FACT & DATA SHEET

presented by
WattsRadiant
Floor Heating & Snowmelting
A Watts Industries Company

ONIX™: Not All Radiant Tubing Is The Same

Onix is a flexible tubing specifically engineered and manufactured for use in radiant floors or as hydronic supply and return tubing.

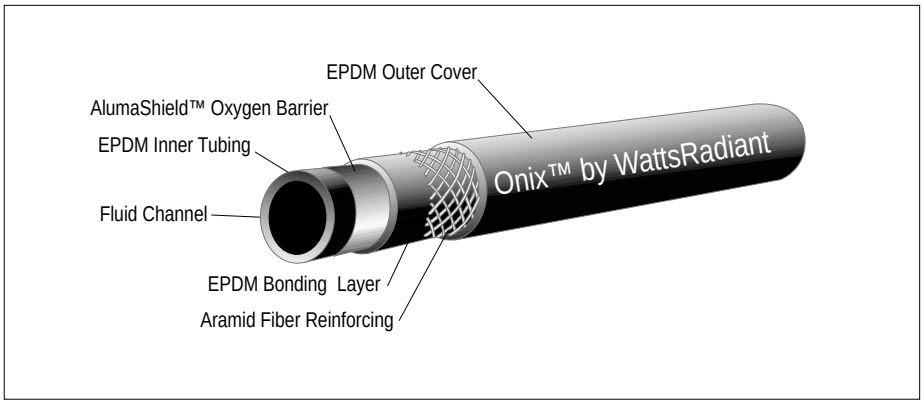
The unique chemical composition and manufacturing process of Onix make it the perfect choice for use as long-lasting, high-temperature hydronic tubing.

Most people are familiar with the many different types of plastic (PEX, polyethylene, CPVC, and ABS to name a few) and their different characteristics and applications. Just as different plastics have different material properties, so do different types of rubber (EPDM, SBR, NBR or nitrile, Neoprene, natural rubber).

Question:
What is Onix?

Answer:
Onix is a polymer-rich **EPDM**; comprising a five layer, synthetic, flexible tube.

The inner fluid channel is a peroxide cross-linked, high-grade EPDM. The inner tube is wrapped with a flexible 00 grade aluminum oxygen barrier. Next is a peroxide cross-linked middle layer of EPDM, wrapped by spiral cords of aramid reinforcing. The cover is a sulphur cross-linked EPDM.



Question:
What is EPDM and why was it chosen for this application?

Answer:
EPDM (Ethylene Propylene Diene Monomer) is a flexible cross-linked molecule. The repeating unit is ethylene, propylene, and a diene, which contains a double bond for crosslinking. The diene is ENB (norbornene).

There are many different grades of EPDM. Unlike other grades of EPDM, the EPDM used in Onix is a high quality, polymer-rich formulation, utilizing relatively high ethylene grades with high molecular weights.

EPDM was chosen because it has a proven track record at high temperature applications. EPDM has been used in applications such as steam hose since World War II. Because of its molecular makeup, EPDM is an extremely stable polymer for high temperature applications.

Question:
What is vulcanization?

Answer:
Vulcanization is the process that cross-links the rubber molecules to form a stronger, more durable molecule. Vulcanization involves immersing the rubber in a steam bath where the energy from the steam and a peroxide catalyst cross-link the rubber molecules into longer polymer chains.

Peroxide vulcanization uses peroxide as a catalyst in the crosslinking process of EPDM. The peroxide is scavenged in the

Who Is Watts Radiant?

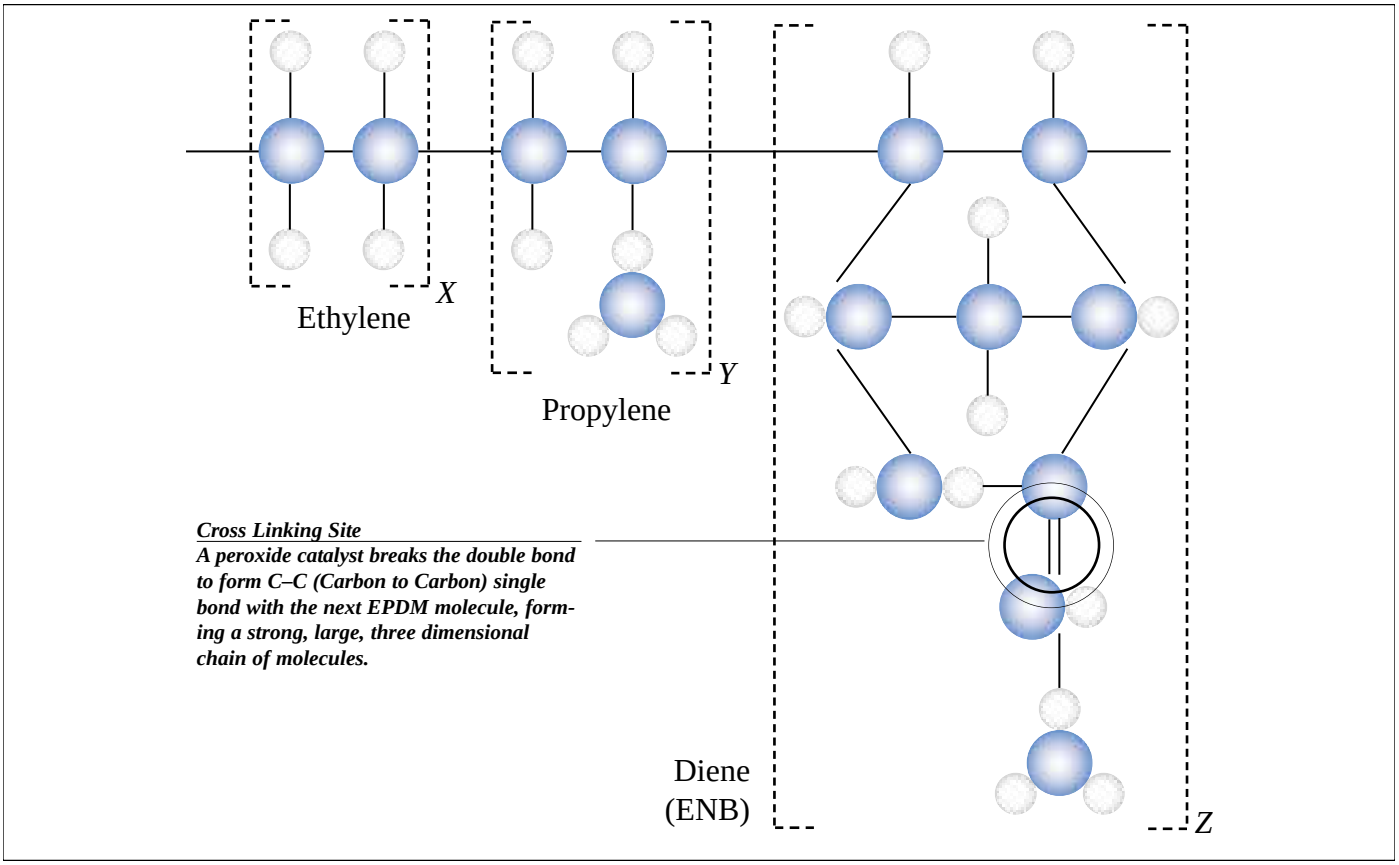
Watts Radiant has been involved in the hydronic radiant floor industry since 1980.

Watts Radiant is a wholly-owned subsidiary of Watts Industries. Since 1874, Watts Industries has been a leading world-wide manufacturer of valves, hydronic heating, and plumbing equipment. Watts is currently traded on the NYSE as WTS.

ONIX TESTING

Third party testing results "place this material [Onix] among the most stable materials we have reviewed." In addition "this compound is among the best that we have tested."

Samples of Onix have been running at 180°F on test panels for over 60,000 hours – CONTINUOUSLY.



process, leaving a single carbon-carbon (C-C) bond.

Cross-linking forms a three dimensional molecular network that makes EPDM extremely stable over a wide range of temperatures and pressures.

Question:
What is aramid fiber reinforcing?

Answer:
Aramid is used as a reinforcement to resist pressure. It gives Onix a 800 psi burst pressure at ambient and a 600 psi burst pressure at 180ºF (compared to 325 psi burst at 180ºF of Pex).

Aramid offers the best heat resistance over time of any reinforcing. Pound for pound aramid is stronger than steel. Aramid is used in bulletproof vests under the trade name Kevlar .

Question:
How is Onix manufactured?

Answer:
Onix is made in a continuous, five-stage process, using three extruders, an aluminum applicator, and an aramid braider. It is then cross-linked in a 325ºF steam bath.

– Raw materials are mixed together, then held until passing Quality Control tests.

– Inner tube is extruded through a die in a screw extruder while being checked by a laser micrometer. Nitrogen gas is used to expand the tube wall and maintain a consistent inside diameter.

– Aluminum oxygen barrier is applied.

– Bonding layer of EPDM is extruded.

– Spiral aramid reinforcement is wrapped.

– Outer cover is extruded.

– Entire Onix assembly is vulcanized in a low-pressure steam bath at 325ºF. Vulcanizing in a pan limits the longest continuous length but is a more consistent/higher quality cure process than a continuous cure process.

Question:

Chemical Facts

EPDM is cross-linked with carbon-carbon single bonds.

It takes more imparted energy from oxygen, sunlight, chlorine, or other damaging agents to break a single bond than a double bond. This is because the double bond has a free "leg" available to reconnect to a new molecule. The result is a very stable long lived material.

Why is there only one manufacturer of EPDM tubing for radiant heating?

Answer:
Watts Radiant holds the patent for radiant floor applications using EPDM with an oxygen barrier.

There are only a handful of polymer manufacturers who have the capacity and volume to produce EPDM tubing. Manufacturing multi-layer EPDM tubing requires a very large capital investment, up to eight times greater than required to extrude plastic. This investment results in a product with only one application - radiant.

Question:
How is Onix tested?

Answer:
Onix has been tested by independent third party labs. Components used in the construction of Onix have been subjected to accelerated lifetime prediction tests, such as differential scanning calorimetry (DSC), and thermogravimetric weight analysis (TGA). The DSC testing studies the oxidation process of the polymer. The TGA test studies weight loss.

– Third party testing results "place this material [Onix] among the most stable materials we have reviewed." In addition "this compound is among the best that we have tested."

Representative samples are periodically placed on Watts Radiant's long term testing panels, where they undergo continuous exposure at elevated temperatures to both water and water/glycol mixes.

– Samples of Onix have been running at 180°F on test panels for over 60,000 hours CONTINUOUSLY.

Quality Control Testing:
– As part of each shift's production, hose samples are pressure tested. Pressures include proof (400 psig) and burst testing.
– A Rheometer test is performed on each batch of compound (tests crosslinking over time by measuring torque).
– Tensile, elongation, specific gravity, viscosity, and moony scorch testing is done on designated batches.
– Tensile and elongation at break is measured for each lot of the aramid reinforcing yarn.

Question:
What is the difference between Onix and flexible tubing like automotive heater hose or other radiant hose?

Answer:
The base polymer for Onix is a high-grade EPDM. The base polymer for heater hose is SBR (Styrene-butadiene rubber). Other material used as radiant hose has been NBR (nitrile-butadiene rubber)
– EPDM is inherently stable at high temperatures, and is not dependent on the anti-oxidant package for protection. An EPDM is like using a stainless steel roof - it is inherently corrosion resistant.
– All extruded and cured pipes (PEX or CPVC, for example) use an anti-oxidant package to extend protection

ONIX Product Dimensions

Product	I.D.	O.D.	Bend Radius	Fluid Capacity per 1000 ft.
3/8"	3/8"	11/16"	3"	6.25 gal.
1/2"	1/2"	7/8"	4"	10.25 gal.
5/8"	5/8"	1"	5"	16.00 gal.
3/4"	3/4"	1-1/8"	6"	25.00 gal.
1"	1"	1-3/8"	8"	43.50 gal.

General Properties of EPDM

Abrasion Resistance	Excellent
Oxidation (resistance of)	Excellent
Ozone (resistance of)	Excellent
Sunlight Aging	Excellent
Heat Aging	Excellent

ONIX: Table of Material Properties

Tensile Strength	1000 psi
Percent Elongation	300 %
Low Temp Flexibility	10 times ID @ -40ºF
Ozone resistance	100 pphm, 50% extension, no cracks
Electrical resistance	Greater than 10 mega ohms
Burst pressures	
at ambient	**800 psi at 73ºF**
at 180ºF	**600 psi at 180ºF**
Thermal conductivity	0.17 Btu/hr-ft-Deg F

against premature "aging" of the pipe. Other rubber materials such as SBR/NBR is extremely sensitive to having the correct anti-oxidant package. Anti-oxidants retard thermal oxidative hardening by capturing radicals and preventing the chemical reaction from propagating. This is similar to using a plain steel roof (NBR or SBR) - you have to paint it (add an exact amount of anti-oxidants) to keep it from rusting.

At the molecular level, the major difference between NBR (or SBR, or neoprene) and EPDM is that **NBR contains carbon-carbon double bonds while EPDM contains very stable carbon-carbon single bonds.**

– Double bonds are very reactive and are "unsaturated." This means that the carbon-carbon double bonds of the NBR are much more likely to be oxidized (age) than the "saturated" carbon-carbon single bonds of EPDM, thus making EPDM a much more stable molecule at high temperatures.

– Single bonds require more energy to break than double bonds.

Because of Onix's inherent benefits for Radiant Floor Heating pipe and Supply and Return Piping—its flexibility, longevity and durability (see table)—it is the best material to use in your next Underfloor, Slab, or snowmelting application.

Why should I install Onix?

Long lasting . . . . . .Backed by a comprehensive 25 year warranty

Most flexible, durable radiant tube available . . . . . .Installs in less time than any other radiant tube

Flexible to -30ºF . . . . . .Easy installations in freezing cold weather

Can't be kinked . . . . . .Double it up and push it through a hole in a joist for faster Staple–Up™ installations

UV resistant . . . . . .Up to 5 years. Leave it exposed on a job-site, worry-free

No special tools required . . . .No expensive connection tool or tube unwinder

Crush resistant . . . . . .Large concrete pours are possible – let the concrete truck roll over Onix (see Onix Installation Manual)

Aluminum oxygen barrier . .Flexible oxygen barrier is protected inside the tubing
– Can't damage it on the jobsite
– Aluminum oxygen barrier is unaffected by temperature (just as effective at 180°F as 100°F, unlike other oxygen barriers on the market)

No expansion . . . . . .No movement when Onix heats up
– Never noisy in a Staple–Up application; stays in contact with subfloor for better heat transfer

ONIX Staple-Up™

ONIX Slab–On–Grade

ONIX Snowmelt

ONIX with SubRay™

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