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Process Guidance Note 6/21(13)

Statutory guidance for hide and skin processes

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Defra would like to acknowledge the work of the Environment Agency's Local Authority Unit in the drafting of this guidance note.

Revision of the guidance

The electronic version of this publication is updated from time to time with new or amended guidance. **Table 0.1** is an index to the latest changes (minor amendments are generally not listed).

Table 0.1 - Revision of the guidance		

Contents

List of Tables

1. Introduction

Legal basis

1.1 This note applies to the whole of the UK. It is issued by the Secretary of State, the Welsh Government, the Scottish Government and the Department of the Environment in Northern Ireland (DoE NI) to give guidance on the conditions appropriate for the control of emissions into the air from hide and skin processes. It is published only in electronic form and can be found on the Defra website. It supersedes PG6/21(96) and NIPG6/21(96).

1.2 This guidance document is compliant with the Code of Practice on Guidance on Regulation page 6 of which contains the "golden rules of good guidance". If you feel this guidance breaches the code or you notice any inaccuracies within the guidance, please contact us.

1.3 This is one of a series of statutory notes giving guidance on the Best Available Techniques (BAT). The notes are all aimed at providing a strong framework for consistent and transparent regulation of installations regulated under the statutory Local Air Pollution Prevention and Control (LAPPC) regime in England and Wales, Scotland and Northern Ireland. The note will be treated as one of the material considerations when determining any appeals against a decision made under this legislation. Further guidance on the meaning of BAT can be found for England and Wales, Scotland, and Northern Ireland.

1.4 In general terms, what are BAT for one installation in a sector are likely to be BAT for a comparable installation. Consistency is important where circumstances are the same. However, in each case it is, in practice, for regulators (subject to appeal) to decide what are BAT for each individual installation, taking into account variable factors such as the configuration, size and other individual characteristics of the installation, as well as the locality (e.g. proximity to particularly sensitive receptors).

1.5 The note also, where appropriate, gives details of any mandatory requirements affecting air emissions which are in force at the time of publication, such as those contained in Regulations or in Directions from the Government. In the case of this note, at the time of publication there were no such mandatory requirements.

1.6 In **Section 4** and **Section 5**, arrows are used to indicate the matters which should be considered for inclusion as permit conditions. It is important to note, however, that this should not be taken as a short cut for regulators to a proper determination of BAT or to disregard the explanatory material which accompanies the arrows. In individual cases it may be justified to:

- include additional conditions;
- include different conditions;
- not include conditions relating to some of the matters indicated.

In addition, conditions will need to be derived from other parts of the note, in particular to specify emission limits, compliance deadlines and mandatory requirements arising from directions or other legislation.

Who is the guidance for?

1.7 This guidance is for:

Regulators

- local authorities in England and Wales, who must have regard to the guidance when determining applications for permits and reviewing extant permits;
- the Scottish Environment Protection Agency (SEPA) in Scotland,
- district councils or the Northern Ireland Environment Agency (NIEA), in Northern Ireland;

Operators who are best advised also to have regard to it when making applications and in the subsequent operation of their installation;

Members of the public who may be interested to know what the Government considers, in accordance with the legislation, amounts to appropriate conditions for controlling air emissions for the generality of installations in this particular industry sector.

Updating the guidance

1.8 The guidance is based on the state of knowledge and understanding, at the time of writing, of what constitute BAT for this sector. The note may be amended from time to time to keep up with developments in BAT, including improvements in techniques, changes to the economic parameters, and new understanding of environmental impacts and risks. The updated version will replace the previous version on the Defra website and will include an index to the amendments.

1.9 Reasonable steps will be taken to keep the guidance up-to-date to ensure that those who need to know about changes to the guidance are informed of any published revisions. However, because there can be rapid changes to matters referred to in the guidance – for example to legislation – it should not be assumed that the most recent version of this note reflects the very latest legal requirements; these requirements apply.

Consultation

1.10 This note has been produced in consultation with relevant trade bodies, representatives of regulators including members of the Industrial Pollution Liaison Committee and other potentially-interested organisations.

Policy and procedures

1.11 General guidance explaining LAPPC and setting out the policy and procedures is contained in separate documents for England and Wales, Scotland and Northern Ireland.

When to use another note rather than PG6/21

1.12 Coating of leather is covered by PG6/22.

2. Timetable for compliance and reviews

Existing processes or activities

2.1 This note contains all the provisions from previous editions which have not been removed. Some have been amended. For installations in operation at the date this note is published, the regulator should have already issued or varied the permit having regard to the previous editions. If they have not done so, this should now be done.

2.2 The new provisions of this note and the dates by which compliance with these provisions is expected are listed in **Table 2.1**, together with the paragraph number where the provision is to be found. Compliance with the new provisions should normally be achieved by the dates shown. Permits should be varied as necessary, having regard to the changes and the timetable.

Table 2.1 - Compliance timetable

Guidance	Relevant paragraph/row in this note	Compliance date
There are no new provisions in this note likely of themselves to result in a need to vary existing permit conditions. For a full list of changes made by this note, excluding very minor ones, see **Table 6.1**.		

2.3 Replacement plant should normally be designed to meet the appropriate standards specified for new installations/activities.

2.4 Where provisions in the preceding guidance note have been deleted or relaxed, permits should be varied as necessary as soon as reasonably practicable.

2.5 For new activities, the permit should have regard to the full standards of this guidance from the first day of operation.

2.6 For substantially changed activities, the permit should normally have regard to the full standards of this guidance with respect to the parts of the activity that have been substantially changed and any part of the activity affected by the change, from the first day of operation.

Permit reviews

2.7 Under LAPPC, the legislation requires permits to be reviewed periodically but does not specify a frequency. It is considered for this sector that a frequency of once every eight years ought normally to be sufficient for the purposes of the appropriate Regulations. Further guidance on permit reviews is contained in the appropriate Guidance Manual for England and Wales chapter 26, Scotland, Practical guide section 10, Northern Ireland Part B Guidance page 9, Northern Ireland Part C Guidance chapter 17. Regulators should use any opportunities to determine the variations to permits necessitated by paragraph 2.2 above in conjunction with these reviews.

2.8 Conditions should also be reviewed where complaint is attributable to the operation of the process and is, in the opinion of the regulator, justified.

3. Activity description

Regulations

3.1 This note applies to LAPPC installations for hide and skin processes. The activities for regulation are listed in **Table 3.1**.

Table 3.1 - Regulations listing activities

LAPPC Activity	England and Wales	Scotland	Northern Ireland
	EPR Schedule 1 reference	PPC Schedule 1 reference	PPC Schedule 1 reference
Part A	Section 6.8 Part A1	Section 6.8 Part A	Section 6.8 Part A
Part B	Section 6.8 Part B	Section 6.8, Part B	n/a
Part C	n/a	n/a	Section 6.8 Part C

The links are to the original version of the Regulations. A consolidated version is not available on www.legislation.gov.uk

For England and Wales, an unofficial consolidated version is available but read the first page of that document in order to understand its status and content.

3.2 The hide and skin processing industry spans a wide range of activities and can be sub-divided according to raw material source, since the raw material used largely determines the end market. The main sub-divisions are:

a) Bovine-hides from cattle and calves are processed into leather for uses which include footwear uppers and soles, leather goods such as handbags and brief cases, upholstery and rugged clothing (for example, motor cycle jackets); **and**

b) Ovine-skins from sheep and lamb divide into two categories, wool sheep skins (i.e. sheep from temperate regions such as Europe, Australia and New Zealand), and hair sheep skins (i.e. sheep from semi-tropical countries, mainly in Africa and Asia). High quality wool sheep skins, particularly from the UK, are processed to produce leather for fashion clothing. Medium-quality skins are used to produce suede or wool-on products, and heavier, generally lower-quality sheep skins are split to produce skivers (for shoe lining, book binding, etc) and chamois.

3.3 Hides and skins from both local and foreign sources may be used and due to the requirement that hides and skins from slaughter houses are collected daily, regional hide markets usually undertake the initial collection and processing of the skins and hides although skins and hides may go directly to a tannery or fellmongery The skin and hide markets collect, classify, weigh and preserve (usually with salt or by chilling) the hides and skins prior to sale to fellmongers and tanners. Imported raw hides and skins are usually salted or brined, or dried, or salted and dried or chilled depending upon the origin. All of these methods of preservation avoid deterioration of the skins.

3.4 Bovine hides are sold from the hide and skin market to tanneries either in the UK or overseas for conversion into leather while the domestic sheep skins are primarily exported in the salted form or sold to fellmongers for removal and sale of the wool and processing of the pelt to "pickle" with acidulated brine. Some sheep skins are processed with wool on for rugs and coats etc.

3.5 The process operations can be divided into four categories:-

- hide and skin storage and limeyard or beamhouse operations;
- tanyard operations;
- post-tanning operations; **and**
- finishing operations.

3.6 In respect of the interface with Part A:-

- It is possible that a hide and skin process may involve tanning hides and skins at plant with a treatment capacity of more than 12 tonnes of finished products per day (section 6.8 Part (A1) (a)). In this case the process would fall to Part A control.

3.7 There are certain process operations which are carried out in the processing of hides and skins which are exempt activities and do not fall within the control regime. If the process only involves the salting of hides and skins and no other process detailed in the Regulations, the process is excluded (section 6.8 'exempt activity' (j)).

3.8 This note refers to skin and hide processes and relates to all treatment and processing of animal skin following the delivery of the skin from either a hide and skin market or a slaughter house or a knackers yard, including the fellmongering operation to remove hair or wool (including the fellmongery of sheepskins), tanning (a process which stabilises the skin), and post tanning operations other than surface coating. For the purpose of this note the term "skin" includes skins and hides.

3.9 This guidance note is not appropriate for processes falling within the Part A definition for national regulatory control.

3.10 Separate guidance has been provided on the finishing of leather by the application of coating materials involving the use of 5 tonnes or more of organic solvents in any 12-month period (PG6/22(11) - Statutory guidance for leather finishing).

3.11 The disposal of certain animal by-products fall under the controls of a European Regulation laying down health rules as regards animal by-products and derived products not intended for human consumption. Regulation (EC) 1069/2009, and the accompanying implementing Regulation (EC) 142/2011, applied from 4 March 2011 and repeals Regulation 1774/2002 (Animal by-products Regulation).

3.12 The Regulation specifies the permitted disposal methods for animal by-products, controls and records the movement of animal by- products and also details hygiene requirements in the collection, transport, storage and processing of animal by-products. Some of the by-products from a hide and skin process, before the skin is limed, pickled or tanned, may fall within these controls. Where there is any conflict between the standards of this note and the EU Regulations, the tighter standard prevails. The Regulations are primarily concerned with the veterinary requirements of animal by-product disposal and for prevention of pathogens in animal feedstuffs.

Limeyard or beamhouse operations

3.13 Sheepskin processing includes a number of stages, typically as follows:

- "soaking" commonly using a biocide, for example sodium hypochlorite solution;
- "painting" or "liming" on the flesh side with a depilatory paint containing typically sodium sulphide and lime;
- "pulling" to remove the wool or hair which is then dried;
- further treatment of the skin in alkaline solutions to release the hair roots;
- further treatment following pH adjustment involving buffer solutions, for example ammonium sulphate and enzymes prior to rinsing and pickling with acid and salt;
- final fleshing to remove unwanted animal fat remaining on the skin;
- splitting the hides horizontally into a grain layer and a flesh layer (can be carried out in either a limed state or tanned state).

These processes result in a product (pickled pelts) which are stable and can be held in store prior to sale to tanneries.

Tanyard operations

3.14 The subsequent processing of sheep skins involves further wet operations, including deliming, bating (a process to clear the grain, reduce swelling peptise fibres and remove protein degradation products), degreasing (sometimes with organic solvents), tanning with trivalent chromium salts or other agents (such as cod oil) in large rotating drums or other processing vessels, incorporation of dyes and oils to confer the required properties of colour, softness and stretch prior to drying and finishing.

Post tanning and finishing

3.15 A number of mechanical operations are also carried out to remove moisture, flatten and "set" the grain or increase the area including staking. The leather may be processed on either side to produce suede or nappa (grain) and may include the application of decorative or protective surface coatings (subject to separate guidance). There may be additional operations undertaken (such as fat-liquoring to replace fat lost in the process to enhance flexibility and impermeability), buffing and milling depending upon the finished product.

3.16 The processing of bovine hides follows a generally similar pattern except that the hides from the hide market are sold direct to tanners who process to the simply tanned condition (known as wet blue/wet white), at which stage the hides may be stored and sold on to other processors. Bovine hides do not normally require degreasing. Simply tanned leather may be further processed or traded in a damp (wet blue/wet white) or dry (crust) state. Hides may be processed whole or divided into "sides" and it is normal for them to be "split" horizontally by machine to produce two pieces of leather for further processing. Finally, the leather may be embossed or ironed to give a decorative or shiny effect.

Triviality

3.17 There are some processes where the regulator should consider whether the releases are trivial. In general if the process cannot lead to the emission of an offensive odour, VOCs or particulate matter the process releases may be trivial. Examples of the types of process operations which may be regarded as trivial are:-

- those which do not involve degreasing using organic solvents;
- where all skins stored or processed arrive in a preserved state (for example chilled or salted);
- where skins are subject to preservation by refrigeration and there is no processing of raw skins;
- where the process does not involve the use of sulphides or ammonia;
- where particulate matter abatement plant discharges within the process buildings.

Guidance on triviality is provided in the General Guidance Manual for England and Wales, Scotland and Northern Ireland.

4. Emission limits, monitoring and other provisions

4.1 Emissions of the substances listed **Table 4.1** should be controlled.

4.2 The emission limit values and provisions described in this section are achievable using the best available techniques described in **Section 5**. Monitoring of emissions should be carried out according to the method specified in this section or by an equivalent method agreed by the regulator. Where reference is made to a British, European, or International standard (BS, CEN or ISO) in this section, the standards referred to are correct at the date of publication. (Users of this note should bear in mind that the standards are periodically amended, updated or replaced.) The latest information regarding the monitoring standards applicable can be found at the Source Testing Association website. Further information on monitoring can be found in Environment Agency publications, M1 and M2.

4.3 All activities should comply with the emission limits and provisions with regard to releases in **Table 4.1**.

The reference conditions for limits in **Section 4** are: 273.1K, 101.3kPa, without correction for water vapour content, unless stated otherwise.

Table 4.1 should be considered in conjunction with the monitoring paragraphs found later in this section.

4.4 Where odour abatement plant is needed to meet the aim in paragraph 4.5, provisions in **Appendix 3** also apply.

Where VOC abatement plant is fitted, there are provisions in **Appendix 3** which should apply.

The aim - odorous emissions

4.5 The overall aim should be that all emissions from contained and fugitive sources are free from offensive odour outside the site boundary, as perceived by the regulator. However, the location of the installation will influence the assessment of the potential for odour impact as local meteorological conditions may lead to poor dispersion conditions. Where the site has a low odour impact due to its remoteness from sensitive receptors, the escape of offensive odour beyond the installation would be unlikely to cause harm.

Table 4.1 - Emission limits, monitoring and other provisions					
Row	**Substance**	**Source**	**Emission limits/provisions**	**Type of monitoring**	**Monitoring frequency**
1	Particulate matter	Emissions from mechanical abrasive processes (except where the final discharge of the abatement plant is within buildings)	20mg/m^3	Indicative monitoring plus annual extractive test	Continuous
2	VOCs	Emissions from degreasing operations involving the use of halogenated VOCs.	Closed cycle machine	Solvent management plan	Annual
3		Emissions from degreasing operations involving the use of non-halogenated VOCs	50mg/m^3 expressed as total carbon excluding particulate matter	Closed cycle machine -solvent management plan Non-closed cycle machine - Extractive test plus solvent management plan	Extractive test is annual
4	Visible emissions		All other releases to air, other than condensed water vapour, should be free from persistent visible emissions. All emissions to air should be free from droplets.		

Monitoring, investigating and reporting

4.6 The operator should monitor emissions, make tests and inspections of the activity. The need for and scope of testing, (including the frequency and time of sampling), will depend on local circumstances. Monitoring of wind speed and direction should normally not be required.

- The operator should keep records of inspections, tests and monitoring, including all non-continuous monitoring, inspections and visual assessments. Records should be:
  - kept on site;
  - kept by the operator for at least two years; **and**
  - made available for the regulator to examine.
- If any records are kept off-site they should be made available for inspection within one working week of any request by the regulator.

Information required by the regulator

4.7 The regulator needs to be informed of monitoring to be carried out and the results. The results should include process conditions at the time of monitoring.

- Adverse results from any monitoring activity (both continuous and non-continuous) should be investigated by the operator as soon as the monitoring data has been obtained. The operator should:
  - identify the cause and take corrective action;
  - clearly record as much detail as possible regarding the cause and extent of the problem, and the remedial action taken;
  - re-test to demonstrate compliance as soon as possible; **and** inform the regulator of the steps taken and the re-test results.

Visible emissions

4.8 The aim should be to prevent any visible airborne emission from any part of the process. This aim includes all sites regardless of location. Monitoring to identify the origin of a visible emission should be undertaken and a variety of indicative techniques are available.

Odorous emissions - general guidance

4.9 The following general guidance is provided to assist regulators in assessment of compliance with the odour provision of paragraph 4.5.

Whilst it is possible to measure the odour strength using a standardised method (dynamic olfactometry as detailed in BS EN 13725), it is not possible to use dynamic olfactometry to quantify the offensiveness of the odour. It is also not possible to use dynamic olfactometry as a field measurement.

In general odour effects are not caused by one single pollutant or chemical species, odour is a 'cocktail' of chemical species emitted from a process. The nose is an extremely sensitive receptor of odour - it can respond to small variations in concentration over periods of a few seconds and at concentrations of fractions of a part per billion.

Different people respond differently to the same odour, and the nature of any odour can vary (because of meteorology, process changes etc.) both in time and between different areas very close to one another.

Assessment of offensiveness of odour should take account of the nature of the odour, the frequency with which it arises, and its persistence. Local authorities should bear in mind that dispersal of odour may, from time to time, be adversely affected by temporary meteorological conditions.

Emissions of odour

4.10 Where there are problems that, in the opinion of the regulator, may be attributable to the installation, such as local complaints of odour or where odour from the installation is being detected beyond the site boundary, the operator should investigate in order to find out which part of their operation(s) is the cause.

4.11 Whilst problems are ongoing, a boundary check should also be made at least once per day/shift, by the operator, when an installation is being operated. The time, location and result of these checks, along with weather conditions such as indicative wind direction and strength, should be recorded. Once the source of the emission is known, corrective action should be taken without delay and where appropriate the regulator may want to vary the permit in order to add a condition requiring the particular measure(s) to be undertaken.

Abnormal events

4.12 The operator should respond to problems which may have an adverse effect on emissions to air.

- In the case of abnormal emissions, malfunction or breakdown leading to abnormal emissions the operator should:
  - investigate and undertake remedial action immediately;
  - adjust the process or activity to minimise those emissions; and
  - promptly record the events and actions taken.
- The regulator should be informed without delay, whether or not there is related monitoring showing an adverse result:
  - if there is an emission that is likely to have an effect on the local community; or
  - in the event of the failure of key arrestment plant, for example, bag filtration plant or scrubber units.
- The operator should provide a list of key arrestment plant and should have a written procedure for dealing with its failure, in order to minimise any adverse effects.

Odorous emissions - monitoring installation performance

4.13 The operator should monitor the performance of the installation to ensure that emissions that may result in a breach of the requirements of paragraph 4.5 are prevented or minimised. This assessment should include inspections of the process, buildings and equipment to check that emissions are being contained and treated to meet the standards of this note.

Continuous monitoring - particulate abatement plant

4.14 Continuous indicative monitoring can be used as a management tool. In conjunction with continuous recording it identifies any trends in emissions; for example, that emissions are gradually increasing, which may indicate a need for maintenance. It can also be used with or without continuous recording to trigger an alarm when there is a sudden increase in emissions; for example if abatement plant fails. For a given concentration of particulate, the output level varies with the instrument. It should be noted that not all monitors provide a linear response to an increase in particulate matter. The monitor should be set up to provide a baseline output when the plant is known to be operating under the best possible conditions; i.e. such that emissions are fully compliant with the authorisation/permit. The instrument manufacturer should be able to set an output level which corresponds to around 75% of the emission limit, to trigger alarms. Thus the alarms are activated in response to this significant increase in particulate loading above the baseline, so that warning of the changed state is given before an unacceptable emission occurs. The regulator may wish to agree the alarm trigger level.

- Emissions from particulate abatement plant (except where the final discharge of the abatement plant is within buildings) where exhaust airflow exceeds 100m^3/min should be continuously indicatively monitored for particulate matter. (By continuous indicative monitoring is meant monitoring to indicate the relative performance and/or process variation. Such monitoring does not provide data to demonstrate compliance with numerical emission limit.) The indicative monitor should be fitted with a visual and audible alarm which activates at a reference agreed with the regulator.

VOC - degreasing using solvents - solvent management plan

4.15 Management of the use of solvent should be demonstrated by the provision of information indicating the average use of solvent per unit of product processed, (or a similar alternative agreed with the regulator).

4.16 Machines should be well maintained.

4.17 High temperatures during the recovery cycle lead to degradation of the solvent and its frequent replacement (‘frequent ‘compared to technically similar dry cleaning machines)

4.18 If significant process changes take place the figure should be revised and agreed with the regulator.

Continuous monitoring

4.19 Compliance monitoring can be carried out either by use of a continuous emissions monitor (CEM), or by a specific extractive test carried out at a frequency agreed with the regulator.

4.20 Where a CEM is used for compliance purposes it must be periodically checked, (calibrated), to ensure the readings being reported are correct. This calibration is normally done by carrying out a parallel stand-alone extractive test and comparing the results with those provided by the CEM.

4.21 For extractive testing the sampling should meet the following requirements:

- For batch processes, where the production operation is complete within, say, 2 hours, then the extractive sampling should take place over a complete cycle of the activity.

Varying of monitoring frequency

4.22 Where non-continuous quantitative monitoring is required, the frequency may be varied. Where there is consistent compliance with emission limits, regulators may consider reducing the frequency. However, any significant process changes that might have affected the monitored emission should be taken into account in making the decision.

Monitoring of unabated releases

4.23 Where emission limit values are consistently met without the use of abatement equipment, the monitoring requirement for those pollutants should be dispensed with subject to the “Varying of monitoring frequency” paragraphs above.

Where monitoring is not in accordance with the main procedural requirements of the relevant standard, deviations should be reported.

5. Control techniques

Summary of best available techniques

5.1 **Table 5.1** provides a summary of the best available techniques that can be used to control the process in order to meet the emission limits and provisions in **Section 4**. Provided that it is demonstrated to the satisfaction of the regulator that an equivalent level of control will be achieved, then other techniques may be used.

5.2 Where the process is largely carried out in open vessels and equipment and hence emissions are released into the process building, the key to effective control is containment within the building or by local extraction. . The operator should be advised of odours perceived by the regulator as soon as possible.

5.3 In most cases the precise management of chemicals used within the process, (especially sulphides), and the partial or complete substitution of ammonia, plus the control of pH of sulphide solutions, (both in the process and as effluent), will be sufficient to control odorous emissions without the need for abatement plant. The potential for prevention of the emission of odours by process change should be considered on an on-going basis. It is possible to substantially reduce odour generation by process optimisation and control.

5.4 The following are examples of relevant odour control techniques:

- containment of odours within process buildings by good design and extract ventilation;
- good housekeeping and raw material handling practices;
- reduction of sulphide use by the adoption of "hair-save" techniques;
- reduction of ammonia use by the partial or complete substitution for ammonium salts as a de-liming agent.

Table 5.1 - Summary of control techniques		
Source	**Substance**	**Control techniques**
Receipt and storage of untreated hides and skins, raw materials and products	Odour	Where raw hides or skins are received these should either be processed on receipt, or preserved by salting icing or chilling. Good stock control is required for iced hides.
Effluent and waste storage		Control of the pH of sulphide containing liquids in the process and as effluent. Mixing with acidic effluents should only be allowed either (a) once sulphide has been oxidised or (b) in an enclosed vessel with extraction through a scrubber.
De-hairing process		Reduction of sulphide use by the adoption of "hair save" techniques, plus good pH control of the process.
Ventilated process air		Vent to suitable abatement plant • biofilters • thermal oxidisers/combustion plant • scrubbers • located to take account of sensitive receptors
Waste gas from odour abatement plant	Odour	Dispersion of any residual odorous releases
	Sulphur oxides	Limit sulphur in fuel
	Carbon monoxide	Good combustion
Waste gases from degreasing operations	VOCs	Abatement and recovery using adsorption and condensation preferred

Techniques to control emissions from contained sources

5.5 Emissions from the process operations covered by this note comprise odours of mixed chemical species but providing that raw and waste materials are correctly stored and handled, the major odour sources are ammonia and sulphides used in de-hairing and liming. Examples of techniques which can be used to minimise emissions from these sources include:

- pH control of sulphide liquors to retain sulphides in solution;
- oxidation of sulphides to sulphate;
- carbon dioxide deliming to reduce ammonia use;
- "hair save" techniques to reduce sulphide use and total ammonia in the effluent, (though disposal of hair is often difficult).

Where these releases cannot be avoided, they should be subject to containment and, where necessary, final treatment to ensure that they do not result in a breach of the requirements in paragraph 4.5. This containment is achieved by ensuring that all operations with potential releases are carried out within enclosed process vessels to prevent fugitive emissions.

5.6 Suitable odour abatement plant should be provided and operated at all times where necessary, to meet the provisions of paragraph 4.5. In cases where local exhaust ventilation is provided for occupational health and safety reasons on processes which may liberate significant odours such as the de-hairing process using sulphides, this ventilation air might require odour abatement

5.7 The use of odour masking agents and counteractants should not be permitted (other than as a scrubber liquor additive).

Degreasing

5.8 Organic solvent based degreasing processes should be undertaken in enclosed or covered vessels to minimise emissions of volatile organic compounds. The emissions from solvent degreasing operations should be controlled by condensation and recovery of the solvents in an enclosed system or by the use of carbon adsorption and recovery.

5.9 Where degreasing is carried out as described above, as an alternative to the numerical provisions of **Table 4.1** Rows 2 and 3, it is acceptable to demonstrate that the equipment is functioning effectively and is well maintained.

5.10 Volatile organic compounds with the hazard statement H340, H350, H350i, H360D or H360F should not be used for degreasing.

5.11 The use of halogenated VOCs should be restricted to use in closed cycle machines

Particulate matter

5.12 Emissions of particulate matter from mechanical abrasion operations should be contained, extracted and arrested if necessary to meet the visible emission provisions or the limits described in **Table 4.1** for particulate matter.

5.13 The methods of removal of collected particulate matter from abatement plant should be undertaken carefully to avoid re-entrainment of dust.

Techniques to control fugitive emissions

Materials handling

5.14 Uncured hides and skins should be transported from the source of arising to the processing site as quickly as practicable. The design and use of vehicles and containers should be such as to prevent the emission of any offensive odour or substance prescribed for air. Where skins are transported which have not been previously treated (i.e. green skins which have not been pickled, chilled, iced or salted) the vehicles and containers used in the collection of the skins should be covered. Containers used for the carriage of pickled skins in liquor should be designed and used to minimise liquid spillage.

5.15 All vehicles, containers, trailers and equipment used for the collection, transfer and handling of the aforementioned raw materials and for holding waste should be readily cleansable, impervious and kept clean.

5.16 All tanks for liquid material storage should be fitted with level indicators or high level alarms to warn of potential overfilling. Where necessary to meet the requirements of row 1 of **Table 4.1** such tanks should be vented to odour abatement plant.

5.17 All surfaces and equipment liable to come into contact with animal material or waste and all walls of areas where such materials are handled should be impervious, capable of being readily cleansed and should be kept clean. The use of wooden process vessels should be permitted.

5.18 All floors of storage and processing areas should be of impervious construction laid to fall to trapped drainage inlets. Drains should be provided where necessary, with sedimentation tanks and interceptors to prevent the transmission of material likely to impair the free flow of any receiving sewerage system.

5.19 Skins should be received and stored prior to processing in a defined, designated storage area. Raw hides and skins should not be stored outside. If they cannot be processed on receipt they should be salted, or iced, or refrigerated. If such storage gives rise to offensive odour which can be perceived beyond the site boundary, the buildings should be vented to suitable abatement equipment and be kept under negative pressure, for example by the fitting of self-closing doors. Vehicles and containers should be emptied into the aforementioned designated area, and should be cleaned as soon as possible after delivery in a further designated area. The location of storage areas for both green skins and conserved skins should take account of the need to minimise emissions of offensive odour.

Process operations

5.20 It is essential during handling of liquid spillages and effluent, that acid and sulphide effluents produced are separated to prevent the uncontrolled reaction and liberation of substances prescribed for air to air.

5.21 Careful process design and operation to avoid the liberation of odorous chemicals and to control effluent and waste materials should avoid the need for ventilation within the raw material handling and processing areas.

5.22 Adequate provisions should be made for the containment of liquid and solid spillages. All spillages should be cleared as soon as possible and in the case of solid materials this should be achieved by the use of vacuum cleaning, wet methods, or other appropriate techniques.

5.23 Good housekeeping should be practised at all times. The adoption of good cleaning and working practices as a routine will reduce process odour emissions. A proper cleaning programme should be instituted for areas with untreated material.

5.24 A senior manager who recognises the importance of controlling the odours produced by the hide and skin process should be designated to be specifically responsible for all aspects of liaison with the regulator and where applicable with members of the general public.

Good hygiene for odour control

5.25 European regulations laying down health rules as regards animal by-products and derived products not intended for human consumption, (Regulation (EC) 1069/2009 and the accompanying implementing Regulation (EC) 142/2011) apply to this sector and are enforced for reasons other than odour control.

Animal by-products legislation is not a reason for including conditions in a permit issued using this guidance note, however the effect of the animal by-products controls assist considerably in odour control for hide and skin processes. Inclusion of detailed hygiene conditions in the permit for odour control reasons is not usually required.

Effluent and waste

5.26 The effluent produced has the potential to generate a significant odour. All effluent should therefore be carefully handled and treatment should be carried out in a manner which will minimise the emission of offensive odours and will render any emission inoffensive and harmless.

5.27 It is essential during handling of effluent and liquid spillages that acid and sulphides are separated to prevent the uncontrolled reaction and emissions of odour.

5.28 Any untreated waste material which is minced on-site (such as fleshings) and discharged with effluent should not be discharged to the normal sewerage system but should be discharged to an effluent treatment plant or storage tank.

5.29 Separated sludge produced by effluent treatment in establishments processing hides or skins received with the wool or hair intact, which has not been dewatered and is not in the process of being dewatered, should not be stored on site for more than 48 hours and should be stored in enclosed skips.

- All effluent storage tanks should be vented to suitable odour abatement plant where necessary to meet the provisions of paragraph 4.5. A minimum extracted air volume should be maintained to the tank at all times (depending upon the tank design it may be necessary to isolate the tank from the odour abatement plant during emptying to avoid tank damage). Care should be taken in emptying the effluent tanks to minimise odour release - consideration should be given to venting the collecting tanker to odour abatement plant.

5.30 All putrescible wastes should be stored within an enclosed storage area, tank or container whilst awaiting removal. They should be disposed of or further treated as soon as possible.

Air quality

Dispersion & dilution

5.31 Pollutants that are emitted via a stack require sufficient dispersion and dilution in the atmosphere to ensure that they ground at concentrations that are deemed harmless. This is the basis upon which stack heights are calculated using HMIP Technical Guidance Note (Dispersion) D1. The stack height so obtained is adjusted to take into account local meteorological data, local topography, nearby emissions and the influence of plant structure.

The calculation procedure of D1 is usually used to calculate the required stack height but alternative dispersion models may be used in agreement with the regulator. An operator may choose to meet tighter emission limits in order to reduce the required stack height.

5.32 Where an emission consists purely of air and particulate matter, (i.e. no products of combustion or any other gaseous pollutants are emitted) the above provisions relating to stack height calculation for the purpose of dispersion and dilution should not normally be applied. Revised stack height calculations should not be required as a result of publication of this revision of the PG note, unless it is considered necessary because of a breach or serious risk of breach of an EC Directive limit value or because it is clear from the detailed review and assessment work that the permitted process itself is a significant contributor to the problem.

5.33 Where offensive odour is likely outside the process site boundary the assessment of stack or vent height should take into account the need to render harmless residual offensive odour.

Ambient air quality management

5.34 In areas where air quality standards or objectives are being breached or are in serious risk of breach and it is clear from the detailed review and assessment work under Local Air Quality Management that the permitted process itself is a significant contributor to the problem, it may be necessary to impose tighter emission limits. If the standard that is in danger of being exceeded is not an EC Directive requirement, then industry is not expected to go beyond BAT to meet it. Decisions should be taken in the context of a local authority's Local Air Quality Management action plan. For example, where a permitted process is only responsible to a very small extent for an air quality problem, the authority should not unduly penalise the operator of the process by requiring disproportionate emissions reductions. Paragraph 59 of the Air Quality Strategy 2007 [Volume 1] gives the following advice:

"...In drawing up action plans, local authority environmental health/pollution teams are expected to engage local authority officers across different departments, particularly, land-use and transport planners to ensure the actions are supported by all parts of the authority. In addition, engagement with the wider panorama of relevant stakeholders, including the public, is required to ensure action plans are fit-for-purpose in addressing air quality issues. It is vital that all those organisations, groups and individuals that have an impact upon local air quality, buy-in and work towards objectives of an adopted action plan."

Stacks, vents and process exhausts

5.35 Liquid condensation on internal surfaces of stacks and exhaust ducts might lead to corrosion and ductwork failure or to droplet emission. Adequate insulation will minimise the cooling of waste gases and prevent liquid condensation by keeping the temperature of the exhaust gases above the dewpoint. A leak in a stack/vent and the associated ductwork, or a build up of material on the internal surfaces may affect dispersion:

- Flues and ductwork should be cleaned to prevent accumulation of materials, as part of the routine maintenance programme.

5.36 When dispersion of pollutants discharged from the stack (or vent) is necessary, the target exit velocity should be 15m/s under normal operating conditions, however, lower velocities than 15m/s are acceptable provided adequate dispersion and dilution is achieved (see also the paragraph below regarding wet plumes). In order to ensure dispersion is not impaired by either low exit velocity at the point of discharge, or deflection of the discharge, a cap, or other restriction, should not be used at the stack exit. However, a cone may sometimes be useful to increase the exit velocity to achieve greater dispersion.

5.37 An exception to the previous paragraph is where wet arrestment is used as the abatement. Unacceptable emissions of droplets could occur from such plant where the linear velocity in the stack exceeds 9m/s.

5.38 To reduce the potential of droplet emissions a mist eliminator should be used. Where a linear velocity of 9m/s is exceeded in existing plant consideration should be given to reducing this velocity as far as practicable to ensure such droplet entrainment and fall out does not happen.

Management

Management techniques

5.39 Important elements for effective control of emissions include:

- proper management, supervision and training for process operations;
- proper use of equipment;
- effective preventative maintenance on all plant and equipment concerned with the control of emissions to the air; **and**
- ensuring that spares and consumables - in particular, those subject to continual wear – are held on site, or available at short notice from guaranteed local suppliers, so that plant breakdowns can be rectified rapidly. This is important with respect to arrestment plant and other necessary environmental controls. It is useful to have an audited list of essential items.

Appropriate management systems

5.40 Effective management is central to environmental performance; it is an important component of BAT and of achieving compliance with permit conditions. It requires a commitment to establishing objectives, setting targets, measuring progress and revising the objectives according to results. This includes managing risks under normal operating conditions and in accidents and emergencies.

It is therefore desirable that installations put in place some form of structured environmental management approach, whether by adopting published standards (ISO 14001 or the EU Eco Management and Audit Scheme [EMAS]) or by setting up an environmental management system (EMS) tailored to the nature and size of the particular process. Operators may also find that an EMS will help identify business savings.

5.41 Regulators should use their discretion, in consultation with individual operators, in agreeing the appropriate level of environmental management. Simple systems which ensure that LAPPC considerations are taken account of in the day-to-day running of a process may well suffice, especially for small and medium-sized enterprises. Regulators are urged to encourage operators to have an EMS for all their activities, but it is outside the legal scope of an LAPPC permit to require an EMS for purposes other than LAPPC compliance. For further information/advice on EMS refer to the appropriate chapter of the appropriate Guidance Manual for England and Wales, Scotland and Northern Ireland.

Training

5.42 Staff at all levels need the necessary training and instruction in their duties relating to control of the process and emissions to air. In order to minimise risk of emissions, particular emphasis should be given to control procedures during start-up, shut down and abnormal conditions. Training may often sensibly be addressed in the EMS referred to above.

- All staff whose functions could impact on air emissions from the activity should receive appropriate training on those functions. This should include:
  - awareness of their responsibilities under the permit;
  - steps that are necessary to minimise emissions during start-up and shutdown;
  - actions to take when there are abnormal conditions, or accidents or spillages that could, if not controlled, result in emissions.
- The operator should maintain a statement of training requirements for each post with the above mentioned functions and keep a record of the training received by each person. These documents should be made available to the regulator on request.

Maintenance

5.43 Effective preventative maintenance plays a key part in achieving compliance with emission limits and other provisions. All aspects of the process including all plant, buildings and the equipment concerned with the control of emissions to air should be properly maintained. In particular:

- The operator should have the following available for inspection by the regulator:
  - a written maintenance programme for all pollution control equipment; **and**
  - a record of maintenance that has been undertaken.

6. Summary of changes

The main changes to this note, with the reasons for the change, are summarised in **Table 6.1**. Minor changes that will not impact on the permit conditions e.g. slight alterations to the Process Description have not been recorded.

Table 6.1 - Summary of changes

Section/ paragraph/ row	Change	Reason	Comment
Abatement provisions set out in Section 5	Moved abatement provisions for odour and VOC to Appendix 2	To simplify the guidance for most users	Odour and VOC abatement plant are rare in the sector
Paragraph 5.11 and Rows 2 & 3 of Table 4.1	Closed cycle machines required for halogenated VOC degreasing	BAT	A numerical limit for VOC use when degreasing is not needed

7. Further information

Sustainable consumption and production (SCP)

Both business and the environment can benefit from adopting sustainable consumption and production practices. Estimates of potential business savings include:

- £6.4 billion a year UK business savings from resource efficiency measures that cost little or nothing;
- 2% of annual profit lost through inefficient management of energy, water and waste;
- 4% of turnover is spent on waste.

When making arrangement to comply with permit conditions, operators are strongly advised to use the opportunity to look into what other steps they may be able to take, for example, having regard to the efficient use of auxiliary fuels, such as gas and electricity. Regulators may be willing to provide assistance and ideas, although cannot be expected to act as unpaid consultants.

Health and safety

Operators of installations must protect people at work as well as the environment:

- requirements of a permit should not put at risk the health, safety or welfare of people at work or those who may be harmed by the work activity;
- equally, the permit must not contain conditions whose only purpose is to secure the health of people at work. That is the job of the health and safety enforcing authorities.

Where emission limits quoted in this guidance conflict with health and safety limits, the tighter limit should prevail because:

- emission limits under the relevant environmental legislation relate to the concentration of pollutant released into the air from prescribed activities;
- exposure limits under health and safety legislation relate to the concentration of pollutant in the air breathed by workers;

- these limits may differ since they are set according to different criteria. It will normally be quite appropriate to have different standards for the same pollutant, but in some cases they may be in conflict (for example, where air discharged from a process is breathed by workers). In such cases, the tighter limit should be applied to prevent a relaxation of control.

Further advice on responding to incidents

The UK Environment Agencies have published guidance on producing an incident response plan to deal with environmental incidents. Only those aspects relating to air emissions can be subject to regulation via a Part B (Part C in NI) permit, but regulators may nonetheless wish to informally draw the attention of all appropriate operators to the guidance.

It is not envisaged that regulators will often want to include conditions, in addition to those advised in this PG note, specifying particular incident response arrangements aimed at minimising air emissions. Regulators should decide this on a case-by-case basis. In accordance with BAT, any such conditions should be proportionate to the risk, including the potential for harm from air emissions if an incident were to occur. Account should therefore be taken of matters such as the amount and type of materials held on site which might be affected by an incident, the likelihood of an incident occurring, the sensitivity of the location of the installation, and the cost of producing any plans and taking any additional measures.

Appendix 1 - Preparation of an odour response procedure

What is an odour response procedure?

An odour response procedure is a summary, provided by the operator, of the foreseeable situations which may compromise his ability to prevent and/or minimise odorous releases from the process and the actions to be taken to minimise the impact. It is intended to be used by operational staff on a day-to-day basis and should detail the person responsible for initiating the action.

The procedure is intended primarily to document foreseeable events which are outside of the control of the operator and those that are preventable by maintenance and operational control (for example pump failure, biofilter compaction or filter breakthrough). The procedure should include a maintenance programme for all odour abatement plant and other odour containment measures (such as building structure, ventilation plant).

What is the format for the odour response procedure?

The odour response procedure should be a written document which is available on-site and should be submitted to the regulator. The regulator may wish to set conditions in the permit/authorisation which reflect the undertakings given in the procedure (for example maximum abatement plant by-pass times, reduced throughput etc).

What should be included in the odour response procedure?

There are four main reasons for releases which may lead to emissions of offensive odour which are:

1. Changes in process conditions leading to more odour generation or a change in the odour characteristics.

2. Conditions which result in fugitive releases due to reduced odour containment.

3. Failures or reduced performance of odour abatement plant.

4. Factors affecting the dispersion between the source and the receptor.

The occurrence of 2 and 3 above can be limited by the production of, and compliance with, an effective plant and building maintenance programme. Examples of other issues which should be considered in each of these categories are given in **Table A**.

In order to prepare an assessment of possible abnormal conditions and the options for mitigation of the odour, the operator will need to consider:

- the activity which produces the odour and the point of odour release;
- possible process or control failures or abnormal situations;
- potential outcome of a failure in respect of the likely odour impact on local sensitive receptors;
- what actions are to be taken to mitigate the effect of the odour release and details of the persons responsible for the actions at the site.

Table A - Examples of issues to consider relating to odour release	
Factors leading to odour release	**Examples of issues to consider**
Those which have potential to affect the process and the generation of odour	Materials input - seasonal variation in weather may affect odour of materials particularly if putrescible. Process parameters such as changes in temperature/pressures Rate of throughput or increased hours of operation High levels of ammonia within the process buildings (possibly due to high ambient temperatures).
Those which affect the ability to arrest/minimise odour	Poor performance of bio-filtration or poisoning (may be the result of poor maintenance or miss-operation) Flooding of the biofilter due to abnormally high rainfall External failure of other utilities, e.g. water supply, gas supply for combustion plant where the operator has signed up to an interruptible gas supply Mechanical breakdown of abatement plant such as pumps, fans etc Power failure Compaction of the biofilter or surface fissures Saturation of a carbon filter bed and subsequent breakthrough of odours Below optimum temperature of a thermal oxidiser or boiler etc Saturation of scrubber liquor, blocked injection nozzles etc.
Those which affect the ability to contain odour	Building damage which affects integrity due to for example storms Power failure Failure of automatic doors, i.e. in open position Failure in procedures to maintain containment (human error)
Those affecting dispersion between the source and sensitive receptors‡	Short term weather patterns which fall outside of the normal conditions for that area and are highly unusual (not just the normal meteorological pattern) - inversions and other conditions unfavourable to dispersion should have been considered in designing the process Weather - wind direction, temperature, inversion conditions if these are normal variants of local weather Loss of plume buoyancy/temperature
‡ The process design should incorporate control measures to ensure that under the normal range of meteorological conditions for the area, no emissions result in offensive odour that is detectable beyond the process boundary.	

Appendix 2 - Odour abatement plant

Odour abatement plant is rare at hide and skin processes, so provisions about it have been moved from sections 4 and 5 to this appendix. That makes section 4 simpler to use for most users.

For sites with odour abatement plant, this appendix should be read as if it is part of section 4.

To aid readability of this appendix, some text has been repeated from section 4.

Table 1 - Emissions limits, monitoring and other provisions

Row	Substance	Source	Emission limits/provisions	Type of monitoring	Monitoring frequency
1		Contained process releases	Where installed any odour abatement plant installed on contained emissions (ventilation air from the process building) should have an odour removal efficiency of not less than 95%.	Determination by manual extractive sampling and analysis by dynamic olfactometry.	On installation, and / or following substantiated complaints.
2	Sulphur dioxide	All activities using heavy fuel oil or other residual type/ comparable Quality Protocol Processed Fuel Oil	1% wt/wt sulphur in fuel	Sulphur content of fuel is regulated under the Sulphur Content of Liquid Fuels Regulations.	
3	Sulphur dioxide	All activities using gas oil/ comparable Quality Protocol Processed Fuel Oil	0.1% wt/wt sulphur in fuel		

Destruction efficiency testing requires simultaneous sampling at inlet and outlet of abatement plant.

Dynamic olfactory results shall be checked by the operator on receipt and sent to the Council within 8 weeks of the monitoring being undertaken.

Activities burning bio-fuels should have a limit set for sulphur in fuel.

Activities burning waste oil not covered by the quality protocol processed fuel oil must comply with the Chapter IV of the industrial emissions Directive (the waste incineration chapter).

Existing plant

4.24 For existing plant, provided the operator can satisfactorily demonstrate that the operation of plant at lower odour removal efficiencies meets the provisions of paragraph 4.5 then these lower odour removal efficiencies shall apply.

New/replacement plant

4.25 Where it can be demonstrated that the provisions of paragraph 4.5 are being met new/replacement plant may be operated at odour removal efficiencies lower than the 95% in **Table 1,** row 1. To provide such demonstration, operators should determine, using dispersion modelling or alternative appropriate technique, what percentage efficiencies are required to meet the provisions of paragraph 4.5.

Inspecting odour abatement plant

4.26 Where it is installed any odour abatement equipment should be inspected at least once a day to verify correct operation and to identify any malfunctions. Depending upon the type of any abatement plant used this inspection should include:

- Identification of any leaks in air handling equipment and ductwork.
- In the case of scrubbing equipment, thermal oxidisers and other combustion equipment, the inspection should include verification of the operation of any continuous monitoring equipment, the presence of any blockages and also identification of any leaks of either odorous air or liquid.
- In the case of biofilters, the surface should be inspected to identify any cracking of the surface or voids in the bed, leaks around the edge of the filter or air handling equipment, review of the moisture content (considering both flooding and drying out) and looking for signs of compaction or uneven flow.
- In the specific case of soil biofilters, the growth of plants and weeds should be inspected as any excessive flow or odour escape is often indicated by scorching of the earth or plant growth dying off.
- The operator should notify the regulator at least 7 days before any periodic monitoring exercise to determine compliance with emission limit values. The operator should state the provisional time and date of monitoring, pollutants to be tested and the methods to be used.
- The results of non-continuous emission testing should be forwarded to the regulator within 8 weeks of completion of the sampling.

Indicative tests for odour abatement plant

4.27 If offensive odours are detected beyond the process boundary or complaints received but there is no obvious cause of odour release, then where odour abatement plant has been installed, it will be necessary to check its performance. **Table 2** provides guide values which would indicate problems with abatement plant. The following are the indicative tests it is envisaged would normally be used:

- In the case of thermal oxidisers or combustion plant, the combustion efficiency is a good indication of performance. Emissions may be tested for carbon monoxide and the indicative guide value in Row 3 of **Table 2** should be used. If emissions exceed this indicative guide value it is likely that the odour destruction efficiency of the abatement plant is reduced and it should be further investigated to identify reasons for the reduced performance.

- In the case of biofilters or scrubbers, emissions may be tested for ammonia or mercaptans/hydrogen sulphide and the indicative guide values in rows 1 and 2 of **Table 2** should be used. If emissions exceed this indicative guide value it is likely that the odour destruction efficiency of the odour abatement plant is reduced and the scrubber/biofilter should be further investigated to identify reasons for the reduced performance. This testing can be carried out using gas detection tubes (further guidance on gas detection tubes is included in **Appendix 3**, paragraph 5).

- In the case of open top biofilters, the sampling method detailed in **Appendix 3** of this note should be used.

The **Table 2** provides indicative guide values which if exceeded indicate that the odour destruction efficiency of the abatement plant is reduced and the plant should be further investigated to identify reasons for the reduced performance.

Table 2 - Indicative guide values

Row	Odour indicators	Indicative guide values
1	Ammonia	1 ppm v/v
2	Organic and inorganic sulphides including mercaptans and hydrogen sulphide (as total sulphur).	1 ppm v/v
3	Emissions of carbon monoxide from thermal oxidisers or combustion plant.	100 mg/m^3 expressed as a 30-minute mean at 273K and 101.3kPa.
N.B. The above values are only to be used in conjunction with the provisions of paragraph 4.27.		

Start up and shutdown

4.28 Higher emissions may occur during start-up and shut-down of a process. These emissions can be reduced, by minimising, where possible, the number of start-ups and shut-downs and having adequate procedures in place for start-up, shut-down and emergency shut-downs.

- The number of start-ups and shut downs should be kept to the minimum that is reasonably practicable.
- All appropriate precautions must be taken to minimise emissions during start-up and shutdown.

Continuous monitoring - odour abatement plant

4.29 Where odour abatement plant is used, continuous monitoring (linked to alarms) should be installed in order to demonstrate compliance with the provisions of this note.

- In the case of thermal oxidisers or combustion plant, emissions should be continuously monitored and continuously recorded for carbon monoxide, or the operating temperature may be used as a surrogate measurement. The monitor should be fitted with an audible and visual alarm to activate if the operating temperature falls below 1123K (850^{o}C) or if the carbon monoxide level exceeds the indicative guide value in row 3 of **Table 2**.
- In the case of scrubbing equipment, pH or Redox of the liquor and liquor flow should be continuously monitored. All liquid scrubbers should be fitted with an audible and visual alarm to activate if the liquor circulation fails or if the pH or Redox falls outside the operating range established during commissioning testing.
- If a bio-scrubber is used, in addition to flow and pH or Redox monitoring, the pressure drop across the scrubber packing should be continuously monitored. The monitor should be fitted with an audible and visual alarm to activate if the pressure drop falls outside the operating range established during commissioning testing.

- If a biofilter is used the pressure drop across the biofilter should be continuously monitored. This can be achieved by measuring the delivery pressure on the main fan. The monitor should be fitted with an audible and visual alarm to activate if the pressure drop falls outside the operating range established during commissioning testing. If the process has more than one fan for different process areas and these fans are not operated when the areas are not in use (for example during the winter period when production levels are low) the value used for alarming may need to be variable depending upon the volume of air being treated and process conditions. In this case, where the alarm level is varied, the set point of the alarm should be recorded.

- The operating levels of the pH, Redox and pressure drop where monitored should be recorded daily.

- The cooling liquid flow of all direct or indirect condensers used for pre-treatment of emissions (including spray tower scrubbers) should be continuously monitored.

Odorous emissions - monitoring installation performance

4.30 The operator should monitor the performance of the installation to ensure that emissions that may result in a breach of the requirements of paragraph 4.5 are prevented or minimised. This assessment should include inspections of the process, buildings and equipment to check that emissions are being contained and treated to meet the standards of this note.

- In addition to the continuous indicative monitoring outlined in paragraphs 4.29 - 4.35, the odour abatement equipment should be inspected at least once a day to verify correct operation and to identify any malfunctions. Depending upon the type of abatement plant used, this inspection should include:

    - identification of any leaks in air handling equipment and ductwork. Where a key component of the odour abatement plant cannot be adequately accessed for inspection then arrangements to enable this should be made;

    - in the case of scrubbing equipment, thermal oxidisers and other combustion plant, verification of the operation of the continuous monitoring equipment, any blockages and also identification of any leaks of either odorous air or liquid;

    - in the case of biofilters, the surface should be inspected to identify any cracking of the surface or voids in the bed, leaks around the edge of the filter or air handling equipment, review of the moisture content (considering both flooding and drying out) and looking for signs of compaction or uneven flow;

- in the specific case of soil biofilters, the growth of plants and weeds. Excessive flow or odour escape is often indicated by scorching of the earth or plant growth dying off.

➢ The results of all inspections should be recorded and action should be taken immediately in the case of abnormal emissions. Additional guidance on abnormal emissions is included in paragraphs 4.12 and 4.13.

Continuous monitoring - VOC abatement plant

4.31 Monitoring of the performance of VOC abatement plant, whether directly or via a surrogate measurement is required to demonstrate compliance with the provisions of this note.

4.32 Where a condenser is used for solvent recovery then the cooling liquid flow should be continuously monitored.

4.33 In the case of thermal oxidisers or combustion plant, scrubbers or biofilters, the provisions of paragraph 4.29 should apply.

4.34 In the case of carbon adsorption plant used for solvent recovery, the performance of the unit should be demonstrated either by continuously monitoring the pressure drop across the carbon bed or, in the case of dual bed units, by establishment of an acceptable operating period for each bed. In the former case the monitor should be fitted with an audible and visual alarm to activate if the pressure drop falls outside the operating range established during commissioning testing. In the latter case the efficiency and the adsorption period selected should be confirmed by use of the monitoring procedure detailed below.

4.35 In order to review adsorption plant efficiency, particularly in respect of solvent breakthrough, emissions from the recovery plant should either be continuously monitored for VOCs or concentrations should be measured in waste gases after the adsorption bed on a weekly basis to indicate adsorption efficiency of the plant. This efficiency measure will identify potential adsorption media deterioration.

Continuous monitoring - general

4.36 Whilst there are no reliable continuous emission monitoring options for odours, where thermal oxidation or combustion equipment is used for odour control, continuous monitoring of carbon monoxide is an option (see paragraph 4.27). Where continuous monitoring (as described in 4.27 and 4.31- 4.35) is required it should be carried out as follows:

➢ The activation of alarms should be automatically recorded.

- All continuous monitors should be operated, maintained and calibrated (or referenced) in accordance with the manufacturers' instructions, which should be made available for inspection by the regulator. The relevant maintenance and calibration (or referencing) should be recorded

- All continuous monitoring readings should be on display to appropriately trained staff.

- Instruments should be fitted with audible and visual alarms, situated appropriately to warn the operator of abatement plant failure or malfunction.

- Purchasers of new or replacement monitoring equipment should specify the requirement for less than 5% downtime over any 3-month period, on ordering.

Calibration and compliance monitoring

4.37 Calibration and compliance monitoring should meet the following provisions as appropriate depending upon the type of abatement plant used:

- Odour testing should take place on commissioning of new/replacement plant to demonstrate compliance with the requirements of **Table 1**, row 1. In addition, it may be necessary to carry out monitoring of emissions of odour at other times where the process is subject to justified complaint of offensive odour and the investigations carried out in accordance with paragraph 4.10 and 4.26 cannot identify a cause for the odour.

- No monitoring result should exceed the emission concentration limits specified in **Table 2**.

- The destruction efficiency of any odour abatement plant required to meet the provisions in **Table 1** should be tested in accordance with the main procedural requirements of BS.EN13725. This testing should be carried out by dynamic olfactometry based upon manual extractive sampling undertaken simultaneously at the inlet and outlet of the odour abatement plant. At least three samples should be taken from both the inlet and outlet. Where the odour abatement plant comprises an open top biofilter, the guidance in **Appendix 3** should assist in developing a sampling protocol.

- Non-continuous emissions monitoring of particulate should be carried out once a year according to the main procedural requirements of BS ISO 9096, with averages taken over operating periods excluding start-up and shutdown. Sampling equipment should be capable of collecting particulate matter of 0.1 microns diameter or less, with an efficiency of at least 75%. This provision is not necessary where the final discharge of the abatement plant is within buildings or the volume of discharged air is less than 100m^3/min or where emissions do not exceed the relevant emission limit in row 1 of **Table 4.1** without the use of abatement plant.

- Where organic solvent degreasing systems are used then subject to paragraph 4.44, non-continuous emissions monitoring of volatile organic compounds should be carried out once a year, for example using a flame ionisation detector. The testing should be should be carried out according to the main procedural requirements of BS EN 13526.

4.38 Continuous monitoring can be either “quantitative” or “indicative”. With quantitative monitoring the discharge of the pollutant(s) of concern is measured and recorded numerically. For pollution control this measurement is normally expressed in milligrams per cubic metre of air, (mg/m^3). Where discharge of the pollutant concerned is controlled by measuring an alternative parameter, (the “surrogate” measurement), this surrogate is also expressed numerically.

Continuous indicative monitoring is where a permanent device is fitted, for example, to detect leaks in a bag filter, but the output, whether expressed numerically or not, does not show the true value of the discharge. When connected to a continuous recorder it will show that emissions are gradually (or rapidly) increasing, and therefore maintenance is required. Alternatively it can trigger an alarm when there is a sudden increase in emissions, such as when abatement plant has failed.

4.39 Where continuous indicative monitoring has been specified, the information provided should be used as a management tool. Where used, the monitor should be set up to provide a baseline output when the plant is known to be operating under the best possible conditions and emissions are complying with the requirements of the permit. Where used to trigger alarms, the instrument manufacturer should be able to set an output level which corresponds to around 75% of the emission limit. Thus the alarms are activated in response to this significant increase in pollutant loading above the baseline, so that warning of the changed state is given before an unacceptable emission occurs. The regulator may wish to agree the alarm trigger level.

4.40 Where continuous monitoring is required, it should be carried out as follows:

- All continuous monitoring readings should be on display to appropriately trained operating staff.

- Instruments should be fitted with audible and visual alarms, situated appropriately to warn the operator of abatement plant failure or malfunction.

- The activation of alarms should be automatically recorded.

- All continuous monitors should be operated, maintained and calibrated (or referenced, in the case of indicative monitors) in accordance with the manufacturers’ instructions, which should be made available for inspection by the regulator.

- The relevant maintenance and calibration (or referencing, in the case of indicative monitors) should be recorded.

- Emission concentrations may be reported as zero when the plant is off and there is no flow from the stack. If required a competent person should confirm that zero is more appropriate than the measured stack concentration if there is no flow.

- Any continuous monitor used should provide reliable data >95% of the operating time, (i.e. availability >95%). A manual or automatic procedure should be in place to detect instrument malfunction and to monitor instrument availability.

4.41 Exhaust flow rates should be consistent with efficient capture of emissions, good operating practice and meeting the requirements of the legislation relating to the workplace environment.

- The introduction of dilution air to achieve emission concentration limits should not be permitted.

Dilution air may be added for waste gas cooling or improved dispersion where this is shown to be necessary because of the operational requirements of the plant, but this additional air should be discounted when determining the mass concentration of the pollutant in the waste gases.

Varying monitoring frequency

4.42 Where there is consistent compliance with the odour removal efficiency standard in **Table 2**, regulators may consider reducing the frequency of any testing where the frequency is specified in the permit. When determining 'consistent compliance' factors to consider include:

- the number of abatement plant continuous indicative monitor alarms.

- the number and frequency of complaints regarding offensive odour.

- how the indicative surrogate performance monitoring of the odour abatement plant reflects actual equipment performance. For example, the operating temperature and carbon monoxide emissions of a thermal oxidiser or combustion equipment are a good surrogate indicator compared to the pressure drop across a biofilter which is a less reliable surrogate indicator.

- the variability of monitoring results, for example, results which range from 5 - 19 mg/m^3 , against an emission limit of 20 mg/m^3 might not qualify for a reduction in monitoring

- the margin between the results and the emission limit, for example, results which range from 95 - 96% destruction when the limit is 95% destruction efficiency might not qualify for a reduction in monitoring.

4.43 As the odour abatement performance of a biofilter is very dependent upon operating conditions and biomass loading, it is not appropriate that reduced monitoring be applied where a biofilter is used.

- The continuous indicative monitoring required by paragraph 4.29 is to demonstrate correct functioning of the odour abatement plant. In this context it is not appropriate that reduced monitoring be applied.

4.44 Where odour abatement plant is required it needs to be optimised to meet the odour destruction efficiency provisions of **Table 1**, row 1. Depending upon the type of abatement plant used, this optimisation will include the following:

- In the case of thermal oxidisers or combustion plant the operating temperature of the system will need to be maintained above 1123K (850^{o}C). In the case of boilers, care is needed in their use for odour abatement as the operating temperature and residence time may not have been designed for odour abatement and there is the potential for quenching in the boiler. In addition, a minimum firing rate for the boiler to ensure that the boiler conditions are always optimised for odour removal should be established. The measurement of odour abatement efficiency of the boiler can be used to demonstrate the correct operating parameters of the boiler.

- In the case of scrubbing equipment, it is likely that multi-stage scrubbing will be necessary to meet the odour destruction efficiency provisions of **Table 1**, row 1. In order to optimise the performance of the scrubber, it is important to ensure that it is well designed (adequate gas/liquid contact), well maintained, that the odours are sufficiently reactive with the scrubbing liquor to remove the odour and also that the reaction products do not themselves produce a volatile odour. In addition, additives to the liquor need to be automatically dosed with control by pH/Redox (over-dosing can lead to secondary odours from the scrubber associated with the chemical reagent).

- Mist eliminators should be fitted where droplet emissions occur and, in relation to new or replacement scrubbing plant, where there is a potential for such occurrence.

- If a bio-scrubber is used, it is important to ensure that it is well designed (adequate gas/liquid contact), well maintained and that potential odours from scrubbing liquor are well managed. The scrubber will require regular inspection to identify possible blockage by biomass. In addition the pH of the liquor will need to be controlled as the microbial activity of the biomass will be adversely affected by high alkalinity (which is a potential problem with emissions from certain pet food manufacturing processes).

- Bio-filtration can be undertaken using enclosed or open topped biofilters filled with wood chips or bark, or possibly peat or heather. It is essential to control the pH of the biomass where high levels of ammonia are present. Further, high alkalinity or high levels of hydrogen sulphide will adversely affect the microbial activity. In these cases it may be necessary to use the biofilter as a secondary treatment after scrubbing. In order to optimise the performance of the biofilter, the biomass must be maintained below 30^{o}C, must be kept moist, must have a gas flow at all times and leakage through edges and fissures must be avoided. Biofilters will require regular treatment to overcome consolidation - this may be by regular surface turning or de- consolidation by digging out the bed.

- The required residence time for the biofilters will depend upon many design conditions and will have to be sufficient to meet the provisions of row 2 of **Table 4.1**. However the recommended residence time for wood / bark filters is a minimum of 60 seconds for lower intensity odours.

Representative sampling

4.45 Whether sampling on a continuous or non-continuous basis, care is needed in the design and location of sampling systems, in order to obtain representative samples for all release points.

➢ Sampling points on new plant should be designed to comply with the British or equivalent standards, (see paragraph 4.2).

Odour response procedure

4.46 The operator should prepare an odour response procedure as outlined in **Appendix 1**. This is a summary of the foreseeable situations which may compromise his/her ability to prevent and/or minimise odorous releases from the process and the actions to be taken to minimise the impact. It is intended to be used by operational staff on a day-to-day basis and should detail the person responsible for initiating the action.

4.47 The odour response procedure should include a list of essential spares for the odour abatement plant. The plant manufacturer should recommend which spares are subject to wear and foreseeable failure and are critical for the correct operation of the odour abatement plant (such as pumps, nozzles etc.) and these should be held on site. It may be acceptable for certain spares to be available on guaranteed short delivery if the absence of a supply at the site would not lead to complete failure of the odour abatement plant or to offensive odours beyond the site boundary.

4.48 The odour response procedure should include analysis of actions in the case of abatement plant breakdown or malfunction. Immediate arrangements should be made to divert odour streams to other suitable abatement plant. Failure to provide suitable temporary abatement plant may lead to the suspension of the process and consequently emergency standby arrangements should be detailed in the odour response procedure. This may include:

- suspending process operations;
- delay the mixing of effluent streams until the sulphide has been completely oxidised;
- by-pass emissions to stand-by or alternate odour abatement plant, for example using a boiler as an emergency odour abatement system.

Appendix 3 - Method for sampling of emissions from biological filters using gas detection tubes

1. Routine monitoring of emissions from biological filters can be readily undertaken using gas detection tubes. However, it is important to ensure that a number of representative samples are obtained and that care is taken in the interpretation of results. The number of samples necessary will depend upon the gas distribution within the biological filter.

2. It is essential that samples are taken from a representative volume of emitted gas as near surface dispersion will significantly affect measured concentrations. Therefore, it is necessary to reduce dispersion and obtain a volume of gas from which to sample. This can be achieved by placing a purpose-made enclosure on top of the filter bed and allowing the emitted gases to accumulate.

3. The enclosure itself should be approximately $0.5m^3$ - $1m^3$ in volume, preferably with a 1 m square open base. The top of the enclosure should have an opening of approximately 50 mm diameter to facilitate sampling. The enclosure call be simply fabricated using a timber frame and plywood or hardboard sides and top with mastic or other suitable sealant applied to the side and top joints.

4. It will be extremely difficult to achieve a seal at the filter bed surface, however the enclosure should be located in order to minimise leakage from the points of contact with the filter bed. The enclosure should remain at the sample location for at least 10 minutes prior to sampling to ensure that a representative sample of emissions is obtained (allowing the volume of the enclosure to be purged three times).

5. The gas detection tubes should be used in accordance with the manufacturer's instructions and results should be evaluated against the indicative guide values in **Table 2**. Amines and amides are a common interference with gas detection tubes for ammonia and therefore results obtained from ammonia gas detection tubes should be compared to a 2 ppm v/v indicative guide value. It may be necessary to monitor for hydrogen sulphide and mercaptans separately depending upon the detector tube specification and in this case the sum of the individual results should be compared with the indicative guide value in row 3 of **Table 2**.

   This method is only suitable for open biomass type biofilters where no final discharge vent or stack exists. Additional information is available in BS EN13725