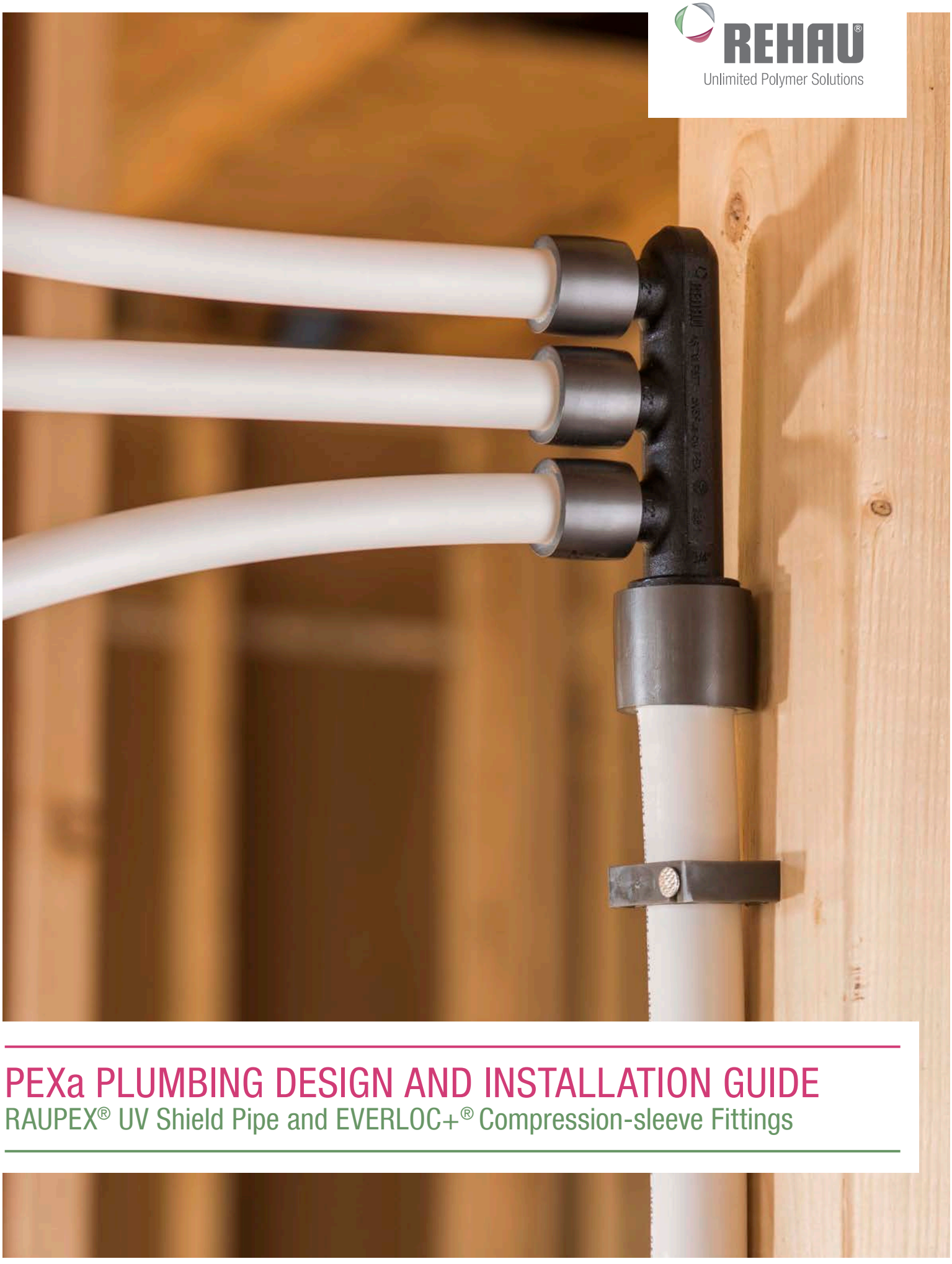
REHAU®
Unlimited Polymer Solutions



PEXa PLUMBING DESIGN AND INSTALLATION GUIDE

RAUPEX® UV Shield Pipe and EVERLOC+® Compression-sleeve Fittings

CONTENTS

For updates to this publication and the most current technical instructions, safety information and manufacturer's recommendations, visit **www.na.rehau.com/resourcecenter**

1. SCOPE

This technical information applies to the REHAU PEXa plumbing system and specifically the assembly and use of the EVERLOC+® compression-sleeve system with RAUPEX® UV shield pipe (PEXa pipe) intended for use in hot- and cold-water potable distribution systems.

For professional use only. Persons using this guide must be experienced and appropriately licensed contractors, who have an understanding of the principles and practices for the installation of hot- and cold-water potable distribution systems.

The information presented in this guide is intended to demonstrate the proper assembly method and installation recommendations for the REHAU PEXa plumbing system. It is the responsibility of the licensed contractor to check the prevailing local codes and to verify that technical information presented in this guide is appropriate for a particular installation.

Nothing in this guide supersedes national or local code requirements or the recommendations of other manufacturers regarding their components. Observe all applicable national, state and local laws, regulations, standards, codes and ordinances. If you believe REHAU product information conflicts with applicable code requirements, industry standards, or the recommendations of other manufacturers regarding their components, contact the REHAU distributor in your area and consult with the building authority having jurisdiction before installing the REHAU PEXa plumbing system.

Before starting the installation process, read the REHAU *PEXa Limited Warranty*, available at www.na.rehau.com/warranties. It can also be obtained from your authorized REHAU distributor or by writing to REHAU Construction LLC, 1501 Edwards Ferry Road NE, Leesburg VA 20176 US.

Proper installation is the responsibility of the installing contractor. Review the REHAU *Technical Guidelines* prior to installation of the REHAU PEXa plumbing system. REHAU *Technical Guidelines* are defined in the REHAU *PEXa Limited Warranty* as: The most current and applicable versions of all the technical literature available on the REHAU North America website at www.na.rehau.com/resourcecenter, including, but not limited to, technical manuals, instruction guides, technical bulletins, submittals and REHAU Academy training presentations. Check the REHAU Resource Center (www.na.rehau.com/resourcecenter) for the latest updates.

Contact the REHAU distributor in your area if you do not understand the information in this manual or if you have questions about the REHAU *Technical Guidelines*.

This guide contains safety-related information that requires your special attention. It is indicated with the safety alert symbol and the signal words described below:

⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a risk of property damage.

Only trained personnel should be engaged in the installation process. Follow the instructions in this guide and other REHAU *Technical Guidelines* and use common sense to reduce the risk of injury or property damage.

⚠ WARNING

Read the instruction manual for the EVERLOC+ compression-sleeve tools before use and follow all safety precautions - improper use can cause serious personal injury

⚠ WARNING

EVERLOC+ compression-sleeve tools use a strong hydraulic force to expand PEXa pipe and compress components of the REHAU EVERLOC+ compression-sleeve system.

To reduce the risk of crush and laceration injury, keep fingers, hands and all parts of your body away from the expander head, hydraulic slide and compression jaws during operation. Remove the battery before attempting to change or adjust the expander head or compression jaws.

2. SYSTEM OVERVIEW

2.1 Application

The REHAU PEXa plumbing system includes RAUPEX UV shield PEXa pipe, PEXa compression sleeves and EVERLOC+ polymer and lead-free brass fittings. This system is designed for potable applications.

The EVERLOC+ compression-sleeve fitting system is a cold-expansion PEXa fitting system that is available in polymer and lead-free (LF) brass and is assembled with a specially designed PEXa compression sleeve. The fitting is designed specifically for use with RAUPEX pipe and can only be assembled with the EVERLOC+ compression-sleeve tools.

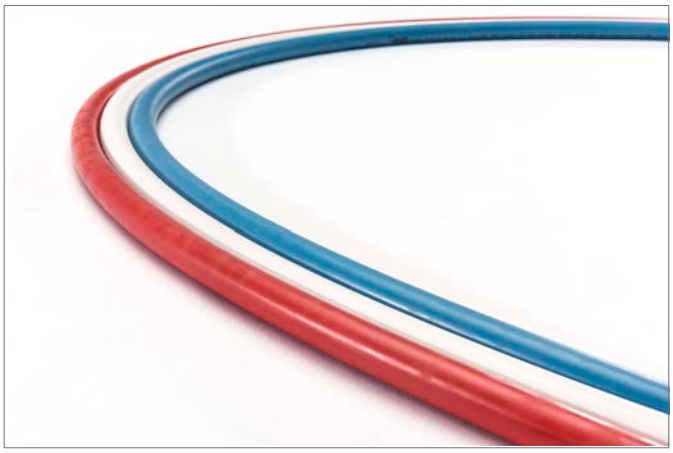


Fig. 2.1: RAUPEX UV shield crosslinked polyethylene (PEXa) pipe

Fig. 2.2: EVERLOC+ compression-sleeve fittings and sleeves

Fig. 2.3: EVERLOC+ compression-sleeve tools

2.2 Standards and Certifications

The governing model codes within the United States and Canada define the required standards for PEX piping systems.

In the US, the model codes that are typically adopted by local jurisdictions are: the International Codes (Mechanical, Plumbing and Residential) governed by the International Code Council (ICC) or the Uniform Codes (Mechanical and Plumbing) and the National Standard Plumbing Code, governed by the International Association of Plumbing and Mechanical Officials (IAPMO).

In Canada, the model code that is typically adopted by local jurisdictions is the National Plumbing Code of Canada (NPCC) which is governed by the National Research Council of Canada (NRCC).

Within these model codes, the standard requirements for PEX pipe and fittings are ASTM F877 or CSA B137.5. These standards define the requirements and test methods for PEX piping systems.

The REHAU PEXa plumbing system is third-party certified by NSF International (www.nsf.org) to the following standards:

- ASTM F876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing
- ASTM F877 Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems
- CSA B137.5 Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications
- NSF/ANSI 14 Plastic Piping System Components and Related Materials
- NSF/ANSI 61 Drinking Water System Components and Related Materials
- NSF/ANSI 372 Drinking Water System Components – Lead Content (complies with the lead-free requirements of the U.S. Safe Drinking Water Act)

2.3 Specification

REHAU provides a recommended specification for domestic water piping and fittings. This recommended specification is provided as a guide for development of the final specification by a architect, engineer, or builder. The architect/engineer/builder shall be responsible to convert this recommended specification into a final specification that meets the functional needs of the client, as well as to comply with all applicable building, plumbing, and mechanical codes. Specifications are available at www.na.rehau.com/resourcecenter.

2.4 Warranty

RAUPEX UV shield pipe and EVERLOC+ compression-sleeve fittings and sleeves are backed by a 25-year limited warranty. EVERLOC+ compression-sleeve tools are backed by a 2-year limited warranty. REHAU offers this warranty when the installation is carried out in accordance with the requirements outlined in the REHAU *PEXa Warranty 855.018*, which is available as a separate document at www.na.rehau.com/warranties. Please read warranty prior to installation.

2.5 Design Services

REHAU Design Services can provide customers with a detailed submittal package to support the installation of the REHAU PEXa plumbing system.

REHAU Plumbing Design Services include:
- BIM library of plumbing system components
- Product submittals
- Project bill of materials
- Support of pipe layout based on the project engineer's approved plumbing piping design

2.5.1 Building Information Modeling Library

The REHAU BIM Library offers a directory of drawings that are easy to download into an active design. BIM files offer efficiencies to project owners through ease of collaboration. The REHAU BIM library offers models of core products including pipe, fittings, manifolds and installation accessories.

2.5.2 LoopCAD® Software

REHAU PlumbingCAD creates professional pipe layout drawings and bill of materials for the REHAU PEXa plumbing system.

3. RAUPEX PEXa PIPE

3.1 Pipe Properties

Crosslinked polyethylene is polyethylene (PE) which has undergone a change in molecular structure whereby the polymer chains are chemically linked, crosslinked (X), with each other to form a three-dimensional network. The result is a flexible thermoset polymer with improved mechanical, thermal and chemical properties.

There are three methods of manufacturing PEX:
- The peroxide method (PEXa), ASTM requires a minimum of 70% crosslinked PE molecules
- The silane method (PEXb), ASTM requires a minimum of 65% crosslinked PE molecules
- The radiation method (PEXc), ASTM requires a minimum of 65% crosslinked PE molecules

RAUPEX pipe is manufactured using the peroxide method (PEXa), which yields the highest, most consistent level of crosslinking. PEXa technology enhances flexibility and thermal memory, providing ease of handling and kink repair compared to PEXb and PEXc.

PEXa has distinct advantages over metal and other polymer pipes:
- Resists pitting and stress corrosion
- Resists scaling and deposit build-up when used with both hard and softened water
- Minimizes noise that is transmitted through pipes
- Resists notching and abrasion damage

RAUPEX is manufactured by REHAU in a facility whose quality management system is ISO 9001 certified. In addition, RAUPEX production is independently monitored annually NSF International, CSA International and Underwriters Laboratories Inc. (UL).

Table 3.1: RAUPEX Properties

Specification	English	SI	Standard
Minimum Density	58 lb/ft^3	926 kg/m^3	ASTM F876
Minimum Degree of Crosslinkling	70%	70%	ASTM F876
Max Thermal Conductivity	2.84 Btu in/(ft^2˚F•hr)	0.41 W/(m˚K)	DIN 16892
Coefficient of Linear Expansion	9.33 x 10-4 in/ft ˚F @68˚F 1.33 x 10-3 in/ft ˚F @212˚F	0.14 mm/(m˚C) @20˚C 0.2 mm/(m˚C) @100˚C	Mean @ 20-70˚C per DIN 16892
Modulus of Elasticity	87,000-130,500 psi @ 68˚F 43,500-58,000 psi @176˚F	600-900 N/mm^2 @20˚C 300-400 N/mm^2 @80˚C	Minimum @ 20˚C per DIN 16892
Tensile Strength	4194-4355 psi @68˚F 2610-2900 psi @176˚F per ASTM D638	26-30 N/mm^2 @20˚C 18-20 N/mm^2 @80˚C per ASTM D638	--
IZOD Impact Resistance	No Break	No Break	--
Roughness	e=0.00028 in.	e =0.007 mm	--
Temperature Working Range	-40 to 200˚F	-40 to 93˚C	--
Maximum Short-term Exposure	150 psig @ 210˚F (48 hr)	1035 kPa @ 99˚C (48 hr)	ASTM F876
UV Resistance	See TB218		ASTM 2657

3.2 Pipe Dimensions and Weights

RAUPEX pipe is available in nominal sizes ranging from 3/8 to 2 in. RAUPEX is in accordance to the dimensional standards defined in ASTM F876. RAUPEX is copper tube size (CTS) outside diameter (OD), which means that the actual OD of the pipe is 1/8 in (3.18 mm) larger than the nominal size.

Wall thickness is defined by the standard dimensional ratio (SDR). RAUPEX UV shield pipe is SDR9, which equates to the outside diameter being approximately nine times the wall thickness.

Table 3.2: RAUPEX Dimensions and Weights

Pipe Size	Average OD in (mm)	Min Wall Thickness in (mm)	Weight lb/ft (kg/m)
3/8 in	0.500 (12.70)	0.070 (1.78)	0.04 (0.07)
1/2 in	0.625 (15.88)	0.070 (1.78)	0.06 (0.08)
5/8 in	0.750 (19.50)	0.083 (2.12)	0.08 (0.11)
3/4 in	0.875 (22.22)	0.097 (2.47)	0.10 (0.15)
1 in	1.125 (28.58)	0.125 (3.18)	0.17 (0.26)
1 1/4 in	1.375 (34.92)	0.153 (3.88)	0.25 (0.37)
1 1/2 in	1.625 (41.28)	0.181 (4.59)	0.35 (0.52)
2 in	2.125 (53.98)	0.236 (6.00)	0.60 (0.90)

3.3 Pipe Markings

RAUPEX pipe markings are repeated every 3 ft (0.9 m), list all certifications and approvals, and include an incremental footage marking to assist with installation.

3.3.1 PEX Designation Code

RAUPEX pipe is further identified with a PEX Material Designation code in accordance to ASTM F876. The PEX Designation Code is the abbreviation for the material - PEX - followed by four numerals.

The PEX Designation Code for RAUPEX UV shield pipe is

PEX 3306

The first numeral **(3)** refers to the chlorine resistance in one of four categories, when tested in accordance with ASTM Test Method F2023 and evaluated in accordance with ASTM F876. This measurement indicates the allowable hours of 140°F water recirculation in 1 day.

0 = none	1 = 4 hours *e.g., 25% of lifetime*	3 = 12 hours *e.g., 50% of lifetime*	5 = 24 hours *e.g., 100% of lifetime*

The second numeral **(3)** refers to UV resistance in one of four categories, when tested in accordance with ASTM Test Method F2657 and evaluated in accordance with ASTM F876. The measurement indicates the allowable time pipe can be exposed to UV without being compromised.

0 = none	1 = 1 month	2 = 3 months	3 = 6 months

The third and fourth numerals **(06)** refer to the Hydrostatic Design Stress for water at 73°F in hundreds of psi. The standard pressure rating at 73°F is derived from this measurement.

06 = 630 psi

3.4 Pressure and Temperature Ratings

The maximum temperature and pressure ratings of the RAUPEX plumbing system are in accordance to ASTM F876, CSA B137.5 and PPI TR-3. The designer shall determine the actual conditions and apply the appropriate and additional design factors as required for any particular project.

According to the REHAU *PEXa Limited Warranty*, the RAUPEX pipe warranty period is for operating conditions at or below 180°F (82.2°C) in permitted applications when the handling, use, installation and maintenance continually complies with all REHAU *Technical Guidelines*.

Table 3.3: RAUPEX UV Shield Pipe Pressure and Temperature Ratings

RAUPEX UV shield Pipe	
Maximum Pressures and Temperatures	Design Factors
160 psi @ 73.4°F (1055 kPa @ 23°C)	0.50 (per ASTM F876, CSA B137.5)
100 psi @ 180°F (690 kPa @ 82.2°C)	0.50 (per ASTM F876, CSA B137.5)
80 psi @ 200°F (550 kPa @ 93.3°C)	0.50 (per ASTM F876, CSA B137.5)

REHAU defines *Elevated Temperature Applications* as those with operating conditions greater than 180°F (82.2°C). When RAUPEX pipes are planned to be operated in conditions greater than 180°F (82.2°C), the designer must sufficiently consider the thermal and oxidative stability performance of the piping material to ensure the PEXa pipe design will meet project service life requirements.

For *Elevated Temperature Applications*, REHAU advises against the use of a stress reduction design factor that lowers the operating pressure as it may not sufficiently account for thermal or oxidative degradation.

REHAU applies a service life methodology for RAUPEX pipes drawn from ASTM F876, CSA B137.5, ISO 9080 and Miner's rule according to DIN 13760 to determine the warranty period. RAUPEX pipes should always be operated at or below the REHAU published temperature and pressure ratings.

When the operating conditions are less than or equal to 180°F (82.2°C), then according to the REHAU *PEXa Limited Warranty* the warranty period for RAUPEX pipe is 25 years. When RAUPEX pipes are operated in *Elevated Temperature Applications*, where the operating conditions are greater than 180°F (82.2°C), contact REHAU Engineering to verify your operating conditions comply with the requirements in the REHAU *PEXa Limited Warranty* for a warranty period of 25 years.

3.5 Excessive Temperature and Pressure Capability

Temperature and pressure (T&P) relief valves are safety mechanisms in case the system overheats (mandatory in hot water distribution systems). These valves act quickly to relieve excess temperature or pressure if either one of these conditions is reached. In the event of a water heating system failure or T&P relief valve failure, RAUPEX pipe has been tested to accommodate short-term exposure conditions of 210°F (99°C) at 150 psi (10 bar) for 48 hours.

NOTICE

Failure to follow pressure and temperature limits may damage the pipe resulting in leaks and operational failures, and will negate any warranty provided by REHAU for RAUPEX pipes. The designer must incorporate proper controls into the system to ensure the pressure and temperature capability of the pipe is not exceeded.

3.6 Corrosion Resistance

RAUPEX pipe is non-reactive and displays excellent corrosion resistance. Corrosion is a process that requires electrically conductive materials and occurs on metals. PEXa, being a dielectric, does not corrode like metal pipes. PEXa also resists the buildup of scale which is common with copper pipe.

3.7 Chlorine Resistance

RAUPEX pipe has been tested in accordance with ASTM F2023, *Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water* as required in ASTM F876. RAUPEX pipe exceeds the minimum extrapolated test lifetime as certified by NSF and PPI for cold water applications, intermittent hot water applications and timed hot water applications.

Based on this testing, when using RAUPEX UV shield pipe for plumbing applications without continuous hot water recirculation, the following water quality conditions must be met:
- The pH of water is 7.0 or higher
- The concentration of free chlorine is 4.0 ppm or lower
- Water temperature is 140°F (60°C) or lower
- Water pressure is 80 psig (550 kPa) or lower
- Oxidative reduction potential (ORP) of 825 mV or lower

This recommendation applies to RAUPEX UV shield plumbing pipes for cold water and intermittent hot water applications (25% @ 140°F, 75% @ 73°F) and for timed hot water recirculation systems for up to 12 hours per day (50% @ 140°F, 50% @ 73°F). The ASTM F876 standard includes designation codes for these applications which are included on the print line of RAUPEX pipes.

When using RAUPEX UV shield pipe for plumbing applications with continuous hot water recirculation, the following water quality conditions must be met:
- The pH of the water is 7.9 or higher
- The concentration of free chlorine is 2.4 ppm or lower
- Water temperature is 140°F (60°C) or lower
- Water pressure is 80 psig (550 kPa) or lower
- Oxidative reduction potential (ORP) of 750 mV or lower

If these conditions are not met, it is necessary to incorporate a time control so the system operates at a maximum 50% @ 140°F and 50% @ 73°F.

It should also be noted that in rare and isolated cases, other characteristics of the makeup of drinking water can impact the long-term performance of plumbing system components even when the water quality levels are within the permissible range set forth by the EPA *National Primary Drinking Water Regulations* and the *Guidelines for Canadian Drinking Water Quality* by Health Canada. The licensed installing contractor must have practical experience within the region of intended use. In addition, consultation with the local plumbing authority and local water authority regarding the performance of plumbing system components should occur before the selection and installation of systems within that specific geographic region. Therefore, the specific application should also be taken into consideration when designing and installing plumbing systems.

3.8 Ultraviolet Resistance

All polymers are susceptible to damage from exposure to the ultraviolet (UV) radiation in sunlight. PEX pipes can be designed to protect against short-term UV damage, but after some time, UV radiation will reduce the lifetime of the pipe. The extent of the reduction depends on factors such as temperature, pressure and chlorination levels in potable water.

REHAU has performed extensive testing of RAUPEX pipes exposed to natural sunlight, leading to the maximum UV exposure times expressed in accumulated days. Once the pipes leave the manufacturing plant, any exposure to UV, including transportation and storage by the wholesaler, is part of the accumulated exposure time.

Although ASTM F876 only categorizes up to 6 months of UV resistance (Material Designation Code = 3**3**06), REHAU has tested and certified RAUPEX UV shield pipe according to ASTM F2657 for the following maximum UV exposure period:

- RAUPEX red, white and blue UV shield pipe: Maximum exposure time of one year accumulated

RAUPEX pipes must be kept in the original packaging until the time of installation. RAUPEX must not be stored outdoors and is not designed for permanent outdoor exposure (with the exception of non-exposed buried applications). Excessive UV exposure will reduce the lifetime of PEXa pipe.

3.8.1 UV Emitted by Fluorescent Lamps

ASTM F2657 was established to test to the worst case scenario for UV exposure by testing in direct sunlight. UV emitted by fluorescent lamps is insignificant when compared to UV present in sunlight. GE Lighting has stated “Solar UV is enormously more photo active and damaging than the UV from linear fluorescent lamps. Solar UV includes UV-A, UV-B and UV-C. UV-A is near UV, not very energetic and is the bulk of UV emitted by florescent lamps.” Therefore, when

REHAU PEXa pipes are installed in the presence of fluorescent lamps the UV emitted by those lamps should have no effect on the lifetime of the pipes. For example, there is no concern of UV damage on REHAU PEXa pipes installed in a boiler room where fluorescent lamps are present.

NOTICE

Failure to follow maximum UV exposure limits may damage the pipe resulting in leaks and operational failures, and will negate any warranty provided by REHAU for RAUPEX pipes.

3.9 Bend Radius

RAUPEX pipe may be bent, even when cold. REHAU support bends can assist to create tight bends without kinking. The typical bend radius used by the installer is 8X the OD. The minimum bend radius is 5X the OD for cold bends. For an even smaller bend radius, the pipe may be heated with a heat gun and bent to no less than 3X the OD. If a tighter bend radius is required, then the designer should consider using a smaller diameter pipe.

Table 3.4: RAUPEX Bend Radius

Bend Radius in (mm)			
Pipe Size	**Typical 8X OD**	**Min. Cold 5X OD**	**Min. Heated 3X OD**
3/8 in	4.0 (102)	2.500 (64)	1.500 (38)
1/2 in	5.0 (127)	3.125 (79)	1.875 (48)
5/8 in	6.0 (152)	3.750 (95)	2.250 (57)
3/4 in	7.0 (178)	4.375 (111)	2.625 (67)
1 in	9.0 (229)	5.625 (143)	3.375 (86)
1 1/4 in	11.0 (279)	6.875 (175)	4.125 (105)
1 1/2 in	13.0 (330)	--	--
2 in	17.0 (432)	--	--

3.10 Chemical Compatibility

While RAUPEX pipes are resistant to many chemicals that are used in typical plumbing applications, there are some chemicals that may damage the pipe.

Chemicals that may be damaging include (but are not limited to):
- Adhesives
- Oil or petroleum-based products
- Paints
- Solvents
- Oxidizing agents
- Disinfectants
- PVC glues
- Solvents and cements

Many factors, such as exposure time, temperature, pressure and other operating parameters, can influence the performance of a pipe that is exposed to a chemical. To determine the impact of a particular chemical, short- and long-term pressure testing may be required. In some cases, a pipe may be resistant to short-term exposure to the chemical, but not resistant to continuous exposure. Each chemical must be evaluated individually. It is the responsibility of the installing contractor to verify chemical compatibility of any chemicals when coming into contact with the polymer material.

3.11 Freeze Break Resistance

The flexibility of the RAUPEX pipe allows it to expand as water freezes in the pipe as long as the pipe has room to expand. When the water thaws, the pipe returns to its original shape. If the pipe is not allowed to expand (e.g., it is encased in concrete), it may burst.

NOTICE

Designers and installers must take precautions to ensure that pipes do not freeze. Frozen pipes may burst resulting in leaks and operational failures.

3.12 Condensation

Condensation occurs on pipes when the surface temperature is lower than the dew point of the environment. This is typically a problem for metallic cold water piping. PEX pipe has a lower thermal conductivity (0.41 W/m°K) than copper (401 W/m°K) resulting in less heat loss to the surface and greater resistance to condensation or sweating. Insulation should be applied to piping to help prevent condensation.

3.13 Pressure Loss

The pressure loss in the PEXa system depends on the flow rate, water temperatures and the properties of the fluid. Use the REHAU LoopCAD® Software which includes a built-in calculator to determine pipe pressure losses for the given conditions. Refer to the REHAU *PEXa Piping Systems Pressure Loss Tables* for the applicable pressure loss table presented at typical flow rates and water temperatures. The pressure loss in PEXa carrier pipe is based on the application of the D'Arcy-Weisbach equation and fluid properties from ASHRAE Fundamentals.

4. EVERLOC+ COMPRESSION-SLEEVE FITTINGS

4.1 Fitting Scope

The EVERLOC+ compression-sleeve system is a cold-expansion PEXa fitting system that is available in polymer and lead-free (LF) brass and is assembled with a specially designed PEXa compression sleeve. The fitting is designed specifically for use with RAUPEX pipe and must only be assembled with the EVERLOC+ compression-sleeve tools.

EVERLOC+ fittings are available in 3/8, 1/2, 5/8, 3/4, 1, 1 1/4, 1 1/2 and 2 in. sizes and are intended for use with RAUPEX SDR9 copper tube size (CTS) pipe manufactured in accordance with ASTM F876

For a detailed description of the REHAU system components, refer to the REHAU *Sustainable Building Technology Product Catalog (855.312)*.

4.1.1 Fitting Features

EVERLOC+ polymer and lead-free (LF) brass fittings have the following features:

1. Four sealing edges
2. Pipe stop
3. Fitting collar
4. Tool jaw body

Fig. 4.1: EVERLOC+ fitting features

4.1.2 Fitting and Sleeve Markings

All polymer fittings include the following marks for identification

REHAU OR

Fig. 4.2: Fitting size marking (e.g., 3/4")

Fig. 4.3: Batch code (e.g., production date)

All LF brass fittings are marked "REHAU"

All sleeves include the following marks for identification

REHAU

- Sleeve size (e.g., 1/2")
- Batch code for production date

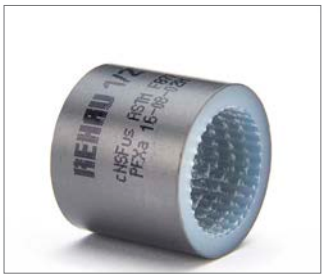


Fig. 4.4: Sleeve markings

4.1.3 Polymer Fittings

EVERLOC+ polymer fittings are available in couplings, tees, elbows, multi-port tees and plugs. All polymer fittings are produced from a polyphenylsulfone (PPSU) material that meets the requirements of NSF 61 for health effects of drinking water system components and complies with the lead-free requirements of the U.S. Safe Drinking Water Act. See also REHAU *Technical Bulletin TB265 EVERLOC+ Polymer Fitting Material - PPSU.*

Fig. 4.5: EVERLOC+ polymer fittings

4.1.4 Lead Free (LF) Brass Fittings

EVERLOC+ LF brass fittings are available as couplings, tees, elbows, plugs and transition fittings to NPT thread and copper solder connections. All metal fittings are produced from ECO BRASS® (UNS 69300 or CW 724R) that meets the requirements of NSF 61 for health effects of drinking water system components and complies with the lead-free requirements of the U.S. Safe Drinking Water Act. See also REHAU *Technical Bulletin TB264 EVERLOC+ Lead-free Brass Fitting Material.*

Fig. 4.6: EVERLOC+ LF brass fittings

4.1.5 Metal Manifolds

Manifolds are 1 in. Type L copper with EVERLOC+ LF brass fittings brazed into the header.

Fig. 4.7: EVERLOC+ metal manifold

4.1.6 PEXa Compression Sleeves

EVERLOC+ compression sleeves are produced using a specially formulated PEXa material and are designed specifically for use with EVERLOC+ fittings and RAUPEX pipe. EVERLOC+ compression sleeves have the following features:

- Co-extruded platinum-colored PE coating
- Squarely cut ends that can be slid over the pipe in either direction
- Grooved and roughened inside surface for locking the sleeve into place once slid over the pipe and fitting

Fig. 4.8: EVERLOC+ compression sleeves

4.1.8 Certifications

The EVERLOC+ compression-sleeve system is certified to the following standards:

- ASTM F877, *Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems*
- NSF/ANSI 14, *Plastic Piping System Components and Related Materials*
- NSF/ANSI 61, *Drinking Water System Components – Health Effects*
- NSF/ANSI 372, *Drinking Water System Components – Lead Content*
- CSA B137.5, *Crosslinked polyethylene (PEX) Tubing Systems for Pressure Applications*

4.2 Fitting Assembly

Before starting the installation process, read the *EVERLOC+ Compression-sleeve System Product Instructions* (855.724).

Assembling the EVERLOC+ compression-sleeve system requires the use of the EVERLOC+ compression-sleeve tools. Only make EVERLOC+ compression-sleeve joints with these tools. Refer to *EVERLOC+ Power Tool Product Instruction Manual* (855.725), *EVERLOC+ XL Power Tool Product Instruction Manual* (855.728) and *EVERLOC+ XL Expander Tool Product Instruction Manual* (855.729) for a complete understanding of operation, care and use of the EVERLOC+ compression-sleeve tools.

⚠ WARNING

Read the instruction manual for the EVERLOC+ compression-sleeve tools before use and follow all safety precautions - improper use can cause serious personal injury.

⚠ WARNING

To reduce the risk of permanent eye injury, always wear close-fitting protective eye wear with side protection. Eye wear must be impact-rated and marked as complying with ANSI Z87.

NOTICE

Use only EVERLOC+ compression-sleeve tools for assembly and installation. Use of other tools will result in an improperly assembled joint, which may result in leaking and property damage.

The basic process of assembling an EVERLOC+ compression-sleeve joint is as follows:

- Make a clean, square cut of the RAUPEX pipe using a RAUPEX cutter
- Slide the EVERLOC+ compression sleeve over the RAUPEX pipe ensuring the sleeve is a minimum of two times the length of the sleeve from the end of the cut pipe to allow for expansion of the pipe only
- Expand the RAUPEX pipe twice, ensuring the expander head is rotated 1/2 of one expander head segment between expansions, using the EVERLOC+ compression-sleeve tools
- Insert the EVERLOC+ compression-sleeve fitting into the expanded end of the RAUPEX pipe until the pipe is touching the pipe stop on the fitting
- Compress the EVERLOC+ compression sleeve over the RAUPEX pipe and EVERLOC+ compression-sleeve fitting using the EVERLOC+ compression-sleeve tools

Required assembly tools include:

- RAUPEX cutter
- EVERLOC+ compression-sleeve tools
- EVERLOC+ expander heads and compression jaws

4.3 Installation Considerations

Some precautions and additional considerations that should be taken when installing the system.

4.3.1 EVERLOC+ Fitting Removal

- EVERLOC+ LF brass fittings CAN be reused, as long the rib area was not damaged during removal.
- EVERLOC+ polymer fittings CANNOT be reused and should be discarded immediately.
- EVERLOC+ compression sleeves CANNOT be reused and should be discarded immediately.

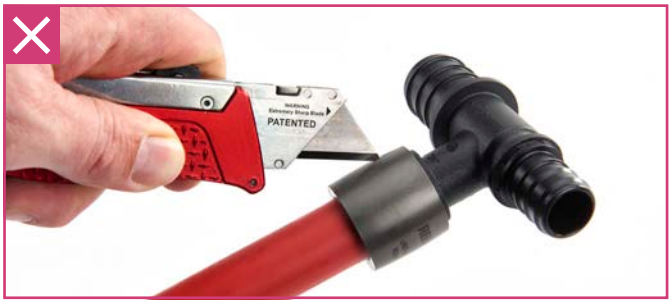


Fig. 4.9: DO NOT cut the EVERLOC+ compression sleeve from finished joint

Fig. 4.10: DO NOT cut RAUPEX pipe from fitting

4.3.1.1 Fitting Removal of Completed Joint (LF brass ONLY)

If it is required to remove the LF brass fitting or disassemble the LF brass compression-sleeve joint, use the following procedure:

If the fitting has been inserted into the pipe and the sleeve has been compressed, safely hold the fitting while it is heated. Be careful not to damage the fitting with the tool.

1. Heat the sleeve directly using a heat gun.
2. Rotate the joint several times while heating.
3. Remove heat and use pliers to pull the sleeve off the fitting, then immediately pull the fitting out of the pipe.

⚠ CAUTION

Do not use open flames to disassemble the joint. Open flames can cause injury or property damage.

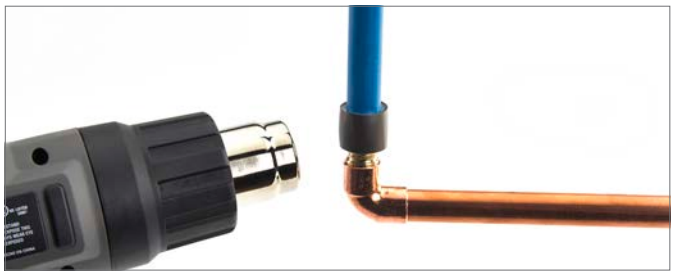


Fig. 4.11: Heating EVERLOC+ compression sleeve with heat gun

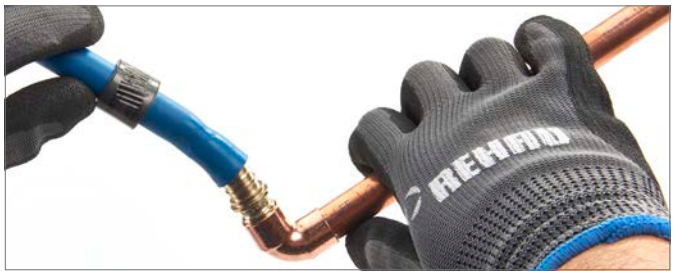


Fig. 4.12: Removing pipe from LF brass fitting

For re-assembly of a joint, the following should be considered:
- The end of the pipe where the previous fitting had been installed must be completely cut off prior to making a new joint. Cutting off a minimum of 3 in (approximately 75 mm) is recommended.

Fig. 4.13: Cut off 3 in. of pipe from end prior to making new joint

4.3.1.2 Fitting Removal of Partially Completed Joint (LF Brass ONLY)

If the fitting has been inserted into the pipe, but the sleeve has not been compressed, attempt to remove it without damaging the fitting. If fitting cannot be easily removed, heat 1 to 1 1/2 in (25 to 38 mm) of the pipe that covers the fitting and pull the fitting out of the pipe.

4.3.2 Protecting EVERLOC+ Joints

REHAU permits EVERLOC+ compression-sleeve joints (polymer and LF brass) to be buried or concealed. REHAU recommends threaded connections never be buried or concealed as they must be accessible for periodic inspection, per prevailing local codes.

The requirement to wrap an EVERLOC+ joint can depend on many factors including location and the presence of other materials that contact or can come in contact with the joint.

When wrapping an EVERLOC+ joint, the following is required:
- Wrap the joint, ensuring a minimum of 50% overlap of the tape
- Avoid wrinkles or kinks in the tape and ensure the joint is completely covered, extending on to the pipe as necessary
- Indicate the location of each joint as required on the “as-built” drawings

Fig. 4.14: REHAU Protective Tape, Red

Fig. 4.15: Linerless Rubber Tape, Black

Note: Use only REHAU recommended protective tapes referenced in REHAU *Technical Bulletin TB266 Protecting EVERLOC+ Joints*. Do not use other types of tapes (e.g., duct tape, standard electrical tape) to wrap the joint, as chemicals in the adhesive may not be compatible with the PPSU fitting material or the PEXa pipe.

Note: Never use heat shrink tubing (e.g., RAUCROSS) to wrap the joint, as the extremely high temperatures produced from a heat gun will soften the pipe and may cause it to pull away from the fitting.

Fig. 4.16: DO NOT use heat shrink tubing for EVERLOC+ joints

4.3.2.1 Concealed in Inaccessible Locations

When EVERLOC+ joints are concealed but are still in open air space (e.g., behind drywall), it is not necessary to wrap the joint. However, the installer should ensure the fitting does not come in contact with chemicals (e.g., PVC glues, solvents and cements) that could damage the fitting material.

4.3.2.2 Buried in a Concrete Slab or sub-base underneath slab

When burying an EVERLOC+polymer joint directly in a concrete slab, or in the sub-base underneath the slab, it is not necessary to wrap the joint. However, there are some additives in concrete or chemicals used in the installation that could potentially damage the fitting material, and in this case, wrapping is recommended. EVERLOC+ LF brass joints buried directly in a concrete slab or in the sub-base underneath the slab must be wrapped.

4.3.2.3 Buried in Soil:
When burying EVERLOC+ joints in soil, outside of a structure, the joint must be wrapped.

4.3.2.4 With Foaming Agents:
Foaming agents and solvents in closed-cell foam insulation kits can damage the PPSU fitting material. Therefore, it is necessary to wrap polymer fittings in a protective tape to protect from polyurethane foams.

4.3.3 Pressure Testing
The compression-sleeve joint is ready for immediate pressure test and use after completion of the assembly process. There is no wait time for the system to be put into service. See Section 6.17.2 for REHAU pressure test procedures.

4.3.4 Pressure and Temperature Ratings
The maximum temperature and pressure ratings of the REHAU PEXa plumbing system are in accordance with ASTM F877 and CSA B137.5 for SDR9 PEX, as defined in Section 3.4.

4.3.5 Ultraviolet Resistance
The fittings and sleeves must never be stored in direct sunlight or stored outside of the original cardboard packaging. In addition, the system is not intended for permanent outdoor applications or in areas with continuous exposure to UV.

4.3.6 Freeze Break Resistance
The flexibility of the RAUPEX pipe allows it to expand as water freezes in the pipe as long as the pipe has room to expand. However, this flexibility does not ensure the integrity of the joint. Therefore, installers must take precautions to ensure that pipes and fittings do not freeze. Freezing may result in leaks and operational failures.

4.3.7 Chlorine Resistance
EVERLOC + compression-sleeve joints have a chlorine resistance rating based on the ratings of RAUPEX pipe, as defined in Section 3.7.

4.3.8 Stress Corrosion Resistance
EVERLOC+ LF brass fittings have been tested in accordance with NSF/ANSI 14 and comply with the requirement for stress corrosion resistance. However, fittings should not be exposed to harmful chemicals or aggressive water conditions that could result in operational failures.

4.3.9 Chemical Compatibility
There are certain chemicals that can damage the EVERLOC+ compression-sleeve system. This applies to external exposure of chemicals and to the transport of such chemicals by the piping system.
Chemicals that may damage the compression-sleeve system include (but are not limited to):
- Adhesives and tapes other than those recommended by REHAU
- Oil/petroleum-based products
- Paints, solvents
- Oxidizing agents (e.g., bleach)
- Disinfectants (e.g., separate dosing unit integrated into building distribution system)
- PVC glues, solvents and cements

Fig. 4.17: DO NOT use harmful chemicals near EVERLOC+ fittings

Ensure that the employed sealants, cleaning agents, building foams, insulation, protective tape, adhesive tape or thread sealants do not contain any components which cause stress cracking or corrosion, such as ammonia, ammonia-bearing, aromatic and oxygenated solvents (e.g., ketone and ether), chlorinated hydrocarbons or chloride ions which can leach.

Protect systems against contact to chemicals and damage. Only use leak detection agents (e.g., foaming agents) approved by the respective manufacturer for PPSU materials. Only use sealants, thread sealants, cleaning agents, building foams, insulation, protective tape, adhesive tape and flux approved by the respective manufacturer for the PPSU materials. Check the compatibility of materials for the corresponding area of application with the manufacturer.

Contact with aromatic and oxygenated solvents (e.g., ketone and ether) as well as halogenated hydrocarbons (e.g., chlorinated hydrocarbons) is not permitted. Contact with water-based acrylic paints and adhesive/protective primers is not permitted.

4.3.10 Copper Soldering

Proper soldering techniques must be followed when soldering all compression-sleeve fittings according to the *Copper Development Association (CDA) Handbook*:

- The surface of the fitting soldering area must be properly cleaned for a good solder connection. Applying flux is not considered sufficient cleaning for the soldering area. Using a proper sanding or brush technique is necessary to remove the surface oxides. In order to prevent further formation of oxides, the flux should be applied immediately after the cleaning process. A proper flux that is compatible with the brass alloy must be used.
- Care must be taken to not overheat the soldering surface as this can lead to the formation of oxides preventing good adhesion of the solder material. It is imperative that the fitting is heated evenly around the entire surface so as to not overheat one particular area.
- All completed solder joints must be tested for joint integrity following the procedures prescribed by prevailing local codes.

4.4 EVERLOC+ Compression-sleeve Tools

Assembling the EVERLOC+ compression-sleeve system requires the use of the EVERLOC+ compression-sleeve tools. Only make EVERLOC+ compression-sleeve joints with these tools.

Before use, read and understand the following safety symbols which are found on the EVERLOC+ compression-sleeve tools.

Safety Alert Symbol – To reduce the risk of injury, follow the specified safety instructions.

Read and follow all safety precautions in the instruction manual. Improper use can lead to serious personal injury or property damage.

To reduce the risk of serious eye injury, always wear proper eye protection.

Risk of electric shock. Never operate the power tool in damp or wet conditions. Never expose to rain or submerge in water or other liquids. Never operate the power tool near wires or cables carrying electric current.

To reduce the risk of severe personal injury, including crush and laceration injury, keep fingers, hands and all parts of your body away from the expander head, hydraulic slide and compression jaws during operation.

NOTICE

Use only EVERLOC+ compression-sleeve tools for assembly and installation. Use of other tools will result in an improperly assembled joint, which may result in leaking and property damage.

4.4.1 EVERLOC+ Power Tool 3/8 to 1 in.

For assembly of EVERLOC+ fittings in sizes 3/8 through 1 in. Use the EVERLOC+ power tool. Refer to *EVERLOC+ Power Tool Product Instruction Manual* (855.725) for a complete understanding of operation, care and use of the tool

Fig. 4.18: EVERLOC+ power tool

EVERLOC+ power tool standard kit:

- EVERLOC+ power tool
- Expansion adapter
- 1/2, 3/4 and 1 in. EVERLOC+ expander heads (quick change)
- 1/2, 3/4 and 1 in. EVERLOC+ compression jaws
- DEWALT® 12V Li-ion battery (DCB127) (2 batteries per kit)
- DEWALT 12V/20V Li-ion charger 120VAC (DCB107)
- DEWALT 12V/20V Li-ion Battery Charger Instruction Manual
- Pipe cutter
- Lubricant
- Cleaning brush
- Tool case
- Product Instruction Manual

Fig. 4.19: EVERLOC+ power tool standard kit

Available Accessories:

- 3/8 in. expander head (quick change)
- 3/8 in. compression jaws
- 5/8 in. expander head (quick change)
- 5/8 in. compression jaws

4.4.2 EVERLOC+ XL Power Tool 1 1/4 to 2 in.

Assembling the EVERLOC+ compression-sleeve system with diameters of 1 1/4 through 2 in. requires the use of the EVERLOC+ XL power tool. Refer to *the EVERLOC+ XL Power Tool Product Instruction Manual* (855.728) for a complete understanding of operation, care and use of the tool.

Fig. 4.20: EVERLOC+ XL power tool

EVERLOC+ XL power tool standard kit:
- EVERLOC+ XL power tool
- Expansion adapter
- 1 1/4, 1 1/2 and 2 in. EVERLOC+ expander heads (quick change)
- 1 1/4, 1 1/2 and 2 in. EVERLOC+ compression jaws
- MAKITA® 18V Li-ion battery (BL1840B) (2 batteries per kit)
- MAKITA 18V Li-ion charger 120VAC (DC18RC)
- MAKITA 18V Li-ion Battery Charger Instruction Manual
- Pipe cutter
- Lubricant
- Cleaning brush
- Tool case (black latches)
- Product Instruction Manual

Fig. 4.21: EVERLOC+ XL power tool standard kit

Available Accessories:
- EVERLOC+ XL expander tool standard kit
- EVERLOC+ XL expander base tool

4.4.3 EVERLOC+ XL Expander Tool 1 1/4 to 2 in.

In addition to the EVERLOC+ XL power tool, the EVERLOC+ XL expander tool can be used for the expansion steps of the 1 1/4 to 2 in. fitting assembly process. Use of this tool in addition to the XL power tool allows for greater efficiency in some installation situations. Refer to the *EVERLOC+ XL Expander Tool Product Instruction Manual* (855.729) for a complete understanding of operation, care and use of the tool.

Fig. 4.22: EVERLOC+ XL expander tool

Fig. 4.23: EVERLOC+ XL expander tool standard kit

EVERLOC+ XL expander tool standard kit:
- EVERLOC+ XL expander tool
- MAKITA 18V Li-ion battery
- MAKITA 18V Li-ion Battery Charger Instruction Manual
- Lubricant
- Cleaning brush
- Tool case (gray latches)
- Product Instruction Manual

Available Accessories:
- EVERLOC+ XL power tool standard kit
- EVERLOC+ expander heads (quick change):
  1 1/4 in., Art. 105078-001; 1 1/2 in., Art. 105079-001; and 2 in., Art. 105080-001
- Large ratchet cutter, Art. 131558-001

5. DESIGN CONSIDERATIONS

5.1 Pipe Sizing

The design and layout of the building hot- and cold-water distribution system shall comply with accepted plumbing engineering practice and as per prevailing local codes.

The REHAU PEXa plumbing system consists of RAUPEX UV shield PEXa pipe and the EVERLOC+ compression-sleeve fitting system and can be designed and sized per the following model plumbing codes:

- ICC International Plumbing Code (IPC)
- ICC International Residential Code (IRC)
- IAMPO National Standard Plumbing Code (NSPC)
- IAPMO Uniform Plumbing Code (UPC)
- NRCC National Plumbing Code of Canada (NPCC)

In addition, a properly designed plumbing system should follow the engineering principles as per the American Society of Plumbing Engineers (ASPE) *Plumbing Engineering Design Handbook Volume II* or equivalent.

For sizing a system in residential and light commercial buildings, use the water supply fixture unit (WSFU) method to determine the required load (GPM) and resulting pipe size as published in the model plumbing codes. Alternatively, or in larger buildings, the uniform friction head loss method can be utilized.

5.1.1 Standard Dimension Ratio

RAUPEX pipe is in accordance to the dimensional standards in ASTM F876 and CSA B137.5. RAUPEX is copper tube size (CTS) outside diameter (OD) which means that the actual OD of the pipe is 1/8 in. (3.18 mm) larger than the nominal size.

Wall thickness is defined by the standard dimensional ratio (SDR). RAUPEX UV shield pipe is SDR9, which equates to the outside diameter being approximately nine times the wall thickness. Since PEX pipe has a thicker wall than copper tube, the inside diameter (ID) is slightly smaller. However, since PEX pipe is not susceptible to the erosion and corrosion issues of copper tube, plumbing systems can be designed at higher velocities which allow for comparable sizing of a system.

5.1.2 Determining Friction Loss

The pressure loss for the REHAU PEXa plumbing system can be calculated using the REHAU *PEXa Piping Systems Pressure Loss Tables (855.861)* available online on the REHAU Resource Center or using the REHAU LoopCAD software pressure loss calculator tool.

5.1.3 Velocity Considerations

The maximum velocity of water flow (feet/second – fps) in the plumbing system should be considered when sizing a REHAU PEXa plumbing system. To determine the pipe size, the WSFU load can be correlated to flow rate (GPM) from tables published in the model plumbing codes.

Once the flow rate is determined, the pipe can be sized based on the allowable maximum velocities per prevailing local codes.

The designer can use the following tables as a guideline:

Table 5.1: Maximum Velocity of Water Flow

Cold-Water Piping	- Typical plumbing codes state maximum velocity of 8 ft/sec - REHAU recommends a maximum design velocity of 10 ft/sec
Hot-Water Piping	- Typical plumbing codes state maximum velocity of 5 ft/sec - REHAU recommends a maximum design velocity of 8 ft/sec
Hot-Water Recirculation Return Piping	- Maximum velocity of 2 ft/sec - Maximum operating temperature of 140°F (60°C)

Table 5.2: GPM per Pipe Size

Pipe Size	GPM @ 2 fps	GPM @ 5 fps	GPM @ 8 fps	GPM @ 10 fps
3/8 in	0.6	1.6	2.5	3.2
1/2 in	1.1	2.9	4.6	5.8
3/4 in	2.3	5.7	9.1	11.3
1 in.	3.8	9.4	15.0	18.8
1 1/4 in	5.7	14.0	22.3	28.1
1 1/2 in	8.0	19.7	31.3	39.1
2 in	13.7	33.4	53.8	67.1

5.2 Equivalent Length of Fittings

It is common practice for designers to convert the pressure drop across fittings to an average equivalent length of pipe. These equivalent lengths are added to the total pipe length. Designers can calculate total pressure loss using this adjusted piping system length.

Table 5.3: Equivalent Length of Fittings

Couplings

Fitting Description	Equivalent Length (ft)
3/8 x 3/8 in. EVERLOC+ LF Brass Coupling	1.1
1/2 x 1/2 in. EVERLOC+ Polymer Coupling	0.4
5/8 x 5/8 in. EVERLOC+ LF Brass Coupling	1.0
3/4 x 1/2 in. EVERLOC+ Polymer Coupling	2.1
3/4 x 3/4 in. EVERLOC+ Polymer Coupling	0.8
1 x 3/4 in. EVERLOC+ Polymer Coupling	2.7
1 x 1 in. EVERLOC+ Polymer Coupling	1.1
1 1/4 x 3/4 in. EVERLOC+ LF Brass Coupling	3.5
1 1/4 x 1 in. EVERLOC+ Polymer Coupling	4.0
1 1/4 x 1 1/4 in. EVERLOC+ Polymer Coupling	2.0
1 1/2 x 1 in. EVERLOC+ Polymer Coupling	4.8
1 1/2 x 1 1/2 in. EVERLOC+ Polymer Coupling	2.0
2 x 1/2 in. EVERLOC+ LF Brass Coupling	3.5
2 x 3/4 in. EVERLOC+ LF Brass Coupling	3.8
2 x 1 in. EVERLOC+ LF Brass Coupling	5.2
2 x 1 1/4 in. EVERLOC+ LF Brass Coupling	5.3
2 x 1 1/2 in. EVERLOC+ LF Brass Coupling	6.1
2 x 2 in. EVERLOC+ Polymer Coupling	2.2

Elbows (PEX to PEX)

Fitting Description	Equivalent Length (ft)
1/2 x 1/2 in. EVERLOC+ Polymer Elbow	1.9
5/8 x 5/8 in. EVERLOC+ LF Brass Elbow	5.4
3/4 x 3/4 in. EVERLOC+ Polymer Elbow	7.0
1 x 1 in. EVERLOC+ Polymer Elbow	10.7
1 1/4 x 1 1/4 in. EVERLOC+ Polymer Elbow	14.2
1 1/2 x 1 1/2 in. EVERLOC+ Polymer Elbow	16.0
1 1/2 x 1 1/2 in. EVERLOC+ LF Brass 45° Elbow	3.4
2 x 2 in. EVERLOC+ Polymer Elbow	24.2

Tees

Fitting Description	Equivalent Length (ft) RUN	Equivalent Length (ft) BRANCH
1/2 x 1/2 x 1/2 in. EVERLOC+ Polymer Tee	0.8	4.4
1/2 x 1/2 x 3/4 in. EVERLOC+ Polymer Tee	-	4.1
3/4 x 1/2 x 1/2 in. EVERLOC+ Polymer Tee	2.4	4.3
3/4 x 1/2 x 3/4 in. EVERLOC+ Polymer Tee	2.4	7.6
3/4 x 3/4 x 1/2 in. EVERLOC+ Polymer Tee	1.3	4.0
3/4 x 3/4 x 3/4 in. EVERLOC+ Polymer Tee	1.2	7.6
3/4 x 3/4 x 1 in. EVERLOC+ Polymer Tee	-	6.8
1 x 1 x 1/2 in. EVERLOC+ Polymer Tee	1.6	3.9
1 x 3/4 x 3/4 in. EVERLOC+ Polymer Tee	2.8	6.5
1 x 3/4 x 1 in. EVERLOC+ Polymer Tee	3.1	10.9
1 x 1 x 3/4 in. EVERLOC+ Polymer Tee	1.2	6.7
1 x 1 x 1 in. EVERLOC+ Polymer Tee	1.6	10.6
1 1/4 x 1 x 3/4 in. EVERLOC+ LF Brass Tee	3.7	5.4
1 1/4 x 1 x 1 in. EVERLOC+ Polymer Tee	3.8	9.7
1 1/4 x 1 x 1 1/4 in. EVERLOC+ LF Brass Tee	4.3	9.6
1 1/4 x 1 1/4 x 1/2 in. EVERLOC+ LF Brass Tee	0.8	5.0
1 1/4 x 1 1/4 x 3/4 in. EVERLOC+ LF Brass Tee	1.3	5.5
1 1/4 x 1 1/4 x 1 in. EVERLOC+ Polymer Tee	2.3	10.1
1 1/4 x 1 1/4 x 1 1/4 in. EVERLOC+ Polymer Tee	2.2	14.4
1 1/2 x 1 x 3/4 in. EVERLOC+ LF Brass Tee	6.8	6.8
1 1/2 x 1 x 1 in. EVERLOC+ LF Brass Tee	5.5	7.9
1 1/2 x 1 x 1 1/2 in. EVERLOC+ LF Brass Tee	5.6	12.4
1 1/2 x 1 1/4 x 3/4 in. EVERLOC+ LF Brass Tee	4.5	5.5
1 1/2 x 1 1/4 x 1 in. EVERLOC+ LF Brass Tee	4.4	8.1
1 1/2 x 1 1/4 x 1 1/4 in. EVERLOC+ LF Brass Tee	4.5	9.5
1 1/2 x 1 1/4 x 1 1/2 in. EVERLOC+ LF Brass Tee	4.3	10.9
1 1/2 x 1 1/2 x 1/2 in. EVERLOC+ LF Brass Tee	1.0	4.9
1 1/2 x 1 1/2 x 3/4 in. EVERLOC+ LF Brass Tee	1.0	5.4
1 1/2 x 1 1/2 x 1 in. EVERLOC+ Polymer Tee	2.2	9.1
1 1 /2 x 1 1/2 x 1 1/4 in. EVERLOC+ LF Brass Tee	1.7	9.6
1 1/2 x 1 1/2 x 1 1/2 in. EVERLOC+ Polymer Tee	2.6	17.0
2 x 1 1/4 x 2 in. EVERLOC+ LF Brass Tee	6.7	14.9
2 x 1 1/2 x 3/4 in. EVERLOC+ LF Brass Tee	5.8	5.7
2 x 1 1/2 x 1 in. EVERLOC+ LF Brass Tee	6.2	7.7
2 x 1 1/2 x 1 1/4 in. EVERLOC+ LF Brass Tee	6.3	9.5
2 x 1 1/2 x 1 1/2 in. EVERLOC+ LF Brass Tee	6.4	11.2
2 x 1 1/2 x 2 in. EVERLOC+ LF Brass Tee	6.5	14.6
2 x 2 x 1/2 in. EVERLOC+ LF Brass Tee	1.1	5.0
2 x 2 x 3/4 in. EVERLOC+ LF Brass Tee	1.0	5.9
2 x 2 x 1 in. EVERLOC+ Polymer Tee	3.2	9.0
2 x 2 x 1 1/4 in. EVERLOC+ LF Brass Tee	1.9	9.7
2 x 2 x 1 1/2 in. EVERLOC+ LF Brass Tee	1.9	10.9
2 x 2 x 2 in. EVERLOC+ Polymer Tee	4.0	25.3

Elbows (PEX to transition)

Fitting Description	Equivalent Length (ft)
1/2 x 1/2 in. C Male or 3/8 in. C Female EVERLOC+ LF Brass Elbow	7.4
1/2 x 1/2 in. C Female EVERLOC+ LF Brass Elbow	7.2
3/4 x 3/4 in. C Female EVERLOC+ LF Brass Elbow	7.1
3/4 x 3/4 in. C Male EVERLOC+ LF Brass Elbow	7.4
1/2 x 1/2 in. MPT EVERLOC+ LF Brass Drop Ear Elbow	7.6
1/2 x 1/2 in. FPT EVERLOC+ LF Brass Drop Ear Elbow	4.9
3/4 x 3/4 in. MPT EVERLOC+ LF Brass Elbow	7.5
3/4 x 3/4 in. MPT EVERLOC+ LF Brass Drop Ear Elbow	7.7
3/4 x 3/4 in. FPT EVERLOC+ LF Brass Drop Ear Elbow	9.0
1 x 1 in. FPT EVERLOC+ LF Brass Drop Ear Elbow	13.6

Adapters (PEX to copper)

Fitting Description	Equivalent Length (ft)
1/2 x 1/2 in. C Female EVERLOC+ LF Brass Adapter	2.3
1/2 x 1/2 in. C Male or 3/8 in. C Female EVERLOC+ LF Brass Adptr	2.4
1/2 x 3/4 in. C Female EVERLOC+ LF Brass Adapter	4.0
3/4 x 1/2 in. C Male EVERLOC+ LF Brass Adapter	0.3
3/4 x 1/2 in. C Female EVERLOC+ LF Brass Adapter	0.5
3/4 x 1 in. C Female EVERLOC+ LF Brass Adapter	3.9
3/4 x 3/4 in. C Female EVERLOC+ LF Brass Adapter	2.7
3/4 x 3/4 in. C Male EVERLOC+ LF Brass Adapter	2.6
1 x 1 in. C Female EVERLOC+ LF Brass Adapter	3.5
1 x 1 in. C Male EVERLOC+ LF Brass Adapter	3.3
1 1/4 x 1 1/4 in. C Female EVERLOC+ LF Brass Adapter	4.1
1 1/4 x 1 1/4 in. C Male EVERLOC+ LF Brass Adapter	4.3
1 1/2 x 1 1/2 in. C Female EVERLOC+ LF Brass Adapter	5.3
1 1/2 x 1 1/2 in. C Male EVERLOC+ LF Brass Adapter	5.4
2 x 2 in. C Female EVERLOC+ LF Brass Adapter	7.0
2 x 2 in. C Male EVERLOC+ LF Brass Adapter	6.9

Adapters (PEX to MPT/FPT)

Fitting Description	Equivalent Length (ft)
3/8 x 1/2 in. MPT EVERLOC+ LF Brass Adapter	2.4
1/2 x 1/2 in. FPT EVERLOC+ LF Brass Adapter	2.8
1/2 x 1/2 in. MPT EVERLOC+ LF Brass Adapter	3.3
5/8 x 1/2 in. MPT EVERLOC+ LF Brass Adapter	2.9
5/8 x 3/4 in. MPT or 1/2 in. C Female EVERLOC+ LF Brass Adptr	3.6
3/4 x 3/4 in. FPT EVERLOC+ LF Brass Adapter	2.8
3/4 x 3/4 in. MPT EVERLOC+ LF Brass Adapter	3.4
3/4 x 1 in. MPT EVERLOC+ LF Brass Adapter	4.3
1 x 3/4 in. FPT EVERLOC+ LF Brass Adapter	0.1
1 x 1 in. FPT EVERLOC+ LF Brass Adapter	3.6
1 x 1 in. MPT EVERLOC+ LF Brass Adapter	3.8
1 1/4 x 1 1/4 in. MPT EVERLOC+ LF Brass Adapter	4.9
1 1/2 x 1 1/2 in. MPT EVERLOC+ LF Brass Adapter	5.9
2 x 2 in. MPT EVERLOC+ LF Brass Adapter	7.3

5.3 Piping Layouts

Most piping layout designs utilize some form of reducing tee in order to branch from a main trunk line to smaller pipe diameters that route to fixtures and appliances. The flexibility of RAUPEX pipe allows you to easily route around obstacles and reduce the number of fittings needed. Multi-port tees function like reducing tees, but reduce the number of connection points. In general, the best system designs utilize the flexibility of the RAUPEX pipe and minimize connections.

5.3.1 Tee and Branch

- Increases installation speed by taking advantage of the flexibility of PEXa pipe
- Reduces pressure at the furthest fixture
- Similar to traditional rigid pipe installation layouts
- Reduces hot water wait time, compared to a home-run system

Parts list:
- Reducing tees
- Straight tees
- Straight or coiled pipe

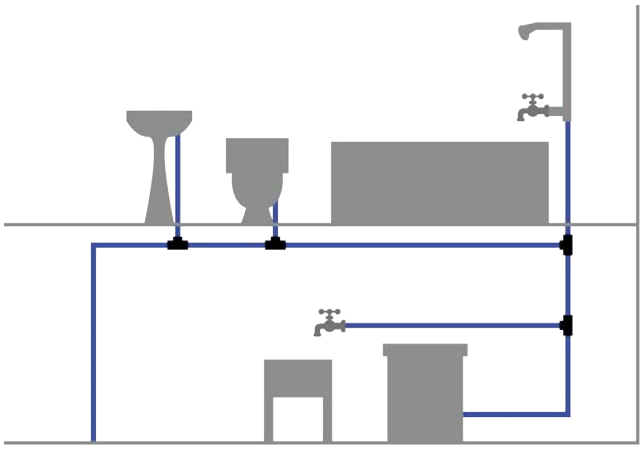


Fig. 5.1: Tee and branch piping layout

5.3.2 Multi-port Tee

- Minimizes number of connections
- Combines tee and branch and home-run concepts
- Systems are pressure-balanced at each manifold
- Reduces hot water wait time, compared to a home-run system

Parts list:

- Flow-through multi-port tees
- Closed-end multi-port tees
- Straight or coiled pipe

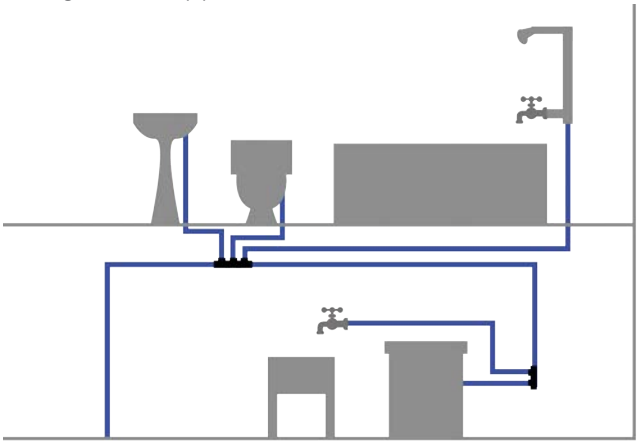


Fig. 5.2: Multi-port tee piping layout

5.3.3 Home-run

- Generally for residential installations
- Eliminates most fittings
- Balances pressure to all fixtures
- Increases hot water wait time, compared to tee and branch and remote multi-port designs
- Uses more pipe
- May require more holes to be drilled in joist spaces

Parts list:

- Multi-port tees
- Straight or coiled pipe

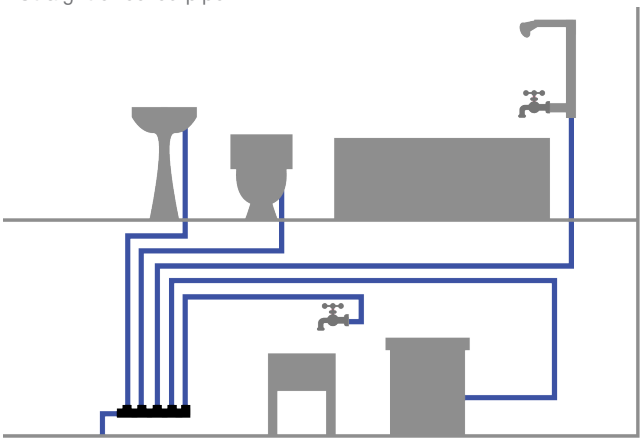


Fig. 5.3: Home-run piping layout

5.4 Thermal Expansion and Contraction

When thermal expansion is anticipated, pipe movement should be controlled to avoid changes that could damage the piping system. Anchoring and use of expansion loops may be used to accomplish this. Allowing for controlled expansion and contraction in multiple parts of a piping system is an accepted means of preventing added stresses in other parts of the system.

RAUPEX piping systems exhibit a higher expansion and contraction rate when subjected to changes in temperature as compared to metallic piping systems. Because of its lower modulus of elasticity, RAUPEX pipe is less rigid than metallic piping and develops less force than metallic pipe when exposed to temperature changes.

5.4.1 Calculating Thermal Expansion of RAUPEX Pipe

When a pipe is anchored at one end but can otherwise freely move in the axial direction, an increase in temperature causes the pipe to increase in overall length. A decrease in temperature causes a decrease in length.

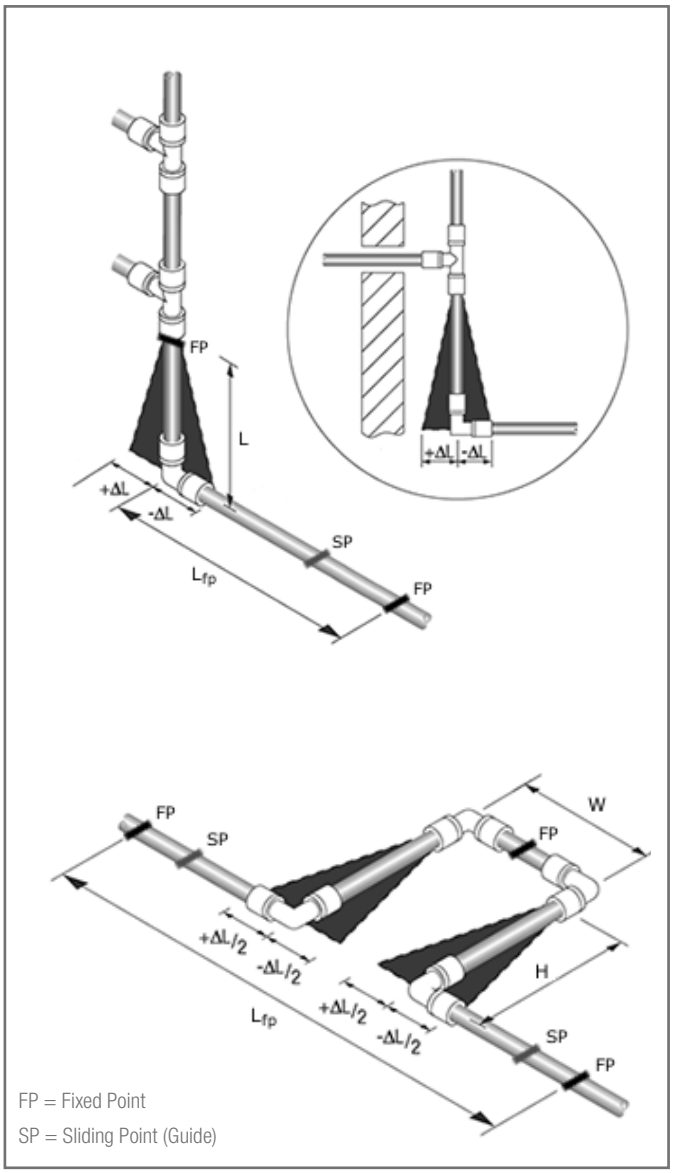
The following equation predicts the net expansion/contraction in the length of a fully unrestrained pipe that occurs in consequence of a given change in temperature:

(1) $$\Delta L = \alpha * L * \Delta T$$

where,
ΔL = change in pipe length, in.
α = coefficient of linear expansion/contraction, in/ft °F
L = initial pipe length, in.
ΔT = change in pipe temperature, °F
Note: See Table 3.1 for coefficient of linear expansion

5.4.2 Calculating L-bend and U-bend for RAUPEX Pipe

RAUPEX pipe will expand and contract when heated or cooled due to a change in water temperature or ambient temperature. Thermal expansion of RAUPEX pipe must be considered in the design and installation of the piping system. Fixed anchor points, guides and expansion loops should be utilized to account for the expansion and contraction of the pipe to prevent any damage to the piping system.



FP = Fixed Point

SP = Sliding Point (Guide)

Fig. 5.4: L-bend and U-bend

Calculation of the length of offset for an L-bend or width and height of a U-bend can be determined as follows, where L = length of offset leg for L-bend (ft), per ASHRAE *2016 Chap 46 Pipe, Tubes and Fittings*

(2) $$L = \sqrt{\frac{3\Delta DE}{CS_A}}$$

D = actual pipe outside diameter (in), source for RAUPEX is Table 3.2
E = modulus of elasticity (psi), source for RAUPEX is Table 3.1
C = constant, 144 (in^2/ft^2)
S_A = allowable stress range

and Δ = anchor-to-anchor thermal expansion or contraction (in)

(3) $$\Delta = \alpha * dT * L_{Fp}$$

where,
α = coefficient of linear expansion([in/[ft°F]), source for RAUPEX is Table 3.1
dT = temperature differential (°F)
L_{FP} = single plane length between fixed points (anchors) (ft)

The width of a U-bend is calculated with the following equation, where W = width of U-bend (ft), per ASHRAE *2016 Chap 46 Pipe, Tubes and Fittings*

(4) $$W = \frac{L}{5}$$

The height of a U-bend is calculated with the following equation, where H = height of U-bend (ft), per ASHRAE *2016 Chap 46 Pipe, Tubes and Fittings*

(5) $$H = 2W$$

5.4.3 Risers

Always comply with prevailing local codes regarding the use of PEX pipe in riser applications. RAUPEX should be supported vertically every floor (not exceeding 10 ft [3.048m] per floor). A pipe guide should be used midway between vertical supports. The mid-story guides do not support the weight of the pipe; they keep it from moving horizontally when the pipe expands.

Note: These are the minimum requirements of the UMC, UPC, IMC, IPC and IRC.

When it comes to hydronic risers, the goal is to control expansion and contraction forces inside the wall cavity and uphold the integrity of the fire stop. To accomplish this, a riser clamp should be placed at the floor and base of each level, along with a mid-story guide. Piping runs must comply with support spacing as defined by the prevailing local codes.

5.5. Installation in Fire-rated Assemblies

In commercial and residential applications, fire-rated wall and floor/ceiling assemblies are an essential component of the overall fire resistant construction for the building. The model building codes define the requirements for these rated assemblies, which includes the type of construction (framed or concrete), the fire rating of the assembly (2 hours, for example), and loading.

For plumbing installations, it is common to route the piping through these rated assemblies. In this case, the model building codes require that the installed components do not diminish the overall rating of the assembly. Therefore, REHAU has completed a series of fire tests with UL and ULC to evaluate the performance of REHAU piping in these types of installations.

Based on this extensive testing, it has been demonstrated that the inclusion of RAUPEX pipe should not adversely affect the overall fire rating of the assembly. RAUPEX pipe is UL and ULC Listed for installation in fire-rated assemblies which includes reinforced concrete slabs, wood-framed floor/ceiling assemblies, framed bearing walls, and framed non-bearing walls. This listing covers UV shield pipes in sizes 3/8 through 2 in.

The fire resistance listings for RAUPEX pipe have been tested to and meet the following standards:
- ANSI/UL 263, *Fire Tests of Building Construction and Materials*
- CAN/ULC-S101, *Standard Methods of Fire Endurance Tests of Building Construction and Materials*

The following design listings can be found on the UL and ULC online certifications directory (www.ul.com and www.ulc.ca).

Table 5.4: Fire-rated Assembly Design Listings

Assembly Description	UL Design No.	ULC Design No.
Reinforced Concrete Slab	No. K917	No. J900
Wood Framed Floor/Ceiling Assembly	No. L588	No. M516
Combustible Bearing Wall	No. U383	No. W316
Combustible Non-bearing Wall	No. V461	No. W458

When using RAUPEX pipe in these types of applications, the specifying engineer and designer should evaluate the design listings to ensure prevailing local code requirements are met. In addition the authority having jurisdiction should review and approve the design before installation.

5.5.1 Firestop Systems

In accordance with model building codes, when RAUPEX pipe penetrates through a fire-rated assembly (i.e., floor, ceiling, wall) the penetration must be protected by an approved through-penetration firestop system. This firestop system shall be tested in accordance with one or all of the following standards and listed by an independent third-party listing agency such as UL, ULC or ITS (Warnock Hersey). The firestop system shall meet all local code requirements prior to installation.

Most common firestop system standards are:
- ASTM E814, *Fire Tests of Through-Penetration Firestops*
- UL 1479, *Fire Tests of Through-Penetration Firestops*
- CAN/ULC S115, *Tests of Fire Resistance of Building Joint Systems*

Several such systems are commonly available across North America. In order to choose an approved firestop system for each specific application where a PEX pipe penetrates a fire-rated assembly, the following information must first be known:
- Nominal size of PEX pipe penetrating the fire-rated assembly
- Number of PEX pipes penetrating through one opening
- Type of assembly being penetrated (i.e. floor, wall, ceiling)
- Construction of fire-rated assembly (i.e. wood, concrete)
- The "F" and "T" ratings of the fire-rated assembly

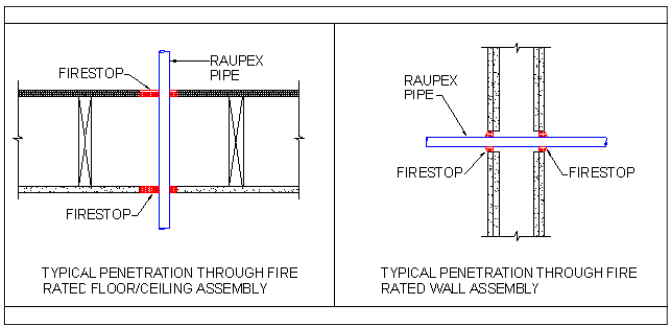


Fig. 5.5: RAUPEX pipe is fire-stopped at both points of entry through the assembly

To determine a product that is locally available and correct for the assembly type, REHAU recommends customers contact local firestop product suppliers to determine which of their firestop products are listed for the intended assembly with PEX pipe:

5.5.2 Installation in Plenum Space (United States)

A plenum is defined as an enclosed portion of the building structure that is designed to allow air movement, thereby serving as part of an air distribution system. Plenums can serve as supply, return, exhaust and ventilation portions of the air distribution system.

The International Mechanical Code (IMC) and Uniform Mechanical Code (UMC) require that combustible materials installed within air plenums have a flame spread (FS) index of not more than 25, and a smoke developed (SD) index of not more than 50. These numbers do not contain units, and are used as index (comparative) ratings of how quickly building materials burn and how much smoke is developed when they burn. Pipes that meet these requirements are sometimes said to have a "plenum rating."

The flame spread index and the smoke developed index are measured during a standardized laboratory test that burns combustible pipe and measures the speed of flame spread and volume of smoke developed. The IMC and UMC specify that the flame spread index and the smoke developed index of a material are to be determined based on one of the following standards:

- ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* or
- UL 723, *Test for Surface Burning Characteristics of Building Materials*

REHAU RAUPEX pipes and EVERLOC+ polymer fittings (1/2 to 2 in.) have received listings through NSF International to the ASTM E84 standard.

Table 5.5: Flame Spread/Smoke Developed ≤ 25/50 RAUPEX Pipe

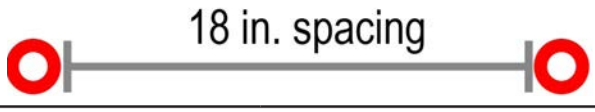
Pipe Description	ASTM E84 18 in. spacing FS/SD
≤3/4 in. RAUPEX UV shield	FS ≤25 / SD≤50
	

Table 5.6: Flame Spread/Smoke Developed ≤ 25/50 RAUPEX Pipe with REHAU Galvanized Support Channel

Pipe Description	ASTM E84 Galvanized support channel FS/SD
3/4 to 2 in. RAUPEX UV shield	FS ≤25 / SD≤50
	

Table: 5.7: Flame Spread/Smoke Developed ≤ 25/50 RAUPEX Pipe and EVERLOC+ Polymer Fittings with 1/2 in. Thick Fiberglass Insulation

Pipe Description	ASTM E84 Wrapped in 1/2 in. thick fiberglass insulation FS/SD
≤2 in. RAUPEX UV shield	FS ≤25 / SD≤50
≤2 in. EVERLOC+ polymer fittings	
	

RAUPEX UV shield pipes have also been evaluated to UL 2846 for plastic water distribution plumbing pipe for visible flame and smoke characteristics. When covered with UL-classified pipe and equipment covering material, RAUPEX UV shield pipe exhibits peak optical densities of 0.5 or less, maximum average optical densities of 0.15 or less, and maximum flame-propagation distances of 5 ft or less.

- UL 2846, *Fire Test Of Plastic Water Distribution Plumbing Pipe For Visible Flame And Smoke Characteristics*

Table 5.8: Optical Density and Flame Propagation with UL-classified Pipe and Equipment Covering Material

Pipe Description	UL 2846 Pipe covered with UL Classified Pipe and Equipment Covering Material
≤2 in. RAUPEX UV shield	FS ≤25 / SD≤50
	

5.5.3 Installation in Plenum Space (Canada)

The National Building Code of Canada 2015 (NBCC-2015) requires that combustible materials installed within air plenums have a flame spread (FS) rating of not more than 25, and a smoke developed (SD) classification of not more than 50. These numbers do not contain units, and are used as index (comparative) ratings of how quickly building materials burn and how much smoke is developed when they burn. Pipes that meet these requirements are sometimes said to have a "plenum rating".

The NBCC-2015 specifies the flame spread rating and the smoke developed classification of a material is to be determined based on the following standard:

- CAN/ULC S102.2-2010, *Standard for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies (Canada)*
- Local code requirements may vary for each location. The engineer/installer is responsible for verifying prevailing local codes are met prior to installation.

RAUPEX pipes and EVERLOC+ polymer fittings (3/8 to 2 in.) have been tested to the latest version of CAN/ULC S102.2-2010. Based on this testing, the following sizes and types of RAUPEX pipes and polymer fittings have obtained a listing according to CAN.ULC S102.2-2010 with no minimum pipe spacing requirements.

5.5.3.1 CAN/ULC S102.2-2010

Table 5.9: Flame Spread/Smoke Developed ≤ 25/50 RAUPEX Pipe

Pipe Description	CAN/ULC S102.2-2010 No spacing requirements FS/SD
3/8 to 1/2 in. RAUPEX UV shield	FS ≤25 / SD≤50
	

Table 5.10: Flame Spread/Smoke Developed ≤ 25/50 RAUPEX Pipe and EVERLOC+ Polymer Fittings with 1/2 in. Thick Fiberglass Insulation

Pipe Description	CAN/ULC S102.2-2010 pipe wrapped in 1/2 in. fiberglass insulation No spacing requirements FS/SD
≤2 in. RAUPEX UV shield	FS ≤25 / SD≤50
≤2 in. EVERLOC+ polymer fittings	
	

Table 5.11: Flame Spread/Smoke Developed ≤ 25/50 RAUPEX Pipe with 1/2 in. Thick Armaflex Insulation

Pipe Description	CAN/ULC S102.2-2010 pipe wrapped in 1/2 in. thick Armaflex insulation No spacing requirements FS/SD
1 to 2 in. RAUPEX UV shield	FS ≤25 / SD≤50
	

The current edition of the National Building Code of Canada permits the use of RAUPEX pipe in plenums per the following sections:

- 2015 National Building Code of Canada, Section 3.6.4.3(1) *Plenum Requirements*
- 2015 National Building Code of Canada, Section 3.1.5.19(2) *Combustible Piping Materials*

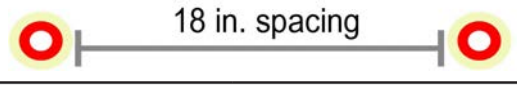
5.5.3.2 CAN/ULC S102.2-2007

In some areas, local provincial codes have not been updated to the 2015 edition of the National Building Code of Canada. Where these local codes prevail, use the following information:

Table 5.12: Flame Spread/Smoke Developed ≤ 25/50 RAUPEX Pipe

Pipe Description	CAN/ULC S102.2-2007 18 in. spacing FS/SD
3/8 to 3/4 in. RAUPEX UV shield	FS ≤25 / SD≤50
	

Table 5.11: Flame Spread/Smoke Developed ≤ 25/50 RAUPEX Pipe with 1/2 in. Thick Fiberglass Insulation

Pipe Description	CAN/ULC S102.2-2007 pipe wrapped in 1/2 in. thick fiberglass insulation No spacing requirements FS/SD
1 to 2 in. RAUPEX UV shield	FS ≤25 / SD≤50
	

5.6 Overhead Installations

Suspended sections of PEX pipe need to be installed using methods to ensure the pipe does not sag. Standard Copper Tube Size (CTS) hangers, including clevis and loop hangers, can be used to support suspended sections of PEX pipe.

The hanger system must be strong enough to support the pipe and its contents. All supports that come in contact with RAUPEX pipe must be approved materials that are compatible with the piping.

RAUPEX will expand and contract when heated and cooled. It is important to incorporate this when designing pathways and supports. RAUPEX may be supported using either a fixed point or sliding support device. Fixed support points, such as locking clips, talon drive hooks and single nail clamps, will rigidly hold RAUPEX in place and minimize the movement of the pipe during expansion or contraction. These are typically installed on both sides of EVERLOC+ fitting locations. Sliding support devices, like the isolating suspension clamps, will permit the pipe to slide within the support during expansion and contraction.

When choosing supports, ensure they will not cut, scratch or damage the pipe. If using metal supports, make sure there are no sharp edges that could damage the pipe.

RAUPEX pipe 3/8 to 1 in. diameter must be supported with a maximum spacing of 32 in (80 cm) horizontally and 10 ft (3 m) vertically. RAUPEX pipe larger than 1 in. diameter must be supported with a maximum spacing of 48 in (120 cm) horizontally and 10 ft (3 m) vertically. Always comply with the prevailing local code for support spacing intervals.

REHAU galvanized steel support channel can be used to gain greater spacing between support hangers. The galvanized steel support channel is specifically designed to support REHAU RAUPEX pipe in sizes 3/4 to 2 in.

The profile of the galvanized support channel is made so the RAUPEX pipe will snap into the support channel without requiring additional fastening methods to hold the pipe in place. The result is a rigid pipe matrix with adequate stiffness to be supported in overhead and exposed applications. The pipe matrix is supported using typical mechanical clevis hangers spaced similar to metallic pipe installations. All pieces of galvanized steel support channel must have a minimum of two supports/hangers.

- Extend support a minimum of 1 in (25 mm) past hanger
- Ensure adequate RAUPEX overhang past support channel to allow installation of EVERLOC+ fitting, if required
- Use 3/8 in. threaded rod to suspend the support channel with a maximum spacing between supports of 8 ft (2.4 m).

Note: Always comply with the prevailing local codes for support spacing intervals.

Fig. 5.6: REHAU galvanized steel support channel

Fig. 5.7: RAUPEX pipe in overhead installation

5.7 Water Quality

RAUPEX pipe and EVERLOC+ compression-sleeve fittings are third-party tested and certified for use where drinking water qualities meet the requirements of the EPA *National Primary Drinking Water Regulations* and the *Guidelines for Canadian Drinking Water Quality* by Health Canada.

The *U.S. Safe Drinking Water Act* and the *Lead and Copper Rule* require public water suppliers to provide non-corrosive drinking water to customers. However, irrespective of the material used, in rare and isolated cases, corrosion can occur even when the water quality levels are within the permissible range set forth by the EPA *National Primary Drinking Water Standards* and the *Guidelines for Canadian Drinking Water Quality* by Health Canada. Some influencing factors on corrosion behavior are water disinfection processes, pH levels, chloride content, sulfate content and the use of an in-house water treatment system.

To evaluate the probability of corrosion for plumbing components in a potable water system, the licensed installing contractor must have practical experience within the geographic region of intended use. Consultation with the local plumbing authority and local water authority regarding these experiences should occur before the selection and installation of potable plumbing components.

The corrosivity of water depends on a multitude of interdependent variables and there are no simple equations or indices for predicting the corrosion potential. It must be understood that corrosion is a phenomenon associated with the behavior of system components in their operating environment. Every material has a unique tendency to corrode or not corrode in a similar environment. However, with local knowledge of specific water characteristics and the environment in which the system components are installed, the design engineer and installing contractor can make proper material selections and determine proper system operating parameters to minimize the potential for corrosion of the piping system.

If local conditions are known to cause corrosion issues, a water quality expert with corrosion experience should be consulted.

In order for the REHAU *PEXa Limited Warranty* to apply, products must not be subjected to damage or wear caused by abnormal operating conditions and the products must not be exposed to harmful chemicals, aggressive water conditions or any external influences that cause damage to the products.

5.8 Hot Water Recirculation

Benefits of hot water recirculation:

- Reduces the time you have to wait to deliver hot water to fixtures that are far from the hot water storage tank, which reduces water waste
- Helps prevent stagnant system conditions in the piping network that can allow for Legionella bacteria growth

Plumbing fixtures that require hot water are not always located in close proximity to the hot water storage tank. Hot water recirculation systems circulate hot water throughout the building and back to the storage tank to maintain warmer water temperatures closer to the hot water fixtures. These systems aim to reduce the wait time for hot water at each fixture.

In order to meet the requirements of the International Plumbing Code Section 607.2:

- 607.2, *Hot or tempered water supply to fixtures*. The developed length of hot or tempered water piping, from the source of hot water to the fixtures that require hot or tempered water, shall not exceed 50 ft (15 m). Recirculating system piping and heat-traced piping shall be considered to be sources of hot or tempered water.
- 607.2.1, *Circulation systems and heat trace systems for maintaining heated water temperature in distribution systems*. For Group R2, R3 and R4 occupancies that are three stories or less in height above grade plane, the installation of heated water circulation and temperature maintenance systems shall be in accordance with Section R403.5.1 of the International Energy Conservation Code.

A properly controlled hot water recirculation system with well-insulated piping is key to meet code requirements and avoid excess energy use. To minimize energy waste, domestic recirculation pump controls are important. Energy can be saved with recirculation pump controls:

- Simple timer controls or occupancy sensors that only recirculate hot water when the building is occupied
  - Temperature-based controls, typically an aquastat, that turn on the pump when the temperature drops below a certain threshold can further assist in the recirculation loop.
- Pressure-change based controls that only speed up when the demand for hot water increases

5.8.1 Legionella Considerations

According to the Center for Disease Control and Prevention, Legionella is a type of bacterium found naturally in freshwater environments, like lakes and streams. It can become a health concern when it grows and spreads in human-made water systems. The bacteria can multiply in warm, stagnant water and affects humans when droplets of water containing high concentrations of the bacterial are inhaled. The bacteria begins to die when the water temperature is elevated above 120°F (50°C), but the disinfection is more effective at higher temperatures. (www.osha.gov/dts/osta/otm/legionnaires/faq.html)

Domestic hot water system design is useful to prevent the growth of this bacteria with these two methods:

- Minimizing dead-leg distances (the volume of water that is between either a hot water storage tank or a recirculation line and the fixture) is crucial to system design. While the 2015 *IPC Section 607.2* may allow for up to 50 ft (15 m) of pipe between these two points, reducing that distance will reduce the volume of water that can stagnate if the fixture is unused for a long period of time. Stagnate water that isn't regularly thermally disinfected may allow Legionella bacteria to grow.
- Increasing the temperature of the water speeds up the thermal disinfection time of Legionella bacteria. You must also avoid scalding risks associated with maximum deliverable water temperatures for occupants, determined by the authority having jurisdiction.

There isn't a component manufacturer or portion of a plumbing system that bears all the responsibility for Legionella growth prevention. The Plastics Pipe Institute *Recommendation Against Mixing Hydronic Heating Water with Potable Water, Recommendation E, 2016* is a good source for non-manufacturer specific Legionella concerns.

5.9 Water Hammer

Water hammer, also called hydraulic shock, commonly occurs when a valve closes suddenly at the end of a pipeline system, and a pressure wave propagates in the pipe, creating vibration and noise.

While these statements may be true for metallic piping systems, the ability of PEX pipe to absorb shock eliminates the need for water hammer arresters, if allowed by prevailing local codes.

6. INSTALLATION CONSIDERATIONS

6.1 Local Code Approvals

The installation of the REHAU PEXa plumbing system for use in domestic plumbing systems must be in accordance with the guidelines that are presented in this technical guide. Prevailing local codes where the system is being installed must be observed. Where local code and this technical guide conflict each other, local code should prevail. However, it is the responsibility of the designer and installer to discuss any variation with REHAU Engineering to ensure any variation will not adversely affect the performance, operation or life expectancy of the system and its components.

6.2 Packaging, Transport, Handling and Storage

6.2.1 RAUPEX Pipe Packaging

RAUPEX pipe coils are shipped in cardboard boxes to protect them from sunlight, rain, dirt and other hazards. Straight lengths of RAUPEX pipe are packaged and shipped in black polyethylene bags. Keep pipe in the original packaging until it is required for installation. Return unused pipe to the packaging.

Avoid the following:
- Dragging pipe over rough objects
- Contact of pipe with petroleum products such as oil, gasoline, paint thinner
- Exposure of pipe to soldering or any open flame
- Excessive or permanent exposure to sunlight

6.2.2 EVERLOC+ Fittings Packaging

EVERLOC+ fittings and sleeves are shipped in cardboard boxes to protect them from sunlight, rain, dirt and other hazards. Keep the products in the original packaging until they are required for installation. Return unused products to the packaging for storage.

Fittings and sleeves must be handled with care. At a minimum, avoid the following:
- Storing loose fittings in tool boxes
- Contact with oil or oily products such as gasoline, paint thinner, glues or solvents
- Exposure of polymer fittings and PEXa sleeves to soldering or any open flame
- Excessive or permanent exposure to sunlight of polymer fittings and PEXa sleeves

6.3 Uncoiling Pipe

For best results when installing RAUPEX pipe from a coil, use a REHAU approved uncoiling device. This will allow the pipe to lay flat (not twisted) when installed. Twisting the pipe may place stress on the pipe after installation.

RAUPEX may be taken from a coil without the use of an uncoiling device. When using this method, be sure to roll the pipe from the coil. Do not lay the coil flat on its side and pull the pipe up over the side of the coil as this will twist the pipe.

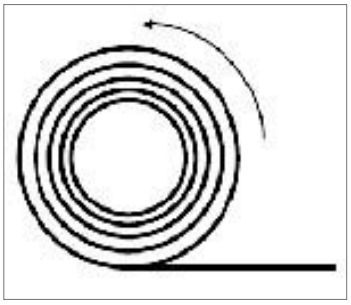


Fig. 6.1: Uncoiling RAUPEX pipe

6.4 Bending Pipe

RAUPEX pipe may be bent, with and without the use of a pipe bend support. The minimum bend radius for RAUPEX in a standard installation is five times the OD of the pipe.

RAUPEX may also be heated to achieve a minimum bend radius of three times the OD of the pipe. A heat gun may be used to heat the pipe. Heat RAUPEX and bend slowly. Once the RAUPEX is bent, remove the heat source and secure the RAUPEX. Avoid overheating RAUPEX (brown discoloration) and do not apply direct flame to RAUPEX to heat it (from a soldering torch, for example).

Table 6.1: RAUPEX Bend Radius

Typical Minimum Bend Radius in (mm)			
Pipe Size	Typical 8X OD	Min. Cold 5X OD	Min. Heated 3X OD
3/8 in	4.0 (102)	2.500 (64)	1.500 (38)
1/2 in	5.0 (127)	3.125 (79)	1.875 (48)
5/8 in	6.0 (152)	3.750 (95)	2.250 (57)
3/4 in	7.0 (178)	4.375 (111)	2.625 (67)
1 in	9.0 (229)	5.625 (143)	3.375 (86)
1 1/4 in	11.0 (279)	6.875 (175)	4.125 (105)
1 1/2 in	13.0 (330)	--	--
2 in	17.0 (432)	--	--

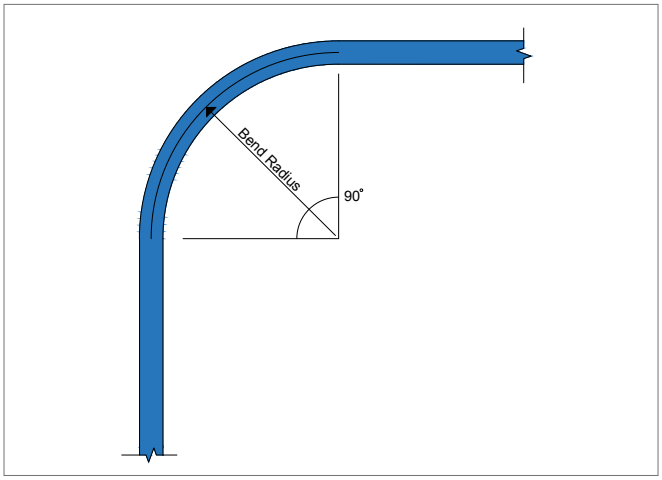


Fig. 6.2: Bend radius of RAUPEX pipe

6.5 Distance Between Fittings

A minimum distance between EVERLOC+ fittings is required to ensure the fittings are not damaged during the expansion process by the installation tools. A minimum pipe length of 3 times the length of sleeve is required between fittings for proper installation.

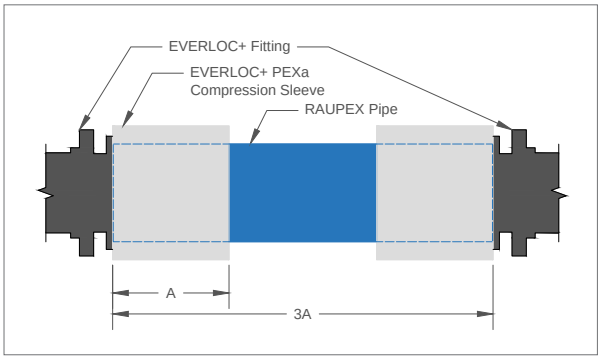


Fig. 6.3: Required minimum distance between fittings

6.6 Pipe Protection

Place pipe protection around RAUPEX pipe to prevent abrasion when passing through the building's framework.

When RAUPEX pipe passes through studs, walls, floor plates, joists and other structural members, care must be taken not to damage the pipe.

Protection is not required for installation in wood studs, walls, floor plates or joists if the following provisions are met:

- The hole is at least 1/4 in (6 mm) larger than the outside diameter (OD) of the pipe
- The pipe is free to move during expansion and contraction
- The hole is clean (e.g., free of splinters, burrs and rough edges)
- The hole is supporting only the weight of the pipe (with fluid), and not a mechanical device
- The hole has smooth, non-abrasive interior surface (e.g., bushing)
- Prevailing local codes allow such practice

Use of PE protection sleeve or other approved support device is required for RAUPEX pipe when passing through holes in steel, concrete or masonry walls, joists and other structural members.

When RAUPEX pipe runs through any abrasive material, or a hole that does not allow free movement, it must be protected by PE protection sleeve or another approved installation accessory, such as suspension clamps or isolators.

Fig. 6.4: Isolation suspension clamps

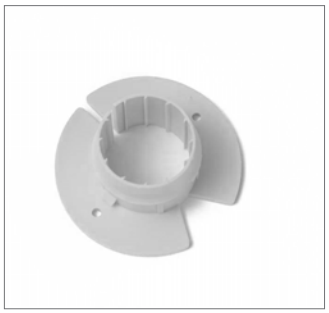


Fig. 6.5: Pipe isolator

Fig. 6.6: PE protection sleeve

RAUPEX pipe is recommended for installation directly within or below a concrete slab. The use of PE protection sleeve or PVC bend guides at slab penetrations is recommended.

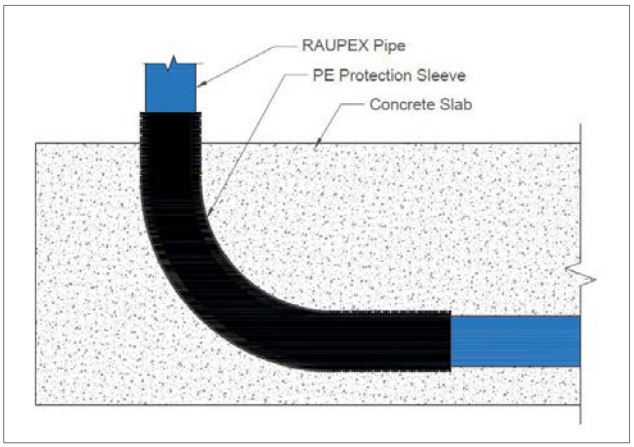


Fig. 6.7: Slab penetration

6.7 Insulation

Thermal conductivity of RAUPEX pipe is much lower than that of metallic pipes. Insulation can be installed to further enhance this property, to decrease energy usage, and maintain water temperature inside the pipe. Because of the thermal properties of RAUPEX pipe, it is also less susceptible to condensation or sweating on cold water lines.

Insulation can be installed on cold water lines to improve resistance to condensation or better maintain internal water temperature. Always comply with prevailing local codes.

6.8 Installation Below-grade, in-slab

RAUPEX may be installed directly within or below a concrete slab. This is especially useful in slab-on-grade construction. RAUPEX pipes encased within concrete slabs are not required to be sleeved.

To protect RAUPEX pipe from abrasion where it passes through the concrete, the use of PE protection sleeves or PVC bend guides at all slab penetrations is recommended.

Continuous sleeving of RAUPEX plumbing pipes buried below or within a concrete slab is not prohibited, however, in such cases the following precaution must be followed:

- When RAUPEX pipes are continuously sleeved below or above a slab, the space between the pipe and the sleeving must never be filled with any liquid chemical, including pesticides or termiticides.
- The annular gap between the pipes at the ends should be filled with silicone or polyurethane expanding foam to help prevent pathways for pests and the mistaken application of harmful chemicals into the space between the pipe and the sleeving.
- Use only sealants that are compatible with RAUPEX pipe.

⚠ WARNING

- Application of pesticides or termiticides between RAUPEX pipe and sleeving is strictly prohibited. Permeation of pesticides or termiticides may occur through the pipe wall resulting in serious injury or death.
- RAUPEX pipes for plumbing applications shall not be installed in contaminated soils or immersed in liquid chemicals. Do not directly spray on or allow organic (petroleum-based) chemicals such as, petroleum distillates, termiticides or pesticides to come into contact with RAUPEX pipes. Permeation of these harmful chemicals may occur through the pipe wall resulting in serious injury or death.

A pressure test on RAUPEX pipes before encasing in concrete is recommended to ensure RAUPEX pipe and connections are leak free. Installers should maintain test pressure on the system during further construction, where practical. Air testing is permitted. If a water (hydrostatic) test is used, the water must be protected from freezing. Detailed pressure testing procedure is outlined in Section 6.17.2.

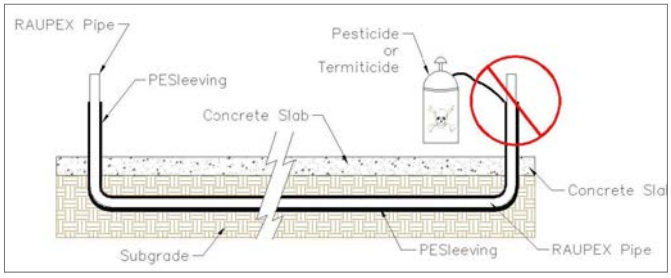


Fig. 6.8: Continuous sleeve installation

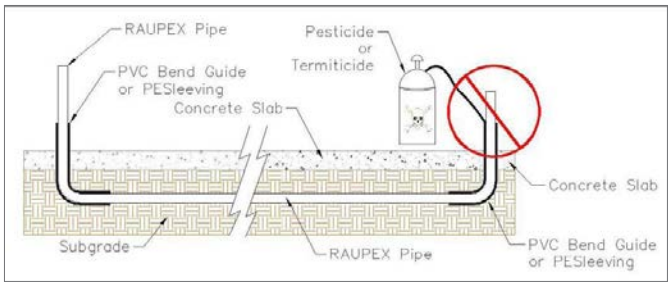


Fig 6.9: Slab penetration protection

6.9 Fixture Connection Common Components

6.9.1 Drop Ear Elbows

The EVERLOC+ LF brass drop ear elbow provides a rigid 90° bend and the ability to secure 1/2 or 3/4 in. RAUPEX pipe where it exits a stud wall or connects to a shower head.

Fig. 6.10: Drop ear elbow

6.9.2 Copper Ells

- The EVERLOC+ tub/shower diverter ell provides a 90° transition from tub and shower valve to RAUPEX pipe.
- The EVERLOC+ closed-end stub out ell provides a 90° transition from RAUPEX pipe to copper. Use closed-end stub out ells at the fixture to exit from the wall.
- The EVERLOC+ straight copper stubs provide a transition from RAUPEX pipe to copper. Use closed-end stub out ells at the fixture to exit from the wall.

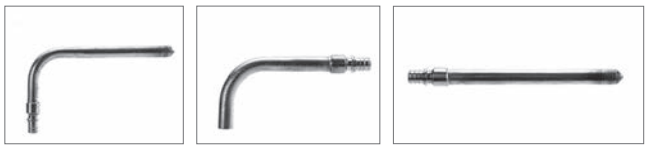


Fig. 6.11: EVERLOC+ copper ells

6.9.3 EVERLOC+ Valves

EVERLOC+ straight and angle stop valves are intended for use with point-of-use fixtures.

Because RAUPEX pipe has the same outside diameter as standard copper pipe, you can use standard compression straight and angle stop valves with stiffeners to connect to RAUPEX pipe.

Fig. 6.12: EVERLOC+ Valves

6.9.4 Other EVERLOC+ Transition Fittings

REHAU also offers following connection types for the EVERLOC+ fittings when making connections to fixtures. Refer to the REHAU *Sustainable Building Technology Catalog* for a complete article listing.

- EVERLOC+ 90° Elbows, PEX to Copper (C Male and C Female)
- EVERLOC+ Adapters, PEX to Copper (C Male and C Female)
- EVERLOC+ MPT Adapters, PEX to MPT
- EVERLOC+ FPT Adapters, PEX to FPT
- EVERLOC+ LF Brass Swivel Adapters, PEX to NPS

6.10 Water Heater Connections

In accordance to *Uniform Plumbing Code (UPC), Section 604.13*: "PEX tubing shall not be installed within the first eighteen (18) inches (457 mm) of piping connected to a water heater." A minimum of 18 in (45 cm) of metallic transition piping must be used for both of the direct connections to water heater connections. Corrugated metal water heater connector pipes of copper or stainless steel are the typical materials for this application.

Within the UPC, this applies to all PEX fitting systems and all types of water heaters (electric, fossil fuel, and indirect-fired) including storage tank type and tankless type (also known as demand or instantaneous) water heaters.

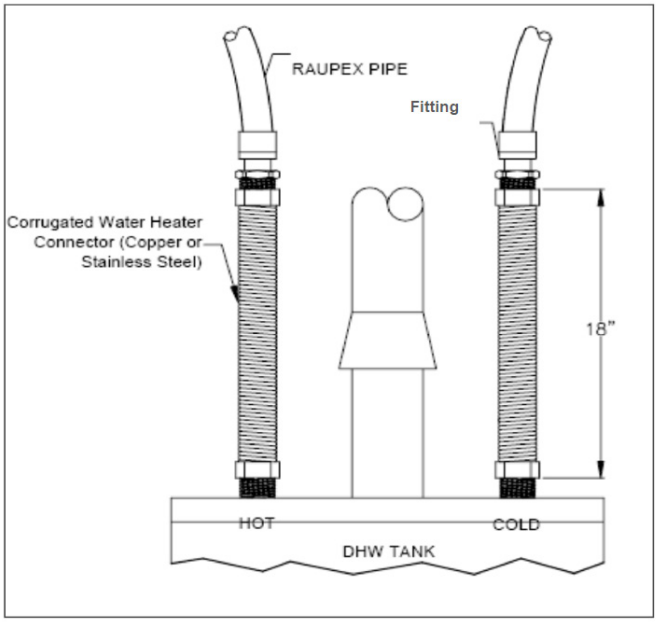


Fig. 6.13: DHW water tank with 18" of metallic transition piping per UPC

In some local jurisdictions, direct connection of PEX pipe to a water heater is allowed. In these cases, RAUPEX pipe may be directly connected as per the following:

6.10.1 Electric, storage-type water heaters

- Direct connection allowed to electric water heaters, which are intended for domestic applications, unless prohibited by the specific water heater manufacturer.

6.10.2 Gas, tankless water heaters

- Direct connection allowed to tankless water heaters, which are intended for domestic applications, unless prohibited by the specific water heater manufacturer.
- Connection must be a minimum 6” distance from flue, specific distance based on specific water heater manufacturer’s recommendation.
- If the minimum distance from flue cannot be accomplished, metallic transition piping is required.

6.10.3 Gas, storage-type water heaters

- Direct connection allowed to gas water heaters, which are intended for domestic applications, unless prohibited by the specific water heater manufacturer.
- Connection must be minimum from 6” from flue and 6” from blower box.
- If the minimum distance from flue and blower box cannot be accomplished, metallic transition piping is required.

6.11 Supporting RAUPEX Pipe

RAUPEX pipe should be installed so that it is aligned and stable.

- Standard Copper Tube Size (CTS) hangers, including clevis and loop hangers, can be used to support suspended sections of pipe.
- Suspended sections of pipe shall be installed so that there is no sag in the pipe system.
- All materials in contact with the pipe shall be approved for use with RAUPEX pipe.
- Ensure supports will not cut, scratch or damage the pipe.
- Suspended installations in wood-frame construction can utilize strut channel hanging with all-thread as the support device with the appropriate clamps to secure pipe to the strut. When clamping pipe, be sure not to deform the pipe with the force of the clamp.
- Installations in steel-frame construction can be done similarly, but can also use beam clamps to secure the all-thread to steel I-Beams.
- Steel joist space can be used as the support method.

When not installing in suspension, other support mechanisms for RAUPEX pipe can be used. These include single nail hooks, pipe support bends, talon drive hooks and locking clips. These can also be used for smaller branch runs of pipe as well as to assist in making bends to connect to fixtures.

RAUPEX pipe 3/8 to 1 in. diameter must be supported with a maximum spacing of 32 in (80 cm) horizontally and 10 ft (3 m) vertically. RAUPEX pipe larger than 1 in. diameter must be supported with a maximum spacing of 48 in (120 cm) horizontally and 10 ft (3 m) vertically. Always comply with the prevailing local code for support spacing intervals.

Fig. 6.14: Single nail hooks

Fig. 6.15: Pipe support bend

Fig. 6.16: Talon drive hooks

Fig 6.17: Locking clip

6.11.1 Galvanized Steel Support Channel

REHAU galvanized steel support channel is designed to support RAUPEX pipe, minimizes pipe expansion and reduces the amount of CTS supports. The profile of the galvanized support channel is designed so the RAUPEX pipe will snap in without requiring additional fastening methods to hold the pipe in place.

The support channel can be cut to meet installation requirements using power tools such as a band saw or hand tools. When cutting, be sure not to bend or alter the overall profile of the channel. After cutting the channel, be sure to remove any sharp edges or burrs to prevent damage to the RAUPEX pipe.

Typical mechanical clevis hangers can be used for support, and the slim profile of the channel allows standard CTS insulation to be installed around it. Installing RAUPEX pipe into the support channel before suspending the assembly is recommended. If fittings will need to be installed in-line with the run of pipe in the support channel, be sure to have the RAUPEX pipe overhang the end of the support channel at least two EVERLOC+ sleeve lengths. Additionally, the galvanized steel support channel shall extend a minimum of 1 in. (2.5 cm) past the hanger.

Use 3/8 in. threaded rod to suspend the support channel with a maximum spacing between supports of 8 ft (2.4 m). Always comply with prevailing local codes for support spacing intervals.

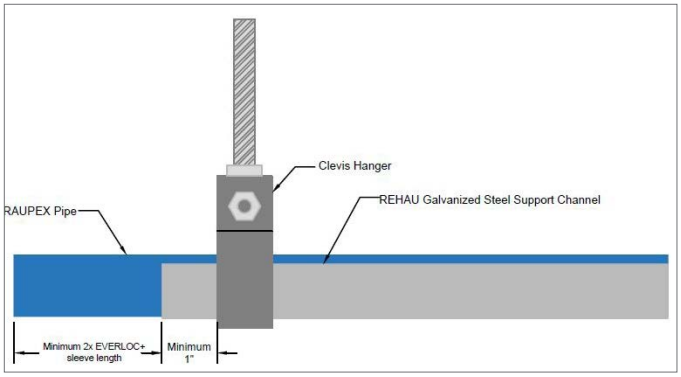


Fig. 6.18: RAUPEX pipe supported with steel support channel

6.12 Supporting EVERLOC+ Fittings

Supports and clamps shall not be placed directly on the EVERLOC+ fitting, multi-port tee or compression sleeve. Always comply with prevailing local codes.

6.13 Copper Soldering

Proper soldering techniques must be followed when soldering all compression-sleeve fittings according to the Copper Development Association (CDA) Handbook:

- The surface of the fitting soldering area must be properly cleaned for a good solder connection. Applying flux is not considered sufficient cleaning for the soldering area. Using a proper sanding or brush technique is necessary to remove the surface oxides. In order to prevent further formation of oxides, the flux should be applied immediately after the cleaning process. A proper flux that is compatible with the brass alloy must be used.
- Care must be taken to not overheat the soldering surface as this can lead to the formation of oxides preventing good adhesion of the solder material. It is imperative that the fitting is heated evenly around the entire surface so as to not overheat one particular area.
- All completed solder joints must be tested for joint integrity following the procedures prescribed by prevailing local codes.

When soldering an EVERLOC+ LF brass fitting:
- The fitting must be soldered onto the copper first.
- The solder joint must be allowed to cool to ambient room temperature prior to making an EVERLOC+ connection.

Fig. 6.19: Solder prior to making EVERLOC+ connection

Fig. 6.20: Never solder after EVERLOC+ connection has been made

⚠ WARNING

- Use gloves and a holding tool. Heated pipe and fittings can cause burns.
- Never use a torch, open flame or heat gun on a pressurized system. Exceeding the temperature pressure ratings will result in dangerous separation of materials leading to serious injury or death.
- Never rework a connection that is under pressure. Depressurize the system, cut out connection and replace

6.14 Kink Repair

RAUPEX pipe is flexible and resists kinking even at temperatures well below freezing. If the pipe does become kinked, flow may be obstructed or reduced. Kinked pipe must be repaired.

Straighten the pipe by heating the area with a heat gun, rotating the heat gun around the pipe to evenly heat the surface. Always use caution when operating a heat gun and never use a torch or open flame to heat the pipe.

When fully heated, the pipe will become transparent. When the kink is gone, turn off the heat gun and let the area cool. (It is normal for small bubbles or wrinkles to appear.) This type of heating will anneal or stiffen the pipe, making it stronger but also less flexible in the heated area. Therefore, do not try to bend the pipe in the same spot. This may require a slight adjustment of fasteners.

6.15 Thawing Frozen Pipe

When conditions occur that allow water to freeze inside the pipe, the flexibility of RAUPEX allows the pipe to expand as water freezes, as long as the pipe has room to expand.

When the water thaws, the pipe returns to its original shape. If the pipe is not allowed to expand (e.g., it is encased in concrete), it may burst. If freezing does occur, the following methods can be used to thaw the frozen section:
- Heat the frozen area with a heat gun. Be sure not to concentrate excessive heat in a single area for too long
- Wrap towels around the piping and pour hot water on the towels
- Use a space heater to warm the room until the frozen section thaws

While the flexibility of the RAUPEX pipe allows it to expand as water freezes in the pipe, this flexibility does not ensure the integrity of the joint. Installers must take precautions to ensure that pipes and fittings do not freeze. This may result in leaks and operational failures.

6.16 Disinfection

Disinfection of the system should always follow prevailing local codes and requirements. If required by code and no conditions are specified, disinfect using chlorination according to AWWA or ICC procedures outlined below:

Table 6.2: AWWA/ICC Disinfection Schedule

Chlorine Concentration	Disinfection Period	Authority
50 to 100 ppm	3 hours	AWWA
50 ppm	6 hours	ICC

Pre-mix solution before injecting into system. Do not allow disinfection solution to sit in system beyond the disinfection period. Thoroughly flush entire system with potable water after disinfection.

6.17 Pressure Testing

REHAU only provides the general guidelines for performing a pressure test on a REHAU PEXa piping system as set forth below.

⚠ WARNING

- Failure to follow proper safety precautions for an air pressure test could result in dangerous separation of the material, leading to serious injury or death.
- Use personal protective equipment. To reduce the risk of eye injury, always wear close-fitting protective eye wear with side protection. Eye wear must be impact-rated and marked as complying with ANSI Z87.1.
- Never use a torch, open flame or heat gun on a pressurized system. Exceeding the temperature pressure ratings will result in dangerous separation of materials leading to serious injury or death.
- Never rework a connection that is under pressure. Depressurize the system, cut out connection and replace.
- To reduce the risk of personal injury, only qualified persons conducting and/or inspecting the pressure test should be present.

The following guidelines apply to both compressed air and hydrostatic (water) testing:

6.17.1 General Recommendations

- A pressure test must always be performed prior to closing in the system (e.g., behind drywall).
- Perform test using water or air at ambient temperature. Do not exceed 150 psi (1030 kPa) for the piping system. Verify maximum pressure limits are not exceeded for all system components prior to performing the pressure test.
  - When air pressure testing with EVERLOC+ polymer fittings do not exceed 120 psi (825 kPa).
- For RFH and SIM systems, a pressure test must always be performed on the system prior to and during the installation of the thermal mass to ensure that RAUPEX pipe and connections are leak free. For dry systems (e.g., joist space), a pressure test must be performed after installation and up to the time that the system is put in operation.
- Tests shall comply with local codes where applicable and, where required, shall be witnessed by the building official.

6.17.2 Pressure Testing with Air

Air can store a high amount of energy as compared to water during a pressure test. Due to this higher energy, different failure modes of system materials must be understood by persons conducting the pressure test.

- If a thermoset polymer (e.g., PEXa pipe) is over-pressurized and fails (bursts), it does so in a ductile mode, meaning that the pipe will swell and then split with no separation of fragments.
- If a rigid thermoplastic polymer material (e.g., PPSU) is over-pressurized and fails (bursts), it does so in a brittle mode and can result in separation of the material.

6.17.3 REHAU Pressure Test Procedure

- Use an air test if conditions do not permit a water test (e.g., freezing conditions, insufficient water supply/pressure).
- Air temperature will affect the gauge pressure. Perform all pressure tests at a constant temperature. Verify maximum pressure requirements for other systems prior to performing the test.
- Conduct a visual inspection of the piping system, to ensure all connections have been properly made and all piping has been properly secured prior to pressurization.
- Perform a preliminary pressure test pressurizing the system to 1.5 times the maximum operating pressure not to exceed the maximum pressures defined above for 30 minutes.
- As the piping expands, restore pressure, first at 10 minutes into the test and again at 20 minutes.
- At the end of the 30-minute preliminary test, pressure must not fall by more than 5 psi from the maximum, and there shall be no leakage.
- After performing the preliminary test, perform the main pressure test immediately. The main pressure test shall last at least 2 hours. The test pressure should be restored and must not fall more than 3 psi after 2 hours. No leakage should be detected.
- It is recommended to maintain pressure on the system during further construction, where practical, to immediately identify any damage. If a water (hydrostatic) test is used, protect the water from freezing or drain water from pipes.
- If any repairs or corrections are necessary, depressurize the system before proceeding.

NOTICE

- When other thermoplastic piping materials (e.g., CPVC, PP-R) are present in the piping system, these sections of piping must be isolated from the REHAU PEXa piping system during the pressure test. The installer must consult the other component manufacturer's installation instructions for pressure testing those sections of the system.
- Always refer to the local codes for pressure testing requirements and use air testing only if approved by the local Authority Having Jurisdiction (AHJ).
- REHAU only provides the general guidelines for performing a pressure test, which by no means supersede or are intended to contradict safety requirements. It is the responsibility of the installing contractor to ensure a proper and safe pressure test is performed on site.
- All other trades must be notified that the pressure test will be conducted on the piping system.

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