ABOUT GSE

INTRODUCTION
GSE is a global manufacturer and marketer of geosynthetic lining solutions, products and services used in the containment and management of solids, liquids, and gases for organizations engaged in waste management, mining, water, wastewater, and aquaculture. GSE has a long history since 1972 of manufacturing quality geosynthetic lining systems and developing innovative products. The company’s principal products are polyethylene based geomembranes, geonets, geocomposites, geosynthetic clay liners, concrete protection liners and vertical barriers. GSE manufactures products primarily to line or cap hazardous and non-hazardous waste landfills; contain materials generated in certain mining processes; and contain water, liquid waste and industrial products in ponds, tanks, reservoirs, sewers, and canals.

MANUFACTURING FACILITIES
Headquartered in Houston, Texas, GSE has manufacturing facilities in Houston, Spearfish, South Dakota, Kingstree, and South Carolina. Our laboratories are accredited by the Geosynthetic Accreditation Institute – Lab Accreditation Program (GAI-LAP). We also have manufacturing facilities in Egypt, Germany, Chile, China, and Thailand. Each facility is equipped to provide the highest quality product with industry leading technology and maximum output to service customers’ needs.

GSE QUALITY ASSURANCE PROGRAM
GSE standard products are backed by an extensive manufacturing quality assurance (MQA) program through its own state-of-the art and GAI-LAP accredited laboratories located at each US manufacturing facility.

The GSE MQA program ensures that all manufactured materials meet or exceed the most stringent quality standards in the industry. All quality control tests are conducted in accordance with established guidelines outlined by ASTM, as well as other recognized test standards and organizations, such as the Geosynthetic Research Institute (GRI).

The MQA program begins with testing and verification of specially formulated resins and other raw materials and extends through delivery to the site. GSE inspects and tests all virgin raw materials upon delivery and before unloading to ensure it meets the strict requirements for geomembrane manufacturing.

All GSE geomembranes are 100% spark tested for pinholes during the manufacturing process to ensure each delivered roll is leak free. Samples from each geomembrane roll are subjected to an array of quality assurance tests to verify that all physical property requirements meet or exceed GSE’s and the customers’ specification standards. Roll Test Data Reports (RTDRs) are provided for each roll of geosynthetic to certify the material meets the required specifications before shipping to the job site.

ENGINEERING SUPPORT
The GSE Engineering Support Staff is comprised of multidisciplinary product professionals to support you across a range of project requirements. This includes knowledge in geomembrane, geosynthetic clay liners, geonet, geocomposite, nonwoven geotextile and concrete protection products and application solutions. Rely on our technical staff to help you solve your project issues.

CUSTOM FABRICATION
The GSE Custom Fabrication Group builds products to your exact specifications. We have extensive experience in prefabricated polyethylene products and components. A few examples of our custom fabricated products are Aqua Tanks, Quick Containment, concrete protection liners, boots, sumps, pads, pipes, daily covers, temporary containment, containment boom and other products to fulfill your fabrication needs.

INSTALLER NETWORK
The GSE Installer Network leads the industry with the most experienced, large, and flexible crews available around the world to meet your installation requirements. Each installer is equipped with state-of-the-art welding and testing equipment to ensure a successful installation. Selecting a qualified installer with the right product knowledge is critical to your success. Let GSE connect you to the right installer to handle your installation project of any size from start to finish.
WHAT IS RADON?
You can’t see radon. And you can’t smell it or taste it. But it may be a problem in your building. Radon comes from the natural (radioactive) breakdown of uranium in soil, rock and water and gets into the air you breathe. Radon can be found all over the world. It can get into any type of building — homes, offices, and schools — and result in a high indoor radon level. Families are most likely to get the greatest exposure at home, where they spend most of their time.

HOW DOES RADON GET INTO YOUR BUILDING?
Radon is a radioactive gas. It comes from the natural decay of uranium that is found in nearly all soils. It typically moves up through the ground to the air above and into your building through cracks and other holes in the foundation. Your home traps radon inside, where it can build up. Any building may have a radon problem. This means new and old buildings, well-sealed and drafty homes, and homes with or without basements.

Radon from soil gas is the main cause of radon problems. Sometimes radon enters the home through well water. In a small number of homes, the building materials can give off radon, too. However, building materials rarely cause radon problems by themselves.

RADON GETS IN THROUGH:
• Cracks in solid floors
• Construction joints
• Cracks in walls
• Gaps in suspended floors
• Gaps around service pipes
• Cavities inside walls
• The water supply

THE RISK OF LIVING WITH RADON
Radon gas decays into radioactive particles that can get trapped in your lungs when you breathe. As they break down further, these particles release small bursts of energy. This can damage lung tissue and lead to lung cancer over the course of your lifetime. Not everyone exposed to elevated levels of radon will develop lung cancer. And the amount of time between exposure and the onset of the disease may be many years.

Like other environmental pollutants, there is some uncertainty about the magnitude of radon health risks. However, we know more about radon risks than risks from most other cancer-causing substances. This is because estimates of radon risks are based on studies of cancer in humans (underground miners).

Radon is known to be the second largest cause of lung cancer after smoking. Some studies indicate that radon is the primary cause of 10 to 15% of lung cancer mortalities. This means that in Denmark about 400 people die every year of lung cancer caused by radon. In England the figure is 4,000 persons and in Sweden unconfirmed studies indicate some 800 persons.

HOW TO LOWER THE RADON LEVELS IN YOUR BUILDING
Since there is no known safe level of radon, there can always be some risk. But the risk can be reduced by lowering the radon level in your building. The most effective method to reduce radon gas from entering a building is to install a radon barrier membrane to prevent the gas from entering. GSE’s Proflex Radon Barrier is an excellent choice for this application and has been proven to be an excellent barrier as tested by SP Technical Research Institute of Sweden.

In addition to using GSE’s Proflex Radon Barrier a ventilation system can also be used to enhance radon protection. A properly installed ventilation system pulls radon from the house and ventilates it to the outside.

Lowering high radon levels requires technical knowledge and special skills. You should use a contractor who is trained to fix radon problems. A qualified contractor can study the radon problem in your building and help you pick the right treatment method.
GSE PROFLEX 1.00 MM RADON BARRIER

GSE ProFlex is a propylene/ethylene copolymer quality Radon Barrier produced from a resin formulation designed to provide a quality geomembrane with excellent flexibility, improved elasticity and resistance to puncture. These properties assure maximum multiaxial elongation to accommodate differential settlement. GSE ProFlex is ideal for most geomembrane applications and major benefits to installation are provided by lower coefficient of thermal expansion and a wide temperature sealing window.

<table>
<thead>
<tr>
<th>Tested Property</th>
<th>Unit</th>
<th>Test Method</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>mm</td>
<td>DIN EN ISO 9863-1</td>
<td>1.0</td>
</tr>
<tr>
<td>Density</td>
<td>g/cm³</td>
<td>DIN EN ISO 1183-1/A</td>
<td>0.89</td>
</tr>
<tr>
<td>Tensile Properties (each direction)</td>
<td></td>
<td>DIN EN ISO 527-3</td>
<td></td>
</tr>
<tr>
<td>Strength at Break</td>
<td>MPa</td>
<td>(Type 5; 100 mm/min; 100 ± 5 g)</td>
<td>19 (16)</td>
</tr>
<tr>
<td>Elongation at Break</td>
<td>%</td>
<td>(Type 5; 100 mm/min; 100 ± 5 g)</td>
<td>900 (700)</td>
</tr>
<tr>
<td>Tear Resistance (Minimum Average)</td>
<td>N</td>
<td>DIN EN ISO 34-1/B(a)</td>
<td>60</td>
</tr>
<tr>
<td>Puncture Resistance (Minimum Average)</td>
<td>N</td>
<td>DIN EN ISO 12236</td>
<td>1,000</td>
</tr>
<tr>
<td>Carbon Black Content</td>
<td>%</td>
<td>ASTM D 1603</td>
<td>3.0</td>
</tr>
<tr>
<td>Carbon Black Dispersion</td>
<td></td>
<td>ASTM D 5596</td>
<td>1/2(2)</td>
</tr>
<tr>
<td>Dimensional Stability (each direction)</td>
<td>%</td>
<td>DIN 53377 (100 °C/1h)</td>
<td>±3.0</td>
</tr>
<tr>
<td>Melt Flow Index</td>
<td>g/10 min</td>
<td>DIN EN ISO 1133 (190 °C/5.0 kg)</td>
<td>≤3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(190 °C/2.16.0 kg)</td>
<td>±1.0</td>
</tr>
</tbody>
</table>

Reference Property

<table>
<thead>
<tr>
<th>Tested Property</th>
<th>Unit</th>
<th>Test Method</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiaxial Elongation at Break</td>
<td>%</td>
<td>Similar to ASTM D 5617, Ø = 500 mm</td>
<td>120</td>
</tr>
<tr>
<td>Low Temperature Brittleness</td>
<td>°C</td>
<td>ASTM 2136</td>
<td>-40</td>
</tr>
<tr>
<td>Radon Resistance</td>
<td>SP/m</td>
<td>--</td>
<td>11.7 × 10³</td>
</tr>
<tr>
<td>Roll Width</td>
<td>m</td>
<td>--</td>
<td>3.0</td>
</tr>
<tr>
<td>Surface</td>
<td>--</td>
<td>--</td>
<td>double-sided smooth</td>
</tr>
</tbody>
</table>

(*) All values - unless otherwise noted - are nominal values. Values in brackets are minimum values within 95% confidence interval.

Notes:
(a) Tolerance ± 10% - Special thickness available upon request.
(b) Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be category 1 or 2. No more than 1 view from category 3.
(c) Standard test conditions: 190 °C / 5.0 kg.
(d) Roll widths and lengths have a tolerance of ± 1%.
Test of Radon Transmission and Permeability

The assignment was to determine the radon transmittance and radon permeability through one material. The material was sent to us by the client. The sample arrived at SP (SP Technical Research Institute of Sweden) on 9th September 2011, with no visible damage.

Description of the test material

The tested material was named GSE Proflex 1.00 mm Radon Barrier with a thickness of 1.0mm. A photo of the material is shown in Appendix 1.

Test equipment

Testing was carried out in a test chamber comprising of two stainless steel boxes. Each box measured 500 x 500 mm. The depth of the receiver box was 104 mm and the depth of the source box was 170 mm. The test sample was placed between the boxes. The sides were then carefully tightened, to ensure an airtight connection between the boxes. A diagram of the test apparatus is presented in Figure 1 below:

The designations $C_i$, $F_i$, etc. are described under Theory.

Figure 1. Test equipment

Radon source

The radon source was a block of natural concrete which contains a small amount of radium. The radioactive decay of radium will produce radon gas (Rn-222) which is emitted to the atmosphere in the source box. Rn-222 is also radioactive and its first decay product (Rn-220) is Polonium-210. Radon decay products (Rn-222) are not gaseous but particles, and cannot pass through the test specimen by diffusion.

SP Technical Research Institute of Sweden

This product was tested by SP Technical Research Institute of Sweden.
PRODUCT DESCRIPTION
ProFlex Radon Barrier is a 1.0 mm thick geomembrane product of unreinforced three-layer ethylene copolymer. The color is black. The membrane is joined with Terostat 81, a butyl rubber sealing tape.

Table 1
Dimensions and weight of ProFlex Radon Barrier

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>1.0 mm ± 10%</td>
</tr>
<tr>
<td>Basis weight</td>
<td>930 g/m² ± 5%</td>
</tr>
<tr>
<td>Width</td>
<td>2 or 4 m ± 2%</td>
</tr>
<tr>
<td>Roll length</td>
<td>25 m -0% / +5%</td>
</tr>
</tbody>
</table>

As an accessory to the radon membrane the following may be supplied:
- Terostat 81, width 20 or 40 mm, for the splicing and transitions.
- Sealant to secure the crossings and joints.
- Butyl tape to reinforce the corners and to penetrations and transitions to other materials.

Corners and cuffs are made of ProFlex Radon Barrier on the construction site.

APPLICATION

General
Radon Membranes are used to reduce the transport of radon from the ground and into buildings, and the application is divided into three user groups as illustrated on page 7. ProFlex Radon Barrier is intended for use in the user groups B-C, but can also be used in group A with the assumptions described in this approval.

Properties

Material Properties
Product properties for new material is shown in Product Data Sheet on page 4.

Air Tightness
ProFlex Radon Barrier function is tested with respect to air tightness of the joints and penetrations with a satisfactory results as shown in Table on page 4.

ENVIRONMENTAL DECLARATION

An environmental declaration is not prepared for ProFlex Radon Barrier. The product contains no substances on environmental authorities’ observation list of hazardous substances. The material can be recycled or sent to a public landfill for disposal.

CONDITIONS OF USE OF SERVICE

Radon Concentration
ProFlex radon barrier should not be applied where the radon concentration in the soil can be expected to exceed 2 MBq/m³. The soil conditions can change due to various reasons during the building’s life, therefore other measures should be taken to reduce the concentration of Radon in the building.

Protection
The membrane must not be damaged by impact from sharp objects, or other objects that come into contact with the membrane. The use in Group B must be used in conjunction with a geotextile between the membrane and the insulation or membrane must be protected immediately after installation utilizing a minimum 30 mm thick insulation with satisfactory compressive strength.

Mounting
ProFlex Radon Barrier should be joined using welding techniques, but may also be joined with use of sealing tape and sealant, and it must be ensured that all joints, penetrations and transitions, floor/wall is airtight. It is assumed that the membrane is mounted with the principal splice and connection details as shown in the Installation Details on page 7, and in according to the principles shown in SINTEF Building Details 520,706. The temperature at the installation should be at least +5 °C. During low temperatures, the sealants and tapes can be softened with hot air.

Trained Installers
ProFlex radon barrier should be installed by a trained installer.

Storage
ProFlex Radon Barrier should be stored dry and protected from damage.

Floor Heat
Heating cables shall not be placed directly on the membrane, and there should be minimum 5 mm non-flammable material between heating cables and the membrane.
GROUPS/CLASS
The Figure below shows the alternative locations of radon membranes in the so-called user groups.

Group A: The membrane is placed in the construction pit on a leveled and prepared surface of crushed stone and sand. Care must be taken to ensure an air tight connection between the Radon Membrane and the piping, the ring-wall or foundation. Consideration should be given to drainage points that can handle any free water and leaks in the construction operation phase.

Group B: The membrane is placed on leveled and prepared surface and should be protected on both the upper and lower side, sandwiched between two layers of insulation. The Radon Barrier should be positioned in a manner to ensure an airtight connection to the building. Consideration should be given to drainage points that can handle any water and leaks in the construction and operation period.

Group C: The membrane is laid on leveled concrete slab and glued or sealed to the structures and penetrations. The need for appropriate protection of the membrane should be considered.
WORLDWIDE LOCATIONS

Our business is global because our customers are global. Headquartered in the U.S. and with manufacturing facilities in Chile, Germany, Thailand, and Egypt, as well as engineering and sales professionals in numerous countries, GSE can provide local service to worldwide customers.

- **Houston - United States**
- **Bangkok - Thailand**
- **Santiago - Chile**
- **Hamburg - Germany**
- **Cairo - Egypt**
- **Suzhou - China**

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GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

**DURABILITY RUNS DEEP**