PEX Pipes for Plumbing
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OUTLINE

• How PEX pipes are made
• Capabilities of PEX pipes, standards, testing
• PEX pipes for Plumbing and other applications
Who is PPI?

- PPI is the major trade association representing all segments of the plastics piping industry.
- PPI is dedicated to promoting the safe use of plastic piping systems through:
  - Contributing to development of standards
  - Educating designers, installers, users and government officials
  - Establishing a forum for problem solving and new ideas
  - Maintaining liaison with industry, educational and government groups
Divisions of PPI

1. **High Temperature Plastics**
   1. PEX and CPVC pipes
2. Fuel Gas
3. Municipal & Industrial
4. Corrugated PE
5. Conduit
PPI High Temperature Division Members - Manufacturers of PEX Pipes

- CPI
- Hewing GmbH
- Mercury Plastics
- Plasco Manufacturing
- REHAU, Inc.
- Viega
- Vanguard Piping Systems
- Watts Radiant, Inc.
- Uponor Wirsbo
- Zurn PEX, Inc.
PPI High Temperature Division Members - Materials, Ingredients

- TOTAL Petrochemicals USA
- Borealis A/S
- BP Solvay Polyethylene N.A.
- Constab Additive Polymers Ltd.
- GE Silicones
- Nova Chemicals
- Noveon
- Padanaplast USA
PPI High Temperature Division Members - Laboratories

- Bodycote Broutman
- Bodycote Polymers
- Hauser Labs
- Jana Laboratories
- NSF International
PEX Pipes for Plumbing

- Clean, safe water
- Corrosion resistance
- Reliable pipes and fittings
- Flexibility in design and installation
- More than 25 years of experience worldwide in potable water applications
PEX: Cross-linked PolyEthylene

• PEX is polyethylene that has been chemically or physically modified to cause the individual molecules to link together, permanently.

• Once PE is cross-linked, it becomes a thermo-set plastic, meaning that it cannot be melted and reshaped. Cross-linking can not be reversed.

• PEX has desirable high temperature strength, reduced sensitivity to notching, improved chemical resistance, and good flexibility.
How is PEX made?

- There are 3 commercial processes:
  - (2 Chemical, 1 Physical)
  1. High-pressure Peroxide ("Engel"); 1960’s
  2. Silane (moisture cure); 1970’s
  3. Radiation (Electron Beam or Nuclear); 1970’s

Each method is proven to make product that meets the strict requirements of ASTM Standards.
High-Pressure Peroxide (Chemical Process)

- Special high-pressure screw extruder
- Small amount of peroxide mixed to PE before extrusion
- Cross-linking takes place in extruder/die, driven by temperature and pressure
- Pipe is cross-linked as it is extruded
- Peroxide is consumed during cross-linking reaction
Silane (Chemical Process)

- Uses a conventional screw-type extruder
- Modified HDPE material is extruded
- Most cross-linking takes place after the material has left the extruder
- Cross-linking is driven by moisture and temperature through exposure to hot water or steam
Radiation (Physical Process)

- Uses a conventional screw-type extruder
- Normal HDPE pipe is extruded
- Cross-linking occurs in a secondary “beaming” operation
  - driven by the strength of the radiation beam
PEX Products

- PEX pipes are produced in nominal dimensions from 3/8” to 2” today in USA (even smaller for special applications).
- PEX pipes are available in natural (white) or colors.
- PEX pipes are available in coils or 20-ft. straight lengths.
- PEX pipes produced >24” in Europe.
Why is PEX a good material for plumbing?

Engineering Reasons:

1. High temperature capability, pressure-rated up to 200° F
2. High pressure capability/stability (reduced creep)
3. Smooth wall, excellent flow characteristics
4. Quiet operation
5. Reduced heat loss and condensation
6. Flexibility for design
7. Proven long life, rigorous certifications, highly tested
Why is PEX a good material for plumbing?

Engineering Reasons:

- Corrosion resistance (not possible)
- No pinhole problems
- No build-up inside
Why is PEX a good material for plumbing?
Installer Reasons:

- Flexibility, reduced fittings, faster
- Flexibility for design
- Secure, reliable fittings reduce leaks
- Lightweight, easy and safe to transport and handle
- Efficient to install, long coils reduces joints
- Clean, safe to work with
Why is PEX a good material for plumbing?

Owner Reasons:

• Excellent flow
• Proven long life
• Corrosion resistant
• Quiet, dampens water hammer
• Non-toxic
• Freeze resistant
• Low thermal conductivity
• Low cost
Plumbing Codes

- PEX is listed as an acceptable material in all national model plumbing codes:
  - International Plumbing Code published by ICC
  - Uniform Plumbing Code published by IAPMO
  - Standard Plumbing Code published by NAPHCC
- Accepted in virtually every state.
- Check with the local Building or Plumbing Official to determine if they are permitting the use of PEX.
Standards for PEX and PEX Systems

1. ASTM F 876 - Materials, Dimensions and Performance for Tube
2. ASTM F 877 - Performance for Tube/Fitting Systems
3. ASTM F 2023 - Chlorine Resistance
4. NSF/ANSI Standard 61 - Toxicological Evaluation for Materials in Contact with Drinking Water; “Health Effects”
5. Various ASTM fitting standards
PEX Pipe Requirements: ASTM F 876

- Pipes are CTS, SDR9, tight tolerances on dimensions
- Long-term Pressure Ratings of:
  - 160 psi @ 73.4°F, 100 psi @ 180°F, 80 psi @ 200°F
- Minimum Quick Burst Capability:
  - 475 psi @ at 73.4°F, 210 psi @ 180°F, 180 psi @ 200°F

Sustained Pressure Tests:
- Ex: 1000 Hrs. at 190 psi @ 180°F
PEX System Requirements: ASTM F 877

• All ASTM fitting systems must be tested to this
• Same quick burst capabilities
• Same sustained pressure requirements
• Excessive Temperature and Pressure test:
  – 150 psi @ 210°F for 720 Hrs. (30 Days)
• Thermocycle Test:
  – Pressurize with 100 psi Nitrogen gas
  – 2 Minutes in 60°F water, 2 Minutes in air, 2 Minutes in 180°F water
  – Repeat 1000 times with no leaks
Chlorine Resistance

- ASTM F 2023
  - Standard Method for Evaluating Resistance to Hot Chlorinated Water

- ASTM F 876 has a Traditional Domestic Requirement:
  - 75% of time at 73.4°F, 25% of time at 140°F
  - Minimum ORP 825 mV
  - (Typical of 4.0 ppm chlorine, pH 6.8)
  - 50 year minimum extrapolated life at 80 psig @140°F
PEX uses Mechanical Fitting Systems

- ASTM F 1807 - Brass or Copper Insert Fittings with Copper Crimp Rings
- ASTM F 1960 - Cold Expansion Fittings with PEX Reinforcing Rings
- ASTM F 2080 - Cold Expansion Fittings with Metal Compression-Sleeves
- ASTM F 2098 - Stainless Steel Clamps for Use with F1807 Insert Fittings
- ASTM F 2159 - Plastic Insert Fittings using Copper Crimp Rings
Designing PEX Plumbing Systems

- PEX can be used in a traditional Main and Branch System
- PEX can be used in a manifold or Home-Run System
- PEX can be combined with Remote Manifolds
- PEX typically can be installed in place of rigid pipes on a size-for-size basis because of smooth wall and elimination of most elbows.
- Codes allow size-for-size replacement
Designing PEX Plumbing Systems

- PEX can be used in a traditional Main and Branch System
Designing PEX Plumbing Systems

- Traditional Main and Branch System
- Traditional installation technique, but faster
- Normal use of reducing tees, elbows
- Pipe sizes up to 2”
Designing PEX Plumbing Systems

- PEX can be used in a Manifold or Home Run System
Designing PEX Plumbing Systems

- Manifold or Home Run System
- 1/2” pipes home-run to each fixture
- Central manifolds
- Few fittings
- Balanced pressure
Designing PEX Plumbing Systems

- PEX can be combined with Remote Manifolds
Designing PEX Plumbing Systems

- Remote Manifolds
- Smaller manifolds installed remotely
- Fed with 3/4”, 1”, 1 1/4” pipe
- Reduced fittings
- Balanced flow
- Copper or polymer manifolds
Designing PEX Plumbing Systems

• Copper “stub ells” are often used outside the walls for appearance, durability
• Standard end-point valves used
PEX Basics

- PEX must not be stored or installed in areas where it will be exposed to sunlight, either direct or indirect. Many PEX materials have extended UV protection for exposure that occurs at the job site but none are rated for continuous exposure.
- Do not use fittings under slabs, unless protected (wrapped) or made of special materials (DZR/red brass).
- PEX is flexible so an installation looks different than an installation with rigid pipe.
PEX Installation

- Minimum Bending Radius is 5-6 times the Outside Diameter of the tube.
- Horizontal runs should be supported every 32 inches (manufacturers will allow up to 48” - a little more sag between supports).
- Vertical runs should be supported 60 inches.
PEX Installation

• Protect PEX from abrasion
  – Use sleeves or plastic isolaters through metal studs (not required in wood studs).
• Use hangers that are smooth without sharp edges - plastic is preferred.
• Hangers should not pinch the tube.
• Use protective plates where PEX passes within 2” of a nailing surface on a stud.
Piping through floor joists and wooden studs

**Drill hole 1/4” bigger than OD of pipe**
PEX Installation

- Linear expansion: 1 in. per 10°F per 100 ft.
- Example: Hot water pipe 50 ft long, 50°F rise will lengthen pipe by 2.5 inches
- Allow for movement
Under Slab Piping

PEX pipe is ideal for these applications
PEX Installation

- Protect PEX from abrasion
  - Sleeve it where it passes through concrete.
PEX Installation

- Pressure test as required by manufacturer or code*
- Air or water test acceptable
  - PEX is ductile, will not shatter if burst
  - No shards will break away from pipe
- Maximum pressure 160 psig
Other Applications for PEX

- Cold Water Service Line applications.
  - AWWA is developing a new Standard for this application.
  - Already approved in model codes.
- Radiant Floor Heating
- Hydronic Snow and Ice Melt
- Piping to baseboard heating
- General hydronic heating
- Turf Conditioning
Cold Water Service Line

– AWWA is developing a new Standard for this application.
– Already approved in model codes.
PEX for Hydronic Applications

- Ferrous systems require “oxygen diffusion barrier” piping
- EVOH barrier co-extruded over PEX
- Barrier performance per DIN 4726
  - Tested at 104°F
- Barrier pipes suitable for baseboard heating, general hydronic heating
  - 100 psi @ 180°F, 80 psi @ 200°F
Radiant Floor Heating - “Wet” systems
PEX pipe inside slabs or in thin overpours
Radiant Floor Heating - “Dry” systems
PEX pipe inside dry thermal mass or below subfloor
Snow and Ice Melting
PEX pipes inside concrete or below pavers
Turf Conditioning:

Paul Brown Stadium - Cleveland
Turf Conditioning:

Eagle Stadium – Lincoln Financial Field
Hydronic Controls

Manifolds, zone valves, water temperature mixing devices all part of hydronic systems
PEX Pipes for Plumbing - Summary

• Clean, safe water
• Corrosion resistance
• Reliable pipes and fittings
• Flexibility in design and installation
• More than 20 years of experience
• PEX pipes now available up to 2” diameter
Thank You for attending!

Questions?

For more info, please visit us at:

www.plasticpipe.org