manufacturers recommendations for use with plastic tubing and ensure temperature and pressure do not exceed the maximum ratings of the Wavin Pex tubing.

Do not install Wavin Pex pipes downstream of any point -or- use water heater or immersed coil heater in a boiler where the output temperature can exceed 180ºF (82ºC) or closer than 6 inches upstream.

When connecting to a gas hot water heater, at least 18 inches of a metal nipple or appliance connector should be used so that the Wavin Pex pipe cannot be damaged by the build-up of excessive radiant heat from the flue.



Wavin PEX-A and SuperPEX can be piped directly to the heater tapping on an electric hot water heater using metallic termination fittings.

Installation Considerations - Potential UV Effects of Artificial Lighting

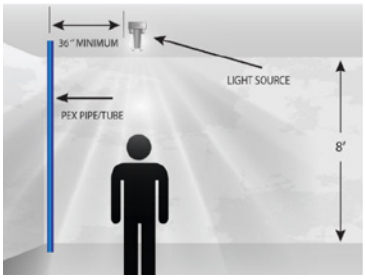
All PEX pipe and tubing produced according to industry standards which are approved for use in hot- and cold-water plumbing applications in the U.S. and Canada must demonstrate a minimum UV resistance of 1 month when tested according to ASTM F2657 and evaluated in accordance with the requirements of the standards. This level of minimum UV resistance is intended to protect these materials from incidental exposure to UV during installation. Therefore, in situations where PEX is installed in indoor locations that exposes it to long-term exposure to artificial UV, the effects of this exposure to artificial light sources which may contain a UV component must be considered as it can affect the pipe lifetime.
PPI developed a set of recommended installation guidelines to reduce the impact of artificial lighting.

Below is an abstract of these guidelines. For the full recommendation we refer to PPI-TN-72[1]

Recommendations for Installation in Residential and Light Commercial Applications

Fluorescent lights are of most concern. Therefor below recommendations are based on the use of fluorescent lights; other types of lights, such as incandescent or LED lights, will be of less concern and closer distances may be used.

When assuming a maximum of twelve (12) hours per day of usage, it is recommended that PEX pipe be installed at a setback distance of no less than 36 inches (91 cm) from direct incidence from the artificial light sources (See picture on the right). When PEX pipes must be installed closer than 36 inches (91 cm) from direct incidence to an (non-LED) artificial light, a layer of exterior protection, such as protective sleeving or a pipe insulation that is compatible with the PEX material, should be installed.

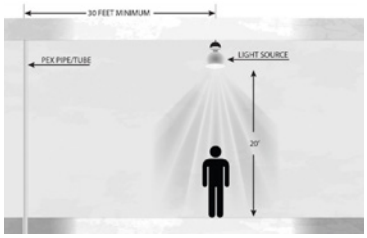


Recommended setback distance between artificial light source (non-LED) and PEX pipe/tubing in a typical residential or light commercial setting

Recommendations for Installation in Industrial, Warehousing, and Large Commercial Applications

For industrial/manufacturing, warehousing, and large commercial applications, such as those with ceiling heights in excess of 20 feet (6.1 m), the distance from the light source to the lighted working area is significantly greater, and the types of light sources employed produce proportionally higher luminous efficiency (Lumen/watt) to achieve the same illuminance value at the working level. Proportionally higher UV irradiance can also be expected. Artificial light sources may be utilized 24 hours per day.

For PEX pipes installed in such commercial or industrial applications it is recommended that they be installed at a setback distance of no less than 30 feet (9.1 meters) from direct incidence by the (non-LED) artificial light source. For PEX pipes installed closer than 30 feet from direct incidence to an artificial light, a layer of exterior protection, such as protective sleeving or a pipe insulation that is compatible with the PEX material, should be installed. (See picture on the right).



Recommended setback distance between artificial light source (non-LED) and PEX in a typical industrial setting

1 https://plasticpipe.org/TN-72plasticpipe.

Bending Pipe

Wavin A-Pex and SuperPEX pipes may be bent to a minimum bend radius of **6 times the O.D.** of the pipe, as shown in the table below.

Nominal tubing size(in)	Outer Diameter (in)	6 x OD
½"	0.625	3.75
¾"	0.875	5.25
1"	1.125	6.75
1¼"	1.375	8.25
1½"	1.625	9.75
2"	2.125	12.75

Note: If using pipe in coils and bending against the coil direction, the minimum bending radius is 3 times the radius given above,

(e.g., 1/2 CTS pipe = 3 x 3,75 = 11,25")

Distance between fittings

To ensure the integrity of Wavin A-Pex fittings during installation and to mitigate stress on both the fittings and pipes, Wavin mandates a minimum distance between fittings. Refer to the table below for the prescribed cut length of pipe corresponding to each nominal fitting size. This table delineates the minimum distances between fittings as follows:

Distance Between Fittings	
Nominal Fitting Size	Cut Length of Pipe
½"	2"
¾"	3"
1"	3 ½"
1 ¼"	4 ½"
1 ½"	6"
2"	2.125

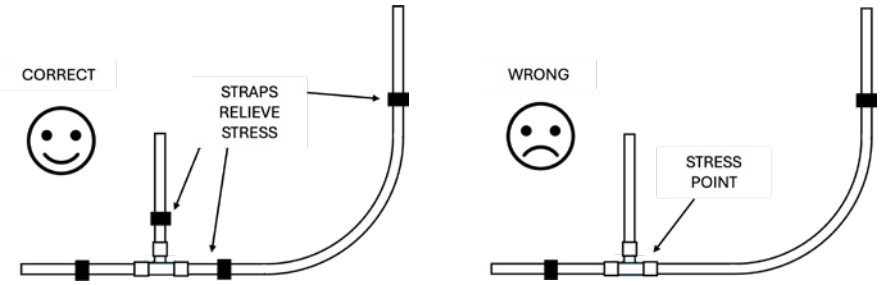
Pipe Support and Inspection

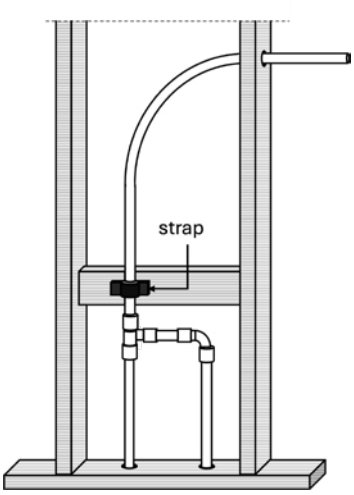
- Plastic hangers and straps are recommended, but metal supports which are designed for use with plastic pipe can be used.
- Supports must not pinch or cut into the pipe and should allow lateral movement.
- Supports must not have sharp edges that would result in abrasion during lateral movement.
- Inspect all supports prior to installation to ensure that sharp edges do not exist that can damage the pipe.
- Never use defective or damaged supports. Replace them.

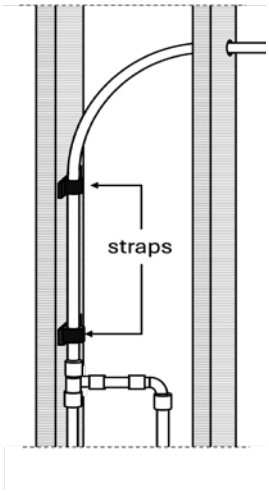
Support Spacing

When joining, piping must be installed without placing stress on the joint. See illustrations that follow for appropriate methods of stress relieving.

- Maximum horizontal pipe support spacing is 32”.
- Vertical pipe shall be supported at every floor and at the mid-floor guide between floors or every 48” in between.





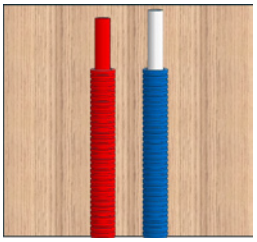


Additional Support

Use protective sleeves or bushings on pipe:

- When penetrating floors.
- At beginning and end of straight runs of piping which penetrate studs or joists.
- At significant changes in direction.
- When penetrating metal studs

Use only continuous lengths of pipe (no fittings) when installing under or within a slab. Make connections above the slab or in an access box. In poor soil conditions, such as mud, rock, black gumbo, or clay, it is necessary to excavate deeper and use good clean fill or granular fill to smooth the trench bottom. Pipe shall be completely buried by a suitable, easily compacted, backfill material such as sand or pea gravel.



Protect pipe with non-metallic sleeves where it penetrates a slab or foundation.

Protect pipe from nail damage where appropriate.

Do not directly connect hose bibbs to **Wavin Pex tubing**. Use a suitable metal fitting, and anchor it to prevent strain on the tubing.

Thermal Expansion

To accommodate temperature-induced expansion and contraction in Wavin PEX pipes, it's important to allow slack when installing them within buildings. These pipes expand and contract at a rate of roughly 1 inch per 100 feet of pipe for every 10°F change in temperature (As calculated below). It's advisable to incorporate offsets and expansion loops into the installation to mitigate these effects. The change in pipe length resulting from temperature variations can be calculated using the equation provided below:

$\Delta L = \alpha(L \bullet \Delta T)$

where:

ΔL = change of length (inches)

ΔT = change of temperature (°F)

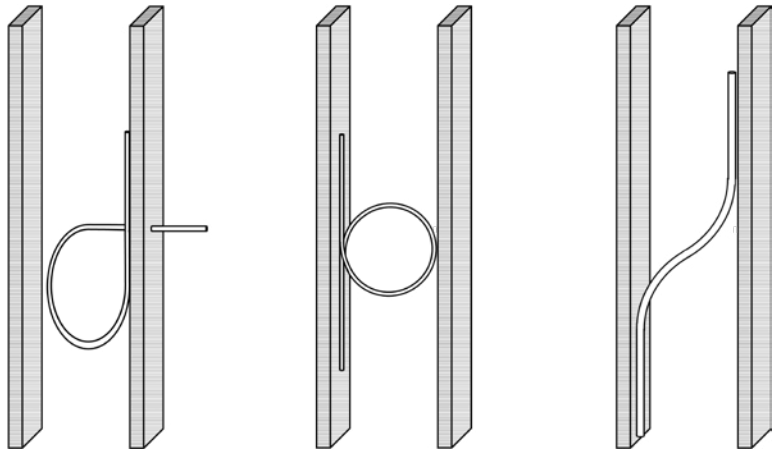
L = original pipe length (feet)

α = coefficient of linear expansion = (8 x 10^(-5) in/in °F)

Example: Given ΔT = 10°F and L = 100 ft. answer: Δ L = 1.0 in.

Expansion and Contraction Loop Techniques

Loop techniques which can help with expansion and contraction of the Wavin PEX systems



Pressure Testing

Pressure Testing and Inspection of the Completed System should be conducted using water. The test pressure must meet or exceed the expected working pressure (main pressure), ranging between 40 psi and not greater than 200 psi at 73°F (For test pressures above 160 psi do not test for longer than 2 hrs.).

Compressed air testing is advisable only if water is unavailable or in situations where cold weather might pose a risk of freezing the system. When conducting compressed air tests, ensure appropriate safety measures are in place and oil free air, and limit the test pressure to a maximum of 100 psi. It's important to note that while PEX tubing is ductile and won't shatter during pressure testing, plastic fittings, or other components, including unassembled fittings, could potentially create hazards. Prior to employing air pressure testing, always consult local codes for compliance. Ensure that there are no oils in the compressed air. Do not use soaps or detergents for leak detection. Oils, soaps and detergents can cause environmental stress cracking.

The duration of the test should not be shorter than 15 minutes.

- Test all installations with ambient temperature potable water.
- A test pressure should be at least 40 psi, but not greater than 200 psi at 73°F (23 °C).
- A test duration shall be 15 minutes minimum.
- For test pressures above 160 psi, do not test for more than two (2) hours.
- Do not use soap or detergent solutions for leak detection.
- Air testing shall be permitted only when water is not available or when cold weather could freeze the system. Under this circumstance, test the system to a maximum of 100 psi for 15 minutes. The pressure shall not drop more than 8 psi during the 15 minute period. A loss of pressure during air test is due to deformation of the pipe followed by slow expansion.

  Air tests shall include appropriate safety precautions such as:

  - Conduct test overnight or on weekends, when job attendance is minimized
  - Personnel should wear eye protection
  - Warning Signs
  - Protect pipe in areas where impact could occur while an air test is in progress

Handling and Storing the Pipe

- Do not drag the pipe over rough terrain, rocks, or any surface which can cut, puncture, or excessively abrade the pipe wall.
- Do not install kinked pipe.
- Inspect all pipe before and after installation. Cut out and replace all damaged sections.
- Store pipe under cover prior to installation where it will not be exposed to sunlight.
- Do not use fittings unless designed especially for Wavin. Look for the appropriate certifications such as the ASTM F1960 marking on all fittings.

Limitations on Pipe use

Do not use in any application where pipe will be exposed to direct sunlight. Store pipe under cover prior to installation where it will not be exposed to direct sunlight.

Do not use in applications where service conditions are inconsistent with the temperature or pressure ratings of the tubing.

Do not allow the tubing or fittings to come into contact with materials that could affect the integrity of the PEX pipes or fitting materials. This would include at least:

- Pipe thread sealing compounds.
- Firewall penetration compounds (exception: water soluble gypsum-based caulking)
- Petroleum-based materials or sealants such as:
    - Kerosene, Benzene
    - Gasoline
    - Solvents
    - Fuel Oils
    - Cutting Oils
    - Acetone, Asphaltic Paint
    - Asphaltic Road Materials
    - Toluene
    - Xylene
    - Strong chlorine ref to Chlorine resistance
    - Nitric and Sulfuric acids
    - Ammonia
    - Surfactants

A product absence from this list does not imply or insure chemical compatibility. Always check the product manufacturers recommendation in this regard.

Do not allow direct contact between high concentrations of termiticides or pesticides with PEX pipe. Backfill and cover underground tubing prior to spraying termiticide or pesticides. Also, it is important to ensure that no pooling or puddling of the termiticide or pesticides occurs between the sleeving and the PEX pipe at the slab penetration.

Do not place PEX pipe in contaminated soils or other contaminated environments. Situations calling for special scrutiny on a case-by-case basis would include (but not be limited to):

- Tank farms or industrial sites containing chemical or petroleum storage tanks and pipelines where a malfunction or leak would contaminate the surrounding soil.
- Storage ponds or land disposal sites for industrial process water or wastewater containing toxic chemicals.
- Solid waste disposal sites.
- An area that has been known to be contaminated by the long-term presence of toxic chemical substances.

Limited Warranty and Limitations of Liability Wavin A-Pex

LIMITED WARRANTY

The Products are warranted to be free from defects in materials and workmanship under normal use, for a period of 25 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.

Claims under this Warranty must be made in writing and submitted to Seller promptly after the defect is discovered and, in any event, within 25 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.

This Limited Warranty is applicable if the product is only used with other Wavin products and accessories. If Wavin A-Pex is used in combination with other brands, the warranty will be limited to 10 years from the initial date of purchase.

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 AND 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.

Limited Warranty and Limitations of Liability Wavin SuperPEX

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The Products are warranted to be free from defects in materials and workmanship under normal use, for a period of 25 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.

Claims under this Warranty must be made in writing and submitted to Seller promptly after the defect is discovered and, in any event, within 25 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.

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CHOICE OF LAW AND 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.

Important Notice

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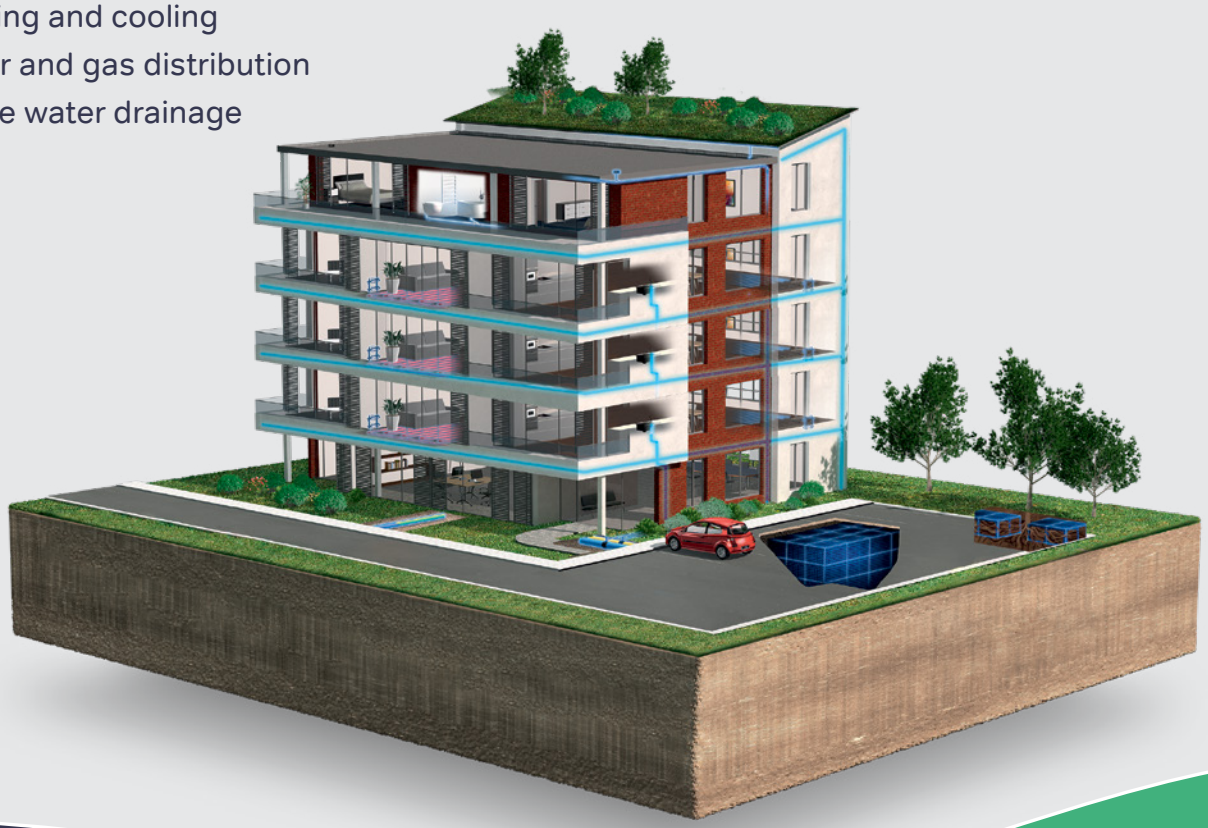

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