Remediation and Verification Strategy for Ground Gases

FORMER GREENSIDE MILLS
SKELMANTHORPE

for

Lovell Partnerships Limited

Report Number 4494

August 2025

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FORMER GREENSIDE MILLS, SKELMANTHORPE

Contents

Appendices

1 INTRODUCTION

1.1 On behalf of Lovell Partnerships Limited, Sirius Geotechnical Limited prepared a Remediation Strategy for the former Greenside Mills in Skelmanthorpe. This was presented as Report No. C9297/RS, dated November 2023, and titled, "Strategy for Remedial and Preparatory Works - Former Greenside Mills, Skelmanthorpe."

1.2 At the request of Lovell Partnerships Limited, Michael D Joyce Associates LLP has subsequently been commissioned to prepare a retrospective Remediation and Verification Strategy for Ground Gases encountered at the site. This document covers the whole of the development as shown in Appendix 1, and is based on the gas protection measures recommended in the Sirius Remediation Strategy.

2 GROUND GAS RISK ASSESSMENT RECOMMENDATIONS

2.1 The Ground Gas Risk Assessment was carried out by Sirius Geotechnical Limited, and included in its Remediation Strategy as follows;

Characteristic Situation 2 (CS2) gas conditions should be adopted within new houses and garages on site.

Table 4 of BS8485 states that CS2 conditions require a minimum gas protection score of 3.5 points for a low-rise residential end-use (Type A buildings).

The required gas protection score could be achieved by utilising a suitable combination of gas-resistant membrane and sub-floor ventilation measures, installed and verified in accordance with CIRIA Report C735[4]*.*

This may include:

- *A beam and block floor, which achieves 0 points.*
- *A minimum 150mm ventilated sub-floor void, which achieves at least 'good performance' and 1.5 points.*
- *A ground gas protection membrane (meeting the requirements of BS8485 Table 7), installed above the ventilated void with beam and block floor system in accordance with the recommendations provided within Table 7 of BS8485. Subject to the satisfactory installation of the membrane, plus independent verification of selected plots, this would achieve a protection score of 2 points.*

([4] CIRIA. 2014. Good Practice on the Testing and Verification of Protection Systems for Buildings against Hazardous Ground Gases).

Hydrocarbon and naphthalene impacted soils, including those identified in pond sediments and TP4/TP206 and TP218/TP223, should not be placed beneath proposed buildings.

Prior to undertaking any construction works on the site, the proposed design of gas protection measures, and strategy for verification should be confirmed in the form of a Gas Protection Verification Plan. This should be agreed with the Local Authority and if applicable the NHBC or relevant warranty provider.

The site is recorded to be located within a lower probability radon area (where <1% of homes are estimated to be at or above the action level). Therefore, no radon protection measures are required for the proposed development.

3 GAS PROTECTIVE MEASURES

3.1 The gas protection measures recommended by Sirius were as follows;

3.2 Gas protection measures in line with Characteristic Situation 2 (in accordance with BS8485: 2015 + A1: 2019) and radon protection in accordance with BR211 (2023) "Guidance on Protective Measures for New Buildings" are required for all plots at the site.

This will require the use of a precast concrete floor with underlying passively ventilated sub-floor void. A typical construction detail is presented in Appendix 4.

A proprietary carbon dioxide, methane and radon resistant membrane is required to be included in the substructure of all plots. This should also protect against Volatile Organic Compounds (VOC). Visqueen Gas and Radon Barrier Membrane is recommended to be a suitable product for this site. An equivalent product from an alternative supplier may be considered, but should be approved by the Engineer before use. The Local Authority and warranty provider may also wish to approve the membrane prior to installation.

The membrane should be pulled taut across the plot and lapped and sealed to the gas resistant damp proof course which should extend across the wall cavities. Gas proof products should be used to fully seal the membrane at overlaps and around service entries. The products used and installation should be in accordance with the manufacturer's recommendations.

3.3 Characteristic Situation 2 (CS2) is essentially equivalent to the NHBC's Traffic Light Classification of **Amber 1.**

3.4 In respect of the gas membrane, Juta GP1 has been chosen by the Contractor. The membrane meets the requirements of BS8485 2015 + A1 2019 "Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings", and BR211 (2023) Radon: Guidance on Protective Measures for New Buildings, as follows. Full details are given in the British Standard and the Technical Datasheet is given in Appendix in Appendix 3.

- *sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m^2/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method;*

- *sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;*

- *sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab);*

- *sufficiently strong to withstand the installation process and following trades until covered, e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc;*

- *capable, after installation, of providing a complete barrier to the entry of the relevant gas; and*

- *verified in accordance with CIRIA C735 [N1].*

3.5 The installation is being carried out by Keytec Installation Services, Cowm Top Business Park, Rochdale, 0L11 2PU, and is in accordance with the YALPAG document Appendix 1 - Requirements for Installation. The installation is being validated by GeoShield Limited, Icon Business Centre, 4100 Park Approach, Thorpe Park, Leeds.

3.6 The site manager shall provide instruction to all relevant site personnel of the gas protection measures and the importance that these measures are not disturbed or damaged. Following installation of the measures, access to them shall be restricted until such time that the protection measures have been inspected and subsequently covered over.

4 VERIFICATION REQUIREMENTS FOR GAS PROTECTION MEASURES

4.1 The verification requirements are set out in the Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) document "Verification Requirements for Gas Protection Systems - Technical Guidance for Developers, Landowners and Consultants", Version 1.1 - December 2016, and presented in Appendix 2.

On completion of the installation of the gas protection measures for each plot, the following procedures for verification must be followed, in line with YALPAG requirements and CIRIA C735, namely;

- The Verifier (consultant to conduct thorough verification (visual) inspection of first plot. Subsequent inspections carried out at approximately frequency of 1 in 10 plots (minimum 5). The Contractor to supply sign-off sheets (verification evidence) including photographs for all other plots. Consideration shall be given to need for/scope of integrity testing is concerns identified by visual inspections.

- A suitably qualified and experienced independent individual should oversee and verify the installation. This may include the Engineer;

- The above individuals shall ensure that component specification and installation for all the plots comply with both the manufacturer's guidelines/instructions and this strategy.

- All components of the agreed gas protection system (set out in Sections 2 and 3) have been subject to verification by way of visual inspection. Evidence in the form of a checklist of YALPAG guidance, Appendix 2 will be required and shall

itemise the specification and inspection of all the individual gas protection components and their correct installation to all the plots;

- Photographic evidence clearly illustrating the points on the checklist and correct installation of the gas protection components shall be required.

4.2 A report should be prepared to demonstrate how the gas protection measures have been installed for each plot and what verification information has been provided to demonstrate the installation has been carried out in accordance with the appropriate guidance.

4.3 As a minimum, the Verification Report for each of the plots should include (but not be limited to):

- Any formal qualifications/experience/training of the general builder carrying out the installation.

- Formal qualifications/experience/training of the persons carrying out the verification of the void and telescopic vents, and the person carrying out the verification of the membrane (namely the Consultant).

- Clear demonstration of the independence of the Consultant carrying out the verification.

- The manufacturer's specification of the gas protection membrane to be used.

- Details of how any non-conformance will be dealt with.

- Timeline of when during the build, each of the gas protection measures have been installed.

- Details of management measures proposed to ensure how damage to the membrane will be prevented prior to the floor being installed and post installation.

- Details of how all relevant site personnel will be made aware of the presence of the membrane and that damage to the membrane must be prevented.

- Details of the extent of overlap and method of sealing (these must be in line with manufacturer's instructions and evidence provided).

- Confirmation with a signed (plot specific unless agreed otherwise) statement confirming that the gas protection measures for each plot were installed as agreed and that the membrane was free from tears and punctures and was lapped and sealed as agreed as joins and around services and sub-floor voids were clear and free from debris will be included in the Verification Report.

- Confirmation with plot specific photographs showing the installed membrane will be included in the Verification Report. This shall cover all the plots.

A D Joyce

BSc MSc ARSM CEng CGeol CEnv MICE FGS SiLC SQP

August 2025

Procedure Notes

The desk study and/or ground investigation have been carried out using reasonable skill and care in accordance with the principles of Ground Investigation and Testing", BS5930: 2013 and BS10175: 2011 + A1: `2013, and the terms of the client's brief. The report has been prepared for the specific purposes notified at the time of the initial enquiry.

By its very nature any ground investigation only encounters and samples a small percentage of the ground. Consequently changes in ground conditions and soil properties can occur between any two exploratory points, for example local features such as soft ground, pockets of contamination and faults. This is also true of the exploration of mineworkings and such features can extend beneath parts of the site not investigated. Unrecorded bell pits and shafts can also exist between exploratory points. The ground investigation is designed to minimize such risks. Conclusions and recommendations are based on the information presented in this report, but unforeseen features may exist. No liability can be accepted for conditions not revealed by the exploratory holes. Therefore, actual ground conditions shall be noted during construction and further advice sought if they differ from those predicted. Michael D. Joyce LLP reserves the right to amend the conclusions and recommendations in the light of further information. Actual methods of construction or alternative designs shall be notified to Michael D. Joyce Associates LLP, such that the recommendations made can be reconsidered in the light of any changes.

Further investigation can be carried out to further reduce uncertainty and risk but ultimately these risks cannot be eliminated. Similarly a desk study normally only considers readily available information and further information could be held by other sources. In commissioning further research or investigation the cost/benefit of doing so must be considered.

It is assumed that groundlevels shall not change significantly from those at present. The groundwater conditions are based on observations made at the time of the investigation, unless stated otherwise. It shall be noted that the observations are subject to the method of the boring or excavation and that groundwater levels shall vary due to seasonal or other effects.

Where buildings are present on a site, structural and asbestos surveys have not been carried out, unless specifically stated. An Unexploded Ordnance Survey has not been carried out unless specifically stated. In relevant situations it would be prudent to commission such surveys.

Where information has been obtained from Third Parties, no liability can be accepted for the accuracy or completeness of this information. Where anecdotal evidence or speculations are presented, they must be treated as such and cannot be relied upon.

APPENDIX 1

Proposed Development Plan

Notes:

This drawing, design and concept are copyright of STEN Architecture.

All Dimensions are to be verified on site before any work commences. If any discrepancies, errors or emissions are noted, these are to be reported to STEN Architecture immediately.

If any other drawings are referenced within this layout, please refer to the specific detailed drawing for design, materials and specific working practices.

PLANNING LAYOUT KEY:

Boundary treatments (see separate drawing for details)

- Bin collection point (bin collection day only)
- Secure 6ft (length) x 2ft (width) x 4ft (height) timber cycle store on 8no. 450sq.flags (900mm x 1800mm). Dwellings with garages to have bicycle hook within for storage.
- Bin storage area on 6no. 450sq.flags (900mm x 1350mm)
- Wall mounted - Mode 3, Type 2, 7kW Electric Vehicle Charging Point
- Post mounted - Mode 3, Type 2, 7kW Electric Vehicle Charging Point

REV:	DESCRIPTION:	BY:	DATE:
S	Gate to rear garden of plot 3 leading onto Marsden Street introduced. Bin storage area serving plot 3 repositioned. Both as per clients comments.	LS	18.04.24
R	Bin storage areas updated as per clients comments.	LS	18.04.24
Q	Title boundary line amended. Rear boundaries of plots 15-20 amended to meet title boundary. Both as per clients comments.	LS	10.04.24
P	Rear boundaries of plots 1-4, 7, 24 & 27-30 amended to meet title boundary as per clients comments.	LS	02.04.24
N	plot 09 moved east by 0.5m	BMS	21.06.23
M	'Puttenham' house type renamed as 'Newbury'	BMS	23.03.23
L	EV charging point locations added	BMS	15.03.23
K	Tweaks to bin and cycle store positions as per client mark up	BMS	10.01.23
J	Cycle stores, bin store areas and patios added. Central path added between parking spaces.	BMS	06.01.23
H	'AS' and 'OP' notes added to blocks, 1747 type handing corrected and side door added. Plot 1 amended to client's comments.	DS	08.11.22
G	Bin collection point serving plots 30-34 relocated closer to adoptable highway as per clients comments.	LS	20.07.22
F	Turning head serving plots 12-15 amended., positions of plots 12 and 14 amended to suit. Knee railing introduced to edge of turning head. All as per clients comments.	LS	01.07.22
E	Garage for plot 1 moved away from Saville Road. Plots 35-37 re-orientated to enable adjacent road to be reduced to private drive. Plots 33-34 moved forward to reduce height of retaining walls at rear. Other minor updates to Planning Officer comments.	BMS	17.06.22
D	Green walls moved back from footpath	BMS	31.03.22
C	Semi detached plots handed so entrance doors are on the high side	BMS	24.03.22
B	Plots to Saville Road amended to provide more rontage and opportunities for landscaping. Detached Osbourne removed. Additional footpaths and visitor parking added	BMS	18.03.22
A	Parking arrangement amended for plot 45	BMS	25.11.21

LOVELL

Client	LOVELL
Project	Skelmanthorpe
Job Number	CAD

STEN ARCHITECTURE

Type	Floor Area Sq Ft	Bed	Total Units	Total	% Used
OPEN MARKET					
3 BEDS					
Lansdown	898	3	7	6286	15.2
Lansdown detached	898	3	2	1796	4.3
Newbury semi	1016	3	1	1016	2.2
Newbury detached	1016	3	4	4064	8.7
Osbourne	1205	3	13	15665	28.3
					58.7
4 BEDS					
Tattenham	1530	4	7	10710	15.2
Grassington	1747	4	12	20964	26.1
					41.3
Total			**46**	**60501**	

	ACRES	Hectares
Approx gross area	4.6	1.86
Approx nett area	3.78	1.53
Coverage per Acre	**16006**	**30**

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Linkedin: Sten Architecture

CLIENT: LOVELL PARTNERSHIPS

SITE: Greenside Mills
Skelmanthorpe

TITLE: Planning Layout

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:500	29.09.21	BMS	--

PROJECT NO:	DRAWING NO:	REVISION:
2156	2156.01	S

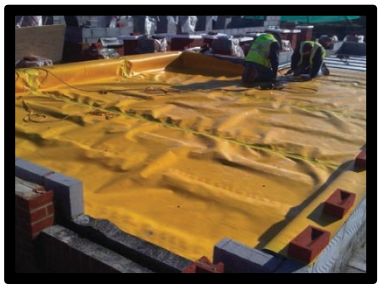
N

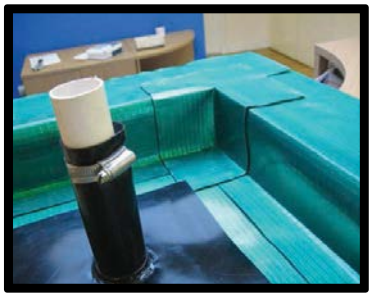
Scaled @ 1:500

0 10m 20m 50m

APPENDIX 2

Verification Requirement for Gas Protection Systems
YALPAG Version 1.1 December 2016





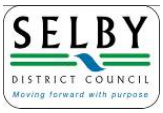
VERIFICATION REQUIREMENTS FOR GAS PROTECTION SYSTEMS

Technical Guidance for Developers, Landowners and Consultants

Yorkshire and Lincolnshire Pollution Advisory Group

Version 1.1 – December 2016

The purpose of this guidance is to promote consistency and good practice for development on land affected by contamination. The Local Planning Authorities in Yorkshire, Lincolnshire and the North East of England who have adopted this guidance are shown below:



Contents Page

Disclaimer

This guidance is intended to serve as an informative and helpful source of advice. It is intended to review this guidance annually, but readers must note that legislation, guidance and practical methods are inevitably subject to change and therefore should be aware of current UK policy and best practice. This note should be read in conjunction with prevailing legislation and guidance, as amended, whether mentioned here or not. Where legislation and documents are summarised this is for general advice and convenience, and must not be relied upon as a comprehensive or authoritative interpretation. Ultimately it is the responsibility of the person/company involved in the verification of land contamination to apply up-to-date working practices and requirements.

Acknowledgments

The authors and YALPAG would like to specifically acknowledge and thank CIRIA for the permission to use sections, including tables and photographs, of the CIRIA C735 document. Mallett, H, Cox (nee Taffel-Andureau), L, Wilson, S, Corban, M (2014) *Good practice on the testing and verification of protection systems for buildings against hazardous ground gases*, CIRIA, C735, London (ISBN: 978-0-86017-739-5). Go to: www.ciria.org

The author, Leeds City Council (Brad Hall, Julia Reynolds), would like to acknowledge the assistance provided by the following people and organisations: East Riding of Yorkshire Council, Doncaster Metropolitan Borough Council, Wakefield Council, Hugh Mallett of BuroHappold, Neil Salvage of PAGeotechnical and John Naylor of Ground-Gas Solutions.

Consultation

The YALPAG Local Planning Authorities were consulted over a four week period in 2015 during the production of this guidance. Consultation comments were considered by the review panel and a number of revisions were made to the guidance to reflect these comments.

Introduction

This guidance has been produced to help developers ensure that they can demonstrate that gas protection systems are appropriate for the development and level of risk associated with a site and that they have been installed correctly and can be relied upon to provide the required level of protection and ultimately demonstrate that, in terms of gas risk, the development is suitable for use. It is intended to improve the quality of reports submitted to Local Planning Authorities on this matter and to give contractors/consultants a point of reference to obtain approval for such work from their client.

The verification of gas protection systems should be an integral part of remediation and agreed between developers and Local Planning Authorities at an early stage in the development.

Failure to comply with this guidance may result in delays to the development. Relevant planning conditions cannot be discharged until the Local Planning Authority is satisfied appropriate verification has been undertaken to confirm that the development is safe.

Available UK guidance regarding gas risk assessment includes:

- CIRIA C665 Assessing risks posed by hazardous ground gases to buildings;
- NHBC Report Edition No: 4 Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present;
- BS 8485:2015 Code of practice for the design of proactive measures for methane and carbon dioxide ground gases for new buildings.

In particular, readers of this document should refer to the detailed guidance on verification published by CIRIA (CIRIA C735 Good Practice on the testing and verification of protection systems for buildings against hazardous ground gases, 2014). This guidance note should be considered as supplementary advice to be used in conjunction with these documents.

This document does not cover risks associated with radon. Please contact individual Local Planning Authority for further information.

The following YALPAG technical guidance documents for developers, landowners and consultants are also available;

- Verification Requirements for Cover Systems.
- Development on Land Affected by Contamination.

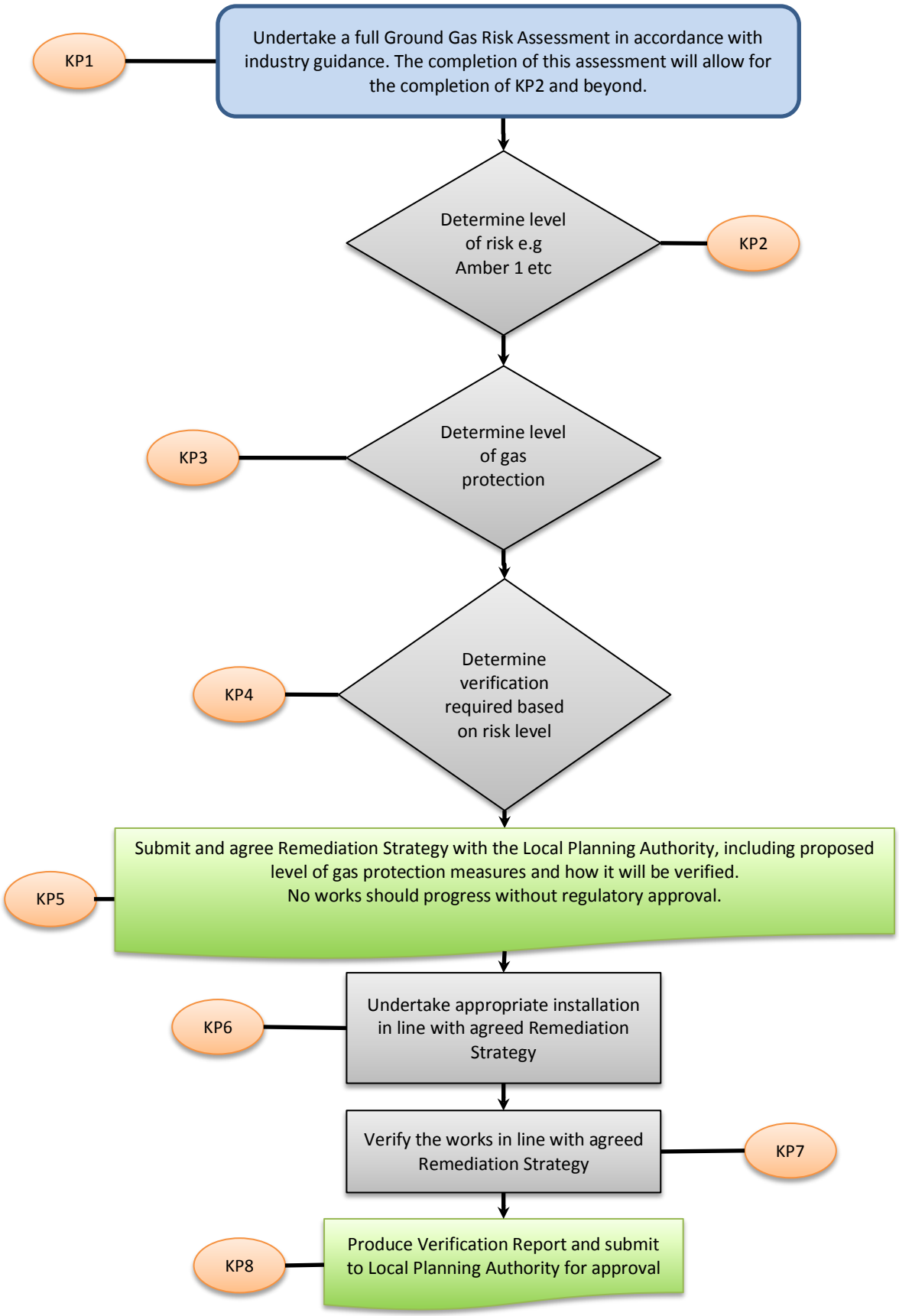
The Process of Verification

Implementation and verification plans for gas protection systems should always be site specific and based on the gas risk assessment and conceptual site model (CSM) for the site in question.

For gas protection systems, acceptable verification will normally comprise the provision of clear evidence that the level of protection is appropriate to the established risk and has been installed by suitably experienced personnel in line with the manufacturer's instructions and appropriate guidance. Critical factors to be considered are:

- What should be installed?
- How should it be installed?
- Who should install it?
- How will correct installation be demonstrated?

Overview Flowchart



Key Points

KP1 Ground Gas Risk Assessment	Undertake an appropriate gas risk assessment for the site in accordance with industry guidance*. On completion of the risk assessment and the generation of the appropriate Gas Screening Value (where required) and on a full understanding of the gas regime/ CSM, move to KP2 to determine the level of risk for the site. **Where the desk study has identified the need for gas monitoring to be carried out it would always be **expected** that site specific gas monitoring data would be used in the gas risk assessment.*
KP2 Level of Risk	The level of gas risk needs to be determined by using the appropriate gas guidance document/s relative to the development (e.g. low rise housing, residential apartment blocks with areas of public open space, commercial or public buildings etc). For example Amber 1 (Low rise housing) equates to Low Risk in Table A1 CIRIA 735. Once the level of risk has been determined move to KP3 and determine the appropriate level of gas protection.
KP3 Level of Gas Protection	The level of gas protection should be based on the level of risk established by the gas risk assessment and CSM. It should provide the appropriate gas protection for the ***lifetime of the development***. Detailed specification of gas protection measures in accordance with appropriate guidance to include (but not be limited to): • Submission of appropriate drawings (site specific plans and details to clearly show where the measures will be installed and how they fit into the design of the building and foundations). • Full written description of the protection measures to be included. • Detailed justification of the protection measures being used along with reference to the guidance document(s) being used.
KP4 Level of Verification Required	The level of qualification and experience of the installer will determine the level of verification required. Verification should always be carried out by an appropriate independent person such as an experienced and suitably trained verification consultant or third party qualified **and** experienced installer (see KP6). **See Appendix 1 for full details of verification requirements for installation of gas protection measures and the associated verification requirements.**

KP5 Submission and Agreement of Remediation Strategy	No installation of gas protection measures should be carried out at the site until the full details (KP1 to KP4) have been approved by the Local Planning Authority and formalised in an agreed Remediation Strategy (including Verification Plan). The Remediation Strategy, incorporating the detailed Verification Plan, should include (but not be limited to): • A summary of the ground gas risk assessment. • The gas protection measures proposed. • Who will undertake the installation including levels of experience and/ or qualifications. • How the works will be verified/ tested and by who. • How the works will be reported to the Local Planning Authority. **See Appendix 2 for details of Remediation Strategy requirements.**
KP6 Installation of Gas Protection	Installation should only be done once the Remediation Strategy has been agreed with the Local Planning Authority and should be carried out in line with the agreed Remediation Strategy. Any deviation away from the agreed Remediation Strategy should be agreed in writing with the Local Planning Authority prior to commencement of installation. **See Appendix 4 for examples of good and poor gas protection installation.**
KP7 Verification of Gas Protection	The verification of the gas protection measures should be undertaken in accordance with the Verification Plan set out in the agreed Remediation Strategy. Any deviation to works away from the agreed Remediation Strategy should be agreed in writing with the Local Planning Authority prior to installation. **See Appendix 5 for an example Verification proforma.**
KP8 Submission of Verification Report	The Verification Report must be produced in line with the agreed Remediation Strategy and Verification Plan. All aspects of the Remediation Strategy must be addressed in the Verification Report along with full details and justification of any deviation. **See Appendix 3 for details of the required contents of the Verification Report. Please note, the required contents should be agreed within the submitted and approved Remediation Strategy at KP 5.**

Appendix 1 – Requirement for Installation and Verification

Copied directly from Annex 1 CIRIA C735

Mallett, H, Cox (nee Taffel-Andureau), L, Wilson, S, Corban, M (2014) Good practice on the testing and verification of protection systems for buildings against hazardous ground gases, CIRIA, C735, London (ISBN: 978-0-86017-739-5). Go to: www.ciria.org

The tables in this appendix should be used for guidance only and are not intended to be used in lieu of sound professional judgment, which should take into account the risk factors affecting the development (the gas regime, the number of buildings, the complexity of design, and the expertise of the installation workforce) on a site-specific basis. The tables should not be used independent of, and without reference to, the accompanying text in the main guide C735.

Situation A – all development types except situation B – non reinforced slabs (from Wilson et al, 2007)

Gas regime/risk	Slab type	Installer experience	Suggested levels of verification and integrity testing
Low risk CS2 (*with venting) Basic radon protection area	Non reinforced All slabs	General builder/ groundworker/ landfill operative (no relevant qualification[1])	Verifier (consultant[4] or qualified and experienced installer[1]) to conduct a thorough verification (visual) inspection prior to all concrete pours. Contractor to supply sign off sheets (verification evidence) including photographs to independent verifier.
		Qualified[1] and experienced installer (minimum one operative to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer) to conduct a thorough verification (visual) inspection prior to 25 to 50 per cent of concrete pours (min one visit). Installer to supply sign off sheets (verification evidence) including photographs to independent verifier for all other pours.
Intermediate risk CS2 (no venting) or CS3 (*with venting) Full radon protection area		General builder/ groundworker/ landfill operative (no relevant qualification[1])	Verifier (consultant[4] or qualified and experienced installer[1]) to conduct a thorough verification (visual) inspection prior to all concrete pours. All joints, pipe penetrations etc independently air lanced to ASTM D4437. Contractor to supply sign off sheets (verification evidence) including photographs to verifier. Consideration given to need for/scope of integrity testing (eg initially on say 25 to 50 per cent of pours then falling to 10 to 25 per cent if acceptable results obtained and no concerns raised by visual inspections).
Gas regime/risk	**Slab type**	**Installer experience**	**Suggested levels of verification and integrity testing**
Intermediate risk CS2 (no venting) or CS3 (*with venting) Full radon protection area	Non reinforced All slabs	Qualified[1] and experienced installer (minimum one operative to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer[1]) to conduct a thorough verification (visual) inspection prior to 25 to 50 per cent of concrete pours (min two visits). 25 per cent all joints, pipe penetrations etc independently air lanced to ASTM D 4437. Remaining 75 per cent joints, pipe penetrations etc tested to recognised standard by installer (as detailed in method statement/CQA plan). Installer to supply sign off sheets (verification evidence) to verifier for all other pours. Consideration given to need for/scope of integrity testing (eg initially on 10 to 25 per cent of pours then falling to 0 to 10 per cent if acceptable results obtained and no concerns raised by visual inspections).
High risk VOCs etc CS3 (no venting) or CS4 and above (*with venting)		Qualified[1] and experienced installer (50 per cent of operatives to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer[1]) to conduct a thorough verification (visual) inspection prior to all concrete pours. All joints, pipe penetrations independently air lanced to ASTM D 4437. Installer to supply sign off sheets (verification evidence) to verifier for all pours. Consideration given to need for scope of integrity testing (eg initially on 25 to 50 per cent of pours then falling to 10 to 25 per cent if acceptable results obtained and no concerns raised by visual inspections).

Notes

* Assumes venting designed to keep steady state concentration of CH4 below one per cent in void, sites designed with higher levels of gas in the void should adjust the frequency of inspection and testing as appropriate

1 Relevant qualification is NVQ Level 2 in gas protection installation (see Section 3.3).

2 Before works start the contractor should produce a detailed installation plan including method statement, CQA procedures and qualifications, on receipt of these the verification protocol could be increased or reduced.

3 Consideration should be given to carrying out leak detection (ie smoke, tracer gas or dielectric testing) on the first plots on higher end sites CS3 and above. If an unacceptable amount of holes are found during these tests then the verification consultant should discuss with the relevant personnel, strategies to prevent this occurring, these could include changing material, improving subgrade preparation, putting up warning signs to reduce the amount of trafficking etc.

4 Verification consultant should be competent, experienced and suitably trained (see Section 3.2). A statement detailing their qualifications and relevant experience should be included in the verification plan.

5 Air lancing is the only integrity test that has an independently recognised international standard that is suitable for testing taped and welded seams.

Situation A – all development types except situation B – reinforced slabs (from Wilson et al, 2007)

Gas regime/risk	Slab type	Installer experience	Suggested levels of verification and integrity testing
Low risk CS2 (*with venting) Basic radon protection area	Reinforced All slabs	General builder/ groundworker/ landfill operative (no relevant qualification[1])	Verifier (consultant[4] or qualified and experienced installer[1]) to conduct a thorough verification (visual) inspection prior to all concrete pours. Contractor to supply sign off sheets (verification evidence) including sub grade acceptance forms and photographs to independent verifier.
		Qualified[1] and experienced installer (minimum one operative to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer[1]) to conduct a thorough verification (visual) inspection prior to 25 per cent concrete pours (min two visits), including vented void, subgrade etc. Installer to supply sign off sheets (verification evidence) including, sub grade acceptance forms, photographs to independent verifier for all other pours.
Intermediate risk CS2 (no venting) or CS3 (*with venting) Full radon protection area		General builder/ groundworker/ landfill operative (no relevant qualification[1])	Verifier (consultant[4] or qualified and experienced installer[1]) to conduct a thorough verification (visual) inspection prior to all concrete pours including vented void, subgrade etc. All joints, pipe penetrations etc independently air lanced to ASTM D4437. Consideration given to the need for and scope of integrity testing (eg initially on say 50 to 25 per cent of pours then falling to 25 to 10 per cent if acceptable results obtained and no concerns raised by visual inspections.
		Qualified[1] and experienced installer (minimum one operative to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer[1]) to conduct a thorough verification (visual) inspection prior to 50 per cent of concrete pours, including vented void, subgrade etc 25 per cent of joints, pipe penetrations etc independently air lanced to ASTM D4437. Remaining joints, pipe penetrations, corners etc tested to a recognised standard by installer (as detailed in method statement and CQA plan). Installer to supply sign off sheets (verification evidence) including, sub grade acceptance forms, photographs etc to independent verifier for all other pours. Consideration given to need for/scope of integrity testing (eg initially on 10 to 25 per cent of pours then falling to 0 to 10 per cent if acceptable results and no concerns raised by visual inspections).
High risk VOC and hydrocarbons CS3 (no venting) or CS4 and above (*with venting)		Qualified[1] and experienced installer (50 per cent of operatives to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer[1]) to conduct a thorough verification (visual) inspection prior to all concrete pours including vented void, subgrade etc. All joints, pipe penetrations etc independently air lanced to ASTM D4437. 100 per cent leak detection considered on VOC/ hydrocarbon contaminated sites.. Consideration given to need for/scope of integrity testing (eg initially on 50 to 25 per cent of pours then falling to 25 to 10 per cent if acceptable results obtained and no concerns raised by visual inspections).

Notes

* Assumes venting designed to keep steady state concentration of CH4 below one per cent in void, sites designed with higher levels of gas in the void should adjust the frequency of inspection and testing as appropriate.

1 Relevant qualification is NVQ Level 2 in gas protection installation (see Section 3.3).

2 Before works start the contractor should produce a detailed installation plan including method statement, CQA procedures and qualifications, on receipt of these the verification protocol could be increased or reduced.

3 Consideration should be given to carrying out leak detection (ie smoke, tracer gas or dielectric testing) on the first plots on higher end sites CS3 and above. If an unacceptable amount of holes are found during these tests then the verifier should discuss with the relevant personnel, strategies to prevent this occurring, these could include changing material, improving subgrade preparation, putting up warning signs to reduce the amount of trafficking etc.

4 Verification consultant should be competent, experienced and suitably trained (see Section 3.2). A statement detailing their qualifications and relevant experience should be included in the verification plan.

5 Air lancing is the only integrity test that has an independently recognised international standard that is suitable for testing taped and welded seams.

6 Where a sufficiently robust protection layer (protection fleece, protection boards or insulation) are laid directly on the membrane, inspection after placement of the reinforcement should not be necessary.

Situation B – low rise housing with ventilated void (from NHBC and Wilson et al, 2007)

Gas regime/risk	Slab type	Installer experience	Suggested levels of verification and integrity testing
Low risk Amber 1	All slabs with min 150 mm ventilated sub floor void	General builder/ groundworker/ landfill operative (no relevant qualification[1])	Verifier (consultant[4] or qualified and experienced installer[1]) to conduct thorough verification (visual) inspection of first plot and after placement of reinforcement if no protection provided. Subsequent inspections carried out at approx. frequency of 1 in 10 plots (minimum 5). Contractor to supply sign off sheets (verification evidence) including photographs for all other plots. Consideration given to need for/scope of integrity testing if concerns identified by visual inspections[3].
		Qualified[1] and experienced installer (minimum one operative to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer[1]) to conduct thorough verification (visual) inspection of first plot and after placement of reinforcement if no protection provided. Subsequent inspections carried out at approx. frequency of 1 in 20 plots. Contractor to supply sign off sheets (verification evidence) including photographs for all other plots. Consideration given to need for/scope of integrity testing if concerns identified by visual inspections[3].
Intermediate risk Amber 2		General builder/ groundworker/ landfill operative (no relevant qualification[1])	Verifier (consultant[4] or qualified and experienced installer[1]) to conduct thorough verification (visual) inspection of first 10 plots and after placement of reinforcement if no protection provided. All joints, pipe penetrations etc air lanced to ASTM D4437. Subsequent inspections (including air lancing) carried out at approx. frequency of 1 in 20 plots Contractor to supply sign off sheets (verification evidence) including photographs for all other plots. Consideration given to need for/scope of integrity testing (eg initially on 30 to 50 per cent of plots then falling to 0 to 10 per cent of plots if acceptable results obtained and no concerns raised by visual inspections).
		Qualified[1] and experienced installer (minimum one operative to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer[1]) to conduct thorough verification (visual) inspection of the first 5 plots and after placement of reinforcement if no protection provided. All joints, pipe penetrations etc air lanced to ASTM D4437. Subsequent inspections (including air lancing) carried out at a frequency of about 1 in 20 plots. Contractor to supply sign off sheets (verification evidence) including photographs for all other plots. Consideration given to need for/ scope of integrity testing (eg initially on 10 to 25 per cent of plots then falling to 0 5 per cent of plots if acceptable results obtained and no concerns raised by visual inspections)[3].
High risk Red VOC and hydrocarbons		Qualified[1] and experienced installer (all operatives to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer[1]) to conduct thorough verification (visual) inspection of all plots, and after placement of reinforcement if no protection provided. All joints, pipe penetrations etc air lanced to ASTM D4437. Consideration given to need for/scope of integrity testing (eg initially on 30 to 50 per cent of plots then falling to 0 to 10 per cent of plots if acceptable results obtained and no concerns raised by visual inspections)[3].

Notes

* Gas regime defined by characteristic situation as set out by Wilson *et al* (2007), and all other recent good practice guidance and British Standards.

** Assumes venting designed to keep steady state concentration of CH4 below one per cent in void, sites designed with higher levels of gas in the void should adjust the frequency of inspection and testing as appropriate.

1 Relevant qualification is NVQ Level 2 in gas protection installation (see Section 3.3).

2 Before the works start the contractor should produce a detailed installation plan including method statement, CQA procedures and qualifications, on receipt of these the verification protocol could be increased or reduced.

3 Consideration should be given to carrying out integrity testing/leak detection (ie smoke, tracer gas or dielectric testing) on the above basis and/or if an unacceptable amount of damage/loss of integrity is found during visual inspections. In this instance the consultant should discuss with the relevant personnel, strategies to prevent this recurring. This could include changing material, improving subgrade preparation, putting up warning signs to reduce the amount of trafficking etc.

4 Verification consultant should be competent, experienced and suitably trained (see Section 3.2). A statement detailing their qualifications and relevant experience should be included in the verification plan.

5 Air lancing is the only integrity test that has an independently recognised international standard suitable for testing taped and welded seams and should be used at the frequency suggested in the table.

Appendix 2 – Remediation Strategy and Verification Plan for Gas Protection Systems

The Remediation Strategy should include a detailed verification method statement. This should address how the gas protection measures will be installed and what verification information will be provided to demonstrate the installation has been carried out in accordance with the appropriate guidance.

As a minimum the report should include (but not be limited to):

- A summary of the gas risk assessment.
- The gas protection measures proposed (including reference to the appropriate guidance documents) and confirmation they will meet the gas protection requirements for the lifetime of the development.
- Technical drawings showing how the gas protection measures will be incorporated.
- Formal qualifications/experience/training of the person carrying out the installation.
- Formal qualifications/experience/training of the person carrying out the verification.
- Clear demonstration of the independence of the person carrying out the verification.
- The manufacturer's specification of the gas protection membrane to be used.
- Full details of what the verification process will comprise and at what stage verification will be carried out.
- Details of how any non-conformance will be dealt with.
- Details of the number of plots to be validated. (Deviation from verification of every plot will need to be justified and agreed with the Local Planning Authority in line with Appendix 1 of this document).
- Timeline of when during the build, each of the gas protection measures will be installed.
- Details of management measures proposed to ensure how damage to the membrane will be prevented prior to the floor being installed, post installation.
- Details of how **all** site personnel (including follow on trades) will be made aware of the presence of the membrane and that damage to the membrane must be prevented.
- Details of the extent of overlap and method of sealing (these must be in line with manufacturer's instructions and evidence provided).
- Confirmation that a signed (plot specific unless agreed otherwise) statement confirming that the gas protection measures were installed as agreed and that the membrane was free from tears and punctures and was lapped and sealed as agreed at joins and around services and sub floor voids were clear and free from debris will be included in the Verification Report.
- Confirmation that plot specific photographs showing the installed membrane will be included in the Verification Report.

Appendix 3 – Checklist for Gas Verification Reports

The Verification Report should include a summary of all the works undertaken, relating to gas protection measures including all elements detailed within the Remediation Strategy.

As a minimum the report should include (but not be limited to):

- Site details.
- Planning Application details.
- Summary of Gas Risk Assessment (including original CSM).
- Details of who carried out installation (qualifications/experience/training).
- Details of who carried out verification (qualifications/experience/training).
- Description of protection measures installed with reference to method statements and drawings and manufacturers specification of the materials used.
- Details of the verification inspection regime.
- Supporting information, plans, air vent installation, photographs, as built drawings.
- Summary of verification data (completed proformas, test results)
- Details of non-conformances and how they were rectified.
- Clear statement saying remedial objectives been achieved supported by lines of evidence including reference to CSM.
- Where necessary further works and/ or long term management.

Appendix 4 – Examples of Good and Poor Installation

Copied directly from Appendix A4 CIRIA C735

Mallett, H, Cox (nee Taffel-Andureau), L, Wilson, S, Corban, M (2014) Good practice on the testing and verification of protection systems for buildings against hazardous ground gases, CIRIA, C735, London (ISBN: 978-0-86017-739-5). Go to: www.ciria.org

GOOD PRACTICE PHOTOGRAPHS

Figure A4.7 *Geovent protruding out of the frontage of the unit. Gas membrane along the sides of the slab preventing lateral gas ingress (courtesy Alderburgh Group)*

Figure A4.8 *Geovent beneath the 2000g taped gas membrane lined up with collector pipes (courtesy Alderburgh Group)*

Figure A4.9 *On site schematics to aid construction workers build the gas protection system (courtesy Alderburgh Group)*

Figure A4.10 *Almost complete coverage available for inspection, minimal jointing, service entries suitable distance from walls, light traffic (courtesy Smith Grant)*

Figure A4.11 *Gas membrane continued through cavity wall and above air bricks (courtesy Hydrock)*

Figure A4.12 *Good edge detail across cavity (courtesy PAGeotechnical Ltd)*

Figure A4.13 Gas proof DPC adhered on top of gas membrane using butyl strips across cavity space (courtesy NHBC)

Figure A4.14 Good perimeter seal (courtesy PAGeotechnical Ltd)

Figure A4.15 LDPE type gas membrane overlap and double sided tape. Sand blinding to protect underside of gas membrane (courtesy A Proctor Group)

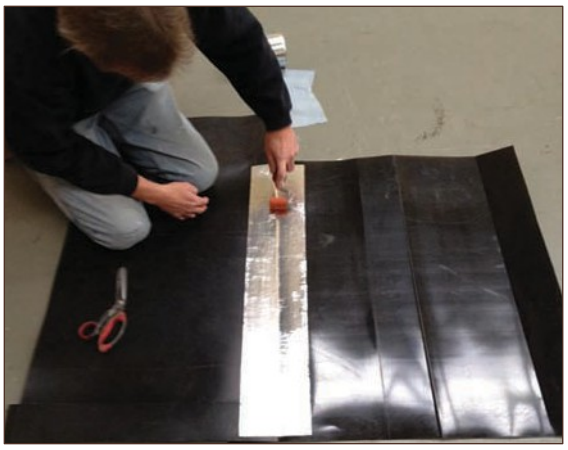


Figure A4.16 Example HDPE type gas membrane and steam roller used to ensure self-adhesive tape is correctly installed (courtesy A Proctor Group)

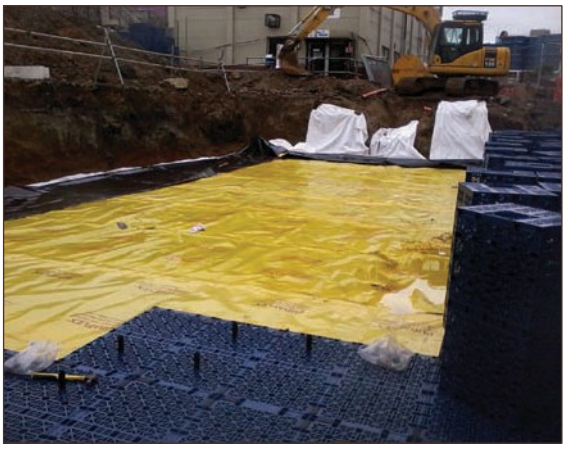


Figure A4.17 Gas membrane installed in attenuation tank (courtesy Industrial Textiles & Plastics Ltd)

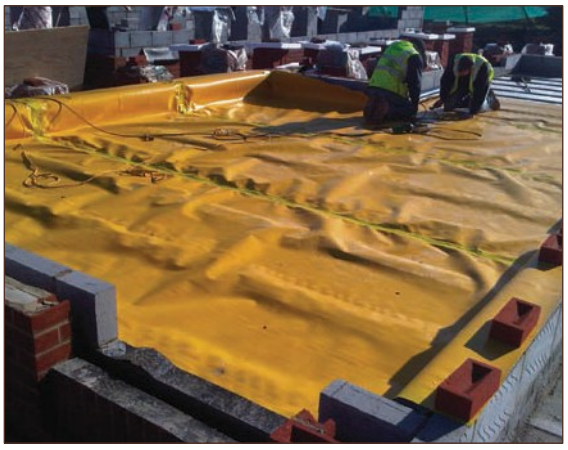


Figure A4.18 Gas membrane installed as part of foundation barrier (courtesy Industrial Textiles & Plastics Ltd)

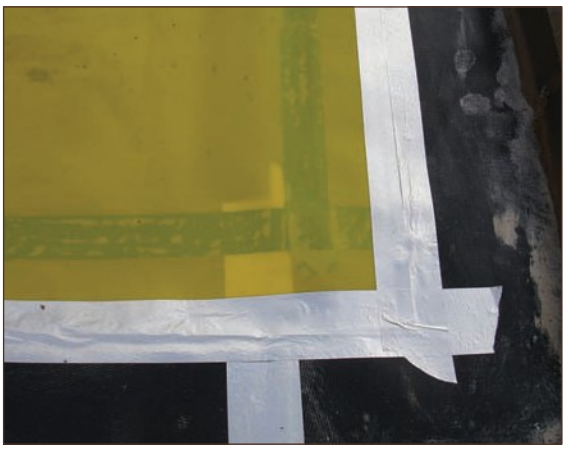


Figure A4.19 *Well-constructed joints with gas resistant DPC, lap and double sided butyl joints visible beneath semi-transparent gas membrane, secondary seal with proprietary single sided tape (courtesy Smith Grant)*

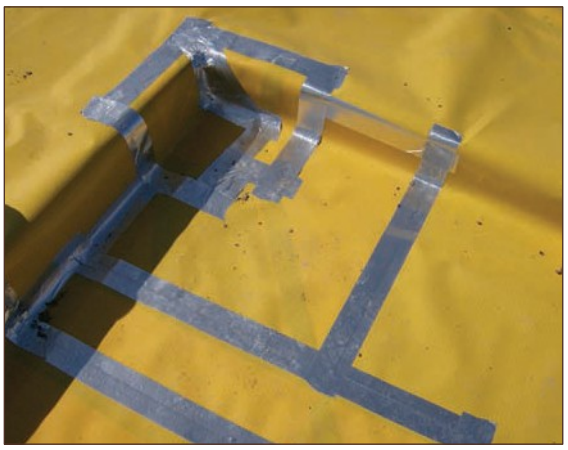


Figure A4.20 *A pre-formed corner unit would have been preferable as fewer joints would have been formed, however the installer has achieved a good level of workmanship in this corner detail (courtesy Smith Grant)*

Figure A4.21 *Good prefabricated corner detail (courtesy MEC Environmental Ltd)*

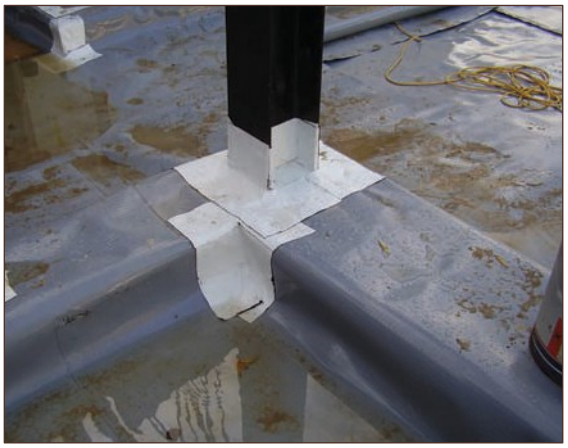


Figure A4.22 *Good detail around stanchion and corner (courtesy PAGeotechnical Ltd)*

Figure A4.23 *Complex column seal (courtesy PAGeotechnical Ltd)*

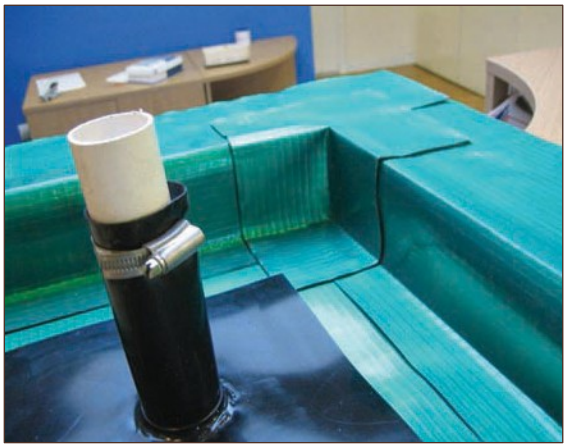


Figure A4.24 *Prefabricated corner detail and top hat (courtesy A Proctor Group)*

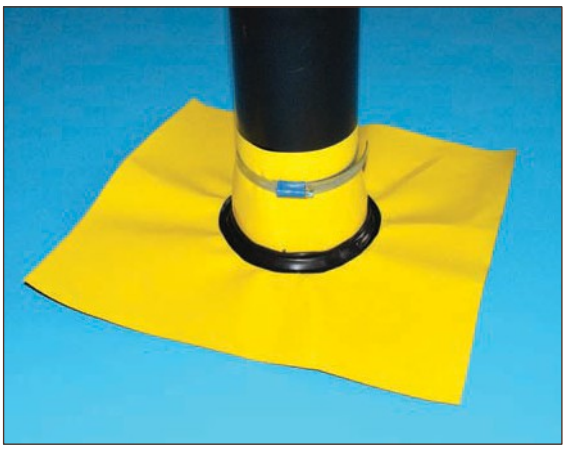


Figure A4.25 *Top hat around service entry (courtesy Industrial Textiles & Plastics Ltd)*

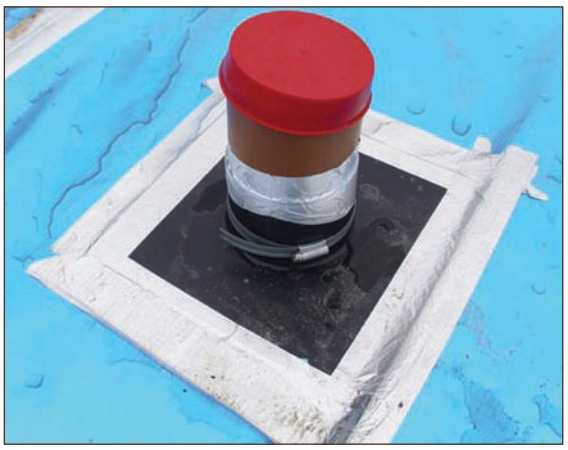


Figure A4.26 *Well-constructed service entry: top hat fits well with service pipe and taped down to gas membrane, secondary seal with proprietary single sided tape (courtesy Smith Grant)*

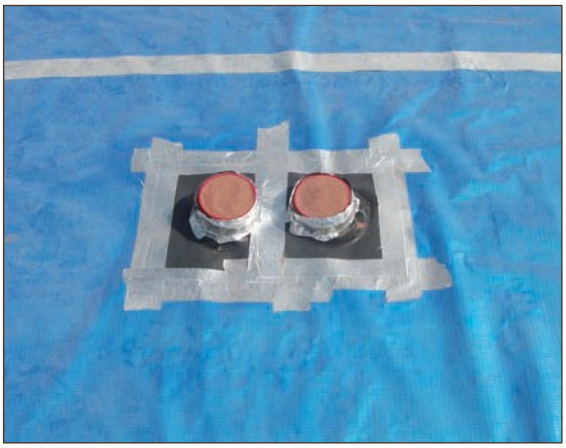


Figure A4.27 *Top hats placed around service entries secured with jubilee clip seals. Top hats secured to gas membrane with double sided butyl tape (courtesy Hydrock)*

Figure A4.28 *Bead of double sided butyl tape provided between interfaces of ID top hat and OD service pipe. When compressed with jubilee clip, forms an effective seal (courtesy Smith Grant)*

Figure A4.29 *Extrusion welding technique (courtesy Industrial Textiles & Plastics Ltd)*

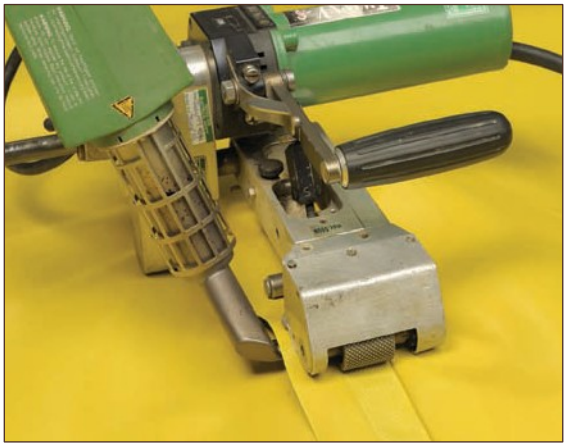


Figure A4.30 *Thermal welding technique (courtesy Industrial Textiles & Plastics Ltd)*

Figure A4.31 Extrusion welding (courtesy PAGeotechnical Ltd)

Figure A4.32 High quality installation of liquid gas membrane to lift pits, including resin gas protection on all screw penetrations (courtesy Card Geotechnics Limited)

A4.2.2 Good practice – passive venting systems

Figure A4.33 Good ventilation in internal sleeper walls, cast into prefabricated beams (courtesy Smith Grant)

Figure A4.34 Open void >300mm deep, good ventilation through internal sleeper walls (courtesy Smith Grant)

Figure A4.35 Good installation of passive gas venting trenches and 'egg-crate' (courtesy Card Geotechnics Limited)

Figure A4.36 Raised air bricks are preferable due to the reduced potential for blockade but the vent trench specified is provided with clean single sized stone (courtesy Smith Grant)

A4.2.3 Good practice – integrity testing

Figure A4.37 Tracer gas testing, whereby gas or smoke is applied under pressure beneath the installed gas membrane and detectors are used to screen for leaks above (courtesy NHBC)

Figure A4.38 Tracer gas testing (courtesy PAGeotechnical Ltd)

Figure A4.39 Scanning for leaks (courtesy PAGeotechnical Ltd)

Figure A4.40 CO_2 injection integrity testing (courtesy Landline Ltd)

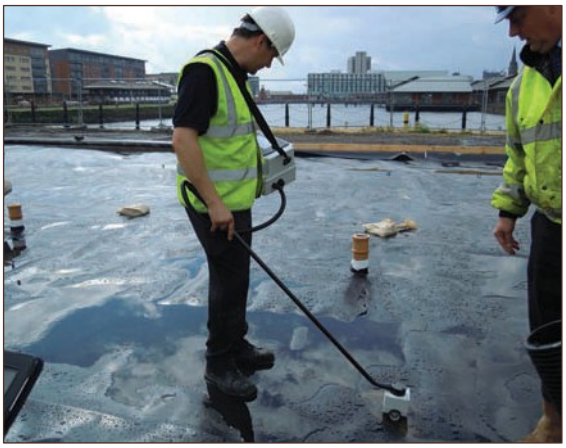


Figure A4.41 Small sand bags are marking holes made in the gas membrane used to check whether injected CO2 has worked its way beneath whole area (courtesy Landline Ltd)

Figure A4.42 Air pressure testing (courtesy GSE Environmental)

Figure A4.43 Dielectric porosity testing for housing scheme (courtesy NHBC)

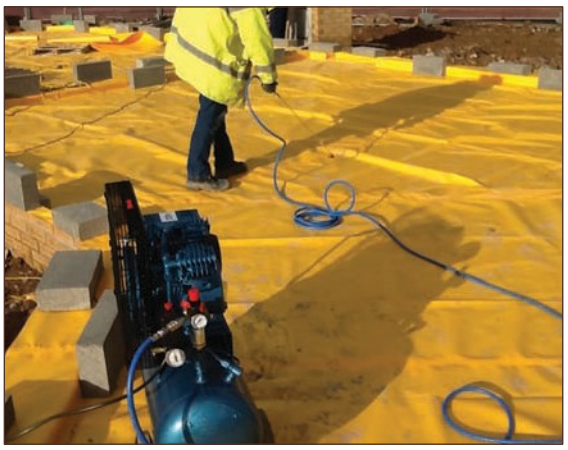


Figure A4.44 Air lance test, used to test the quality of welded seams along gas membrane joints (courtesy MEC Environmental Ltd)

Figure A4.45 Spark testing (courtesy GSE Environmental)

Figure A4.46 Testing a weld with 'dog bone' grips (courtesy MEC Environmental Ltd)

BAD PRACTICE PHOTOGRAPHS

Figure A4.47 Follow-on works purposefully penetrating gas membrane (courtesy Card Geotechnics Limited)

Figure A4.48 Loose nails and over construction debris likely to be left in place beneath gas membrane – poor preparation of gas membrane prior to sealing service penetration (courtesy Card Geotechnics Limited)

Figure A4.49 Lifted gas membrane at corner position. Light penetrating through confirms damage to aluminium internal core layer (courtesy NHBC)

Figure A4.50 Large/heavy/sharp objects being moved over unprotected gas membrane (courtesy Card Geotechnics Limited)

Figure A4.51 Gas membrane torn by reinforcement (courtesy MEC Environmental Ltd)

Figure A4.52 Gas membrane cut by scaffolders and bricklayers after installation (courtesy MEC Environmental Ltd)

Figure A4.53 Gas membrane left exposed for long period of time, shows significant fraying at cavity edge (courtesy NHBC)

Figure A4.54 Gas membrane damage/tearing at edge of ground floor slab screed layer where it was left exposed to elements for period of time (courtesy NHBC)

Figure A4.55 Gas membrane at stepped junction of slab to integral garage, appears to be susceptible to tearing when screed is poured. Screed may also weigh down on gas membrane if fitted too tight (courtesy NHBC)

Figure A4.56 Gas membrane at edge of concrete screed. Screed has been grinded to achieve desired levels, gas membrane shows extreme wear and damage as a result (courtesy NHBC)

Figure A4.57 Unprotected gas membrane damaged by heavy traffic (courtesy MEC Environmental Ltd)

Figure A4.58 Damage caused to gas membrane by follow-on trade who cut/shaped the dry lining board directly on the unprotected installed gas membrane (courtesy NHBC)

Figure A4.59 Gas membrane slit at the bottom of a cavity tray to enable water to drain away (courtesy Smith Grant)

Figure A4.60 Some stones could penetrate gas membrane if sufficient force is applied (courtesy Smith Grant)

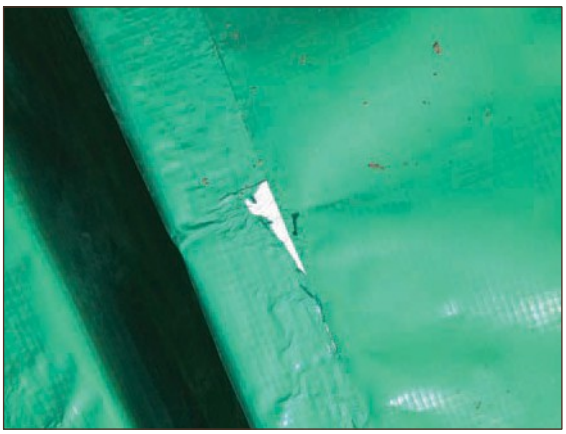


Figure A4.61 *'Stripping' occurs on gas membranes that contain aluminium foil. The foil gets too hot under the outer layer of LDPE or PP and the top layer of the gas membrane sticks to the roller which strips it off, leaving the aluminium completely exposed (courtesy MEC Environmental Ltd)*

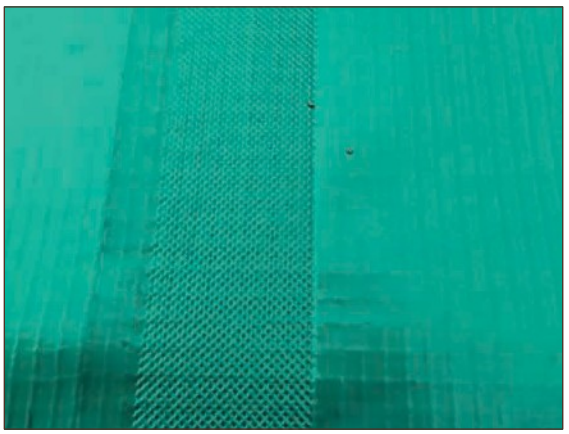


Figure A4.62 *Wedge weld on an LDPE aluminium gas membrane, where the installer used metal nip rollers. This destroyed the top layer and probably the bottom layer, leaving aluminium exposed between the weaves. This failed dielectric testing along all joints (courtesy MEC Environmental Ltd)*

A4.3.2 Bad practice – gas membranes installed incorrectly

Figure A4.63 *Absence of surface preparation prior to laying of gas membrane, debris likely to pierce gas membrane (courtesy Card Geotechnics Limited)*

Figure A4.64 *Insufficient length of gas membrane protruding through wall to overlap with gas membrane within building (courtesy Card Geotechnics Limited)*

Figure A4.65 *Wrinkling of gas membrane over joint has resulted in gaps (only visible due to the use of a transparent gas membrane) and the secondary seal uses ordinary gaffer tape rather than a proprietary product (courtesy Smith Grant)*

Figure A4.66 *Follow-on trades proceeded work before gas membrane joints sealed (courtesy Card Geotechnics Limited)*

Figure A4.67 *Traffic over mesh resulted in several punctures, in addition most joints were found to be poorly constructed. Taped joints are difficult to construct in adverse weather (courtesy Smith Grant)*

Figure A4.68 *A pre-formed corner unit would have been preferable. The installer could not produce sufficient quality despite the amount of tape applied (courtesy Smith Grant)*

Figure A4.69 *Attempt at corner detailing using non-proprietary duct tape (courtesy Smith Grant)*

Figure A4.70 *Inadequate corner detailing. The use of preformed proprietary products would have avoided such bad practice (courtesy NHBC)*

Figure A4.71 *No corner detailing leading to stress point on gas membrane (courtesy Smith Grant)*

Figure A4.72 *Joint between top hat and gas membrane has lifted due to poor fit and attempt to construct in very wet conditions (courtesy Smith Grant)*

Figure A4.73 *No bead of double sided butyl tape provided between interfaces of ID top had and OD service pipe: cannot be compressed enough to form seal (courtesy Smith Grant)*

Figure A4.74 *Gap between OD of service pipe and ID of top hat to large: cannot be compressed enough to form seal, even with the application of additional tape (courtesy Smith Grant)*

Figure A4.75 *Jubilee clip on service entry insufficiently tightened so joint is uncompressed (courtesy Smith Grant)*

Figure A4.76 *No double sided tape used in joints (courtesy Smith Grant)*

Figure A4.77 *Small lap and no single sided tape used to achieve secondary seal (courtesy Smith Grant)*

Figure A4.78 *Gap in jointing over wall cavity big enough to insert fist (courtesy Smith Grant)*

Figure A4.79 Gas membrane not continuous over internal wall. It had been deliberately cut open for unknown purpose (courtesy Smith Grant)

Figure A4.80 Column left unsealed (courtesy PAGeotechnical Ltd)

Figure A4.81 No seal to perimeter pipe (courtesy PAGeotechnical Ltd)

Figure A4.82 Gas membrane used to bridge cavity wall instead of DPC, leaving it exposed to damage by follow-on trades (courtesy Smith Grant)

Figure A4.83 Poor quality installation of liquid gas membrane. Liquid gas membranes come in two colours (black and white) allowing coverage of each coat to be easily assessed. Here the gas membrane has been spread too thinly and inconsistently. In addition, it appears to have been applied to a damp surface, causing blistering (courtesy Card Geotechnics Limited)

Figure A4.84 Taped joints are difficult to construct in adverse weather. Also difficult to inspect if covered with snow (courtesy Smith Grant)

A4.3.3 Bad practice – passive venting systems

Figure A4.85 *Clean single sized stones with no fines acting as venting media, however no ventilation gaps in internal sleeper walls (courtesy Smith Grant)*

Figure A4.86 *Cavity is becoming blocked with detritus. The vent holes in the beam are no longer visible (courtesy Smith Grant)*

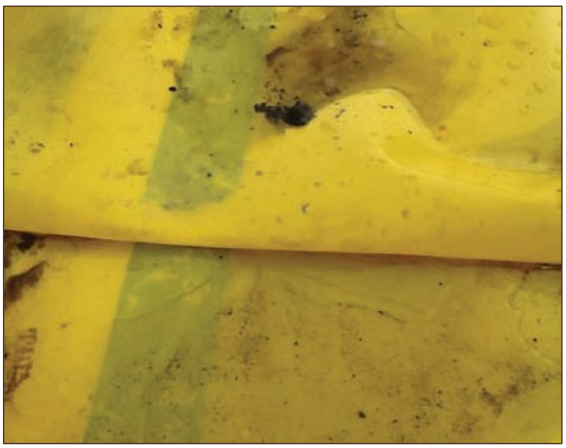


Figure A4.87 *Tape joint with crease running through and air bubbles where gas membrane not in complete contact with tape. Rollers should have been used to produce a consistent seal (courtesy MEC Environmental Ltd)*

Figure A4.88 *Ventilator becoming detached to fit to external block work. This is due to builders requiring increased cavity widths to achieve thermal properties expected by Building Regulations (courtesy NHBC)*

Figure A4.89 *No ventilation in internal sleeper wall (courtesy Smith Grant)*

Appendix 5 –Verification Proforma

Copied Directly From Appendix A5 CIRIA C735

Mallett, H, Cox (nee Taffel-Andureau), L, Wilson, S, Corban, M (2014) Good practice on the testing and verification of protection systems for buildings against hazardous ground gases, CIRIA, C735, London (ISBN: 978-0-86017-739-5). Go to: www.ciria.org

VISUAL INSPECTION OF GAS PROTECTION MEASURES

Site name:	Gas characteristic situation:
Job number:	Type of development and building/block checked: (residential/ commercial/other)
Date:	Building description:
Visit by:	Foundation type: (suspended floor/raft/other)
Weather at time of inspection:	Gas protection type: passive/active

No.	Item	Comments (see notes)
1 Gas membrane		
1.1	Condition of sub-grade and underside of gas membrane	
1.2	Gas membrane type	
1.3	Gas membrane condition	
1.4	Joining tape product	
1.5	Lapping design	
1.6	Laps, welds and joints seals	
1.7	Service entries seals	
2 Passive venting		
2.1	Sub-floor void	
2.2	External wall airbricks	
2.3	Internal sleeper walls	
2.4	External vent trenches/ducts	
3 Active venting		
3.1	System details	
Additional notes:		

Notes: inspection checklist

1.1	Underside of gas membrane	Check that the sub grade does not contain rough/uneven surfaces, is appropriately clean and that there are no hard/sharp objects. That protective sand blinding or geotextile (if specified) is present and meets the design criteria.
1.2	Gas membrane type	Manufacturer and product specification, gauge, colour, brand/name, material batch/roll numbers, storage arrangements (protected from dirt/damage?)
1.3	Gas membrane condition	Open punctures, tears, rips, stretching? Excessive footprints/evidence of traffic? Presence of debris? Repairs? Signs of weakness such as raised or sunken indentations? Protection plan in place to restrict access to lain gas membrane?
1.4	Joining tape product	Product type, brand, thickness, material, width, colour? Use of double sided tape?
1.5	Lapping design	Joints lapped and sealed in accordance with manufacturer's requirements/ specification? Minimum overlap insured? Sections taped twice?
1.6	Laps and joints sealed	Welds complete? Appropriate joining/double sided tape used?
1.7	Service entries sealed	Top hats seal arrangements fixed around service entries? Use of Jubilee clips?
2.1	Sub-floor void	Is a check possible? Void former? Gravel (type/specification)? Height of void space? Is it clear?
2.2	External wall airbricks	Numbers, size, positions as design drawing?
2.3	Internal sleeper walls	Ventilation holes (honeycomb brickwork/pipe crossings?) – size, spacing, location in accordance with design?
2.4	External vent trenches/ducts	Located and constructed in accordance with design drawings? If open-topped gravel – gravel type/presence of fines? If pipe or other vent, check position and construction for functionality and absence of blockages. Ability of void former to withstand bearing of the superstructure?
3.1	Active venting	Type of air supply: mechanical, natural, combined? Location/condition/number of fans and vents? Location and size of inlets? Provision of air-cleaning devices and air heaters? Supply and exhaust ductwork? Alarm provision/installation? Gas monitoring system in under-floor void?

Photographs

No.	**Description**

The gas protection measures inspected:	a Are acceptable and comply with the specification
	b Are acceptable but attention is drawn to issues related to item no. xxx
	c Are not acceptable due to the issues related to item no. xxx

Name: **Signature:** **Date:**

APPENDIX 3

Juta GP1 Technical Datasheet

GROUND GAS PROTECTION
GP®1 SAM
TECHNICAL DATA SHEET

JUTA | TITANTECH®

GP®1 SAM

GP®1 SAM, gas protection self adhesive membrane, is a bituminous gas proof and water proof sheet, composed of self-adhesive SBS polymer modified bitumen incorporating GP®1 with an upper surface finish of black reinforced LDPE, and a lower surface finish of siliconized release film. GP®1 SAM is used for the gas/ waterproofing of underground structures where harmful ground gasses are anticipated, and as a self adhesive accessory to GP®1.

Thickness	1.2 mm
Width	0.9 m or 0.3 m
Length	20 m
Weight	1100 g/m²

TITANTECH®
For developers of brownfield and contaminated sites the TITANTECH® family of products represent a major step forward in safeguarding projects against gaseous and chemical contamination.

Handling
Roll weights can be in excess of 20 kg (approx 33 kg/roll) and hence appropriate care and equipment is required for unloading and handling. This product is non-toxic nor flammable.

Storage
Rolls of GP®1 SAM should be stored on in a cool, dry place, and be protected from exposure to rain, sun, heat and cold temperatures prior to installation. Exposure to sunlight for extended period of time could cause difficulty with removal of the release film.

Certifications

BBA APPROVAL INSPECTION CERTIFICATION CERTIFICATE 22/6076

Please Scan

CE UK CA UK NI

Rev 2024

GROUND GAS PROTECTION
GP®1 SAM
TECHNICAL DATA SHEET

GP®1 SAM

Feature	Characteristics	Test Method	GP®1 SAM
Physical Properties	Thickness	EN 1849-2	1.2 mm
	Width	EN 1849-2	0.9 or 0.3 m
	Length	EN 1849-2	20 m
	Weight	EN 1849-2	1100 g/m^2
Hydraulic Press	Water Tightness	EN 1928	Pass
	Water Vapour Transmission	EN 1931	0.013 g/m^2/day
Mechanical Properties	Tensile Strength (MD/CMD)	EN 12311-2 (A)	500 N/50mm
	Elongation (MD/CMD)	EN 12311-2 (A)	> 12 %
	Resistance to Static Load	EN 12370	20 kg
	Joint Strength	EN 12317-2	> 30 N
	Durability and Water Tightness (Ageing and Chemicals) 60 kPa	EN 1847	Pass
	Resistance to Nail Tear (MD/CMD)	EN 12310-1	> 300 N
	Resistance to Fire	EN 13501	F Euro Class
Gas Permeability	Methane Permeability	EN ISO 15105-1	< 0.68 ml/m^2/day/atm
	Carbon Dioxide Permeability	EN ISO 15105-1	< 2.81 ml/m^2/day/atm
	Radon Permeability	K124/02/95	8.0 x 10^{-15} m^2/S
Compliance and Certification	CE Mark - EN13967:2012 + A1:2017 Type (A/T)		
	BS 8485:2015 Compliant (Methane and Carbon Dioxide Barrier)		

JUTA UK

Please contact JUTA UK Directly for more information on GP®1 SAM

Installation

GP®1 SAM should be installed in accordance with the product installation guidelines, and in accordance with BS 8485:2015, and/or BS 8102:2009.

It is recommended that GP®1 SAM is not applied in temperatures below 10°C, in colder weather the material can be warmed slightly to aid adhesion.

Accessory Products

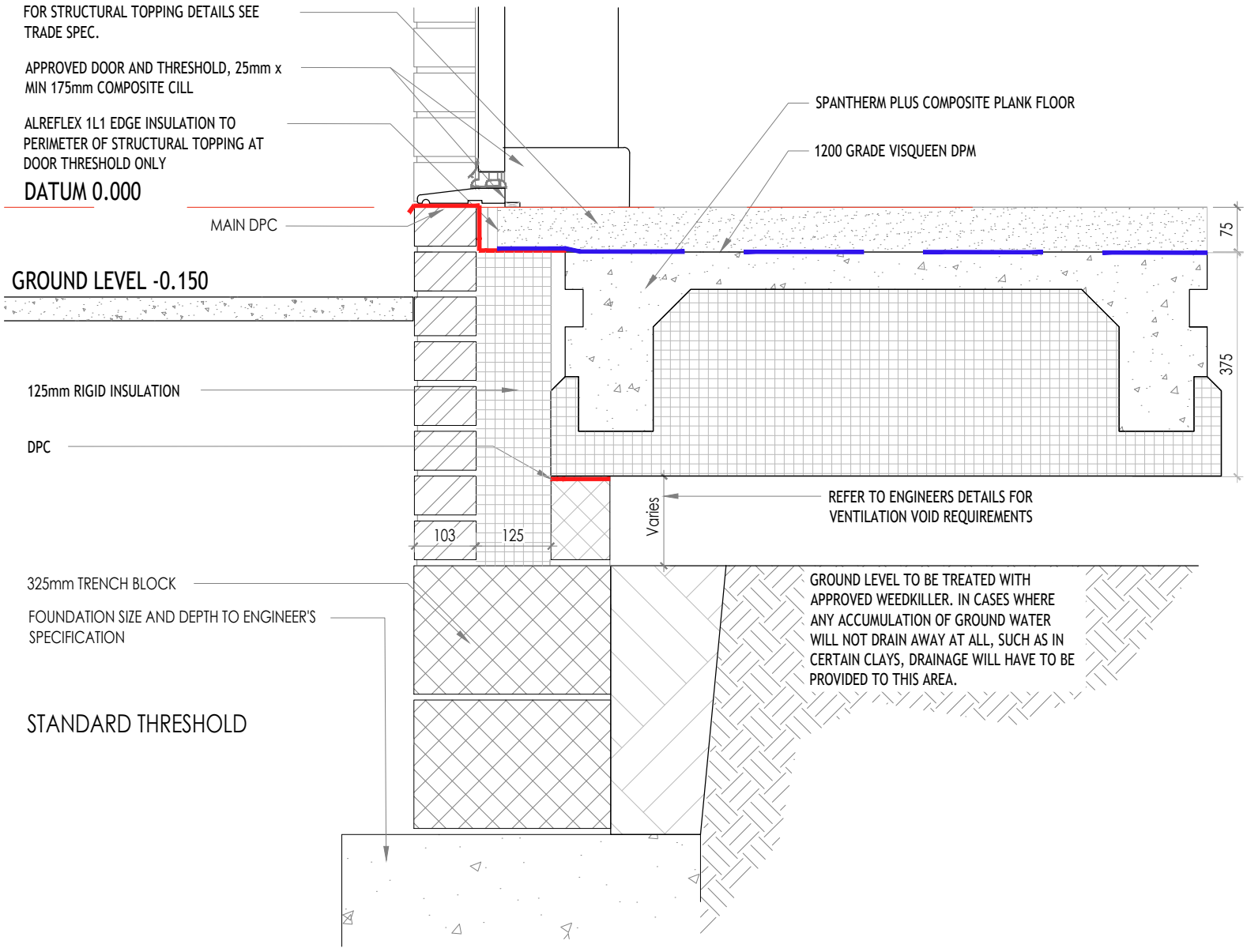
- GP® Primer
- GP® Protection Board
- GP® Protection Fleece

APPENDIX 4

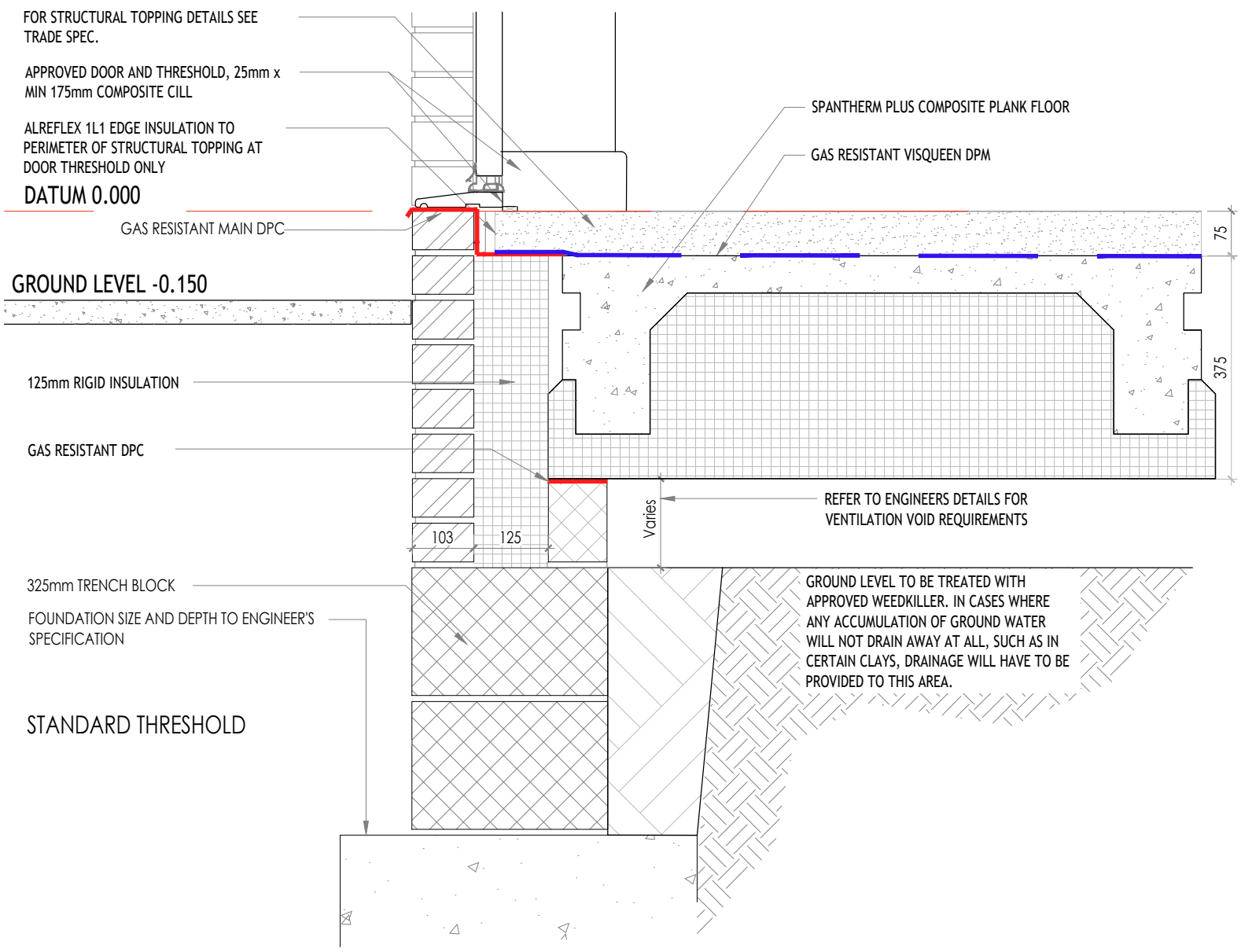
Construction Detail for Gas Protection Measures

Do not scale the drawing. Use figured dimensions in all cases. Check all dimensions on site. Report any discrepancies to BH Architecture before proceeding.

Insulated Plank Ground Floor Detail



Insulated Plank Ground Floor Detail - Gas Membrane



Suitability	Revision	Date	Drawn By	Checked By
S4	C02	28/08/24	LJ	DB

Insulated added to sub floor wall cavity and chipboard finish removed.

Suitability	Revision	Date	Drawn By	Checked By
S4	C01	15/04/24	GR	CR

Construction Issue.

Revision

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ARCHITECTURE www.bharchitects.co.uk
INTERIORS DESIGN www.blakehopkinson.co.uk Co.No. 9493963

BHA Project No:
RES1082

Project Name:
Lovell Eastern

Drawing Title:
Insulated Plank Ground Floor Detail with & without Gas Membrane

Model File Name: RES1082-BHA-DET-ZZ-M2-A-0001

Drawn By:	Date Drawn:
CR	15/04/24
Checked By:	Date Checked:
MJ	15/04/24

Scale at A3:	Suitability:	Revision:
1:10	S4	C02

File Name:
RES1082-BHA-DET-ZZ-DR-A-5046