Mr PEX® tubing key benefits

• Mr PEX® tubing is crosslinked using peroxide crosslinking, a so called PEX-a process. By means of heat, a peroxide mixed into the PE raw material is split into radicals. These radicals react with the PE polymer chain and absorb hydrogen atoms to become inert. The polymer chains now become radicals. They, in turn, become inert by joining together - forming crosslinks.

• As mentioned, the peroxide is split by means of heat. That means that the tubing material needs to be quite hot for the reaction described above to take place. It must be well over the crystalline melting point temperature of around 270°F. The material must also be correctly shaped (must have its tubing form) while the crosslinking takes place inside the polymer melt. After crosslinking has taken place, the material is cooled down and the crystals are formed around the crosslinking points, reinforcing these areas. These principles are valid for all PEX-a processes.

• For other crosslinking methods like radiation crosslinking (PEX-c) and Silane crosslinking (PEX-b) the crosslinking takes place at temperatures well below the crystalline melting point. For these methods, when tubing is heated over the melting point, there will be a loss of crystals when the material is cooled down again. The crosslinks will partially disturb the formation of previously existing crystals. So there will be a loss of strength after this reheating - which is not the case for PEX-a tubing.

• PEX-a is crosslinked while melted, and as described above, this will result in a lowered crystallinity. Typically, a lower crystallinity means a lower strength. Therefore, the raw material utilized in traditional PEX-a processes need to have a quite high density (which is practically the same as high crystallinity). Typical raw material density is at least 0.950 kg/m^3, and this results in density of around 0.939 kg/m^3 after crosslinking. This is approximately the minimum density required in order to meet the ASTM F 876/877 strength requirements.

• Radiation and Silane crosslinked tubing have densities that are approximately the same as the raw material they are produced of - around 0.940 to 0.941 kg/m^3. This is approximately the required minimum for them to meet the ASTM PEX standards. Since density is directly related to stiffness (or flexibility) we note that Radiation and Silane tubing are slightly stiffer than traditional PEX-a processes (their density os approximately 0.002 kg/m^3 higher - and this makes up a clearly noticeable difference.

• The Mr PEX® Tubing process starts with a raw material with a density of around 0.940 kg/m^3 and the final product has a density of around 0.930 kg/m^3!! This is considerably less than other PEX process, and results in a very flexible tubing. How is it possible that a material with this low density still exceeds the ASTM requirements for PEX? The reason is that inventors of this process has succeeded to align most molecular chains AROUND the tubing circumference! Traditional extrusion processes does not provide any orientation of molecules, but their orientation are at random. By having the molecules aligned around the tubing they are ready to absorb the stress caused by inside pressure. So in spite of its lower density, this tubing can actually resist a higher inside pressure than traditional PEX tubing! Burst pressure testing can easily confirm that the pressure resistance is higher for Mr PEX® Tubing! At the same time, since few molecules are stretched along the tubing, the flexibility is even better than what is explained by the density alone!

• Another major difference is the homogeneity. Traditional PEX-a processes have raw materials with high density and high molecular weight making the polymer flow characteristics quite poor. The material is mainly pushed through the extruder and raw material particles are just melted together. The flow is very little stirred during the extrusion. Not so in the Mr PEX-a process. The material is thoroughly worked, the original raw material particles are thoroughly blended, and even stretched out to orient the molecules around the tubing. The result is a excellent homogeneity, antioxidants well disbursed, and better overall properties. Homogeneity can be checked by holding tubing samples towards a bright light. Turn slowly and look through tubing walls. You may notice "cloudiness" in some PEX Tubing.

PEX property comparisons

Property	Mr PEX® Tubing	Traditional PEX-a	PEX-b and PEX-c
Flexibility	Considerable more flexible than any other PEX tubing meeting ASTM	Somewhat better flexibility than Radiation and Silane crosslinked tubing.	Stiffer to work with
Strength	Withstands somewhat higher inside pressures than other PEX Tubing	Meets ASTM	Meets ASTM
Homogeneity	Excellent	Not very good. Worse than Radiation & Silane	Good
Thermal Memory	Excellent	Good. Better than Radiation & Silane.	Strength decreases after heated up to transparency.
Kink repairability	Excellent	Excellent	See above
Kinking resistance	Excellent	Fair. Better than Radiation and Silane	More vulnerable to be kinked
Barrier property	Measured 25 times better than DIN 4726	Meeting DIN 4726	Meeting DIN 4726
Thermostability	Excellent	Better than ASTM requirements	PEX-c: Better than ASTM requirements. PEX-b: Silane cross-links are reversible
Crosslinking distribution	Excellent	Fair	PEX-c: x-link gradients PEX-b: Manufacturer dependent
Memory of being coiled	Little. Easy to bend in any direction.	Fair. Better than Radiation and Silane.	Tougher to straighten out.
Min. bending radius	Narrower than any other PEX tubing	Fair. Better than Radiation and Silane	Largest
Crack propagation resist.	Excellent	Excellent	PEX-c: Fatigue cracks can develop PEX-b: Unknown
Density	~0.930 - the lowest	~0.938 - much more	~0.941 - highest
State when crosslinked	Melted	Melted	Not melted
Crystal size and distribution	Samll and even	Fair	Larger and more un-even
Degree of crosslinking	Over 70%	Over 70%	Typically below 70% (but approved for that in ASTM)
Process uniqueness	There is just one manufacturer	Several manufacturers - not unique	Available to anyone
Commercial dependence	None	Uponor dominates	Uponor dominates

2613 - 87th Court W • Northfield, MN 55057 • 952-652-2472; Fax: -2378 • www.MrPEXSystems.com • mrpex@mrpex.com