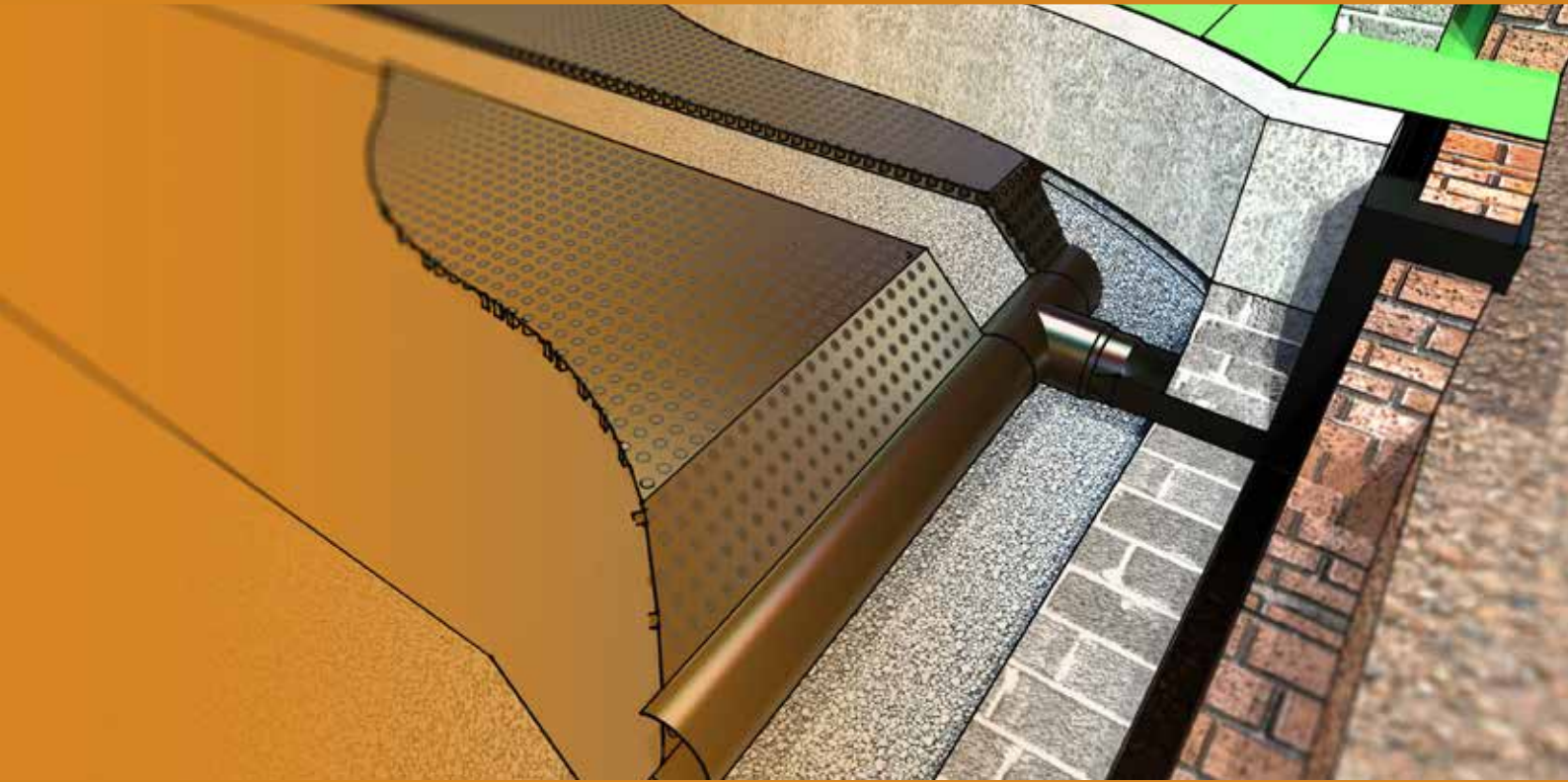


Ground Gas Protection

WE'VE GOT GROUND GAS COVERED



The A. Proctor Group Ltd is a family-owned company in its fourth generation which has been providing solutions and products to the construction industry for over 50 years. One of our five core divisions is Ground Gas Protection Systems.

Gas protection systems are critical in developments constructed on sites affected by permanent ground gas and/or volatile organic compound (VOC) contamination. Systems are designed using the methodology which is set out in various advisory documents and legislation. The primary purpose is the prevention of hazardous gases and contaminants from the underlying soils that may cause harm to occupiers. A well-designed system should also perform the function of a damp-proof membrane, assisting in preventing the uptake of moisture into the construction.

Whatever your requirement, our head office team of highly trained specialists is on hand to provide technical advice to assist in all aspects of designing gas protection systems. From recommending the ideal level of protection for a particular site, through to selection of suitable materials, and advice on detailing, our team will work with you to ensure that all elements are covered.

As part of providing this complete service to customers, we have developed relationships with strategic partners; these include:

- Consultants specialising in all aspects of gas protection system design
- Specialist installation sub-contractors
- Consultants offering independent verification of gas protection installations

The A. Proctor Group can facilitate contact between our clients and professional companies in the field of gas protection systems, who can offer quotations for:

- **Full design** of systems in line with site-specific investigation, and remediation strategy covered by £1m professional indemnity
- **Installation** of gas protection measures by CSkills NVQ Level 2 qualified installation contractors
- **Verification** by independent consultants providing validation plans including relevant levels of integrity testing specific to site risks

The A. Proctor Group has been a contributor and funder to various CIRIA advisory documents including C665, C716 and C735.



Why are gas protection measures needed?

The accepted industry methodology of determining the risk to an end user of a building, in line with guidance and legislation, comprises 'source,' 'pathway' and 'receptor.' This methodology is used by design consultants during the creation of the conceptual site model to provide the remediation strategy, in the context of the associated risks specific to the site and construction.

Current legislation and advisory documents stipulate levels of protection required, depending on the specific permanent ground gas or VOC risks associated with the site. Landfill or naturally occurring gas (or its components) can enter buildings through:

- Gaps around service pipes
- Construction joints
- Wall cavities
- Cracks in walls and ground slabs

In most buildings, measures to protect against ground gas are constructed below the ground floor level. A permanent ground gas (or VOC) protection solution consists of several individual elements, combining to form an integrated system. This is done to limit the reliance on one individual component. These components are separately designated, in relation to gas protection in BS8485:2015 (permanent ground gas) and CIRIA C748 (VOCs), as:

1. Structural barrier (floor & substructure design)
2. Ventilation protection (floor slab type)
3. Membranes
4. Monitoring and detection
5. Pathway intervention

Depending on the site risks present, these components will be used to determine the overall protection system chosen. At the A. Proctor Group we have been involved in the supply and specification of gas protection systems since 1990, specifically in the areas of venting and dilution, and membranes.

Our PROVOID ventilation system is backed by a proven track record in the supply of quality materials for passive ventilation systems. As well as the necessary pipe work arrangements, the system is provided with options on air inlets and outlets to suit specific site requirements.

The A. Proctor Group also supplies the PROTECH GM range of proprietary gas barrier membranes, designed to protect against permanent ground gases and VOCs. Our specialist technical team is available to advise on membrane specification in order to tailor specifications to individual site requirements, and can also advise on levels of required installation and verification.

Our range of reinforced gas barriers are complemented with a variety of sealing tapes, tophats, self-adhesive flashings and gas-resistant DPCs.

Types of Gases

RADON (Rn)

Radon is a radioactive, colourless, odourless gas which occurs naturally in the environment, and can migrate into any building that is built over a source. If it accumulates in a building, it increases the risk of lung cancer for occupants. In 2009, the World Health Organisation (WHO) stated that radon is the cause of 15% of lung cancers worldwide.

CARBON DIOXIDE (CO₂)

Carbon Dioxide is toxic, odourless and colourless, and in high concentrations can result in asphyxiation. The gas is formed by the oxidation of carbon compounds such as that which occurs in landfill sites. When CO₂ levels reach a concentration of 3%, symptoms of headaches and shortness of breath will occur; these become severe at 5%, and at 7 - 10% will cause suffocation.

METHANE (CH₄)

An odourless flammable gas that is explosive when released into the atmosphere at levels as low as 5%, and exposed to a source of ignition. Methane is formed where there is below-ground degradation of organic substances e.g. landfill sites, sewage treatment areas, mining operations and peat bogs.

VOLATILE ORGANIC COMPOUNDS (VOCs)

VOCs are organic compounds that are volatile under normal environmental/atmospheric conditions. They can be found in the ground in solid, liquid and dissolved state, and as gases. Some VOCs are short-lived, therefore their impact can change rapidly as they degrade to other chemicals. Typical VOCs encountered on brownfield and industrial sites include:

Petroleum (non-halogenated) hydrocarbons (e.g. benzene, toluene, butylbenzenes)

Halogenated hydrocarbons (e.g. chlorinated ethenes, ethenes and associated breakdown products as from dry cleaning fluids or degreasers or chlorofluorocarbons [freons])

Nitrogen, sulphur and oxygen-containing organic compounds (e.g. tetrahydrofuran)



Protech GM+

Low / Medium Risk Characteristic Sites



Protech GM+ is a high performance proprietary LDPE reinforced gas barrier; which has been specifically designed to conform to the latest guidance documents. Due to its unique composition the membrane is extremely robust and flexible, and therefore easy to install on site. The membrane also provides protection from damp, therefore there is no need to install a separate DPM. Protech GM+ incorporates a reinforced grid to ensure that maximum protection is achieved when installed to manufacturers' instructions.

TYPICAL PROPERTIES	
Roll Length	50m
Width	2m
Weight	0.29kg/m ²
Thickness	0.4mm
Colour	Yellow
CO ₂ Permeability BRE Gas Chromatograph	0.06 g/m ² 31 ml/m ² /day
Methane Permeability (K _g) (m/s)	1.396 x 10 ⁻¹¹
Radon permeability	1.1 x 10 ⁻¹ m ² /s

Features and Benefits

- High performance reinforced virgin polymer proprietary gas membrane
- Superior tear resistance
- Complies with the latest guidance
- BBA certified
- Robust and flexible
- Easy to install & is supplied on a roll in accordance with current guidance

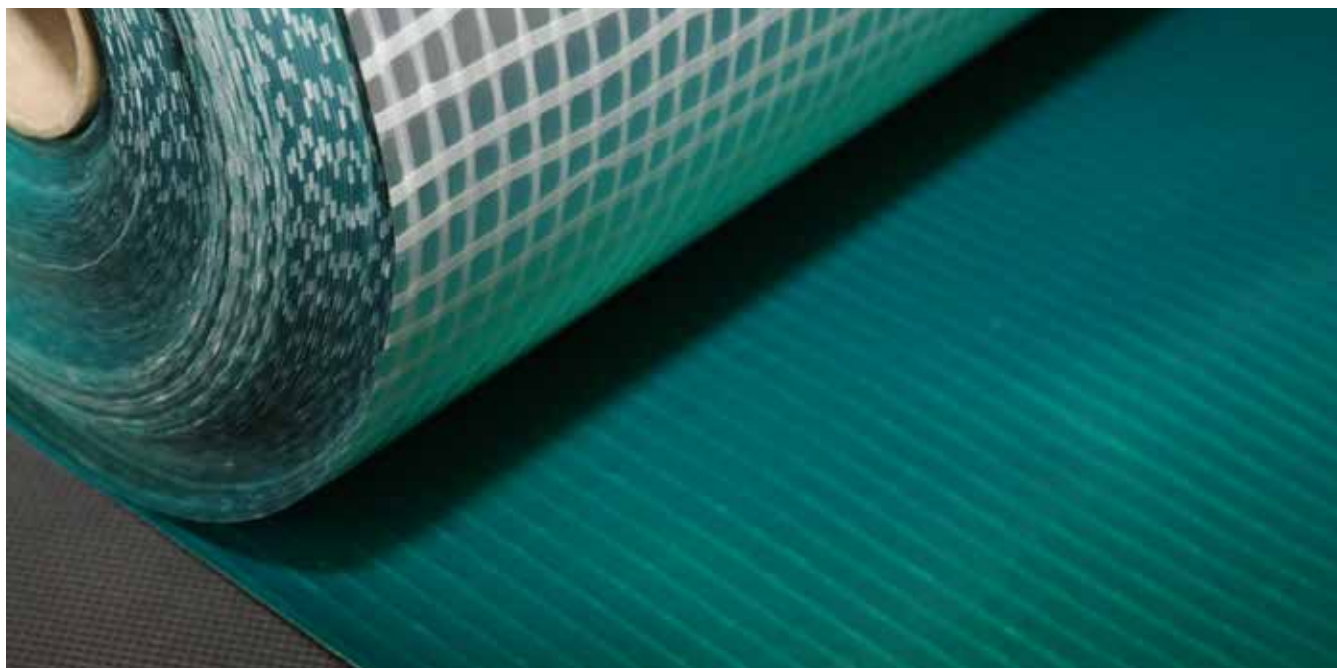
REGULATIONS COMPATIBILITY

	CIRIA 665 CHARACTERISTIC SITUATION 2	CIRIA 665 CHARACTERISTIC SITUATION 3-6	BS8485 CHARACTERISTIC SITUATION 2	BS8485 CHARACTERISTIC SITUATION 3-6	BRE 211 RADON	NHBC AMBER 1	NHBC AMBER 2 & RED
CARBON DIOXIDE	✓	✓	✓	✓	N/A	✓	✓
RADON	N/A	N/A	N/A	N/A	✓	N/A	N/A

The table above can be used as a basic guide but for site specific guidance please contact the A. Proctor Group technical department

Accessories

- Protech GM+ Starter Band
- Protech GM Tape
- Protech GM Tophats
- Protech GM Flashing
- Protech GM+ Corner Units
- Protech GM Primer
- Protech Protection Board
- Protech GM Protection Fleece
- Protech SAGM (Self Adhesive Gas Membrane)



Protech GM Super

High Risk Characteristic Sites



Protech GM Super is a high performance proprietary LDPE reinforced gas barrier, which incorporates a 12 micron aluminium foil layer for maximum protection against ground-borne gases. Please contact our technical department for further details. The product has been specifically designed to conform to the latest guidance documents, and its unique composition makes the membrane extremely robust and flexible, and easy to install. The membrane also provides protection from damp, therefore there is no need for a separate DPM.

TYPICAL PROPERTIES	
Roll Length	50m
Width	2m
Weight	0.37kg/m ²
Thickness	0.4mm
Colour	Green / Silver
Methane Permeability (ISO 15105-1)	≤ 0.1 ml/day/m ²

Features and Benefits

- BS8485:2015 Compliant
- High performance reinforced virgin polymer proprietary gas membrane
- Superior tear resistance
- Aluminium core for reduced methane permeability on higher risk sites
- Complies with the latest guidance
- BBA certified
- Robust and flexible
- Easy to install

REGULATIONS COMPATIBILITY

	CIRIA 665 CHARACTERISTIC SITUATION 2	CIRIA 665 CHARACTERISTIC SITUATION 3-6	BS8485 CHARACTERISTIC SITUATION 2	BS8485 CHARACTERISTIC SITUATION 3-6	BRE 211 RADON	NHBC AMBER 1	NHBC AMBER 2 & RED
METHANE	✓	✓	✓	✓	N/A	✓	✓
CARBON DIOXIDE	✓	✓	✓	✓	N/A	✓	✓
RADON	N/A	N/A	N/A	N/A	✓	N/A	N/A

The table above can be used as a basic guide but for site specific guidance please contact the A. Proctor Group technical department

Accessories

- Protech GM Super Starter Band
- Protech GM Tape
- Protech GM Tophats
- Protech GM Flashing
- Protech GM Super Corner Units
- Protech GM Primer
- Protech Protection Board
- Protech GM Protection Fleece
- Protech SAGM
(Self Adhesive Gas Membrane)



Protech VOC Flex

High Risk Characteristic Sites

Protech VOC Flex is a high performance 6 layer flexible proprietary reinforced VOC barrier and is suitable for use on brownfield sites that require protection from dangerous contaminants such as hydrocarbons. The Protech VOC Flex has been developed to ease installation on site due to the flexibility of the membrane. It is also suitable as a high performance damp proof membrane.

PROPERTY		UNIT	MEAN	TOLERANCE	METHOD
Roll size		m	2 x 50		
Thickness		mm	0.55		
Weight		g/m ²	562	± 50	DIN EN ISO 536
VOC Methane Permeability		ml/day/m ²		<0.1	ISO 15105-1
Tensile strength	MD	N/50mm	621	> 430	EN 12311-1 +Mods EN 13859-1
	CD		608	> 530	
Elongation	MD	%	32	< 60	EN 12311-1 +Mods EN 13859-1
	CD		30	< 60	
Nail tear resistance	MD	N	500	> 430	EN 12310-1
	CD		510	> 480	

Accessories

- Protech VOC Flex Starter Band
- Protech VOC Tophats
- Protech VOC Flashing
- Protech VOC Corner Units
- Protech VOC Primer
- Protech Protection Board
- Protech VOC Protection Fleece

Features and Benefits

- Exceptional chemical resistance
- Additional damp proofing protection
- Flexible membrane to ease installation on site
- Robust & durable multi-layer membrane
- High resistance to puncturing

INSTALLATION

Protech VOC Flex should be unrolled over the prepared ground or sub-floor which should be swept and free from any sharp protrusions. The A. Proctor Group would advise that Protech VOC Flex is welded to provide protection against VOCs as per CIRIA C716 : 2012 Remediating and mitigating risks from VOC vapours from land affected by contamination. We can advise on site specific jointing techniques where applicable.

In areas where the membrane crosses cavity walls or internal single skin walls, Protech VOC Flex Starter Band should be used in conjunctions with Protech VOC Flex Internal and External preformed corner units. Pipe penetrations should be sealed with Protech VOC Top Hats or Protech VOC Flashing Strips. Stanchions and columns should be sealing with Protech Primer and Protech VOC Flashing strips (Photos, isometric and standard details are available on our website).

For further information regarding permeation testing results please visit our website www.proctogroup.com or contact our technical department on 01250 872261.



Protech GM HM

High Risk Characteristic Sites

Protech GM HM is a high-impact proprietary 1mm HDPE hydrocarbon and gas resistant barrier, with outstanding chemical resistance, mechanical properties, environmental stress crack resistance, dimensional stability and thermal ageing characteristics. Due to its composition, the membrane is extremely robust and therefore reinforced steel can be placed directly on the membrane without the need for a protection board prior to the floor being cast. The membrane is also ideally suited for laser screed applications. The membrane also provides protection from damp and therefore there is no need to install a separate DPM.

TYPICAL PROPERTIES	
Roll Length	3.9m *
Width	12.5m *
Density	0.94g/cm ³
Thickness	1.0mm
Colour	Black
PHYSICAL CHARACTERISTICS	
Tensile Strength @ Break ASTM D-6693	17 kN/m
Tensile Strength @Yield	30 kN/m
Tear Resistance @ ASTM D 1004	130N
Puncture Resistance	350N

*Various roll sizes available.

Accessories

- Protech GR-DPC
- Protech GM Tophats
- Protech SAGM (Self Adhesive Gas Membrane)
- Protech GM Flashing
- Protech GM HM Corner Units
- Protech GM Primer
- Protech Protection Board
- Protech GM Protection Fleece
- Protech SAGM (Self Adhesive Gas Membrane)

Features and Benefits

- High impact, proprietary hydrocarbon and gas membrane
- Outstanding chemical resistance
- Extremely robust
- Ideal for laser screed applications

REGULATIONS COMPATIBILITY

	CIRIA 665 CHARACTERISTIC SITUATION 2	CIRIA 665 CHARACTERISTIC SITUATION 3-6	BS8485 CHARACTERISTIC SITUATION 2	BS8485 CHARACTERISTIC SITUATION 3-6	BRE 211 RADON	NHBC AMBER 1	NHBC AMBER 2 & RED
METHANE	✓	✓	N/A	N/A	N/A	✓	✓
CARBON DIOXIDE	✓	✓	✓	✓	N/A	✓	✓
RADON	N/A	N/A	N/A	N/A	✓	N/A	N/A
HYDROCARBON VAPOURS & LIQUID	✓	✓	✓	✓	N/A	✓	✓

For further information regarding permeation testing results please visit our website www.proctogroup.com or contact our technical department on 01250 872261.



Protech SAGM

High Risk Characteristic Sites

Protech SAGM is a self-adhesive gas and waterproofing membrane and has four layers consisting of two outer layers of self-adhesive modified bitumen, with an inner 100 micron core of polyethylene for stability and finally a 50 micron core of Aluminium which gives the product its gas resistance. Protech SAGM should be used on any site where Carbon Dioxide, Radon or Methane is a problem. Methane will occur on any construction, on any sites previously used for landfill. Such conditions can exist on household, commercial and industrial sites. Protech SAGM is perfect for detailing work around awkward penetrations and finishes. It is suitable for vertical, horizontal, stepped and cavity applications.

TYPICAL PROPERTIES	
Roll Length	15m
Width	1m
PHYSICAL CHARACTERISTICS	
Tensile Strength (N / 50mm)	EN 12311-1
Transverse	300
Longitudinal	300
Elongation (%)	EN 12311-1
Longitudinal	10 ± 5
Transverse	10 ± 5
Methane Gas Trans Rate ml/m ² /24hr	<0.09
Water vapour transmission properties	≤ 4,0 E-09 (EN 1931)

Accessories

- Protech GM Flashing
- Protech GM Primer
- Protech Protection Board

Features and Benefits

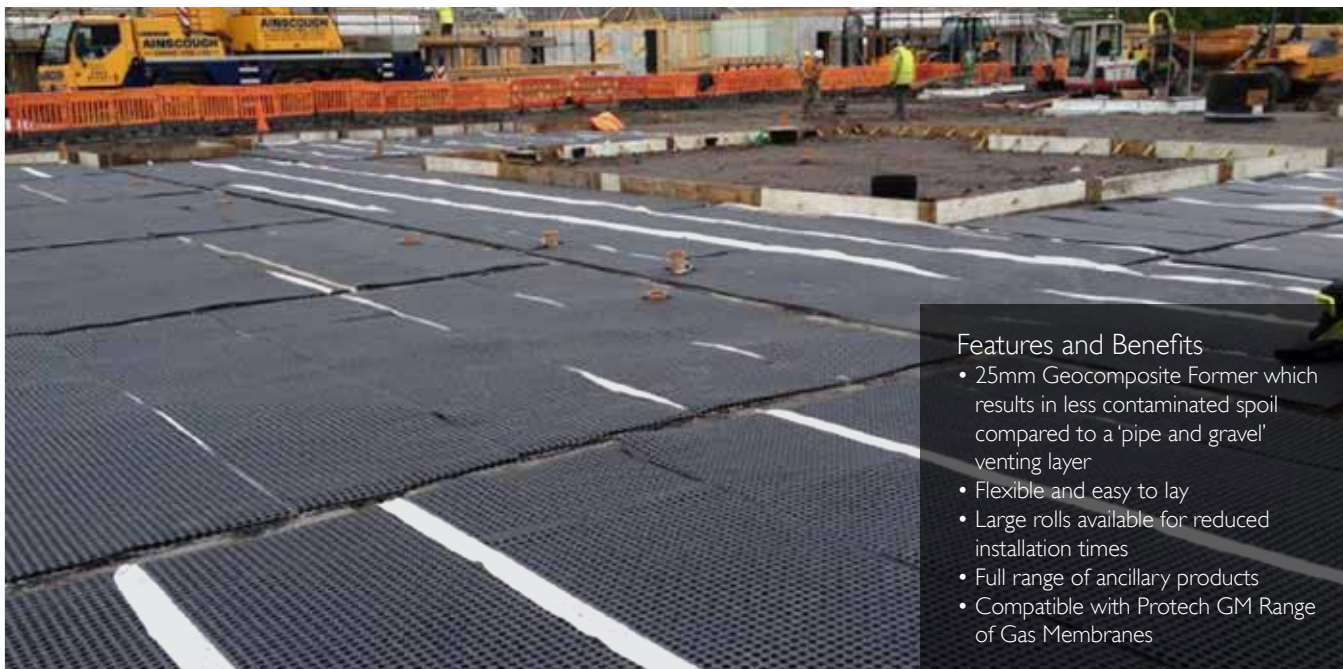
- Self-Adhesive Membrane
- Multi Layer Membrane incorporating a aluminium foil layer
- Flexible Membrane to ease installation on site
- Tanking Applications
- Excellent for detailing work

INSTALLATION

Protech SAGM comes with an outer and inner release film, which should only be removed at the time of use. SAGM installation must not be carried out below 5°C and some warming with a hot air gun may be required between temperatures of 5 and 10°C to ensure a satisfactory seal. Ensure exact positioning prior to removal of the release film, as product will adhere instantly and any repositioning may compromise the adhesive properties. Care should be taken when applying to porous materials that Protech GM Primer should be used first.

Protech SAGM should be installed in accordance with BS 8215:1991, BS 8000: Part 3, 1989 and BS 5628: Part 3:1985.

Protech SAGM is classified as non hazardous when used in accordance with the relevant British Standards. The product should be stored out of direct sunlight, and should avoid strong acids, alkalis and oxidising agents.



Features and Benefits

- 25mm Geocomposite Former which results in less contaminated spoil compared to a 'pipe and gravel' venting layer
- Flexible and easy to lay
- Large rolls available for reduced installation times
- Full range of ancillary products
- Compatible with Protech GM Range of Gas Membranes

Provoid 25 High Risk Characteristic Sites

Provoid 25 is a 25mm thick single-sided geocomposite that provides a void beneath floor slabs which, when connected to air inlets and outlets, allows sufficient air changes to dilute gases to safe concentrations when designed correctly.

Provoid 25 can be laid in strips at predetermined centers or in a full blanket depending on site requirements. Being only 25mm thick means there is a reduced dig when compared to the alternative of 200 to 300mm of clean stone. If Provoid is laid in strips it must be bedded in 200mm of clean stone to achieve a good venting performance in compliance with BS8485:2015.

Provoid 25 is flexible and can be laid horizontally and vertically to deal with awkward foundation arrangements. Because of its flexibility, it will cope easily with settlement under the slab without compromising the system.

We offer venting design advice in line with DOE (1997) Passive venting of soil gases beneath buildings. We can offer venting layouts and detailing of inlets and outlets on existing foundation slab layouts. If calculations are required to prove a specific venting performance, we can arrange quotations for these through our strategic partners.

TYPICAL PROPERTIES	
Roll Length	50m
Width	450mm / 900mm
Thickness	25mm
Compressive strength	300 kPa
Gas flow capacity - Composite	0.024 m³/s (Calculated ¹)

¹Gas flow calculation based on a discharge coefficient of 0.61 with a pressure difference of 10Pa and a standard air density of 1.29kg/m³

Accessories

- Venting System Components
 6,000mm² ventilation area
 1: Ground Level Gully Vent Box*
 2: Provoid Connector 'T-Piece'
 3: Provoid (Geotextile side down)

* Provoid Gully Vent Boxes need to be set in 150mm surround of no fines concrete. No vehicular trafficking should be driven over Gully Vents.



REGULATIONS COMPATIBILITY

	CIRIA 665 CHARACTERISTIC SITUATION 2	CIRIA 665 CHARACTERISTIC SITUATION 3-6	BS8485 CHARACTERISTIC SITUATION 2	BS8485 CHARACTERISTIC SITUATION 3-6	BRE 211 RADON	NHBC AMBER 1	NHBC AMBER 2 & RED
METHANE	✓	✓	✓	✓	N/A	✓	✓
CARBON DIOXIDE	✓	✓	✓	✓	N/A	✓	✓
RADON	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HYDROCARBON VAPOURS & LIQUID	✓	✓	✓	✓	N/A	✓	✓

* The table above can be used as a basic guide but for site specific guidance please contact the A. Proctor Group technical department



Protech GR-DPC



Protech GM Tape



Protech GM Tophat



Protech SAGM



Protech GM Flashing



Protech GM Corner Units



Protech GM Primer



Protech Protection Board



Protech GM Protection Fleece



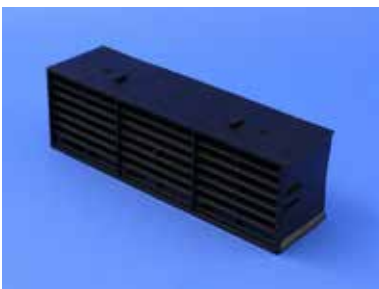
Protech GM Starter Band



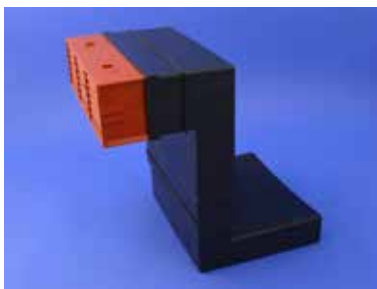
Provoid Venting Components



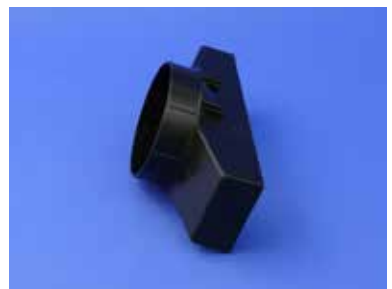
Provoid Venting Components



Multifix Airbrick



Periscopic Underfloor Ventilator



Horizontal Adaptor

Legislation and advisory documents

Background

There have been numerous changes to legislation over the last 10 years in relation to sites affected by permanent ground gases and VOC contamination. Approved Document C (2004)¹ sets out the basic procedures for sites affected with contamination, however more up to date guidance is available through British Standards (BSi) and the CIRIA suite of documents relating to contamination.

Radon (Rn)

Protection from radon is set out in BRE report 211 (1999)². This document is somewhat out of date, and improved legislation is being looked at. Since it was published, the WHO's 2009 report³ found that 15% of lung cancer cases were linked to radon, which would equate to approximately 6500 new cases of lung cancer each year in the UK. The Health & Safety Executive states that around 1100 premature deaths occur each year due to radon.

The Radon Council recommends an emphasis on better-designed ventilation below the slab and reinforced proprietary gas barriers, rather than 2000g DPMs, along with independent validation of the designed measures on a particular project.

Permanent Ground Gas

Gases such as carbon dioxide and methane or landfill gas are referred to as 'permanent gas.' CIRIA C665 (2007)⁴ introduced gas screening value calculations, allowing sites to be characterised between 1 - 6. Gas screening value calculations are also used in BS8485 (2015)⁵, where the building type and characteristic situation are paired to give a point score to achieve relevant protection. Points are allotted to the system dependent on the structural barrier (ground floor slab), ventilation protection and the membrane. Housing and public buildings require more points than industrial and commercial buildings, due to the higher risk to the receptor.

There is now a greater emphasis not only on the quality of materials used, but also on the design performance of ventilation systems, together with their installation and verification. It is now recommended that installation teams attain Construction Skills NVQ Level 2 qualifications in gas membrane installation. Also the requirement for independent validation and integrity testing (if required) is set out in BS8485 (2015), CIEH Ground Gas Handbook (2009)⁶ and CIRIA C735 (2014)⁷.

VOCs

When faced with a site with VOC contamination, it is important to carefully identify the specific VOC contaminants present in order to find the right solution. It is not as simple as requesting a 'Hydrocarbon vapour proof barrier.' Consideration needs to be given to specific vapour modelling of the membrane being proposed. CIRIA C716 (2012)⁸ contains recommendations that sites with VOC issues require ventilation. This was to address a degree of design confusion as some sites with VOCs were having ventilation omitted due to the point scoring system built into BS8485 (2007), together with CIRIA C748 (2014) which provides guidelines on the VOC Migration into Buildings. It is worth noting that BS8485 (2015) relates to permanent gas and does not necessarily apply to sites with VOC contamination.

Independent validation is stipulated as a requirement on sites with VOC contamination, with relevant integrity testing which is set out in CIRIA C735 (2014).

Summary

At the A. Proctor Group we can offer design advice to maintain adherence to all relative legislation and guidance specific to your site. If required we can arrange contact for clients with companies who can offer full designs covered by professional indemnity. We also offer Product Presentations on current ground protection legislation and design requirements, or on the Protech GM Range.

References;

¹ Dept of Environment (2004) Approved document C

² BRE (1999) Radon: Guidance on protective measures for new buildings

³ The World Health Organisation (2009) The radon handbook

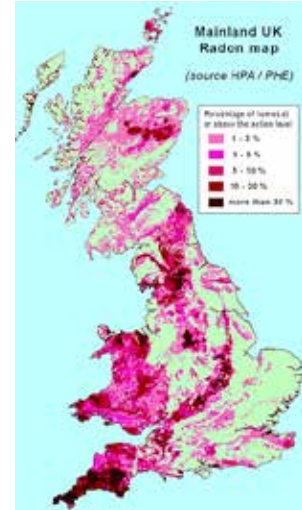
⁴ Wilson S, Oliver S, Mallett H, Hutchings H and Card G (2007) CIRIA C665 – Assessing risk posed by hazardous ground gas to buildings

⁵ BSi British Standards (2015) BS8485 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings

⁶ Wilson S, Card G and Haines S (2011) The chartered institute of environmental health ground gas handbook

⁷ Mallett H, Taffel-Andureau L, Wilson S and Corban M (2014) CIRIA C735 – Good practice on the testing and verification of protection systems for building against hazardous ground gases

⁸ Welburn P, Baker K, Borthwick K and MacLoed C (2012) CIRIA C716 – Remediating and mitigating risks from VOC vapours from land affected by contamination





"I believe the success of the A. Proctor Group is down to a solid foundation of innovation backed up by an excellent, loyal and committed team, every one of them playing an important role in our continued success. Scotland provides us with a unique platform to launch our ideas, systems and products. I am fiercely proud of this heritage and our brand."

Keira Proctor
Managing Director, A. Proctor Group Ltd

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