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Process Guidance Note 6/29(12)

Statutory Guidance for Di-isocyanate Processes

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Revision of the Guidance

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

Date of amendment	Chapter/paragraph where amendment can be found	Nature of amendment - what paragraphs have been inserted, deleted or amended - what subject matter is covered by amendment

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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 Assembly 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 di-isocyanate processes. It is published only in electronic form and can be found on the Defra website. It supersedes PG6/29(04).

1.2 This guidance document is compliant with the Code of Practice on Guidance on Regulation page six of which contain 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[1] giving guidance on the Best Available Techniques (BAT)[2]. 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.

1.4 In general terms, what is BAT for one installation in a sector is 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 is 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] this and other notes in the series are issued as statutory guidance in England and Wales under regulation 64(2) of the Environmental Permitting Regulations. The notes are also issued as guidance in Scotland and statutory guidance in Northern Ireland.

[2] further guidance on the meaning of BAT can be found for England and Wales, Scotland, and Northern Ireland.

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, and 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 constitutes 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 PG6/29

1.12 This note is not intended to cover coating operations using di-isocyanates, such as painting. More relevant guidance should be used where appropriate, for example:

- PG6/23 – Coating of metal and plastic processes
- PG6/34 – Re-spraying of road vehicles
- PG6/40 – Coating and re-coating of aircraft and aircraft components
- PG6/47 – Original coating of road vehicles and trailers

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 amended or removed. 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 the table below, 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 1: Compliance timetable

Guidance	Relevant Paragraph/Row in this Note	Compliance Date
Compliance with VOC emission limit value where significant VOC emissions are from substances **other** than HFCs/pentane used as blowing agents.	Table 3, Row 2	Within 18 months of the publication of this guidance note.
Requirement to identify and record individual substances used as blowing agents on site including annual usage, ODP, GWP and POCP figures – to be made available to the regulator on request (Note 1, below)	Table 3, Row 4	Within 12 months of the publication of this guidance note and annually thereafter.
Cleaning operations, techniques and substances should be reviewed annually to identify any cleaning steps which can be eliminated and a report should be compiled which will be made available to the regulator on request.	Paragraph 5.20	Within 12 months of the publication of this guidance note and annually thereafter.
Note 1: see paragraph 3.5 & Section 7 for further information		

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. **Section 6** provides a summary of all changes.

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[3]. Further guidance on permit reviews is contained in the appropriate Guidance Manual for England and Wales, Scotland and Northern Ireland. 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] For details see England and Wales, GGM chapter 26, Scotland, Practical guide section 10, Northern Ireland Part B Guidance page 9.

3. Activity description

Regulations

3.1 This note applies to LAPPC installations for Di-isocyanate Processes. The activities are listed for regulation as follows.

Table 2: Regulations listing activities			
LAPPC	**England and Wales**	**Scotland**	**Northern Ireland**
	EPR Schedule 1 reference	PPC Schedule 1 reference	PPC Schedule 1 reference
Part A	n/a	n/a	n/a
Part B	Section 4.1 Part B	Section 4.1 Part B	Section 4.1 Part B
Part C	n/a	n/a	n/a

3.2 This note refers to any activity, other than those associated with Part A1 activities (England & Wales), Part A activities (Scotland) and Part A activities (Northern Ireland), involving in any period of twelve months:

i. the use of less than 1 tonne of toluene di-isocyanate or other di-isocyanate of comparable volatility or, where partially polymerised, the use of partly polymerised di-isocyanates or pre-polymers containing less than 1 tonne of those monomers; **or**

ii. the use of 5 tonnes or more of diphenyl methane di-isocyanate or other di-isocyanate of much lower volatility than toluene di-isocyanate or, where partly polymerised, the use of partly polymerised di-isocyanates or pre-polymers containing 5 tonnes or more of these less volatile monomers, where the activity may result in a release into the air which contains such a di-isocyanate monomer.

iii. Cutting polyurethane foams or polyurethane elastomers with heated wires.

3.3 This note covers all parts of the process from the receipt of materials through to the disposal and processing of waste materials. This includes treating, handling and storage of any materials used and the finishing and treating of products at the installation.

3.4 Polyurethanes are produced by the reaction of di-isocyanates with polyols. Rates of reaction and processing conditions are influenced by the use of catalysts, notably tertiary aliphatic amines. Polyurethanes can be expanded to produce foams by the addition of physical or chemical "blowing agents."

Blowing Agents

3.5 Following the Montreal Protocol (1987) on Substances that Deplete the Ozone Layer, the polyurethane foam industry looked to develop alternative blowing agents to the then widely used chlorofluorocarbons (CFCs) and other ozone-depleting substances (ODS). Main replacements were hydrochlorofluorocarbons (HCFCs), fluorinated gases with significantly lower ozone depletion potential (ODP) than CFCs, but with a high Global Warming Potential (GWP) (see also **Section 7**, Further Information).

Further amendments to the Montreal Protocol (19th Meeting of the Parties to the Montreal Protocol (2007) make HCFCs subject to an accelerated phase-out programme in developing countries.

There are two major replacement options for HCFCs in foam manufacture:

- Hydrofluorocarbons (HFCs) which have zero ODP but a high GWP (controlled under the Kyoto Protocol);
- Natural substances such as hydrocarbons (HCs) which have zero ODP and zero/negligible GWP.

Other examples of blowing agents include liquid carbon dioxide, carbon dioxide generated by the reaction between water and di-isocyanate, n-pentane, iso-pentane (also known as 2-methylbutane), cyclo-pentane and butane.

3.6 Polyurethanes with a diversity of properties can be produced according to the choice of di-isocyanate, polyol, catalysts, blowing agent and processing parameters. They can, however, be divided into three broad categories:

Rigid foams

These diphenylmethane di-isocyanate (MDI) based products are produced by either a dispensing or spraying technique. Dispensing, however, is much more widely used than spraying in factory situations. The blowing agents used are fluorinated hydrocarbons (HFCs), pentanes or carbon dioxide generated by the reaction between water and MDI. For the most part they have a closed cell structure which encapsulates almost all of the blowing agent introduced into the mixed liquids which then generates the rigid foam. Rigid foams are, for the most part, used in construction applications to capitalise on their excellent thermal insulation properties, high strength to weight ratio and their ability to bond auto-adhesively to many other construction products.

Flexible foams

These may be produced using MDI and/or TDI. The most common blowing agent is water although methylene chloride may also be used. Flexible foams made with MDI are predominantly moulded cushions for use in the automotive and furniture industries, though some are produced as slabstock.

Elastomers and foamed elastomers

These may be produced by a variety of techniques, including reaction injection moulding, rotational moulding and hand mixing. The di-isocyanates used include MDI and naphthalene di-isocyanate (NDI). Water is widely employed as a blowing agent. Thermo-plastic urethanes (TPUs) are granulated after manufacture and are subsequently moulded into a final product.

3.7 The key emissions from these processes are those consisting of volatile organic compounds (VOC), di-isocyanates and particulate.

The following parts of the process may give rise to VOC:

- Handling, loading and mixing processes involving solvents
- The admixing of blowing agents with polyols on site
- All cleaning operations using solvent-borne cleaning fluids
- Handling and storage of waste solvents and solvent-contaminated wastes
- Spraying and coating activities

3.8 The following parts of the process may give rise to di-isocyanates:

- Bulk tanker delivery/off loading
- Bulk storage
- Maintenance
- Dispensing/foaming operations
- Transfer and handling of materials

3.9 The following parts of the process may give rise to the release of particulate matter:

- Materials handling and storage
- Product finishing and treatment
- Waste handling, storage and treatment
- Spraying and cutting activities

Triviality

3.10 There may be some processes which involve either the use, in any twelve-month period, of more than 5 tonnes of di-isocyanate or less than 1 tonne of TDI, but which emit prescribed substances to air in such small quantities that they are incapable of causing harm.

These processes may be exempted from local air pollution control under Schedule 1, Part 1, paragraph 6 of the Environmental Permitting (England and Wales) Regulations 2010 on the grounds of "triviality".[4] The final decision will be a matter for each local enforcing authority, based on the facts of the individual case.

[4] PPC (Scotland) Regulations and Schedule 1, Part 2, paragraph 2(2) of the PPC Regulations (Northern Ireland) 2003.

However, it is suggested that the following questions may be addressed in reaching that decision:

a. *How much free monomer is present in any pre polymer being used?* In particular, consideration may be given to exemption of processes which only involve the use of di-isocyanate pre-polymers with very low free monomer content, perhaps below 0.5%.

b. *What are the properties of any blowing agents used?* Are the ozone depletion potential (ODP), photochemical ozone creation potential (POCP), global warming potential (GWP) and toxicity low?

   Are the blowing agents incorporated within the polyol as delivered to site or admixed on site? If incorporated then the case for exemption may be strengthened.

   Is more than 500kg of free blowing agent stored in site at any one time? If yes, then the case for exemption may be weakened.

   What quantities of blowing agents are used on site per annum? Where more than 5 tonnes per annum is used the case for exemption may be weakened.

c. *What types and quantities of organic solvents are used for cleaning injection and moulding equipment and as a carrier in release agents per annum?* Where more than 1tonne per annum is used then the case for exemption may be weakened.

d. *How much di-isocyanate is present on the premises at any time?* If less than 2 tonnes are present, the case for exemption may be strengthened.

e. *Are the emissions contained or fugitive?* If all emissions are fugitive and are acceptable to the Health and Safety Executive under the Control of Substances Hazardous to Health (COSHH) Regulations, this might support exemption.

f. *Is the foam system introduced into a closed mould or an open mould?* The potential for emissions is reduced by the use of closed moulds.

g. *How is the di-isocyanate dispensed?* (Pouring gives rise to much lower levels of droplet and aerosol emissions than spraying).

4. Emission limits, monitoring and other provisions

4.1 Emissions of the substances listed **Table 3** below 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 3**.

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

Table 3 should be considered in conjunction with the monitoring paragraphs found later in this section.

Table 3: Emission limits, monitoring and other provisions					
Row	**Substance**	**Source**	**Emission limit/ provisions**	**Type of monitoring**	**Monitoring frequency**
1	Di-isocyanate as total NCO group	Abated emissions	0.1 mg/Nm^3 averaged over any 2-hour period whilst plant is in operation	Quantitative	Annual
2	VOC (expressed as total carbon excluding particulate matter)	Abated emissions	100 mg/Nm^3 as 30 minute mean (see Note 1)	Quantitative	Annual
3	Particulate matter	Abated emissions	50 mg/Nm^3	Indicative	Continuous during normal operation
Note 1 – some activities may just emit HFCs or pentane (which are used as blowing agents) and no other VOCs. In these cases neither the emission limit nor the monitoring provisions in Row 2 should be applied. If any other VOCs are emitted, such as methylene chloride, the provisions in Row 2 are applicable, unless the amounts of these other VOCs are so small that they are unlikely to have more than a trivial environmental impact.					
4	Substances used as blowing agents	▪ Identify and record substances used as blowing agents on site, including the ODP, GWP and POCP figures (see paragraph 3.5) for each substance (see also Section 7). ▪ Record annual usage of individual substances used as blowing agents to be made available to the Regulator upon request			

Monitoring, investigating and reporting

4.4 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.

- The operator should keep records of inspections, tests and monitoring, including all non-continuous monitoring, inspections and visual assessments. The 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

4.5 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.

- 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.
- 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

4.6 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.

- Where ambient monitoring is carried out it may also be appropriate for the regulator to specify recording of wind direction and strength.
- Where combustion units are in use for dryers then the combustion process should be controlled and equipment maintained as appropriate.

4.7 Emissions from combustion processes should in normal operation be free from visible smoke. During start up and shut down the emissions should not exceed the equivalent of Ringelmann Shade 1 as described in British Standard BS 2742.

- 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.

Where there are problems that, in the opinion of the regulator, may be attributable to the installation, such as local complaints of visual emissions or where dust from the installation is being transported off the site, the operator should inspect in order to find out which operation(s) is the cause.

If this inspection does not lead to correction of the problem then the operator should inform the regulator in order to determine whether ambient air monitoring is necessary. Ambient monitoring either may be by a British Standard method or by a method agreed with the regulator.

Whilst problems are ongoing, a visual check should also be made once per day 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.

Emissions of Odour

4.8 The overall aim should be that all emissions 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 for local meteorological conditions which 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.

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 transported off the site, the operator should inspect in order to find out which operation(s) is the cause.

Whilst problems are ongoing, a boundary check should also be made once per day 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

4.9 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.

Start up and shutdown

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

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

Continuous Monitoring

4.11 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 meter 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 arrestment plant has failed.

4.12 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.

4.13 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 arrestment 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 emissions monitor (CEM) 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

Calibration and compliance monitoring

4.14 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.

4.15 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.

4.16 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; **and**
- For all activities the sampling period should be sufficient such that at least three results are obtained.

4.17 Should the activity either be continuous, or have a batch cycle that is not compatible with the time available for sampling, then the data required should be obtained over a minimum period of 2 hours in total.

- For demonstration of compliance where a CEM is used no daily mean of all 15-minute mean emission concentrations should exceed the specified emission concentration limits during normal operation (excluding start-up and shut-down); **and**

- no 15-minute mean emission concentration should exceed twice the specified emission concentration limits during normal operation (excluding start-up and shutdown).
- For extractive testing, no result of monitoring should exceed the emission limit concentrations specified.

4.18 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 of monitoring frequency

4.19 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.

4.20 The following should be considered when deciding whether compliance is consistent:

a. the variability of monitoring results, for example, results which range from 15 - 45 mg/m^3, against an emission limit of 50 mg/m3 might not qualify for a reduction in monitoring.
b. the margin between the results and the emission limit, for example, results which range from 45 - 50 mg/m^3 when the limit is 50 mg/m^3 might not qualify for a reduction in monitoring.

Consistent compliance should be demonstrated using the results from at least:

- three or more monitoring exercises within two years; or
- two or more monitoring exercises in one year supported by continuous monitoring.

Where a new or substantially changed process is being commissioned, or where emission levels are near to or approach the emission concentration limits, regulators should consider increasing the frequency of testing.

4.21 Where continuous quantitative or indicative monitoring is required, it is not appropriate that reduced monitoring be applied, as the monitoring is required to demonstrate either compliance with emissions limits on an ongoing basis or to demonstrate correct functioning of arrestment equipment.

4.22 Where an operator can demonstrate that a number of individual extracts vent from similar parts of the process which lead to emissions of the same nature and volume, the regulator may approve a sampling programme involving monitoring less frequently than once a year. In any case, each stack should be tested at least once every 4 years and at least 25% of all stacks should be tested each year. Emissions from arrestment plant should be tested at least once a year.

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.

Sampling provisions

4.24 Care is needed in the design and location of sampling systems in order to obtain representative samples for all release points. The operator should ensure that adequate facilities for sampling are provided on vents or ducts. Sampling points on new plant should be designed to comply with the British or equivalent standards.

4.25 Where monitoring is not in accordance with the main procedural requirements of the relevant standard, deviations should be reported as well as an estimation of any error invoked.

4.26 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**).
- The operator should ensure that relevant stacks or ducts are fitted with facilities for sampling which allow compliance with the sampling standards.

5. Control techniques

Summary of best available techniques

5.1 The following table 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.

Table 4: Summary of control techniques

Source	Substance	Control techniques
Cutting and finishing operations	Particulate matter	Containment/arrestment plant (paragraph 5.2)
Spraying		Arrestment plant (paragraphs 5.3 – 5.6)
Storage / handling / transfer of di-isocyanates	Di-isocyanates	Containment (paragraph 5.8 – 5.14)
Cleaning of equipment	VOC	Minimise and contain (paragraph 5.18 – 5.22)
Use of blowing agents	VOC	Replace/contain (paragraph 5.12)

Techniques to control emissions from contained sources

Particulate

5.2 Emissions from activities likely to give rise to airborne particulate matter, for example the cutting and finishing of products, should be collected and extracted, where necessary, to suitable arrestment equipment. Alternative procedures, such as wet cutting, may be employed if the operator can demonstrate their effectiveness to the satisfaction of the local enforcing authority.

5.3 Where spray up is carried out in totally enclosed proprietary type spray booths, the booth should be designed to meet the emission limit for particulate matter in **Table 3**. Local enforcing authorities should be provided with a guarantee from the spraybooth manufacturer that a newly installed booth will meet this emission concentration limit, and the guarantee should be supported by emission test data for the spraybooth type to which the guarantee relates.

5.4 Where an existing spraybooth is upgraded to achieve the above emission concentration limit in respect of particulate matter, a guarantee should be obtained from either the spraybooth manufacturer, or the company who carries out the upgrading, that the upgraded booth will meet the emission concentration limit.

The guarantee should be supported by emission test data for the spraybooth type, fitted with the filtration system, to which the guarantee relates.

5.5 Where no such guarantee is obtainable, either for a new booth or for an existing booth which has been upgraded, or where the operator feels that upgrading of his existing booth is unnecessary, emission testing from that specific booth should be required, in accordance with **Table 3** to demonstrate compliance with the emission concentration limit for particulate matter. Additionally, where problems of particulate matter emissions are perceived, a particulate matter emission monitoring exercise should be required, even if a manufacturers guarantee is available for the booth.

5.6 Where a proprietary type spraybooth is not available, all spraying should be carried out in a totally enclosed area, and the spraying area should be under negative pressure throughout spraying and curing, in order to prevent fugitive emissions of odour and particulate matter. Emissions from such spraying facilities should be measured at least once every 12 months to demonstrate compliance with the particulate matter emission limit in **Table 3** above.

Techniques to control fugitive emissions

Materials, handling and storage

5.7 The receipt, handling and storage of isocyanates and other potentially odorous or harmful substances should be carried out in such a way that emissions are prevented, or where not practicable due to process characteristics, minimised and rendered harmless.

5.8 Where di-isocyanates are stored in fixed tanks, contaminated air displaced from the headspace of such tanks during filling should be back-vented to the delivery tanker, or a carbon adsorption cartridge or other means of arrestment.

5.9 At some installations, di-isocyanates are stored in portable, non-pressurised containers. Where this is in practice, such containers should be stored according to the manufacturers' recommended storage temperatures and allowed to acclimatise to working temperatures before use. These containers should not be pressurised, for example, to effect delivery of material from them unless they are specifically designed for this. All such containers, whether full, partially empty, or empty, should be kept securely lidded.

5.10 Any vents serving containers, bulk storage tanks or mixing vessels should be fitted with a silica gel or other suitable air dryer to prevent ingress of water vapour. The air intake should be separate to the exhaust vent to avoid isocyanate reacting with water on the silica gel to form insoluble polyureas.

5.11 Where foam blowing agents are stored in fixed tanks or pressurised vessels, the emission to air of gas displaced by the delivery of blowing agents into such tanks or pressure vessels should be minimised, for example, by the provision of a back-venting system to the delivery tanker. Where blowing agents are stored at ambient pressures, storage temperatures should be well below the boiling point of the materials in storage.

5.12 At some installations, foam blowing agents are stored in portable, non-pressurised containers. Where this is in practice, such containers should be at temperatures below the boiling point of the liquid in storage, and should be out of direct sunlight. Such containers should not be pressurised, for example, to effect delivery of material from them unless they are specifically designed for this. All such containers, whether full, partially empty, or empty, should be kept securely lidded.

5.13 Bulk chemical storage tanks and containers should be completely contained by bunding which is sealed and resistant to the chemicals in storage and capable of holding 110% of the capacity of the largest storage tank within the bund or 25% of the total capacity of all the tanks within the bund, whichever is the greatest.

5.14 To prevent overfilling, all bulk storage tanks and containers should be fitted with suitable audible and visual alarms which will operate when any tank is in danger of becoming overfull. Where practicable (for example, where raw material delivery pumps are not mounted on delivery vehicles) an interlock to the tank filling system should be provided. Alternative tank filling procedures may be followed, subject to the agreement of the local enforcing authority.

Dust and spillage control

5.15 Where spillages of liquid occur, they should be immediately cleaned up and contaminated material should be held in a vented, labelled container. Sufficient supplies of decontaminant and a suitable absorbent material should be kept at all times. A written procedure for dealing with spillages should be agreed with the regulator.

5.16 Adequate provision to contain solid spillages is needed. Closed containers prevent wind whipping of dusty waste materials such as particles collected by arrestment plant.

- Dusty wastes, such as those from finishing operations and bag filters, should be stored in closed labelled containers and handled in a manner that avoids emissions.

- All spillages should be cleared as soon as possible; solids by vacuum cleaning, wet methods, or other appropriate techniques. Dry sweeping of dusty spillages should not be permitted.
- A high standard of housekeeping should be maintained.

5.17 Where proprietary booths are provided, all spraying operations should be carried on in the booth so as to prevent fugitive emissions of odour and particulate matter. Booths should be fitted with a means of preventing spraying operations from continuing in the event of positive pressure within the booth.

Cleaning techniques

5.18 Emissions of volatile organic compounds, from cleaning operations should be minimised in accordance with paragraphs 5.19 to 5.22 below.

5.19 Operators should be encouraged to make arrangements for the despatch for recycling or re-use of all dirty solvents which have been used (for example, for equipment cleaning) and all other liquid wastes which contain volatile organic compounds.

5.20 Fewer cleaning steps and alternative cleaning techniques should be adopted where practicable. Examples of alternative techniques include using water (with or without mechanical, chemical or thermal enhancements) or using organic solvents which are significantly less volatile.

- Cleaning operations, cleaning techniques and cleaning substances should be reviewed annually to identify:
  - steps which could be eliminated or automated;
  - substances which can be substituted;
  - the technical and economic feasibility of changing to different cleaning solutions.

  A short summary of the conclusions of each assessment should be made available to the local authority upon request.
- Any solvents used for cleaning should be kept in enclosed containers whilst not in active use.
- Wiping cloths or brushes should be impregnated with cleaning solvent in a controlled manner, using a dispenser or similar device.
- Used wiping cloths or brushes should be stored in enclosed containers pending recovery or disposal.

Air Quality

Dispersion & Dilution

5.21 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.

5.22 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.

Ambient air quality management

5.23 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

5.24 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 effect dispersion:

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

5.25 When dispersion of pollutants discharged from the stack (or vent) is necessary, the target exit velocity should be 15m/sec under normal operating conditions, (but see 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.

5.26 An exception to the above 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 9 m/sec. To reduce the potential of droplet emissions a mist eliminator should be used. Where a linear velocity of 9m/sec 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

5.27 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

5.28 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.

5.29 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. Authorities are urged to encourage wider adoption of EMS by operators, 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

5.30 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 shut down
  - 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

5.31 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 below in **Table 5**. Minor changes that will not impact on the permit conditions e.g. slight alterations to the Process Description have not been recorded.

Table 5: Summary of changes

Section / Paragraph / Row	Change	Reason	Comment
1. Introduction			
	Addition of links	Change to electronic format	Removes need for extensive footnotes/references
2. Timetable for Compliance & Reviews			
	Simplification of text	Make note clearer	
	Addition of links	Change to electronic format	Removes need for extensive footnotes/references
3. Activity Description			
Para 3.5 Blowing Agents	Additional information on replacement blowing agents for HCFCs	Informs long term business decisions where HCFCs may be phased out in favour of natural substances with low ODP/GWP	
Para 3.10 Triviality	Additional questions to aid assessment of triviality relating to blowing agents and cleaning using organic solvents	Inclusion of thresholds aids triviality assessments	HFCs and HCs are increasingly popular and some substances can have a high Global Warming Potential (GWP) and Photo Ozone Creation Potential (POCP)
4. Emission limits, monitoring and other provisions			
	Used to be Section 5 in previous note.	Section 4 in previous note deleted	
Table 3, Row 2	VOCs ELV has not been changed but requirement is now for abated VOCs to be monitored where sources of VOC emissions are from substances other than HFCs/pentane used as blowing agents.	Clarify the monitoring requirements from VOC emissions from abated sources.	To ensure that, where VOCs (other than HFCs and pentane) are used in a process in amounts that are not trivial and

Table 3, Note 1	Para 5.3 of PG6/29 (04) incorporated into Table 3 as Note 1.		abatement is in place, that these VOCs are monitored.
Table 3, Row 4	Requirement to identify and record individual substances used as blowing agents on site including annual usage, ODP, GWP and POCP figures – to be made available to the regulator on request	Informs the BAT decision by the regulator as to whether monitoring may be required due to the quantity of HFCs/HCs used on site.	Some HFCs have a high GWP/POCP and direct monitoring of abated releases may be appropriate where significant quantities are being used.
Paras 4.6 – 4.7 Visible Emissions Para 4.8 - Emissions of odour	Revised text describing approach to take to visible and odorous emissions. Removal of arrowed condition suggesting inclusion of an odour boundary condition.	Allows more flexibility in managing visible/odorous emissions.	Conditions requiring boundary checks will normally only be appropriate where potential odour is particularly offensive (see chapter 17 of the GGM).
5. Control techniques			
	Used to be Section 6 in previous note	Section 4 in previous note deleted leading to renumbering of sections.	
Para 5.8 – 5.9	Change from requirement that di-isocyanates should be stored only in fixed tanks.	Recognition that many sites store di-isocyanates in mobile, non-pressurised containers.	Storage in this manner must be within the manufacturers' recommended storage conditions.
Para 5.20	Requirement to review annually cleaning steps, document and make the report available to the regulator upon request.	Opportunity to reduce costs of monitoring through substitution.	
Air Quality	Clarification of exhaust velocity requirements.	Make note clearer	

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. Regulators may be wiling 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
- 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.

Global warming potential (GWP)

Whilst not preventing sunlight reaching the surface of the earth, some of the gases in the earth's atmosphere (carbon dioxide, for example) are able to absorb infrared radiation (IR), trapping some of the IR emitted back into space from earth and thus causing a rise in the surface temperature.

Global Warming Potential translates the quantity of emission of gases into a common measure to compare the contributions of each gas, relative to carbon dioxide, to the absorption of infrared radiation in 100 years perspective.

Ozone depletion potential (ODP)

Plants and animals are protected from the majority of the sun's harmful UV-radiation by ozone that forms a layer in the stratosphere. Ozone levels have declined as a consequence of the use of CFCs and halons released into the atmosphere.

A depletion of the ozone layer will increase the UV-radiation at ground level. Ozone depletion potential, ODP, translates the quantity of emission of gases into a common measure to compare their contributions, relative to CFC-11, to the breakdown of the ozone layer.

Photochemical ozone creation (POCP)

Photochemical ozone or ground level ozone is formed by the reaction of volatile organic compounds and nitrogen oxides in the presence of heat and sunlight. Photochemical ozone creation potential translates the quantity of emission of gases into a common measure to compare their contributions, relative to ethylene, to the formation of photochemical oxidants.

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.