SECTION ONE: XPS Benefits, Health and Safety Messages

Message #1: Energy-efficient extruded polystyrene (XPS) foam insulation is a highly beneficial building insulation product that is in wide use throughout the world for residential and commercial construction.

Supporting proof points

- In residential and commercial building applications, energy-efficient and moisture-resistant XPS foam is used to insulate walls, ceilings, roofs and foundations.
- XPS foam is used as building insulation because it is highly energy-efficient—in other words, it reduces the amount of energy needed to maintain temperature control within a space.
- Furthermore, no other foam building insulation provides the same level of protection against water damage as XPS foam insulation.
- XPS foam insulation reduces the cost to heat and cool residences and commercial buildings, resulting in significant cost savings.
- According to the U.S. Environmental Protection Agency (U.S. EPA), buildings account for an estimated 36 percent of total energy use and 30 percent of greenhouse gas emissions.
- XPS foam insulation helps achieve advanced energy efficiency and greenhouse-gas reduction goals.

Message #2: XPS building insulation is formulated to meet rigorous international building and fire safety codes and standards.

Supporting proof points

- Flame retardants enable manufacturers of XPS foam building insulation to meet the building and fire safety codes and standards necessary to protect life and property.
- Research shows that flame retardants slow the spread of fire and can allow occupants additional time to escape. The building codes that set levels of fire-safety performance for foam insulation products are based on years of careful analysis, extensive testing and a deliberative development process.
- Flame retardants currently in use in XPS foam insulation are subject to regulation by the U.S. Environmental Protection Agency and regulators around the world.
• It is important to note that since the 1970s, civilian fire deaths and the number of residential fires started to decline, and continue to do so.
  o The National Fire Protection Association reports that there were 7,395 deaths from fire in 1977; there were 3,010 in 2009.
  o Because of the ongoing concern and risk of death and damage from fires, manufacturers of XPS foam insulation use flame retardants to meet strict fire-safety requirements in buildings.

**Message #3:** Architects, builders and building occupants can be confident that currently installed extruded polystyrene foam insulation in walls and ceilings are safe and have been approved for use.

*Supporting proof points*

• HBCD, the flame retardant currently used in XPS foam insulation, has been used safely for decades to help protect people and property from fire.
• There is no credible evidence demonstrating that foam insulation products are a significant source of exposure to HBCD in the indoor environment.
• A chemical’s risk is determined by scientific assessment of hazard and exposure (risk assessment.)
  o Risk assessors use a tool called a “margin of exposure” (MOE) to determine whether potential chemical exposures put people at risk. In risk assessment terms, MOEs greater than 1 demonstrate low risk and low concern. For HBCD, regulators across the globe have determined that MOEs for HBCD among the general population are far higher than 1, demonstrating very low risk to building occupants from HBCD.

  o **(FOR TECHNICAL AUDIENCES:** MOE is a comparison (ratio) between lifetime safe exposure levels and actual or estimated human exposure levels. Lifetime safe exposure levels are based on no effect levels determined in laboratory animal studies and include large safety factors to take into account the most sensitive members of the population - elderly, infants, children, pregnant and nursing mothers, etc. In calculating a MOE, as long as the MOE is greater than 1.0, indicating that the safe exposure level is greater than the actual exposure, then the MOE indicates low risk and low regulatory concern, the practical scientific definition of safety.

  o As indicated by the MOE values in the table, the public is not at risk from HBCD-treated foam insulation in existing structures, because building occupants’ actual exposures to HBCD in foam insulation are extremely low and calculated MOEs are high (ratios much greater than 1.0 for exposure scenarios related to XPS foam insulation products). Biomonitoring data shows that general population exposures to HBCD are well below lifetime safe exposure levels set by health authorities such as the U.S. EPA, FDA, Health Canada, the European, Food Safety Authority, etc.)
<table>
<thead>
<tr>
<th>Study</th>
<th>Target Population</th>
<th>Reference Value</th>
<th>Predicted Exposure</th>
<th>Margin of Exposure**</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU 2012*</td>
<td>Workers using powdered formulations</td>
<td>0.1 mg/kg-d</td>
<td>0.293-0.786 mg/kg-d</td>
<td>&lt;1; potential for risk (risk reduction measures required)</td>
</tr>
<tr>
<td>EU 2008*</td>
<td>Workers using powdered formulations</td>
<td>0.1 mg/kg-d</td>
<td>varies</td>
<td>~0.3; risk reduction measures required</td>
</tr>
<tr>
<td>NAS 2012*</td>
<td>Child sucking fabric</td>
<td>0.2 mg/kg-d</td>
<td>0.026 mg/kg-d</td>
<td>~7</td>
</tr>
<tr>
<td>AU 2012</td>
<td>Toddler</td>
<td>0.1 mg/kg-d</td>
<td>0.000286 mg/kg-d</td>
<td>~350</td>
</tr>
<tr>
<td>AU 2012</td>
<td>Infant</td>
<td>0.1 mg/kg-d</td>
<td>0.000124 mg/kg-d</td>
<td>~800</td>
</tr>
<tr>
<td>EU 2008</td>
<td>Breast-feeding infants</td>
<td>0.1 mg/kg-d</td>
<td>0.000015 mg/kg-d</td>
<td>~6600</td>
</tr>
<tr>
<td>EU 2010</td>
<td>Breast-feeding infants</td>
<td>0.9 mg/kg-d</td>
<td>0.0001 mg/kg-d</td>
<td>9000</td>
</tr>
</tbody>
</table>

*Exposure scenario not relevant to XPS foam insulation products.

**MOE values greater than 1 indicate low risk and low regulatory concern, the practical scientific definition of safety.

- A number of government agencies have conducted risks assessments on HBCD and have concluded that HBCD poses no risk for building occupants because the exposure is so low:
  - The European Commission, 2008: “There is at present no need for...risk reduction measures...” This “conclusion applies to all [exposure] scenarios for consumers and for humans exposed via the environment.”
  - Environment Canada, 2011: “Based on the available information, it is concluded that HBCD is not entering the environment in a quantity or concentration or under conditions that constitute...a danger in Canada to human life or health.”
  - Health Canada has also concluded that margins of exposure for HBCD are adequately protective of the most sensitive populations, indicating low risk and no need for regulatory action.
  - Government of Australia, 2010: “Exposure to HBCD from all sources appears to be low and hence low risk is expected.”

- Due to the absence of any market-ready alternatives, in May 2013, the U.N. Stockholm Convention on Persistent Organic Pollutants (POPs) agreed to allow signatories to the treaty to apply for a five-year exemption for continued use of HBCD because of its essential use in energy-efficient foam building insulation throughout the world.
Message #4: The companies that manufacture extruded polystyrene foam have been innovating for the future by identifying the next generation of XPS foam insulation.

Supporting proof points

- New flame retardants for use with foam insulation have been developed and have been evaluated through the U.S. EPA Design for the Environment Program.
- One of the new flame retardants (polymeric FR) has won several awards for sustainable design, including the Michigan Green Chemistry Governor’s Award.
- Our companies are committed not only to sustainability and innovation, but also quality and safety.
  - As production of these new flame retardants ramp up, our companies are working with testing labs and evaluation services to ensure that XPS foam insulation manufactured with the new FRs continue to meet the physical property, performance and fire safety characteristics expected of XPS foam insulation.
  - These products are not yet widely available in XPS foam products until global production capacity of the new FRs and product testing of reformulated XPS foam insulation is complete.

SECTION TWO: XPS PERFORMANCE MESSAGES

Message # 1: Extruded polystyrene (XPS) foam insulation is inherently moisture resistant.

Supporting proof points

- XPS is a high performance, closed-cell rigid foam insulation that is manufactured in proprietary processes that melt plastic resin and additives into a molten material which is then extruded through a die, where it expands and cools into a uniform closed-cell rigid foam insulation board.
- The uniform closed-cell structure of XPS insulation foam is inherently moisture resistant.
- This is important because over time, foam insulation that does absorb moisture loses its R-value (thermal efficiency), which reduces its insulation power.

Message #2: XPS foam insulation is more moisture-resistant than EPS insulation due to the different manufacturing processes.

Supporting proof points

- Molded bead expanded polystyrene (EPS) is made with small foam beads that are placed in a mold. These beads are exposed to steam while in the mold and this causes the beads to expand and stick together to form a bun shape that is then cut into boards. This manufacturing process can result in interconnected voids between the foam beads which can provide potential pathways for water to penetrate into the insulation.
- The resulting penetration and absorption of moisture results in reduced R-value over time.
Message # 3: The installation of XPS foam insulation in walls, roofs, attics and foundations provides high R-value and high energy savings.

Supporting proof points

- The thermal efficiency of an insulating material is expressed as R-Value, where R is the material’s resistance to heat flow.
- The higher the R-Value, the greater the insulating power. Higher R-Value provides higher energy savings.
- XPS foam insulation boards provide continuous insulation, helping improve the overall performance and energy efficiency of buildings.
- An world-wide list of independent studies show that XPS provides a higher thermal performance in moist and wet applications than competing products like EPS, because EPS can absorb water, which diminishes its R-Value.
- XPS foam insulation resists water absorption and maintains a high long term R-Value.

Message # 4: Builders can be confident that XPS foam insulation maintains a high R-value over the long term.

Supporting proof points

- When moisture is absorbed by an insulation, it drastically reduces the thermal efficiency (or R-Value), greatly reducing its ability to insulate.
- Real-world studies along with laboratory tests show that when exposed to moisture, EPS absorbs more water and loses more R-value than XPS foam insulation.
- Experts have reviewed independent technical studies, and findings confirm that XPS performs better than EPS in applications where moisture exists—such as below-grade—because of the closed-cell structure of XPS foam insulation.

Message # 5: XPS foam insulation manufacturer’s stand behind the proven, long-term performance of XPS foam insulation in all applications, including below-grade applications.

Supporting proof points

- A 2009 evaluation published by the EPSMA (now EPSIA) on the long-term below-grade performance of EPS and XPS is not well supported or peer-reviewed and is inconsistent with previous significant worldwide research in the field. Experts have examined the EPS study and have called its conclusions into question.
  - According to Jay Crandall P.E.: “The reported XPS performance does not appear to be consistent with in-field performance generally and more extensively reported by others. The reasons for this outcome do not appear to be sufficiently explained by this limited study which included only two XPS samples at one study site. Furthermore, the details of the study and the original laboratory report have not been publicly disclosed at the time of this writing.” [Journal of Cold Regions Engineering, Vol. 24, No. 2, June 1, 2010, p. 50.]
  - The data used in the EPS study was reportedly conducted by the same test lab and at the same test site as apparently used in two prior studies [SPI, 19941; AFM Corp., 19962] for which there are also unanswered questions on data reliability.

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In reviewing the 1996 AFM Corp. study, Crandall wrote: “The reason for the abnormally high (as compared to other studies) moisture intake of the one XPS sample in this study [AFM Corp., 1996] is unexplained. Given the anecdotal nature of this study (particularly with only one sample of XPS), other sources were considered as more authoritative by the ASCE 32 committee in establishing design values for XPS. In addition, some samples incurred damage during execution of the test methodology, which raised questions regarding reliability of the test data as a whole, particularly given the small sample size.” [Journal of Cold Regions Engineering, Vol. 24, No. 2, June 1, 2010, p. 48.]

A 2013 EPSIA evaluation of XPS foam insulation purportedly sampled from four buildings. This information was published without supporting documentation or peer-review:

- No documentation has been published on evaluation design, execution and data analysis
- No information has been published on application and exposure details
- No information has been published on sampling witnessing and handling (chain of custody)
- No information has been published on sample cleaning, preparation, storage and conditioning and testing details
- No information has been published on sample characteristics (thickness, density, surface)

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3 Technical Bulletin EPS Below Grade Series 105 March 2014 (EPSIA)