

## Ecoflex® unbonded slip systems vs. bonded polyurethane systems

### The difference

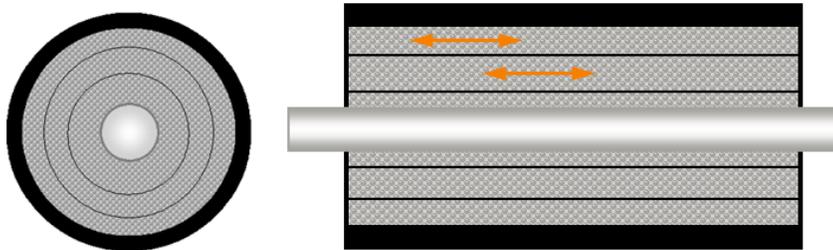
There are two main types of pre-insulated piping systems—unbonded slip systems and bonded polyurethane (PUR) foam systems.

Unbonded slip systems, such as Uponor Ecoflex®, feature a core service pipe of flexible crosslinked polyethylene (PEX) tubing with a multi-layered PEX-foam insulation around the tubing and a corrugated high-density polyethylene (HDPE) jacket. This style of pre-insulated piping allows increased flexibility because the different layers in the piping system can “move” independently from one another.

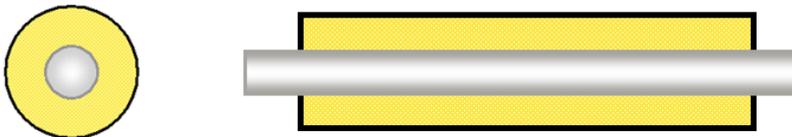
With bonded systems, a rigid polyurethane foam is essentially a “glue” that adheres to the core service pipe as well as the outer jacket of the piping system. This type of system makes the piping very rigid and also makes it difficult to separate the foam from the pipe because it is bonded together.

### Unbonded slip systems offer four main advantages:

- Ease of fitting installation
- Significantly less off-gassing
- Thermal performance
- Flexibility



Unbonded slip system (Ecoflex)



Bonded system (polyurethane)



Ecoflex unbonded slip system

# Ease of fitting installation

The most important aspect of fast installations with a pre-insulated pipe system is accessing the pipe to install a fitting. With Ecoflex, fitting installations are faster, easier and cleaner compared to rigid polyurethane foam systems.



vs.



## Ecoflex systems

Ecoflex systems use ASTM F1960 ProPEX® expansion fittings or WIPEX™ compression fittings. To install a fitting, simply remove the corrugated HDPE jacket with a utility knife and then cut away each layer of the PEX-foam insulation. Once the service pipe is exposed, simply make the connection.

## Bonded systems

With bonded systems, manufacturers recommend cutting the jacket, peeling it away from the foam, removing the foam with a chisel or saw and removing the excess foam with sandpaper. Using the sandpaper is a delicate process as it is important not to perforate the oxygen-diffusion barrier on the service pipe. The oxygen-diffusion barrier on PEX protects the ferrous components in the system from corrosion.

# Insulation off-gassing

Off-gassing is a natural occurrence of the manufacturing process for both PEX-foam and polyurethane-foam systems. How and when the foam comes in contact with the carrier pipe can have an adverse effect on the system's thermal performance. In fact, Uponor has performed testing that shows polyurethane foam conductivity stabilizes in just two years with a significant decrease in insulation value and thermal performance. The graph to the right illustrates the test results.

## Ecoflex systems

After manufacturing PEX foam, Uponor lets it dwell for six days to stabilize before being placed on the PEX carrier pipe. This allows for off-gassing to take place and ensures steady thermal performance throughout the system's lifespan.

## Bonded systems

With bonded systems, the polyurethane foam is sprayed into the HDPE jacket and hardens. Once the foam hardens, low-conductivity, high-pressure gases exist inside the cells of the foam when compared to atmospheric pressure. Over time, the higher-pressure gases diffuse through the cells outward, escaping the foam. As the pressures inside the cells stabilize, the net conductivity of the remaining gases increase. This diffusion process continues to occur

**85%** time savings with Ecoflex

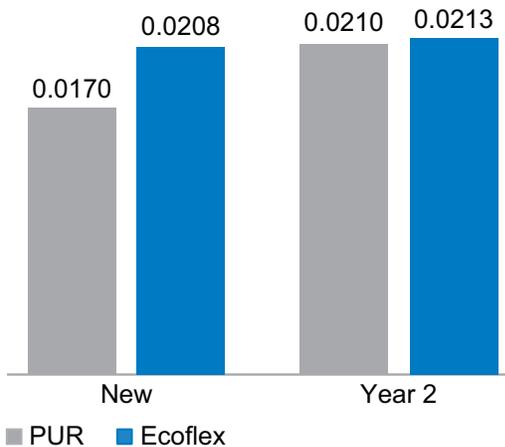


# Time comparison

**Ecoflex:** Approximately 5 to 8 minutes per fitting

**Bonded:** 45 minutes or more per fitting

Thermal conductivity of foam (Btu/h/ft/°F)



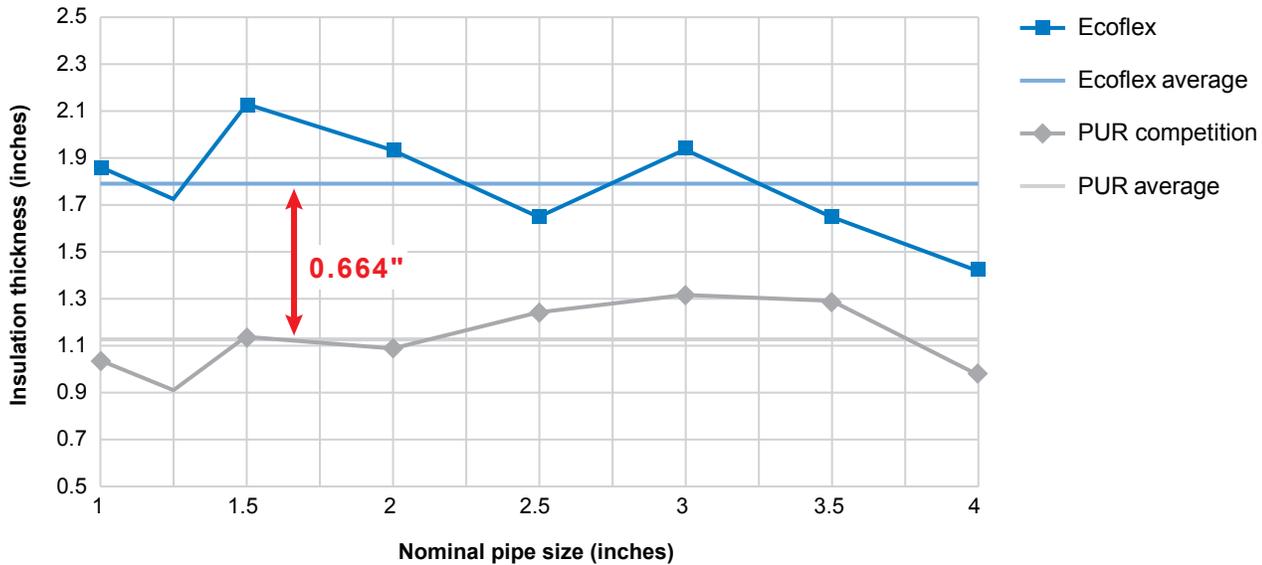
Testing performed in Ochtrup, Germany in 2008

until the pressure inside the cells reach a balance with the surroundings. This process yields acceptable performance for the system initially; however, thermal performance diminishes as time progresses.

# Thermal performance

Thermal performance of pre-insulated pipe systems consists of two main factors: insulation thickness and insulation thermal conductivity. Refer to the chart below to see the difference between Ecoflex insulation thickness and polyurethane foam thickness.

## Insulation thickness



The chart above shows the average difference between Ecoflex and bonded systems is 0.664". Knowing the foam insulation thickness and conductivity makes it possible to determine a system's heat loss.

The following formula uses thermal resistance methodology for a cylinder to calculate the resistance of the foam,  $R_{\text{foam}}$ . The larger the resistance, the better the performance.

$$R_{\text{foam}} = \frac{\ln \left[ \frac{r_o}{r_i} \right]}{2\pi L k_{\text{foam}}}$$

System	New product		2-year-old product	
Ecoflex PEX foam	4.67	18% Improvement with Ecoflex	4.56	42% Improvement with Ecoflex
Bonded PUR foam	3.95		3.20	

Upon initial installation, Ecoflex PEX-foam systems offer an 18% increase in thermal performance over bonded polyurethane foam systems. After two years of service, the thermal performance of Ecoflex increases to 42% over polyurethane foam systems.

Ecoflex offers  
**18% to 42%**  
better thermal performance

The following data was used to gain each respective system's thermal resistance:

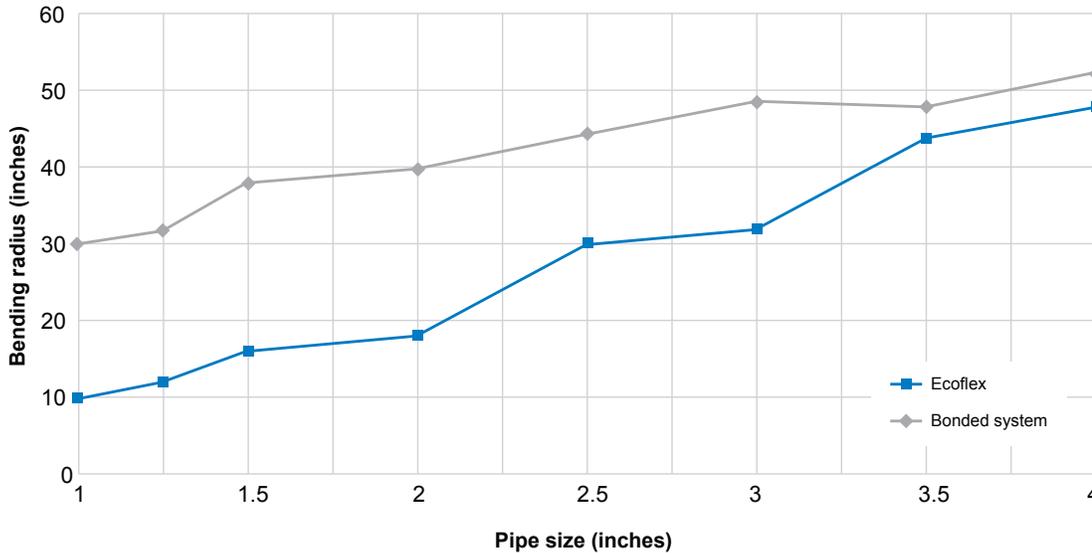
- The  $r_i$  value (2.13") is the average outside diameter of service pipes (1" to 4").
- The  $r_o$  value is  $r_i$  plus the average insulation thickness from the insulation thickness chart above.
- For Ecoflex,  $r_o$  is 3.92"; for bonded systems,  $r_o$  is 3.25".
- The length (L) of pipe for this analysis is assumed to be 1 unit foot.

# Flexibility

Refer to the chart below to see the difference in bending radius when comparing flexible Ecoflex with rigid polyurethane foam systems. Bending radius formation is for single-service pipe configurations.

**40%** tighter bend radius with Ecoflex

## Bending radius



## Ecoflex benefits

- 25+ years of global proven performance
- Manufactured in the U.S.A. in Apple Valley, Minn.
- Features a multi-layer, closed-cell, PEX-foam insulation and corrugated outer jacket for outstanding flexibility and durability, allowing for a fast and cost-effective installation
- Full range of additional services from cut-to-length, delivered-to-site service to design and onsite installation assistance
- Combine above services with Uponor's custom product manufacturing capabilities to provide what you want, when you want it
- Only product in the flexibility comparison to have a true corrugation, allowing for the jacket to be extremely flexible along its longitudinal axis yet very stiff and strong cross-sectionally
- Closed-cell PEX-foam has much larger cells yielding increased flexibility
- Layers of foam are not bonded to each other or to the service pipe and jacket, allowing for each layer to move independently (same relationship as between a steel rod and a braided steel cable—both have similar strength but the cable is much more flexible)
- Two standard products available:
  - Ecoflex Single with one service pipe
  - Ecoflex Twin with two service pipes
- Ecoflex Thermal available for heating and cooling applications; Ecoflex Potable available for potable-water applications
- Ecoflex Single available in standard coils up to 1,000 ft. with service pipes ranging in size from 1" to 4" Uponor PEX or 1¼" to 4" HDPE
- Uponor Ecoflex Twin available in standard coils up to 1,000 ft. with service pipe sizes ranging from 1" to 2½" Uponor PEX
- Backed by a 25-year limited warranty on Uponor PEX carrier pipe and ProPEX fittings

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