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Department
for Environment
Food & Rural Affairs

Process Guidance Note 2/03(13)

Statutory guidance for electrical furnaces

Revised: July 2013

Llywodraeth Cymru
Welsh Government

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The Scottish
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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

Date of change	Section/ paragraph where change can be found	Nature of change - what paragraphs have been inserted, deleted or amended - what subject matter is covered by the change
July 2013	Throughout	Addition of colour coding to tables

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 electrical furnaces. It is published only in electronic form and can be found on the Defra website. It supersedes PG2/03(06) and NIPG2/03(06).

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 (in chapter 12 of the General Guidance Manual), Scotland, and Northern Ireland, (in chapter 9).

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 this statutory 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 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 PG2/03

1.12 There are separate Process Guidance notes for hot and cold blast cupolas and rotary furnaces (PG 2/05) and casting, grinding and fettling, finishing and other foundry operations (PG 2/04).

PG notes 2/06, 2/07, 2/08 and 2/10 address the melting of aluminium, zinc, copper and magnesium and their alloys. Where an installation is potentially covered by both PG2/03 and either PG2/06 or PG2/08 (e.g. an electrical furnace melting copper) then the more stringent emission limits and provisions should be applied.

1.13 PG6/35 covers thermal spraying of metal coatings and metal compound coatings, spray forming (also known as spray casting or spray deposition) and metal powder processing where metal is melted, atomised and the resulting powder is collected.

2. Timetable for compliance and reviews

Existing processes or activities

2.1 There are no known crucible or reverberatory furnaces operating as Part B installations in the UK and references and guidance to such furnaces have been removed in this revised PG2/03. 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, Scotland, Practical guide section 10 and 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 the melting of ferrous metal and ferrous metal alloys in electrical furnaces and the melting of non-ferrous metals and their alloys. The activities for regulation are listed in **Table 3.1**.

Table 3.1 - Regulations listing activities

LAPPC	England and Wales	Scotland	Northern Ireland
	EPR Schedule 1 reference	PPC Schedule 1 reference	PPC Schedule 1 reference
Part B	Section 2.1 Part B Section 2.2 Part B	Section 2.1 Part B Section 2.2 Part B	Section 2.2 Part B
Part C	n/a	n/a	Section 2.1 Part C Section 2.2 Part C
The links are to the original version of the Regulations. A consolidated version is not available on www.legislation.gov.uk.			

3.2 This note refers to electric arc (under 7 tonnes) and other electrical furnaces (for example, induction (including vacuum furnaces) or electro slag re-melting furnaces) in which iron, steel or ferrous alloys are melted, refined, held or poured. This note also covers the melting of nickel and cobalt alloys, **except** for non-ferrous alloy processes with a furnace, bath or vessel with a designed holding capacity of 5 tonnes or more, which would be a Part A1/A2 installation in England & Wales and a Part A installation in Scotland, depending on the designed holding capacity of any furnace, bath or holding vessel.

3.3 This note also covers the pouring of metal into a ladle and metal treatments undertaken in the furnace or ladle. These treatments include nodularisation with magnesium to produce ductile iron, carburisation using a carbon source and desulphurisation which may typically use calcium carbide or soda ash.

Induction furnace

3.4 Induction furnaces are either of the coreless or channel type. The electricity applied to the power coils in both furnaces generates eddy currents in the metal charge thereby creating the necessary heating effect. In the coreless type the refractory crucible is surrounded by a cylindrical power coil while in the channel furnace the power coil is enclosed by a loop containing metal connected to the furnace bath. Preheating of the charge materials may be carried out for electrical furnaces by fossil fuel fired burners.

3.5 The induction furnace (IF) is a batch melting furnace consisting of a water-cooled copper coil, the inside of which is internally refractory lined. The outside is insulated and enclosed in a steel shell. The furnace body is mounted in a frame equipped with a tilting mechanism.

3.6 The furnace is charged by a lifting magnet or by a vibrating conveyor. Other charging methods include use of a charge bucket or by hand (the latter being the most common method for smaller furnaces). A large number of foundries use IF for producing relatively small lots in a large variety of compositions. Furnace capacities range from 10 kg to 30 tonnes. Thermal efficiency usually ranges from 60 - 70 %.

3.7 The coreless induction furnace cannot be used for refining, hence, for steel, it has to be charged with steel scrap only. If necessary, the metal can be refined after melting in an AOD (argon-oxygen decarburisation) converter or special treatment ladles.

3.8 After charging the furnace, the induction coil is powered by an alternating current of high fixed or variable frequency (50, 250, up to 5000Hz) provided by a power unit. Cooling water prevents the coil from being heated by the current. The magnetic field inside the coil induces eddy currents in the metallic charge itself. The eddy currents create heat in the metallic charge by the Joule effect. Once the metal is molten the electro-magnetic forces create an intense stirring in the bath. This allows a good homogenisation of the metal. Little oxidation of the charge material takes place, especially when a cover is placed over the charge.

3.9 After melting, the chemistry of the melt is adjusted with alloy additions and the proper tapping temperature is obtained. If necessary the metal is deoxidised by adding aluminium or other agents and the furnace is tapped.

3.10 High powered furnaces allow melting following the "tap and charge" method: the furnace is tapped completely empty and charged with cold material to start the next melting cycle. On low powered (mains frequency) furnaces the "molten heel" method is used: approximately one third of the molten metal is tapped before cold charge material is added. This technique increases the production rate on these low powered furnaces due to the better electromagnetic coupling between the melt and the coil compared to a less dense (cold) charge.

Electric arc furnace (EAF)

3.11 Arc furnaces in the ferrous foundry industry are invariably of the direct type and depend upon the generation of an arc between the graphite electrodes and the charge metallics. Heating of the charge is accomplished by both resistance to the passage of the electric current and by radiation.

3.12 The EAF is a batch melting furnace consisting of a large bowl shaped, refractory lined body with a dish shaped hearth. This wide furnace shape allows handling of bulky charge material and leads to efficient reactions between slag and metal. Typically the shell diameter is 2 - 4 m. The furnace is covered by a refractory roof with ports for three graphite electrodes supported by arms allowing movement up and down. Most furnaces use roof charging. By moving the roof and electrodes aside, the furnace can be charged using a drop bottom charging bucket or a magnet. The metal charge is heated by an electric arc, created by a three phase alternate electrical current between the three graphite electrodes positioned above the charge that acts as neutral.

3.13 The furnace is tapped by tilting it, forcing the metal to flow through the spout. Opposite the spout a working door allows de-slagging and sampling operations prior to tapping. The furnace lining can be acid (Si-Al based refractory) or basic (MgO based refractory). The acid type refractory is used for melting scrap with low sulphur or phosphorus content, since the furnace does not allow the removal of these elements. A basic lining allows the use of virtually all kinds of steel scrap. It is also used for the production of high alloy and manganese steels.

3.14 In steel foundries the capacity of an EAF usually ranges from 2 - 50 tonnes capacity. They can be run intermittently and are suitable for a wide range of steel analyses. They can provide steel at high temperatures with typical meltdown times of about one to two hours while achieving high thermal efficiencies up to 80%. Total melt time is typically 1 - 4 hours.

Refining ladles

3.15 Refining ladles are refractory lined containers specially designed for treating the molten metal outside the melting furnace. They can be equipped with a heating system. (electric arc or induction).

Decarburisation

3.16 This is a refining operation that holds the carbon content of the charge material within a specific range, as required. Decarburisation starts by injecting oxygen into the metal bath. This creates a strong stirring action during which carbon in the melt is burnt. At the same time the "boiling" reduces iron oxide, burns out silicon, and flushes out hydrogen and nitrogen from the metal bath. All impurities (oxides) are trapped in the slag. During melting, sand may be added to bring the slag to the proper consistency. When the carbon reaches the required level, oxygen injection is stopped and silicon and manganese are added to halt the boiling reaction. After slag removal the metal composition is controlled and adjusted as necessary. Finally the metal is deoxidised by adding aluminium or other agents into the melt stream during tapping to prevent the formation of carbon monoxide bubbles during solidification.

3.17 The refining abilities of the acid lined EAF are restricted to decarburisation because of the nature of the lining. Consequently considerable care is necessary in selecting the charge. The charge consists of balanced quantities of pig iron, foundry returns and purchased scrap.

Dephosphorisation and desulphurisation

3.18 A basic lined EAF may be charged with virtually any combination of scrap and foundry returns including those with higher phosphorus and sulphur levels than desirable, as refining can take place within the furnace.

3.19 Dephosphorisation of the melt is performed by the periodic addition of lime during meltdown. Upon the injection of oxygen phosphorus oxide is formed and trapped in the slag together with other metallic oxides and impurities. The lime keeps the slag very basic which stabilises the phosphorus oxide. At the same time carbon is burnt out. After sufficient time, oxygen injection is stopped and the slag fully removed.

3.20 Desulphurisation takes place in a second stage, in a similar way but at a higher temperature. Lime or limestone is added to the melt, reacting with the sulphur to form insoluble CaS that is trapped by the slag. Periodical additions of carbon, aluminium or FeSi reduce metallic oxides (e.g. manganese and chromium oxides) thereby minimising losses of these elements from the metal bath. All other impurities (oxides) are trapped in the slag and removed during the final deslagging operation.

Metal treatment in iron foundries

3.21 Following melting, the metal composition is modified and refined mainly by the addition of carbon, ferro-silicon, and ferro-manganese. Other alloying elements may be added dependant upon the specification of the metal being produced.

3.22 Handling of slag from ferrous processes is not likely to give rise to dust emissions.

4. Emission limits, monitoring and other provisions

4.1 Emissions of the substances listed in **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 and the oxygen and water references should be that which corresponds to the normal operating conditions in the process concerned.

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

Table 4.1 - Emission limits, monitoring and other provisions					
Row	**Substance**	**Source**	**Emission limits/provisions**	**Type of monitoring**	**Monitoring frequency**
1	Total particulate matter	From stack emissions and from all arrestment plant (see Note 1)	20 mg/m^3	Recorded indicative monitoring	Continuous (see Note 1)
				Plus	
				Extractive monitoring	Annual
2	Nickel, cobalt, chromium and their compounds	Where appropriate in relation to the metal alloy being melted.	Total emission in combination 5mg/m^3 (see Note 2)	Extractive monitoring	Annual
3	All emissions to air other than condensed water vapour	All emissions to air	Free from persistent visible emissions	Visual assessments	At least daily unless fitted with a continuous indicative monitor and alarm (see paragraph 4.8)

Note 1 - where no arrestment plant is required to meet the emissions limits refer to paragraph 4.27.

Note 2 - (applies only to Row 2) Environment Agency guidance M2 gives BS EN 14385 and associated MID 14385 (Method Implementation Document) as the preferred method for the determination of total emissions of metals by isokinetic sampling and impingement. Use of this method gives total metals in both the particulate and vapour phases. Metal emissions in the vapour phase are generally considered to be negligible, therefore, it is not necessary to apply the clauses in EN 14385 that are related to the measurement of metals in the vapour phase.

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. Records should be:
  - kept on the site of the permitted activity;
  - 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; the provisions listed below apply to all external emissions to air, including fugitive emissions – for example from buildings and from roof or wall vents.

4.7 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;

4.8 Emissions from combustion processes in normal operation should 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 emissions to air should be free from droplets and persistent fume;
- If necessary to achieve these requirements the emissions should be contained so that they are not fugitive. They should be extracted to a specific emission point capable of being monitored and the emission limit for particulate matter should be 20mg/m^3.
- Where an emissions point is not fitted with a continuous indicative monitor and alarm in accordance with **paragraph 4.17**, visual assessments of emissions should be made frequently and at least once each day whilst the process is in operation. The time, location and result of these assessments should be recorded.

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 detected beyond the site boundary, the operator should investigate in order to find out which part of their operation(s) is the cause.

If this investigation does not lead to correction of the problem then the operator should inform the regulator who will determine whether ambient air monitoring is necessary. Ambient monitoring may either 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 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.

Emissions of odour

4.9 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 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.

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.

Start up and shutdown

4.13 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

4.14 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.

4.15 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.

4.16 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.

4.17 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 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.

Calibration and compliance monitoring

4.18 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.

4.19 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.

4.20 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.

4.21 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 shut-down).

- For extractive testing, no result of monitoring should exceed the emission limit concentrations specified.

4.22 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.

Varying of monitoring frequency

4.23 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.

4.24 When determining "consistent compliance" the following are cases which might not qualify for a reduction in monitoring:

a) variability of results: cases where monitoring results vary widely and include results in the range 12 - 18 mg/m^3 (when the emission limit is 20mg/m^3)

b) the margin between the results and the emission limit: cases where results over a period are 18mg/m^3 or more (when the emission limit is 20mg/m^3).

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

- three or more consecutive annual monitoring campaigns; **or**

- two or more consecutive annual monitoring campaigns 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.

4.25 A reduction in monitoring frequency should not be permitted where continuous quantitative or indicative monitoring is required. These types of monitoring are needed to demonstrate at all times when the plant is operating, that either the emission limits are being complied with or that the arrestment equipment is functioning correctly.

Monitoring of unabated releases

4.26 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.

4.27 Where no arrestment plant is required to meet the emission limits, the operating parameters applying at the time of the stack monitoring exercise should be recorded. If the operator does not intend to vary these parameters during the course of the year then there is no need for a continuous indicative monitor. If the operator envisages significant variation in the operating parameters then a continuous indicative monitor should be used to demonstrate compliance or stack sampling should be undertaken to cover the range of parameters being used. If the regulator finds during the course of the year that different parameters are being applied and no continuous indicative monitor has been required, they can then require it or specify additional stack sampling to cover the particular conditions. The relevant parameters should include: feedstock type, maximum melt temperature, flux or other additions and emission flow rates.

Representative sampling

4.28 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.

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.

Table 5.1 - Summary of control techniques

Release source	Substance	Control techniques
Raw material storage	Dust	Store potentially dusty materials in buildings or appropriate containers
• Re-lining of the furnace with refractory material • Charging the furnace • Metal treatment operations • Melting operations • Combustion	Particulate matter, metallurgical fume and smoke	Prevent fugitive emissions by using fully enclosed buildings Contain, extract, monitor and abate where necessary to meet the requirements and limits of **Section 4**

Techniques to control emissions from contained sources

Particulate matter, metals and their compounds

5.2 Emissions of particulate matter should be captured, extracted and abated if necessary to meet the visible emission provisions of **paragraphs 4.6 - 4.8** and the limits described in **Table 4.1** for particulate matter and for metals and their compounds.

- Emissions should be abated where necessary to meet the limits.
- All new plant should be designed such that emissions are extracted and ducted so that monitoring can take place in accordance with the provisions of **Table 4.1.**
- Where particulate matter emissions are abated using a wet scrubber, the scrubber should be regularly inspected and maintained. Action should be taken to deal with any blockages that occur due to accumulation of solids, for example adding flocculating agents to the liquor to settle the solids out. Where scrap metal is melted, care in assessing and selecting incoming scrap is required in order to minimise furnace emissions.

Unless full, effective abatement (e.g. dry filtration plant) is being used, only “clean" scrap should be melted. For this purpose, "clean" scrap should be taken to be scrap which is free from significant amounts of contamination such as dirt, foreign material, oily residues, paint or other organic materials (e.g. rubber or plastic).

- A scrap control system should be put in place to ensure that only "clean" scrap is melted, unless full, effective abatement plant is being used. Evidence should be provided to the regulator that the necessary assessment and selection system is operating, as well as details regarding who has been trained to operate it.

- Details should be recorded and kept in accordance with **paragraph 4.4**.

Techniques to control fugitive emissions

5.3 Emissions from the melting operations covered by this note comprise very fine particulate matter, in the form of fume and smoke. The control of fugitive emissions from these processes is mainly by the use of dilution to achieve the provisions described in **paragraphs 4.6 - 4.8** with regard to visible emissions.

In some cases improvements to the fabric of the buildings in which activities are carried out may suffice to prevent fugitive emissions. Where the provisions in **paragraphs 4.6 - 4.8** are not met then fugitive emissions should be prevented or minimised by the use of containment and extraction, and the extracted emissions should be addressed as described in **paragraph 5.2** above.

Extraction systems should be designed, in particular, to deal with those operations which are likely to generate excessive or fugitive emissions, for example charging of the furnace, metal treatment, oxygen lancing and pouring. An enclosure fitted with extract ventilation to arrestment plant may be a necessary control measure.

- Correctly designed extraction systems should be used where necessary to achieve the limits and requirements of **Table 4.1** and **Section 4**.

- The method of collection of waste from dry arrestment plant should be such that dust emissions are minimised.

- Dusty wastes should be stored in closed containers and handled in a manner that avoids emissions of dust.

- Internal transport of dusty materials should be carried out so as to prevent or minimise airborne dust emissions.

5.4 Adequate provision to contain liquid and solid spillage is needed.

- 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.

Air quality

Dispersion & dilution

5.5 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.

5.6 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.

5.7 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

5.8 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."

Nickel air quality target level

5.9 The nickel air quality target level (20ng/m^3 annual average) comes into effect on 31.12. 2012 (England, Wales, Scotland, Northern Ireland). It is to be attained by taking all necessary measures not entailing disproportionate costs.

HEPA filters can provide greater control at small particle sizes but at a cost for energy to drive the greater pressure loss across the finer filter.

Stacks, vents and process exhausts

5.10 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.

5.11 When dispersion of pollutants discharged from the stack (or vent) is necessary, the target exit velocity should be 15m/s 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.

5.12 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.

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. In such circumstances, the potential for offensive odour emissions should be carefully considered.

- Where a wet scrubber is installed the stack should be constructed of impervious materials, lined or coated so as to minimise the effect of corrosion.

Management

Management techniques

5.13 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

5.14 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.

5.15 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

5.16 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

5.17 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**
Title of PG note and activity description	Removal of references to crucible and reverberatory furnaces	No crucible or reverberatory furnaces are known to be operating in the UK.
Section 1 - Introduction	Simplification of text	Make note clearer
	Addition of links	Change to electronic format
Section 3 - Activity description	Changes to activity description to update information. Figure of EAF removed.	Figure considered to be too generalised and with only one Part B installation operating an EAF, it is also considered irrelevant.
Section 4 - Emission limits, monitoring and other provisions	Used to be Section 5 in previous note	Section 4 in previous note deleted
Table 4.1 - Emissions and other monitoring provisions	Removal of 50mg/m^3 ELV for EAFs with existing abatement	All known EAFs are either Part A2 or controlling particulate to 20mg/m^3 (BAT)
	Total metals to be measured in particulate phase only	Metals emissions in vapour phase considered to be negligible and gives scope to reduce monitoring costs
Paragraphs 4.6 – 4.8 (Visible emissions)	Revised text describing approach to take to visible emissions.	Allows more flexibility in managing visible emissions
Paragraphs 4.9 (Emissions of odour)	Revised text describing approach to take to odorous emissions.	Allows more flexibility in managing odorous emissions
Para 4.24	Revised text describing how consistent compliance might be demonstrated using results from monitoring campaigns	Clarifies the intention of the original wording

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. 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.