

REMEDIATION STATEMENT

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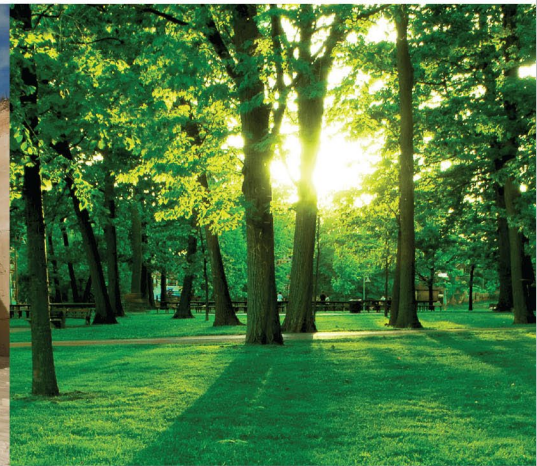
STONE PIT HALL, HORN LANE
NEW MILL, HOLMFIRTH, HD9 7DH

FOR

MR S SYKES

REPORT REF: MSS 3522REM

Engineering Geologists and Environmental Scientists



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ASHTON BENNETT CONSULTANCY

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FEBRUARY 2024

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QUALITY MANAGEMENT FOR REPORT

Project	Stone Pit Hall, Horn Lane, New Mill, Holmfirth, HD9 7DH	REMEDICATION STATEMENT	
Client	Mr S Sykes		
Date	February 2024		
Version	Issue 1		
Prepared by	Frances A Bennett	BSc (Hons), CGeol, FGS, FIMMM, C.WEM, MCIWEM, CEnv, MIEEnvSci	Director Ashton Bennett Ltd
	Tristan Bennett	BSc (Hons)	Engineer



1. INTRODUCTION

This report comprises a Remediation Statement undertaken for the site of Stone Pit Hall, Horn Lane, New Mill, Holmfirth, HD9 7DH. The work was commissioned by Mr S Sykes and was carried out by the Ashton Bennett Consultancy.

It is proposed to construct an extension on the west side of the existing property and to demolish three store sheds and construct one large garage on a similar footprint. The Kirklees Planning Application Number is 2021/93034.

A Phase I Desk Study and environmental soil testing was completed by Ashton Bennett in August 2023 as Report MSS 3522.

This Remediation Statement details the proposed Remediation Strategy and Validation Strategy. If contamination or other concern is detected during the construction works then an Amended Remediation Statement will be forwarded to Kirklees Council planning for approval.

The Remediation Strategy aims to satisfy the local Environmental Protection Department that the site will be environmentally fit for purpose; it aims to satisfy the requirements of the Local Building Control and Building Insurance and aims to ensure that construction workers and future site users are not detrimentally affected by the repurpose of the site.

This report describes the Remediation Strategy for the site work, the Validation Strategy and will be followed by a Validation Report on completion of remediation to confirm by evidence that the Contractors and any other parties involved in the remediation have undertaken the work diligently and strictly in accordance with this Remediation Statement.

1.1 The Proposals

The proposals are to add an extension to the house and to demolish existing sheds and replace with a garage and hard standing in the area to the east of, and separate to the house.

1.2 The Author

This report was prepared by Frances A Bennett an engineering geologist who has a degree in Geology, a postgraduate qualification in Soil Mechanics and is a Chartered Geologist CGeol, Chartered Environmentalist CEnv and Chartered Water and Environmental Manager C.WEM and FIMMM with over 45 years of experience in the fields of geology, geotechnical engineering, hydrogeology, contamination, mining, slope stability, the environment and waste disposal.

1.3 Sources of Information

The following data have been referenced in relation to compiling this Report:

- Geological mapping from British Geological Survey 1:50,000
- Geological mapping from British Geological Survey 1:10,000
- Ordnance Survey mapping 1845 to date
- Assessing Risks posed by hazardous ground gas to buildings, CIRIA C665, 2007.
- Protecting Development from methane, CIRIA Report 149, CB Card, 1995.
- Verification Requirements for Gas Protection Systems, YALPAG, Dec 2016.
- CIRIA C758D (2019) Abandoned Mine Workings Manual Ed. Parry D and Chiverrell C, 546pp. ISBN 978-0-86017-765-4.
- BS8485 :2015+2019, Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.
- The Coal Authority

The information for this report is also from sources recommended by the Institute of Civil Engineers (ICE), the Association of Geotechnical and Geoenvironmental Specialists (AGS), Construction Industry Research and Information Association (CIRIA) and the Department of the Environment Transport and the Regions (DETR). The report has been compiled in accordance with the latest ICE, DETR, Department of Environment, Food and Rural Affairs (DEFRA), British Standard Draft Documents and British Standards, CIRIA, CLR 11 & other CLEA Reports and Eurocode 7.

In addition, the scope of the investigation has used the extensive knowledge and experience of the staff of Ashton Bennett Consultancy to assess the data and to interpret the findings.



2. THE SITE

2.1 Site Description

The site lies to the north of the Penistone and Holmfirth Road, the A635, which runs west to east between Holmfirth and Wakefield in West Yorkshire. The site sits on Horn Lane immediately north of the A635 and south of Arce Lane.

The site is bounded to the north, east and west by trees and bushes with open land beyond. The site is bounded to the south by a low stone wall and bushes with Horn Lane beyond.

The site comprises a house and garden and three store sheds lying to the east of the house.

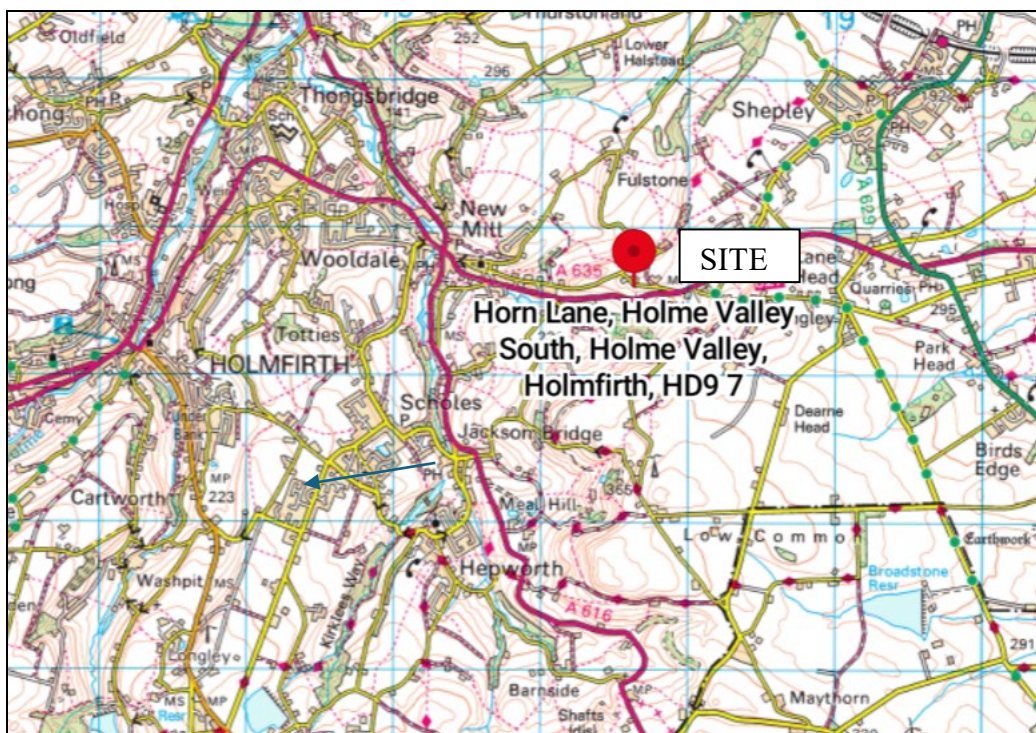


Figure 1

Site Location Plan



Figure 2 Detailed Site Location Plan

The site lies around National Grid Reference 417648E 408615N at a height of around 268m above Ordnance Datum.

A Site Location Plan is presented as Figure 1 and a Detailed Site Location Plan as Figure 2. A Proposed Development Plan is presented as Figure 3. Waste and Landfill Sites as Figure 4 and Made Ground as Figure 5. A Geological Faults and Bedrock Geology Plan is presented as Figure 6. Figure 7 illustrates a Venting material and Figure 8 presents an Installation of gas membrane and services entry.



Figure 3 Proposed Development Plan

3 SITE HISTORY and INDUSTRIAL LAND USE

3.1 Site History

The site is shown on the OS maps to have been open land prior to the existing property being constructed, likely prior to 1854. The immediate surrounding area has only been residential and open land while quarries and a colliery and a sewage works and a colliery spoil tip have existed to the far surrounding area of site.

3.2 Industrial Land Use

There is no recorded industrial land use on the site or within the vicinity of the site.

In the surrounding area there has historically been a colliery 83m to south east circa 1855 and listed as a disused colliery circa 1904.

These land uses are unlikely to have detrimentally affected the nature of the site.



Figure 4 Waste and Landfill Sites

There are no active or recent landfill sites within 500m of the site. The BGS records and the LA/mapping indicate no historical landfill within 500m of the site. There are no historical EA/NRW landfills or historical or recently closed waste sites within 500m of site.

Waste exemption licences exist within 250m of the site area as shown in Figure 4. The closest is located 180m to the west of site at Ebson House Farm for storage of sludge. All exemptions within 250m are located at Ebson House Farm 221m and 236m distant to the north east construction,

burning of waste as a fuel in a small appliance, use of sludge for the purpose of reseeded a waste water treatment plant and use of effluent to clean a highway gravel bed.

Made ground is evident 83m to the south east and represents the former colliery spoil tip as shown on Figure 5. Further worked ground is shown 400m to the south west and to the north east. Made ground is not shown to be within the site area.



Figure 5 Made Ground

4. SITE GEOLOGY

4.1 Geology

The published British Geological Survey Map (BGS) at a scale of 1:10,000 shows the site to be underlain by sandstones, mudstones and siltstones of the Pennine Lower Coal Measures Formation. Immediately underlying the site is the Grenoside Formation Sandstone in the centre and east of the site. The west of the site is immediately underlain by mudstones and siltstones of the Pennine Lower Coal Measures Formation. The Greenmoor Rock Sandstone outcrops to the west and north east of site and the 80 Yard Rock Sandstone outcrops to the south east of site, divided by a geological fault.

Superficial drift deposits are not shown to overlie the solid strata.

The site geology is presented in Figure 6.

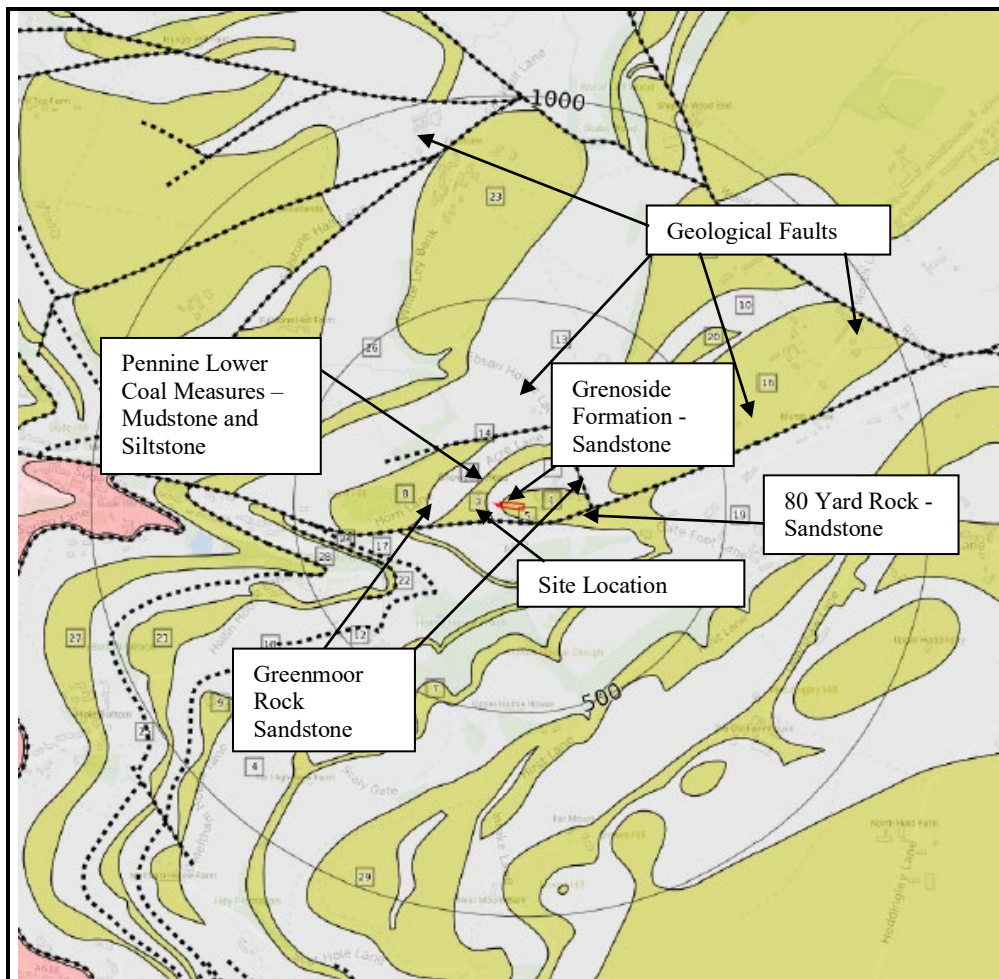


Figure 6 Geological Faults and Bedrock Geology Plan

4.2 Geological Faults

The BGS maps do not indicate the presence of any geological faults crossing the site. The maps show the presence of faults trending west to east to the south of the site. It is possible that smaller faults sub parallel to this may exist in the strata causing fissuring and fracturing to the rock. Due to the cessation of tectonic activity in the area, faulting is unlikely to detrimentally affect the stability of the site.

5. REMEDIATION

5.1 Source of Gas

The Phase I Desk Study highlighted the presence of one infilled ground area 83m to the south of the site, south of the A635 and at a significantly lower ground level. This represents mine tailings from a former colliery mining the 80 Yard Coal, a thin inconsistent coal seam. Mine tailings can produce methane gas, however the tailings are open to the atmosphere and mining was probably completed by 1904 and therefore it is expected that any methane gases would have vapourised into the atmosphere by now.

Methane and carbon dioxide gases can travel up to 250m through permeable strata. The site is underlain by sandstone and mudstone sequence, and the mine tailings lie on mudstone. It is a

very low risk that any methane could detrimentally affect the proposed house extension and garage buildings.

It was recommended in the Phase I Desk Study that it would be prudent to install a methane membrane beneath the floor of the proposed house extension. There is no requirement to install a membrane beneath the separate garage building.

The Remediation Statement therefore discusses the remediation required to make the house extension safe for use. Based on the information obtained, the remediation has been designed for a very low risk of methane being emitted from the mine tailings and migrating to the site.

5.2 Objectives

The objective of the Remediation Strategy is to ensure, according to the 1990 Environment Act the land is unlikely to cause harm to human health by methane and carbon dioxide gases from local sites entering the proposed residential house. The objective of the Remediation Strategy is to ensure an environmentally safe site for the proposed residential house.

The results of the Desk Study indicated that the site should be classed as 'Amber 1' under the NHBC traffic Light classification system, assuming that precast concrete floors with a ventilated void below would be used for construction. This will require the installation of a fully lapped and sealed gas resistant membrane, the installation of which shall be independently verified.

The remedial objectives for this site are:

1. To install low risk gas protection measures in accordance with NHBC Amber 1 and CS1 (BS 8485:2015) specification in the proposed house. Due to the presence of mine tailings within 100m it was considered prudent to increase the risk to low and CS2 (BS 8485:2015)
2. Upon identification of any unexpected contamination, a suitable strategy to determine any remedial action is to be in place.
3. To reduce the risks to construction workers, and ensure that appropriate personal protective equipment (PPE) is used and/worn and the requisite working practices are adhered to. No further guidance with regards to this is considered necessary as part of this document.
4. Validation of Remediation to confirm and evidence the remediation is undertaken diligently and in accordance with the Remediation Strategy and Validation Strategy and in accordance with YALPAC / Kirklees planning requirements and legislation.

5.3 Methodology and Scope of Works

The works are to include the installation of gas protective measures in the proposed extension to the residential house.

Construction should be a reinforced concrete cast in situ floor slab, suspended, non suspended or raft, with at least a 1200g DPM and incorporated gas resistant membrane and underfloor venting with all joints and service entries sealed.

At this stage, it is not known which membrane system will be installed across the site, or the level of experience offered by the installer. Such information will need to be confirmed to the Local Authority and warranty provider for approval prior to beginning construction.

The installation details of the proposed membrane will also need to be submitted for approval prior to undertaking the works on site. The installation details should be in accordance with all relevant building standards, and in accordance with the membrane manufacturers standard details.

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.

Recommendations for the level of protection required are reproduced from BS8485:2015, Code of Practice for the design of protective measures for methane and carbon dioxide ground gas for new buildings. Table 2 from BS8485 determines a very low risk as Charateristic Situation CS1 and a low risk as CS2.

Table 2 CS by site characteristic GSV

CS	Hazard potential	Site characteristic GSV ^{A)} L/h	Additional factors
CS1	Very low	<0.07	Typically <1% methane concentration and <5% carbon dioxide concentration (otherwise consider an increase to CS2)
CS2	Low	0.07 to <0.7	Typical measured flow rate <70 L/h (otherwise consider an increase to CS3)
CS3	Moderate	0.7 to <3.5	-
CS4	Moderate to high	3.5 to <15	-
CS5	High	15 to <70	-
CS6	Very high	>70	-

^{A)} The figures used in this column are empirical.

Table 4 from BS8485 determines a gas protection score or points for a residential house or Type A building which is a high risk building due to small rooms and high occupancy. This determines a CS1 as requiring nil points and CS2 as 3.5 points.

Table 4 Gas protection score by CS and type of building

CS	Minimum gas protection score (points)			
	High risk	Medium risk		Low risk
	Type A building	Type B building	Type C building	Type D building
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5 ^{A)}	5.5 ^{A)}	4.5	3.5
5	— ^{B)}	6.5 ^{A)}	5.5	4.5
6	— ^{B)}	— ^{B)}	7.5	6.5

When the minimum gas protection score has been determined for the building as a whole, or for each part of the building, then a combination of two or more of the following three types of protection measures should be used to achieve that score:

- the structural barrier of the floor slab, or of the basement slab and walls if a basement is present;
- ventilation measures; and
- gas resistant membrane.

Table 5 in BS8485 gives a score of 0.5 for a cast in situ ground-bearing floor slab (with only nominal mesh reinforcement), and a score of 1.0 to 1.5 for a cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations.

Table 6 in BS8485 gives a score for various ventilation methods. It recommends a minimum of pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building) for 0.5 points.

Table 7 in BS8485 gives a score for gas membranes of 2 provided they conform to criteria in 1 to 6 below.

The gas resistant membrane should meet all of the following criteria:

1. be sufficiently impervious to the gases with a methane gas transmission rate <math><40.0\text{ ml/day/m}^2/\text{atm}</math> (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method);
2. sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
3. sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab);
4. 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);
5. capable, after installation, of providing a complete barrier to the entry of the relevant gas; and
6. verified in accordance with CIRIA C735 [N1]

In total, provided the recommendations are followed, the score for a CS2 of 3.5 is achieved, by 1 or 1.5 for the floor slab, 0.5 for the venting and 2 for the membrane. Although the risk is considered to be very low or CS1, the presence of the tailings and the domestic use of the house extension means it would be prudent to adopt a CS2 category. The required CS2 score of 3.5 points can be achieved as detailed.

The venting area could be installed with a cusped high density polyethylene (HDPE) sheet with a geotextile fabric bonded to the end of the cusps as detailed in Figure 7. Aggregate can be used instead, but it must not be MOT Grade 1 or 2. It should be clean washed aggregate with particles no smaller than 20mm and with no fines. Aggregate would need to be 300mm depth.

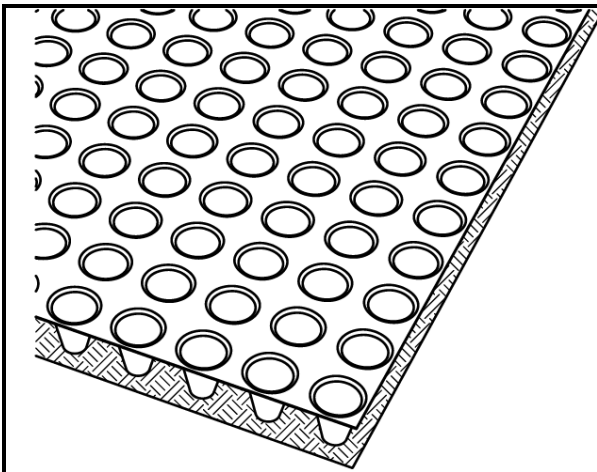


Figure 7 Venting material

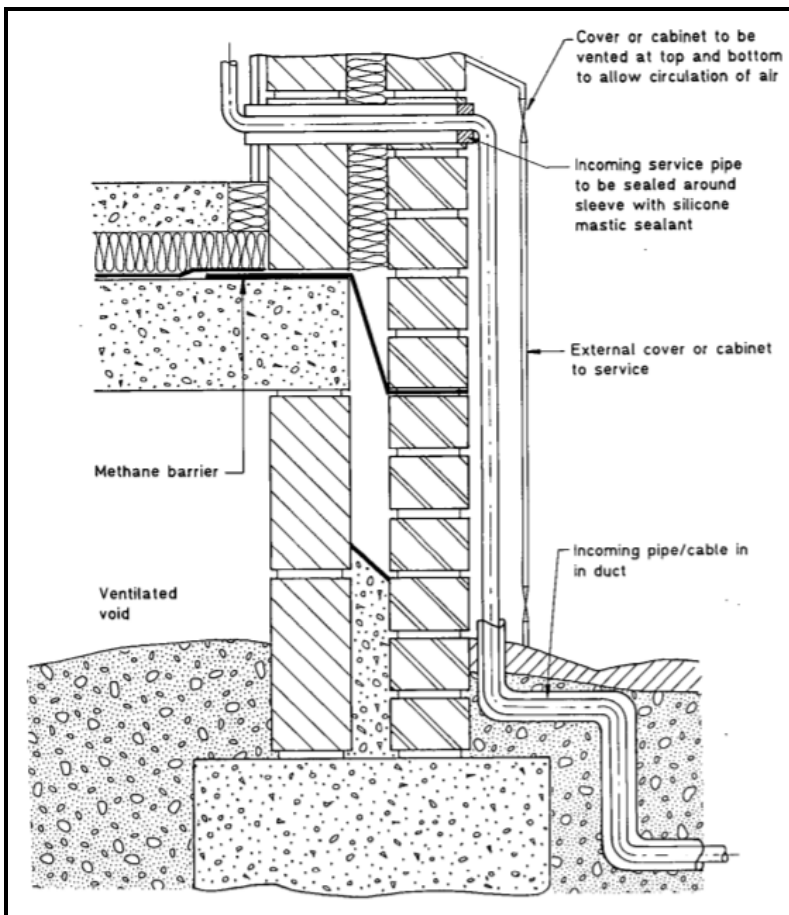


Figure 8 Installation of membrane and service entries

6. VALIDATION STRATEGY

The Validation Strategy is to ensure and to collect evidence that the site remediation is being undertaken diligently and in accordance with the Remediation Statement and with legislation. A Validation Engineer will be appointed to undertake the validation on commencement of the Works.

Such person will be independent of the client and the Contractor and will have the appropriate qualifications.

All work will be photographed to provide a comprehensive diary of work undertaken and to aid Validation.

On completion of the installation of the gas membrane the following procedures for verification must be followed, in line with the guidance given in the 'Yorkshire and Lincolnshire's Pollution Advisory Group (YALPAG)' guidance document "Verification Requirements for Gas Protection Systems", which includes:

- A suitably qualified and experienced independent individual (consultant, qualified or experienced installer) should conduct a thorough visual inspection
- All joints and service penetrations are to be adequately sealed.
- The independent verifier shall ensure that component specification and installation complies with both the manufacturer's guidelines/instructions

All components of the agreed gas protection system shall be subject to verification.

Evidence in the form of a checklist (see final pages of the YALPAG guidance) will be required and shall itemise the specification and inspection of all individual gas protection components and their correct installation including;

- Photographic evidence clearly illustrating the points on the checklist and correct installation of the gas protection components; and
- All data to form part of a Verification Report which must include, inter alia, prints of all digital photographs and description of features depicted.

7. VALIDATION

The remediation work will be validated as described above in the areas of remediation and reporting of results to Planning Services, plus olfactory and visual observations during selected site visits. The planning of works, consents and licenses and site management will be undertaken by the client Mr S Sykes and his Contractors.

Planning Services will be informed when the Remediation will be undertaken.

If during the excavation for development and services encounters soil or groundwater with an unusual odour or colour, Ashton Bennett will be informed and the soil/water will be tested for potential contamination, and an assessment made if it requires remediation. If remediation is required then an Amended Remediation Statement will be forwarded to planning.

A Validation Report will be issued to Planning Services on completion of the Remediation and should include.

- Details of qualifications of Validating Engineer
- Planning Application Details
- Details and photographs of all work undertaken
- Details of who carried out the installation
- Details of who carried out the verification
- Description of protective measures installed with reference to method statements and drawings and manufacturers specification of the materials used
- Details of the verification inspection

- Supporting information including plans, photographs and as built drawings
- Summary of verification data
- Clear statement that remedial objectives have been achieved supported by evidence

If any material is excavated by the Contractor that has an unusual odour/nature, then Ashton Bennett Consultancy will be notified by the site, samples will be collected for environmental testing and any necessary new remediation strategy reported to the Planning Services. In addition, Kirklees Council will be notified in writing immediately, should any unexpected contamination be encountered at any stage of the development process. Revision to the Remediation Statement will be submitted to and approved in writing by the Local Planning Authority and works will thereafter be carried out in accordance with the approved revised Remediation Statement.

8. GENERAL REMARKS

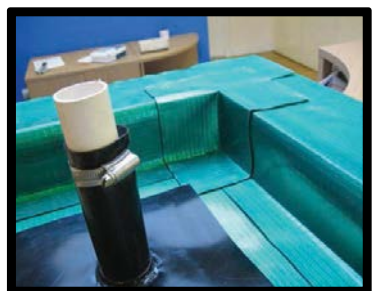
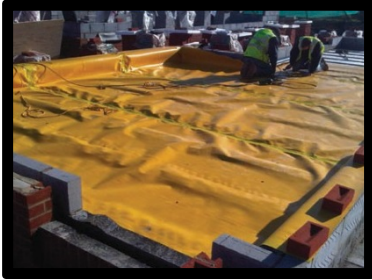
This report truly reflects the conditions found during the Remediation Statement. Whilst the Remediation Statement was undertaken in a professional manner taking due regard of additional information which became available as a result of ongoing research the results portrayed only pertain to the information attained and it is possible that other undetected information and undetected ground and gas conditions and undetected contamination and undetected mining may exist. The Remediation Statement was only undertaken within the site boundaries and should not be used for interpretation purposes elsewhere. These conclusions are only a brief summary of the report, and it is recommended that the Report MSS 3522REM is read in full to ensure that all recommendations have been understood.

This report is provided for the sole use of the clients (Mr S Sykes) and no responsibility will be accepted by this Consultancy to any other parties who rely on this report entirely at their own risk. The copyright for this report is held by Ashton Bennett Consultancy and no reproduction of any part or all of the report can be undertaken or any other reproduction undertaken without the written approval of this Consultancy.

Frances A Bennett
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Appendix A





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:



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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.

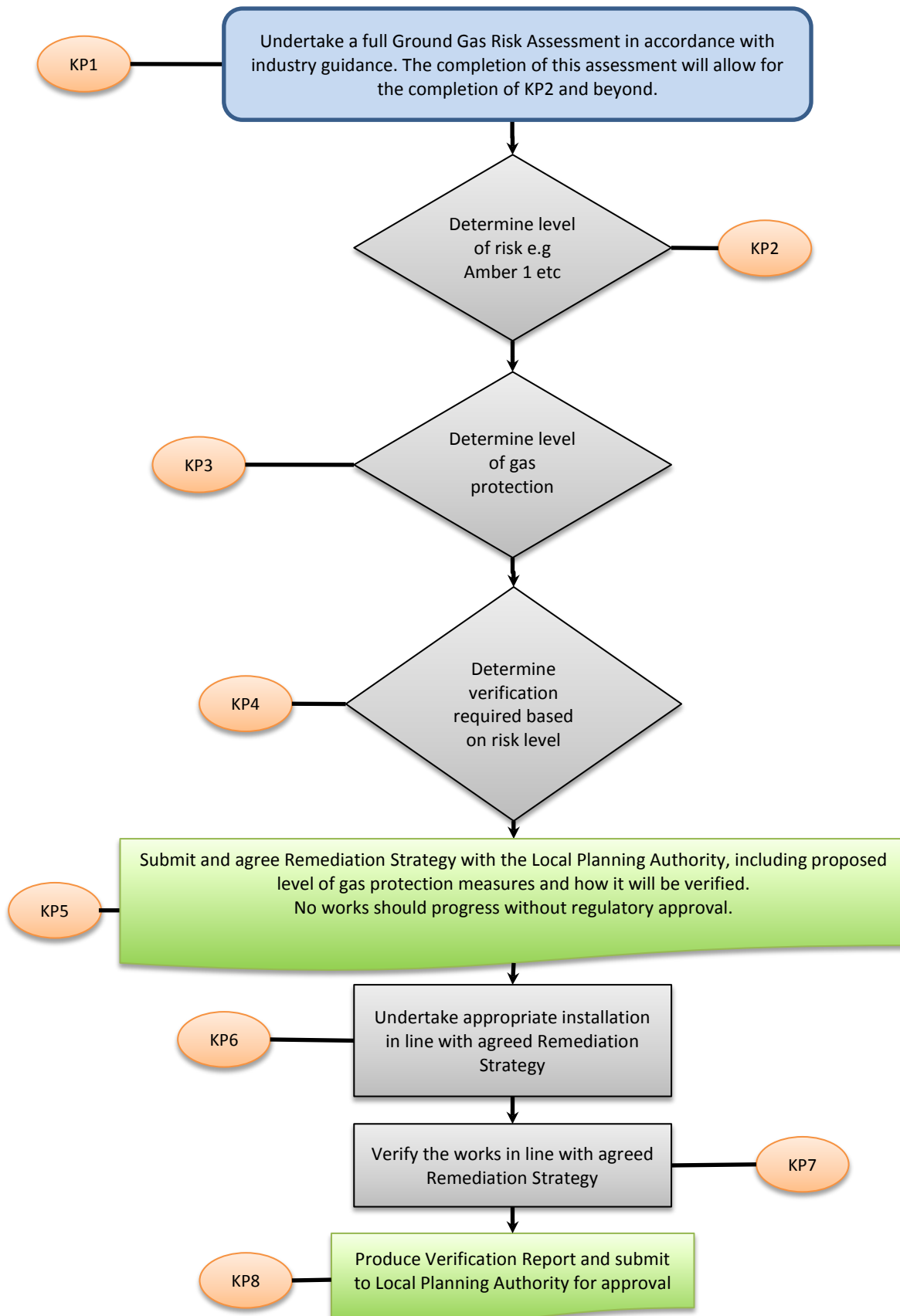
The Process of Verification

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

<p>KP1</p> <p>Ground Gas Risk Assessment</p>	<p>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.</p> <p><i>*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.</i></p>
<p>KP2</p> <p>Level of Risk</p>	<p>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).</p> <p>For example Amber 1 (Low rise housing) equates to Low Risk in Table A1 CIRIA 735.</p> <p>Once the level of risk has been determined move to KP3 and determine the appropriate level of gas protection.</p>
<p>KP3</p> <p>Level of Gas Protection</p>	<p>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 <i>lifetime of the development</i>.</p> <p>Detailed specification of gas protection measures in accordance with appropriate guidance to include (but not be limited to):</p> <ul style="list-style-type: none"> • 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.
<p>KP4</p> <p>Level of Verification Required</p>	<p>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).</p> <p>See Appendix 1 for full details of verification requirements for installation of gas protection measures and the associated verification requirements.</p>

<p>KP5</p> <p>Submission and Agreement of Remediation Strategy</p>	<p>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).</p> <p>The Remediation Strategy, incorporating the detailed Verification Plan, should include (but not be limited to):</p> <ul style="list-style-type: none"> • 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. <p>See Appendix 2 for details of Remediation Strategy requirements.</p>
<p>KP6</p> <p>Installation of Gas Protection</p>	<p>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.</p> <p>Any deviation away from the agreed Remediation Strategy should be agreed in writing with the Local Planning Authority prior to commencement of installation.</p> <p>See Appendix 4 for examples of good and poor gas protection installation.</p>
<p>KP7</p> <p>Verification of Gas Protection</p>	<p>The verification of the gas protection measures should be undertaken in accordance with the Verification Plan set out in the agreed Remediation Strategy.</p> <p>Any deviation to works away from the agreed Remediation Strategy should be agreed in writing with the Local Planning Authority prior to installation.</p> <p>See Appendix 5 for an example Verification proforma.</p>
<p>KP8</p> <p>Submission of Verification Report</p>	<p>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.</p> <p>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.</p>

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 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).
		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 pours 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 pours 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)

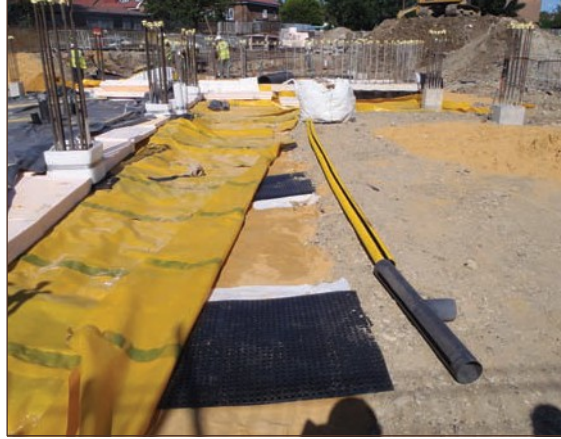


Figure A4.8 Geovent beneath the 2000g taped gas membrane lined up with collector pipes (courtesy Alderburgh Group)



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)

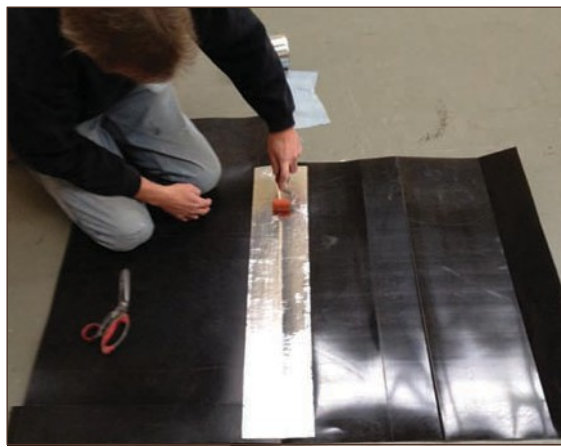


Figure A4.16 Example HDPE type gas membrane and steam roller used to ensure self-adhesive tape is correctly installed (courtesy A Proctor Group)

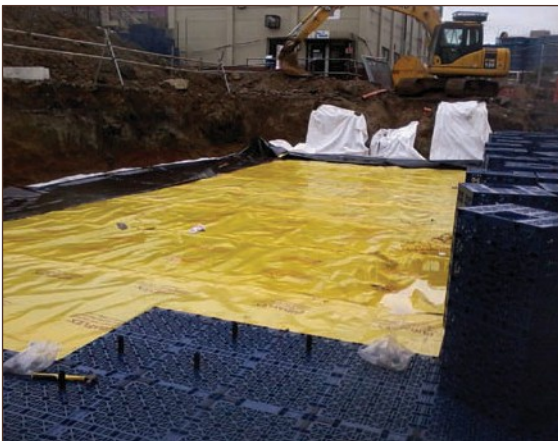


Figure A4.17 Gas membrane installed in attenuation tank (courtesy Industrial Textiles & Plastics Ltd)

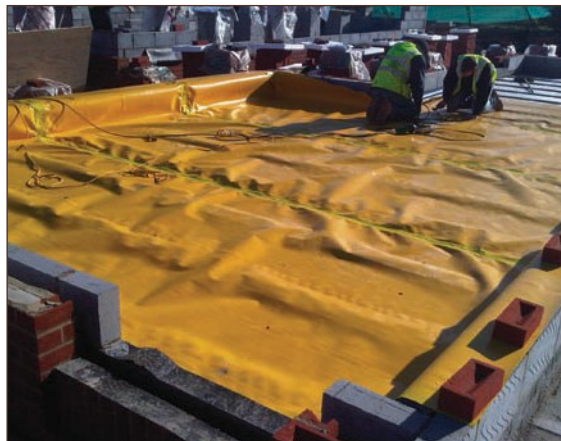


Figure A4.18 Gas membrane installed as part of foundation barrier (courtesy Industrial Textiles & Plastics Ltd)

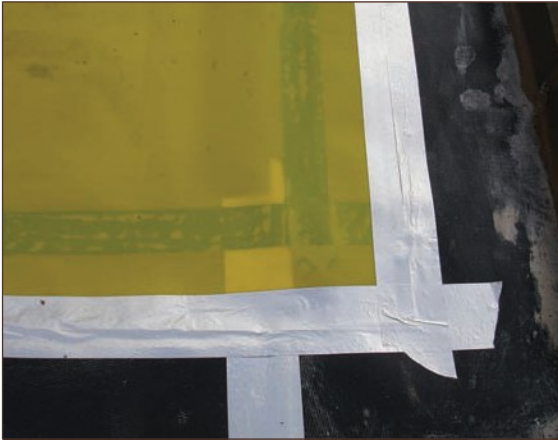


Figure A4.19 Well-constructed joints with gas resistant DPC, lap and double sided butyl joints visible beneath semi-transparent gas membrane, secondary seal with proprietary single sided tape (courtesy Smith Grant)

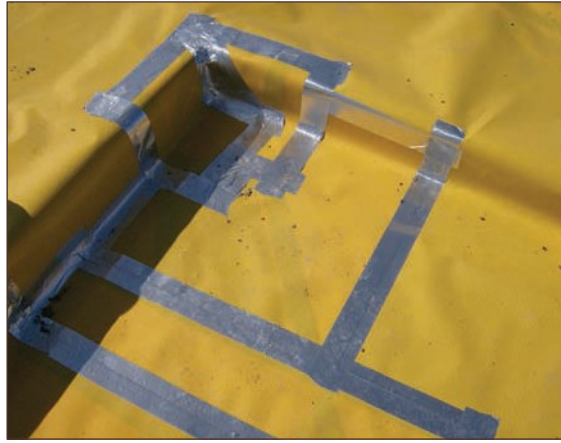


Figure A4.20 A pre-formed corner unit would have been preferable as fewer joints would have been formed, however the installer has achieved a good level of workmanship in this corner detail (courtesy Smith Grant)



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

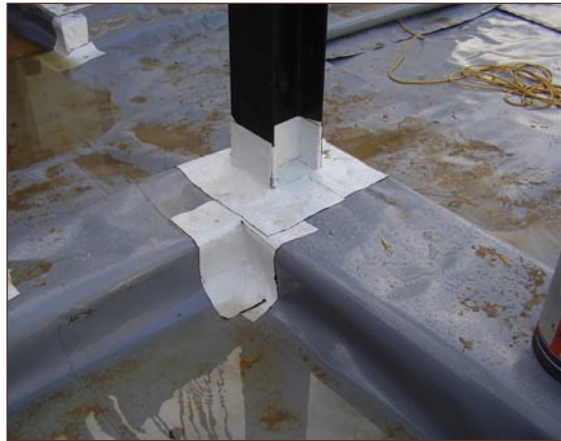


Figure A4.22 Good detail around stanchion and corner (courtesy PAGeotechnical Ltd)



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

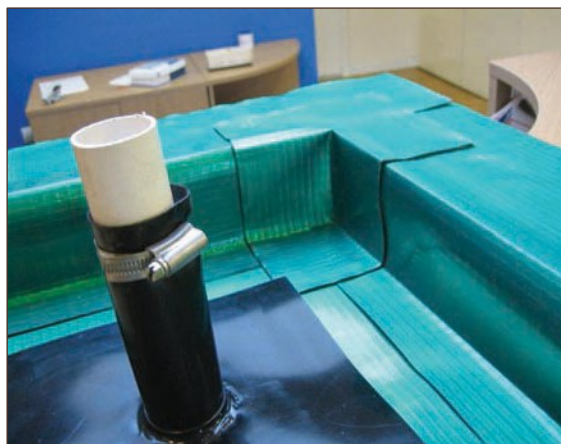


Figure A4.24 Prefabricated corner detail and top hat (courtesy A Proctor Group)

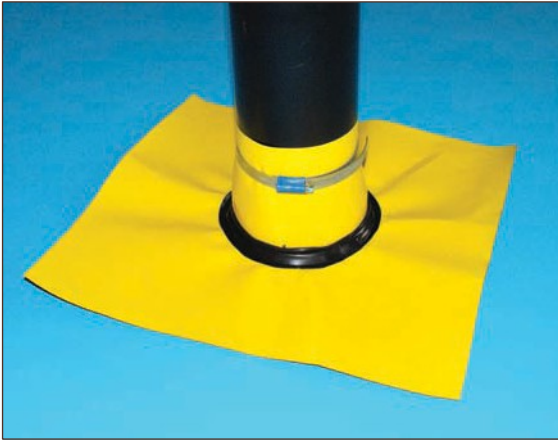


Figure A4.25 Top hat around service entry (courtesy Industrial Textiles & Plastics Ltd)

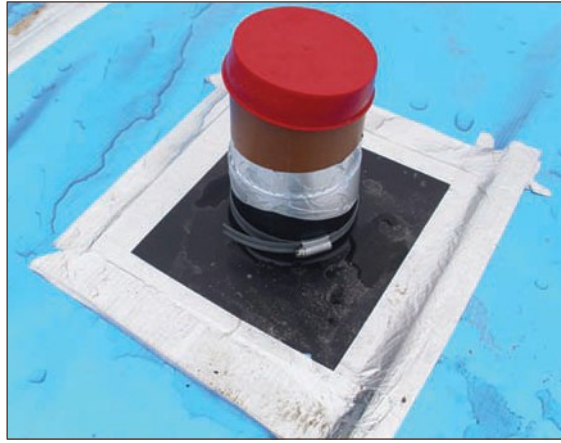


Figure A4.26 Well-constructed service entry: top hat fits well with service pipe and taped down to gas membrane, secondary seal with proprietary single sided tape (courtesy Smith Grant)

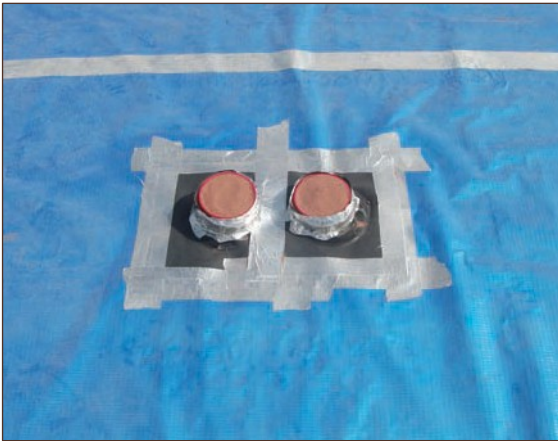


Figure A4.27 Top hats placed around service entries secured with jubilee clip seals. Top hats secured to gas membrane with double sided butyl tape (courtesy Hydrock)



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 CO₂ injection integrity testing (courtesy Landline Ltd)

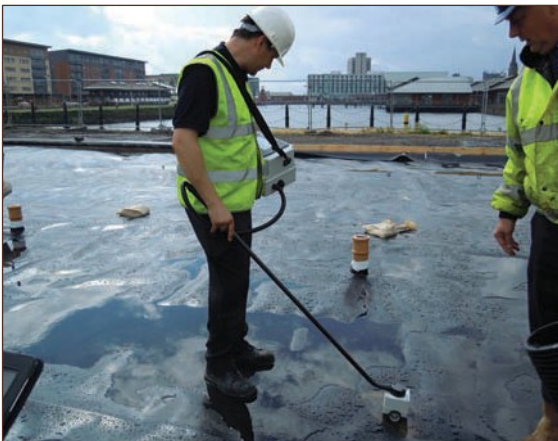


Figure A4.41 Small sand bags are marking holes made in the gas membrane used to check whether injected CO₂ has worked its way beneath whole area (courtesy Landline Ltd)



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)

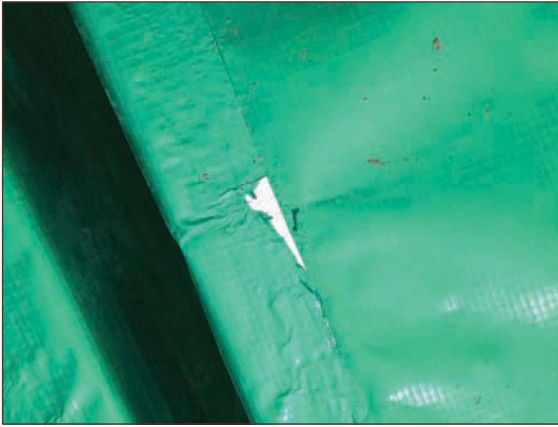


Figure A4.61 'Stripping' occurs on gas membranes that contain aluminium foil. The foil gets too hot under the outer layer of LDPE or PP and the top layer of the gas membrane sticks to the roller which strips it off, leaving the aluminium completely exposed (courtesy MEC Environmental Ltd)

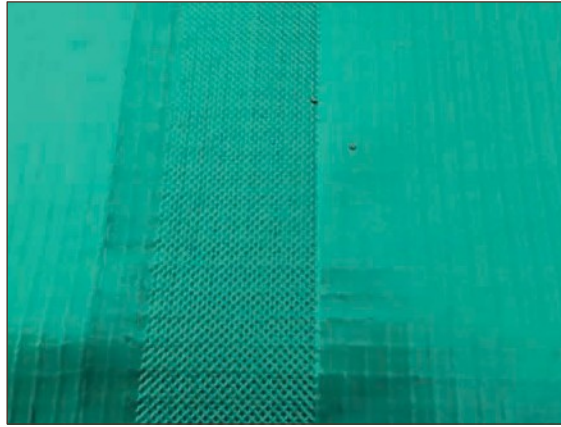


Figure A4.62 Wedge weld on an LDPE aluminium gas membrane, where the installer used metal nip rollers. This destroyed the top layer and probably the bottom layer, leaving aluminium exposed between the weaves. This failed dielectric testing along all joints (courtesy MEC Environmental Ltd)

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 hat 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 too 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)

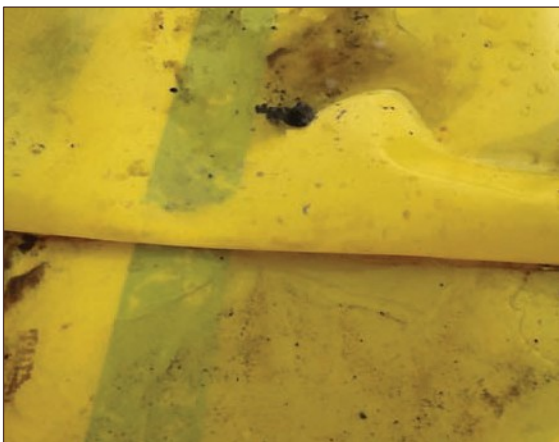


Figure A4.87 Tape joint with crease running through and air bubbles where gas membrane not in complete contact with tape. Rollers should have been used to produce a consistent seal (courtesy MEC Environmental Ltd)



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:

