

CASE STUDY #26: Armstrong Residence

Location: Lewiston, Idaho
Project Type: High-End, Luxury Home
Systems: Radiant Floor Heating, Plumbing
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PROFILE:

Idaho Dream Home Features Healthy, Energy-Efficient, Cost-Saving Interior

When it came time to build their 7,400-square-foot dream home in Lewiston, Idaho, Rebecca Armstrong and her family made energy efficiency a top priority. With the reality of rising fuel prices, the Armstrongs felt it was imperative to look for practical, alternative solutions to heating their home. Also, with a family member suffering from serious health problems due to prolonged metal and chemical exposure, they wanted a home that minimized toxins and pollutants as much as possible, including those that could arise from any materials used to build their new home.

To achieve these objectives, the Armstrongs turned to Smart Solutions Inc., located in nearby Kamiah. Smart Solutions describes itself as a “high-performance building products distributor, offering specialty design and consulting,” with an emphasis on energy efficiency and healthy living. “What we proposed was a new and innovative indoor comfort system that combined heating, cooling, domestic hot water and ventilation,” explains John Palecek, who serves as an engineering/technical consultant for Smart Solutions. His company and the systems it recommended did not disappoint.

Upon completion in the fall of 2005, the two-story, 23-room Armstrong home was estimated to be at least 75 percent more energy-efficient than homes built to the 1993 Model Energy Code benchmark, developed by the Council of American Building Officials. (See Appendix A.) As a result of Smart Solutions’ efforts, the structure recently earned the grand prize in the first annual UPONOR DREAM

HOME COMPETITION. Uponor – formerly known as Wirsbo – is a leading manufacturer of plumbing and heating systems, featuring crosslinked polyethylene (PEX) tubing, for the residential and commercial building markets across North America and Europe.

PEX for plumbing: One of the products Palecek opted to use to achieve optimal efficiency was Uponor’s AQUAPEX® tubing for the home’s plumbing system. It was chosen for its installation flexibility and lower cost, and because it is corrosion-resistant and considered more environmentally friendly than copper pipe.

AQUAPEX is made of crosslinked polyethylene (PEX), which eliminates many of the joints necessary in rigid plumbing systems – copper or plastic – thus saving time and money. It has been used successfully around the world for more than 30 years, first in radiant floor heating systems and later for plumbing lines. PEX tubing has a life expectancy of more than 100 years when used under normal operating conditions. In the two decades since Uponor Wirsbo brought PEX to North America, more than two billion feet of it has been installed on this continent alone. Worldwide, that in-service figure stands at more than 11 billion feet.

The AQUAPEX system features ProPEX® fittings, which use the shape memory of the tubing itself to form a connection that is fast, permanent and reliable. The connections are easily made with a ProPEX expander tool that expands the tubing enough for the fitting to be inserted. The tubing then shrinks around the fitting, as it returns to its original shape. The result is a connection that actually gets stronger over time. ProPEX fittings allow for visual inspection and eliminate the need for torches, glues and gauges.

“That’s one of the things that sold us on AQUAPEX,” explained Palecek. “It was important to find something that was flexible and required minimal welding, since we were working with polystyrene in insulated form construction, which can melt or recede when soldering joints.”

PEX for heating and cooling: Palecek made the unusual decision to use AQUAPEX not only for the plumbing in the Armstrong home, but also for the radiant heating and cooling system. You might have expected him to choose Uponor’s hePEX plus tubing, which has an oxygen-diffusion barrier, designed to prevent corrosion – not in the tubing, but in the ferrous components in the radiant system. However, since Smart Solutions specified non-ferrous heating components – namely brass and stainless steel – that barrier protection was not needed.

Responding to his client’s priorities, Palecek opted for radiant heating and cooling over forced air for reasons of comfort and health as well as energy efficiency. With forced air, vents are typically situated on one wall at ceiling level, resulting in an uneven flow of air. With radiant, heated or cooled water flows from the heat

source through PEX tubing installed underneath the floor in a looped configuration, with the pipe loops set equidistant from one another. As a result:

- Heating and cooling is quickly and evenly dispersed at floor level where it is most needed by the home's inhabitants.
- The temperature is always consistent from room to room, regardless of location and despite the home's 12-foot to 24-foot ceilings.

Two other advantages are the lack of noise and air pollution. Unlike forced-air systems, radiant doesn't use noisy blowers to circulate the warmth or cooling through the ambient air. As the name "forced air" implies, all that air movement also keeps dust, allergen and pollutants in circulation, which would hardly have met the Armstrong's demand for a clean environment.

Last, but not least, radiant heating and cooling consumes less energy in delivering the same level of comfort. "Radiant heat and in-floor cooling is about 30 percent more energy-efficient than a comparably sized forced-air system," says Palecek. "You can keep the thermostat set at a lower temperature in the winter – and at a higher setting in the summer – than you would with a forced-air system to achieve a comparable level of heating or cooling."

The PEX payoff: "Given the unique nature of this project, it would have been very difficult to install the Armstrongs' plumbing, heating and cooling system without the use of AQUAPEX," Palecek notes. "I would estimate that we saved more than 40 percent on labor costs alone, since PEX tubing was much easier to work with than copper. We were more than happy with the results – in fact, we were ecstatic."

Rebecca Armstrong and her family echo that sentiment. She reports that the heating system cost an average \$4.23 per day to operate during the winter of 2005-2006, including heating, domestic hot water and ventilation. A typical wood-framed home in the area with a forced-air furnace would incur fuel bills three to five times that amount, Palecek estimates.

"We are extremely pleased with the operating costs," says Armstrong, noting the size of the home with its "exceptionally high ceilings. The rooms have an even temperature throughout, and there are no cold spots. Overall, the entire system is outstanding and far exceeds anything we contemplated."

Appendix A: Piping Requirements

John Palecek of Smart Solutions estimates that approximately 1,500 linear feet of 1-inch, ½-inch and ¾-inch Uponor AQUAPEX tubing was used for the plumbing system in the Armstrong home in Lewiston, Idaho. Specifically:

- 300 linear feet of 1-inch tubing was used for main supply line (hot and cold).
- 400 linear feet of ¾-inch tubing was used for the hot-water return line and the feed lines to all showers and tubs.
- 800 linear feet of ½-inch tubing was used for the supply lines to all other fixtures.

In addition, approximately 11,300 linear feet of 1-inch, ¾-inch and ½-inch PEX piping was used for the in-floor hydronic heating and cooling system. Specifically:

- 100 linear feet of 1-inch tubing was used for the heat pump room's piping.
- 700 linear feet of ¾-inch tubing was used for supply and return piping.
- 10,500 linear feet of ½-inch tubing was used for the in-floor piping.

Appendix B: Other Efficiency Measures

In addition to AQUAPEX, Smart Solutions maximized energy efficiency by using the following in the Armstrong home's construction:

- An expanded polystyrene (EPS)-insulated concrete form wall provides an airtight envelope and a minimum 50 percent savings in energy. In addition, EPS was used to insulate the floors and ceilings, providing an airtight box.
- To further tighten the envelope, Smart Solutions recommended windows with insulated frames and a nonmetallic foam glass spacer.
- A custom heat and energy recovery displacement ventilation system supplies fresh air from vents located low on the walls and near the floor. At the same time, vents located high on walls near the ceiling remove stale air from the room. The system eliminates drafts, controls humidity, maintains consistent temperatures, and minimizes dust. It also has the ability to exchange the air completely, while efficiently recovering the energy from that air — and the moisture within it — year-round.
- Rather than running the radiant heating system off a boiler, Palecek chose a five-ton geothermal heat pump, which is three to five times more efficient. A customized control system, created by Smart Solutions, eliminated the need for multiple heat pumps. The single heat pump supplies not only 100 percent of the energy for the seven radiant heating zones, but also handles all of the home's radiant cooling and domestic hot water needs.

Appendix C: AQUAPEX Benefits

- **Proven Reliability:** AQUAPEX tubing has been proven in use in radiant floor heating and plumbing systems for more than 30 years, longer than any other flexible plumbing system on the market. No other flexible system on the market could provide this long history of proven performance.
- **Reliable ProPEX Fittings:** Uponor's ProPEX fittings make it possible for installers to eliminate the use of torches, glues and gauges. That means installers can make fast, easy connections that will last. ProPEX connections even allow for visual inspection, so there is no concern with connections that are left "unmade." ProPEX fittings carry a 10-year warranty when installed by a professional contractor.
- **Corrosion-Resistance:** Smart Solutions chose AQUAPEX because it offered corrosion-resistance, as well as a 25-year warranty.
- **Comprehensive Training:** Training assures that every installer is familiar with proper installation techniques for AQUAPEX and that customers are satisfied with the quality of the product and its installation.

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For more information about the benefits of cross-linked polyethylene (PEX) tubing, contact a reputable manufacturer, such as Uponor North America (www.uponor-usa.com).

Hi-res versions of these images are available for immediate download in .tif format by using this link:
www.LNCmail.com/pr/up0636-cs26.html



UP0636-1855.tif (above) and **UP0636-1866.tif** (right)
The great room in the Armstrong Home.



UP0636-1890.tif (left) and **UP0636-1905.tif** (below)
Kitchen area in the Armstrong Home.



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UP0636-1923.tif

“We are extremely pleased with the operating costs,” says Rebecca Armstrong of her new home’s radiant floor heating and cooling system.



UP0636-1929.tif

John Palecek of Smart Solutions, Inc. with three of seven Grundfos zone circulators, which move hot and cold water for the radiant floor system.



UP0636-1932.tif

John Palecek of Smart Solutions, Inc., shown inside the mechanical room with the ECONOR geothermal, five ton heat pump, which provides hot and cold water to the radiant floor heating and cooling system and all the homes domestic hot water.



UP0636-1945CB.tif

John Palecek and Claudia King of Smart Solutions Inc.

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UP0636-1960.tif

Homeowners Tom, Rebecca and Leona Armstrong. Rebecca's parents enjoy separate living quarters downstairs in the home.



UP0636-smartsolutions2.tif

West elevation of the Armstrong home in Lewiston, Idaho.



UP0636-02_17-START.tif

This photo was taken at the start of the project. It shows the ARXX High-Performance Wall System, which is an insulated concrete form wall consisting of expanded polystyrene and recycled polyethylene.



UP0636-08_35-PREP.tif

Shown here is the installation of Insul-Deck floor panels with Uponor Wirsbo tubing for the radiant heating and cooling system.

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UP0636-08_42-PREP.tif

John Palecek is shown here doing a final check of the tubing prior to the concrete pour.



UP0636-09_21-POUR.tif

Concrete pour over the Insul-Deck floor panels and UPONOR PEX tubing, creating an efficient, high mass, structural radiant floor.



UP0636-10_09-FLOOR.tif

Installation of window and door bucks in the ARXX High-Performance Wall System.



UP0636-Winner.tif

John Palecek (left) of Smart Solutions receives his grand-prize award from Dean Johnson, host of the home-improvement television series, *Hometime*. Johnson was one of the judges in the Uponor Dream Home Promotion.

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