ENVIRONMENT AND HERITAGE SERVICE

GUIDANCE FOR PROCESSES PRESCRIBED FOR AIR POLLUTION CONTROL BY THE CHIEF INDUSTRIAL POLLUTION INSPECTOR

CHIEF INSPECTOR'S GUIDANCE TO INSPECTORS (PART B PROCESSES)

MELTING AND PRODUCING ALUMINIUM, MAGNESIUM AND THEIR ALLOYS

B PROCESS GUIDANCE NOTE - GNB 2/4 VERSION 1

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1. INTRODUCTION

This Note is issued by the Chief Industrial Pollution Inspector as one of a series providing guidance for processes prescribed for Air Pollution Control (APC) by the Chief Inspector in Regulations made under the Industrial Pollution Control (Northern Ireland) Order 1997.

A further series of Notes is produced by the Department of the Environment (NI) for those processes prescribed for air pollution control and subject to regulation by the District Councils.

This Note provides a guide on standards and techniques to Inspectors in their assessment of an application for, or variation of, an APC authorisation under the Order.

This Note will also be of interest to operators of such processes, however it should be understood that whether an authorisation is granted, and on what conditions, will depend on the particular circumstances of each application. Parameters such as individual process characteristics and site location may influence the nature of the conditions that are included in an authorisation.

A key objective of the legislation is to ensure that, in carrying on a prescribed process, the best available techniques not entailing excessive cost (BATNEEC) will be used -

(i) for preventing the release of prescribed substances into the air or, where that is not practicable by such means, for reducing the release of such substances to a minimum and for rendering harmless any such substances which are so released; and

(ii) for rendering harmless any other substances which might cause harm if released into the air.

This Note comprises guidance in relation to new and existing processes and is based on an assessment of best available techniques as qualified by the requirement not to entail excessive cost. (The definition and meaning of BATNEEC is contained in the Industrial Pollution Control Part A and B processes "A Practical Guide".)

The guidance contained in this Note is based on the current state of knowledge and understanding of these processes, their potential impact on the environment, and the available control techniques at the time of publication. The guidance will be updated regularly, (as a minimum the Note will be reviewed at not more than four yearly intervals from the date of publication), to reflect changes in knowledge and understanding. It will not always be possible to revise the Notes quickly enough to keep in absolute step with rapid changes. It is therefore recommended that operators and their advisors check with the Inspectorate as to whether there have been any changes before relying on this Note for the purpose of making an application or taking other significant action under the Order.

2. PROCESS DEFINITION

2.1 This Note applies to processes involving the melting and producing aluminium, magnesium and their alloys where the aggregated design holding capacity of molten metal is at least 0.5 tonnes but less than 5 tonnes or more than 5 tonnes if in conjunction with die casting as described in Schedule 1 - Section 2.2, Part B of the Industrial Pollution Control Order (Prescribed Processes and Substances) Regulations (Northern Ireland) 1998.

2.2 For the purpose of this Note, refining is defined as "to cleanse, reduce or remove deleterious elements, oxides or other gangue material, for example, by means of the addition of salt flux or the injection of gases to the molten metal". However, the metallurgical properties of aluminium and aluminium alloys and magnesium and magnesium alloys are such that even during melting of ingot it is often necessary to carry out a limited form of refining operation. This Note relate to the melting of

ingot metal and clean returned or scrap material and the concurrent refining operations carried out.

This Note also applies when any related process for the refining of aluminium or magnesium or their alloys, (which are sometimes described by process operators as metal treatment operations) are carried out in conjunction with melting and casting processes. There are four main metal treatment (or refining) operations carried out in aluminium and magnesium processes and these are as follows:

(a) *grain modification* - for aluminium alloys this usually involves the addition of small amounts of metal, for example, sodium or strontium, to the melt to enhance casting characteristics. Grain modifiers for magnesium alloy processes are usually in the form of zirconium or hexachloroethane (see also (d)). The Paris Commission (PARCOM) adopted PARCOM Decision 93/1 in June 1993. It requires all uses, with certain specified exceptions, of hexachloroethane (HCE) in the non-ferrous metals industry to be phased out by the end of 1997. In 1994 the EC proposed a ban on the use of HCE in the non-ferrous metal industry to bring EC legislation into line with decisions taken by PARCOM.

(b) *fluxing* - this usually involves the addition of solid fluoride based fluxes to the melt to remove solid contaminants. Fluxes for magnesium alloy processes are usually alkaline earth halides.

(c) *degassing* - for aluminium processes this involves the removal of hydrogen gas from the melt, traditionally by the addition of solid degassing agents, for example, hexachloroethane. The main uses of HCE in aluminium foundries were due to be phased out by the end of 1992 in accordance with PARCOM Decision 92/4. All uses of HCE in aluminium foundries are due to be phased out by the end of 1996. The UK was among the countries which adopted this decision in 1992. A more recent variation involves flux injection where the solid degassing agent is carried into the furnace within a stream of either nitrogen or argon gas. For magnesium processes nitrogen or argon gas sparging may take place for degassing and oxide removal. Degassing of magnesium alloys may also be effected by a mixture of chlorine and argon gases.

(d) *oxidation control* - magnesium alloys may contain up to 0.1% beryllium by weight to prevent the oxidation of magnesium or for grain modification. Alternatively a master alloy of aluminium/beryllium, containing up to nominally 5% beryllium may be added to the molten magnesium to give the same overall beryllium loading. This form of oxidation control is most likely to be encountered in magnesium alloy production and in high pressure die casting of magnesium alloys. Oxidation control may also be achieved by blanketing the surface of the metal with a carrier gas containing up to 4% sulphur hexafluoride or by sprinkling sulphur powder.

This Note does not relate to the extraction or recovery by thermal means of aluminium from mixed scrap, (for example using a sloping hearth furnace). The extraction of copper, aluminium or zinc from mixed scrap is the subject of another Note in this series, GNB 2/2.

2.3 In the context of this Note “process” comprises the whole process including the treating, handling and storage of any materials used in the process as well as products and wastes produced by the process.

3. GENERAL REQUIREMENTS

3.1 New processes must comply with the standards contained in this Note immediately.

3.2 It should be the aim to bring existing processes up to current standards whenever the opportunity arises. Account should be taken of the plant's technical characteristics; it rate of utilisation and the length of its remaining life; the nature and amount of polluting emissions from it and the desirability of not entailing excessive costs for the plant concerned.

3.2 As part of the first application for authorisation of existing processes, those areas of the process that require upgrading to achieve the standards of this Note should be identified, and the possible techniques which are to be employed indicated. Under normal circumstances, a detailed programme for upgrading, including timetable, should be submitted with the application.

4. RELEASES INTO AIR

4.1 Reference Conditions

4.1.1 All pollutant concentrations from contained releases should be expressed at reference conditions of temperature 273K (0°C) and pressure 101.3 kPa (1 atmosphere) without correction for water vapour content.

4.1.2 These units and reference conditions may not be suitable for continuous monitoring methods and may, by agreement with the Inspectorate, be converted for day to day control purposes, into values more suitable for the available instrumentation.

4.2 **Emission Targets**

4.2.1 All contained releases should comply with the following emission standards (expressed as 15 mean concentrations except total particulate):-

Pollutant	**Concentration (mg/m^3)**
Total Particulate (including handling of raw materials and residues)	50
Chlorine	5
Fluoride (as hydrogen fluoride)	5
Sulphur Dioxide (for magnesium alloy melting processes)	300

4.2.2 The aim should be that all releases are free from offensive odour outside the process site boundary, as perceived by the Inspectorate.

4.2.3 All releases, other than steam or condensed water vapour, should be colourless, free from persistent mist or fume and free from droplets. These requirements relate to the point of final discharge into the air from abatement plant or vents and discharge points from the building housing the process.

4.2.4 Emissions from combustion processes should in normal operation be free from visible smoke and in any case should not exceed the equivalent of Ringlemann Shade 1. (BS 2742:1969).

4.2.5 The introduction of dilution air to achieve emission target concentrations is not permitted. However, if emission standards are already being met, dilution air may be used to reduce or render harmless the impact of visible or odourous substances. Exhaust flow rates should be consistent with efficient capture of emissions, good operating practice and meeting the requirements of legislation relating to the workplace environment.

5. RELEASE ROUTES

The principal release routes to air are:-

Pollutants	**Source**
Particulate	Materials handling, fluxing, furnace operations and casting.
Chlorine & Fluoride	Fluxing.
Sulphur Dioxide	Oxidation control.

6. TECHNIQUES FOR RELEASE MINIMISATION

6.1 Introduction

The techniques selected need to include releases from raw materials reception/storage, internal transportation, and from processing.

The process should be designed and operated in such a way that the substances released have the minimum impact on the environment. As a general principle the Inspectorate should be looking for evidence of the prevention, minimisation and rendering harmless of all releases of prescribed substances, and the rendering harmless of all other releases in the application, and requiring this in the authorisation.

Releases from the process may require a combination of several abatement techniques and the careful control of the process route taken in order to deal with the releases. The applicant should review all the options that are available and demonstrate that the combination of primary process and selected abatement equipment represents BATNEEC.

6.2 Techniques

6.2.1 Materials handling

6.2.1.1 Stocks of dusty, or potentially dusty materials, (for example fluxing powders and scrap metal), should be stored in such a manner as to prevent wind whipping, (for example, by covering, screening or dampening), and loading to and from stock piles should be carried out so as to prevent emissions to the air. All such materials should be stored in covered containers, purpose-built silos or under cover.

6.2.1.2 Residues arising from the process should be handled under dry conditions and stored in clearly designated bays or containers. Dross or ash should be handled and stored under dry conditions; storage should be in clearly designated bays or containers after cooling.

6.2.1.3 Adequate provision should be made for the containment of solid spillages. All spillages should be cleaned up as soon as possible and in the case of dusty materials this should be achieved by the use of vacuum cleaning, wet methods, or other appropriate techniques. Dry sweeping of spillages should not be permitted where it may result in the generation of airborne dust.

6.2.2 **Furnaces and Melting Operations**

6.2.2.1 Emissions from melting and holding furnaces should be adequately contained, (for example, by the use of extract hoods and exhaust ventilation) to prevent fugitive emissions from the building, subject to the exceptions detailed in par. 6.2.2.3. Where necessary, emissions should be vented to suitable arrestment plant to meet the requirements of Section 4.2 of this Note.

6.2.2.2 Emissions from charging and pouring operations should be adequately contained, (for example, by the use of local exhaust ventilation) and, where necessary, vented to a suitable arrestment plant, to meet the requirements of Section 4.2 of this Note. Where provided furnace doors should be kept closed except for a minimum period during charging of the furnace while working the metal.

6.2.2.3 The requirements of par. 4.2.1, 6.2.2.1, 6.2.2.2 and 7.2.1 to 7.2.4 should only apply to furnaces where either of the following apply:

(a) charge material, other than clean ingots, runners, risers, returned castings and machinings, is melted, or

(b) any of the following metal treatment materials are used:

i. Hexachloroethane
ii. Metallic sodium
iii. Sulphur powder
iv. Chlorine gas

6.2.2.4 The use of grain modifiers, oxidation control materials, fluxes and degassing agents should be reduced to a minimum consistent with good operating practice.

6.2.2.5 Consumption of sulphur hexafluoride should be minimised by:

i. Local containment within crucibles and furnaces to prevent leakage,
ii. Minimising disruptions to the blanketing layer, and
iii. Minimising dosing rates consistent with satisfactory oxidation control.

6.2.2.6 Furnaces should be fitted with temperature controls adequate to prevent the emission of substances prescribed for air into the air, for example, magnesium alloys should normally be maintained at less than 1103K (830°C) and high magnesium content aluminium alloys maintained at less than 1053K (780°C) to avoid the generation of magnesium oxide fume.

6.2.2.7 Care should be taken in the selection of material and its introduction to the furnace in order to prevent the emission of substances prescribed for air into the air. Where contaminated materials (for example, runners and risers contaminated with lubricants, oily or painted scrap) are melted emissions should be exhausted to suitable arrestment plant (for example, an afterburner) as necessary to meet the requirements of Section 4.2 of this Note.

6.2.3 **Arrestment Plant**

Where emissions are vented to an afterburner chamber, the furnace should only be charged when the afterburner exhaust temperature exceeds 1123K (850°C). Where the furnace includes a door, the door should be interlocked to prevent introduction of material into the furnace unless the afterburner temperature exceeds 1123 K (850°C). The afterburner temperature should be maintained at not less than 1123 K (850°C) at all times during operation of the furnace. This temperature should be continuously monitored and continuously recorded and an audible and visual alarm should be fitted to activate when the temperature falls below 1123K (850°C). The residence

time, air supply and turbulence should be sufficient to ensure complete combustion of waste gases to meet the requirements of Section 4.2 of this Note.

6.2.4 **General Operations**

6.2.4.1 Effective control of emissions requires the maintenance and proper use of equipment, as well as the prudent supervision of process operations. Effective preventive maintenance should be employed on all plant and the equipment concerned with the control of emissions to the air. Essential spares and consumables should be held or be available at short notice.

6.2.4.2 Any malfunction or breakdown leading to abnormal emissions should be dealt with promptly and process operations adjusted until normal operations can be restored. The Inspectorate should be informed without delay and all such malfunctions should be recorded in a log book, retained by the operator for a minimum of 4 years and available for examination by the Inspectorate.

6.2.4.3 Staff at all levels should receive the necessary formal training and instruction in their duties relating to control of the process and emissions to air. Particular emphasis should be given to training for start-up, shut down and abnormal conditions.

6.2.4.4 A high standard of housekeeping should be maintained.

6.2.5 **Dispersion from Chimneys and Vents**

6.2.5.1 The applicant will need to satisfy the Inspectorate that an appropriate assessment of vent and chimney heights has been made. This should provide adequate dispersion of prescribed substances, and other substances which might cause harm, whose release cannot be prevented. Some guidance is given in Technical Guidance Note D1 (ISBN 0-11-752794-7).

6.2.5.2 It may be necessary for dispersion modelling to be carried out which takes into account local meteorological data, local structures and topography, as well as other local releases, (for example, sites with any large volume emission, significant non-combustion sources or multiple release points and sites where there are sensitive receptors nearby).

6.2.5.3 Applicants should provide clear information on the parameters used and the assumptions made in their assessment, especially when using dispersion models. The assessment of background concentrations of pollutants will be particularly relevant. Statutory air quality standards and other recognised criteria should be taken into account.

6.2.5.4 Process upsets or equipment failure giving rise to abnormally high release levels over short periods should be assessed. Even if a very low probability of occurrence can be demonstrated by the applicant, a value for the chimney or vent height should nevertheless be set to avoid any serious damage to health in such circumstances.

6.2.5.5 The Operator should have procedures in place to reduce load or shut-down plant in the event of inadequate dispersion conditions.

6.2.5.6 Chimneys or process vents should be designed to provide efflux velocities that meet the requirements for stack aerodynamic downwash as described in Technical Guidance Note D1. Care should be taken to avoid generating positive pressure zones within the chimney unless the chimney wall is impervious or lined. Where a wet method of arrestment is used, the linear velocity within the arrestment equipment should not exceed 9 m/sec, to avoid entrainment of droplets.

6.2.5.7 Chimney flues, process vents and all ductwork should be leakproof. Chimney flues and ductwork leading to the chimneys should be adequately insulated to minimise the cooling of waste gases and prevent liquid condensation on internal surfaces. Chimney flues and ductwork should be regularly cleaned to prevent accumulation of material.

6.2.5.8 Chimney or process vents should not be fitted with any restriction at the final opening, (for example, a plate, cap or cowl), where it is necessary to achieve dispersion of the residual pollutants, except for a cone to meet the efflux velocity requirements of par. 6.2.5.6. The discharge should be vertically upwards.

7. COMPLIANCE MONITORING PROGRAMME

7.1 General

Conditions in the authorisation should require the results of all monitoring to be recorded. It should further distinguish between:

- compliance records;
- measurement or records for which regular formal returns to the Inspectorate are not normally required; and
- operational records made by the operator during the normal course of operating the process.

7.2 Monitoring Requirements

7.2.1 Particulate emissions should be continuously indicatively monitored and continuously recorded to indicate performance of abatement plant. The instrument should be fitted with audible and visual alarms which should activate at a reference level agreed with the Inspectorate. Emission events which lead to the alarms being activated should be electronically recorded. These monitors should be checked to ensure that they are functioning correctly in accordance with the manufacturer's instructions. Continuous emission charts and records should be retained by the operator for a minimum of 4 years and available for examination by the Inspectorate.

7.2.2 The sampling positions for all monitoring instruments should be agreed with the Inspectorate. Care is needed in the design and location of sampling systems to obtain representative samples.

7.2.3 Annual measurements (as a minimum) should be made for emissions of total particulate, chlorine as well as fluorides (as hydrogen fluoride).

7.2.4 Where sulphur powder is used in magnesium alloy processes emissions of sulphur dioxide should be measured at once a year.

7.2.5 Where sulphur hexafluoride is used, its level of consumption should be reported to the Inspectorate at least once per year.

7.2.6 The frequency of testing should be increased as part of commissioning new or substantially changed processes.

7.2.7 Visual assessments of emissions should be made frequently and at least once a day and adverse results should be recorded in the log book. Remedial action should be taken immediately in the case of abnormal emissions.

7.2.8 The results of all monitoring and inspections should be recorded in the log book. The log book and all continuous monitor charts and records should be retained by the operator for a minimum of 4 years and made available for examination by the Inspectorate. Adverse results should be investigated immediately and in all cases should be recorded in the log book. The operator should ensure that the cause has been identified and corrective action taken, and this action recorded in the log book.

7.2.9 The reference test method for particulate emissions in chimneys or ducts is that of British Standard BS 3405: 1983. Alternative methods of testing may be acceptable by agreement with the Inspectorate, provided that it can be shown that comparable results are obtained. The concentration of all other pollutants should measured by methods agreed with the Inspectorate. The onus is on the operator, that the appropriate equipment, laboratory facilities, expertise and quality control procedures are provided to ensure accurate results.

7.2.10 The Inspectorate should be advised at least 7 days in advance of any periodic monitoring exercise to determine compliance with emission standards, as well as the provisional time and date of monitoring, pollutants to be tested and the methods to be used.

7.2.11 The results of all non-continuous emission testing should be forwarded to the Inspectorate within 8 weeks of the completion of the sampling.

7.2.12 Where any emission measurement exceeds the specified emission standard specified in par. 4.2.1, the results should be forwarded to the Inspectorate. Where any emission exceeds twice the specified emission standard specified in par. 4.2.1, the Inspectorate should be advised immediately.

7.2.13 Where arrestment plant includes a scrubber, the liquid flow should be continuously monitored, (for example, by a variable orifice flow meter), and the liquor pH should be continuously monitored.

7.2.14 **Environmental Monitoring**

The impact of the process on the environment will be affected by the size of the release and the site's location. The need for environmental monitoring should be addressed in the application, where necessary, to demonstrate that the release have been adequately rendered harmless by the application of BATNEEC.