APPLICATION FOR AN ENVIRONMENTAL PERMIT UNDER THE ENVIRONMENTAL PERMITTING (ENGLAND AND WALES) REGULATIONS 2016 (AS AMENDED)

ENVIRONMENTAL PERMITTING TECHNICAL REQUIREMENTS DOCUMENT

DESCYCLE
metals made new

TDA
Wilton Centre - Pioneer Group
Wilton
Lazenby
Redcar
TS10 4RF

ECL Ref: DESC.01.01/EPTR
Version: Issue 2
11/12/2025

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APPENDICES

ACRONYMS/TERMS USED IN THE TEXT

ASCR	**Application Site Condition Report**
BAT	**Best Available Techniques**
BRef	**Best Available Techniques Reference Document**
DAA	**Directly Associated Activities**
DES	**Deep Eutectic Solvent**
DSEAR	**Dangerous Substances and Explosive Atmospheres Regulations 2002**
EA	**Environment Agency**
ECL	**Environmental Compliance Limited**
ELV	**Emission Limit Value**
EMS	**Environmental Management System**
EP Regulations	**Environmental Permitting (England and Wales) Regulations 2016 as amended**
EP	**Environmental Permit**
EPTR	**Environmental Permitting Technical Requirements**
ERA	**Environmental Risk Assessment**
FPP	**Fire Prevention Plan**
HAZOP	**Hazard and Operability**
MMH	**Mixed Metal Hydroxides**
PCB	**Printed Circuit Boards**
PM	**Particulate Matter**
POPs	**Persistent Organic Pollutant**
PPMR	**Planned Preventative Maintenance Regime**
The Installation	**Solvent-Based Metal Recovery Installation**
UKAS	**United Kingdom Accreditation Service**
VOC	**Volatile Organic Compound**
WAMITAB	**Waste Management Training and Advisory Board**
WEEE	**Waste Electrical and Electronic Equipment**

1. INTRODUCTION

1.1. Overview

1.1.1. Environmental Compliance Limited ("ECL") have been commissioned by DEScycle to prepare an Environmental Permitting Technical Requirements document ("EPTR") to form part of the Environmental Permit ("EP") application at their Solvent-based metal recovery installation, hereafter referred to as "the Installation", located at the Wilton Centre, Redcar, TS10 4RF ("the Site").

1.1.2. The activities undertaken at the Installation will comprise two listed activities and a bespoke waste operation that fall under Schedule 1 and Schedule 9 of the Environmental Permitting (England and Wales) Regulations 2016 as amended ("EP Regulations") respectively.

1.1.3. Issue 2 of the EPTR has been updated to confirm that all process effluent will be contained and sent off site for hazardous waste disposal. DESCycle however, request that an improvement condition be added to any permit that the EA may be minded to issue, such that process effluents can be fully characterised, and alternative disposal methods investigated.

1.1.4. In addition, some parts of the application are considered to be Commercially Confidential. Redacted copies of all application documents have been provided to the Environment Agency ("EA"), however, for ease of review, any text considered confidential has also been highlighted in grey.

1.2. Installation Location

1.2.1. The Installation covers an area of approximately 0.88 hectares.

1.2.2. The Site Location Plan (DESC.01.01-01) details the Environmental Permit Boundary (outlined in green) and is provided with this application submission.

1.3. The Applicant

1.3.1. The applicant is Argo Natural Resources Limited (11151531) trading as DEScycle.

1.4. Pre-Application Advice

1.4.1. Pre application advice from the Environment Agency ("EA") was received on the 6th of March 2025, following a MS Teams meeting held on 4th March 2025.

1.4.2. [redacted]

2. INSTALLATION ACTIVITIES

2.1. Activities

2.1.1. The activities proposed are detailed in Table 1, together with the directly associated activities in Table 2.

Table 1: Permitted Activities

Activity Reference	Activity	Description of Activities	Limits of Activities
AR1	**Schedule 1** Section 2.2 Part A(1)(a)	Producing non-ferrous metals from secondary raw materials by chemical activities	From receipt of raw materials and shredded WEEE waste to the storage and despatch of product
AR2	Section 4.2 Part A(1)(a) (v)	Producing inorganic chemicals such metal oxides	From receipt of raw materials and shredded WEEE waste to the storage and despatch of product
AR3	**Schedule 9** Bespoke Waste Operation	**R4**:Recycling/ reclamation of metals and metal compounds. **R5**:Recycling/ reclamation of other inorganic materials **R13**: Storage of wastes pending any of the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where it is produced D15: Storage pending any of the operations numbered D1 to D14 (excluding temporary storage, pending collection, on the site where it is produced)	Shredding of WEEE waste (printed circuit boards) The maximum quantity of waste to be treated at the site shall not exceed 75 tonnes of non-hazardous waste or 10 tonnes of hazardous waste per day. No waste shall be stored on site for longer than 6 months.

Table 2: Directly Associated Activities (DAAs)

Activity Ref	Directly Associated Activity	Description of Specified Activity	Limits of Specified Activity
DAA1	Treatment and Storage of waste	Waste Electrical and Electronic Equipment for storage and recovery (R4/R5/R13/D15)	Treatment and Storage shall be within a building or with weatherproof covering: shall be carried out on an impermeable surface with sealed drainage.
DAA2	Drying of mixed metal hydroxides ("MMH")	MMH will be dried in a vacuum oven	Drying will depend on evaluation of filtration and washing performance. The solvents are low volatility' therefore remain with DES after extended drying periods.

2.2. Waste Codes to be Accepted

2.2.1. It is proposed to accept the waste codes as provided in Table 3.

Table 3: Waste Codes to be Accepted

Code	Description
16	**Other wastes from industrial processes**
16 02	**Electrical and electronic equipment**
16 02 13*	discarded equipment containing hazardous components other than those mentioned in 16 02 09 to 16 02 12
16 02 14	discarded equipment other than those mentioned in 16 02 09 to 16 02 13
16 02 15*	hazardous components removed from discarded equipment
16 02 16	components removed from discarded equipment other than those mentioned in 16 02 15
20	**Municipal waste and similar materials from commerce and industry**
20 01	**Separately collected fractions (except 15 01)**
20 01 35*	discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components (6)
20 01 36	discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35

2.2.2. The total quantity of waste accepted at the Installation will be up to 21,000 tonnes per annum. This is estimated to comprise 18,625 tonnes of non-hazardous waste and 2,475 tonnes of hazardous waste. Whilst this is the maximum the Installation could accept, in reality annual quantities of waste received are likely to be in the region on 300 tonnes per year.

2.2.3. The total storage capacity of incoming waste will be approximately 45 tonnes.

3. MANAGEMENT TECHNIQUES

3.1. Technical Competence

3.1.1. Under the EP Regulations, AR2 is classified as a relevant waste operation, and, accordingly, a Technically Competent Manager will be required. Paul Hewett will fulfil this role; and is registered with the Waste Management Industry Training and Advisory Board ("WAMITAB") Scheme – Registration Number 143380. He will obtain the relevant qualifications within 12 months of operation (or sooner depending on permitting timescales).

3.1.2. All employees will be appropriately trained to ensure they can undertake their roles and responsibilities in a safe manner. All employees will undertake an induction programme, as well as job role specific training. All certificates are held on record for the individual.

3.1.3. The design and maintenance of infrastructure, plant and equipment is undertaken by competent people in-house, or where required specialist contractors are employed.

3.2. Management System Overview

3.2.1. DEScycle will operate a management system which is appropriate to the Installation and its operations and complies with the EA's Online Guidance "Develop a management system: environmental permits[1].

3.2.2. It is envisaged that the Plant Manager will have overall responsibility for environmental matters at the Installation.

3.2.3. Senior management are committed to high standards of protection for people and the environment which is further defined in company policies and procedures. The key commitments include:

- establishment of management system to ensure compliance with the Environmental Permit;
- communication of information to those that work on behalf of the organisation that could impact on these systems;
- selection criteria for personnel within key roles supported by appropriate training;
- objectives and targets to drive continual improvement; and
- allocation of resources to ensure systems are implemented and developed to a high standard.

3.3. Plan

3.3.1. The planning element of the management system includes:

- identification of environmental impacts and aspects associated with the activities, and assessing their significance; including an assessment of the potential environmental risks including those posed by the work of any contractors on site;

[1] https://www.gov.uk/guidance/develop-a-management-system-environmental-permits

- identification and evaluation of relevant legal and other relevant requirements including Permit requirements;
- identification of environmental objectives and targets that will be focussed on reducing the impact of the identified significant environmental aspects, in conjunction with financial planning and investment;
- a series of risk assessments to cover a range of issues, including site operations, maintenance, accidents, training and records, this includes the assessment of climate change; and
- details of how DEScycle ensures that any relevant standards, guidance and codes of practice are met on an ongoing basis.

3.3.2. The outcomes of the above are:

- a comprehensive understanding of the potential and actual impacts of the permitted activities on the surrounding environment and people's health;
- the correct appropriate measures selected to manage environmental risks and prevent or minimise their effects so as not to cause pollution;
- a series of documented procedures covering all aspects of the Installation's activities; and
- a series of documented environmental objectives and targets, together with an action plan/development programme to ensure that these are met.

3.4. Implementation and Operation (Do)

3.4.1. This element includes:

- ensuring that management system roles and responsibilities are clearly defined and documented, and that site staff are made aware of these;
- ensuring that the Installation is operated by suitably competent staff who have received the necessary training in all aspects of the plant's operation, including where contractors are used, ensuring that they are suitably competent; in this regard:
  - the skills and competencies necessary for key posts are documented; these key posts include contractors, those responsible for liaising with contractors and those purchasing equipment and materials,
  - training requirements are identified by means of a documented training needs analysis,
  - documented training records are kept and updated as required,
  - training specifically addresses environmental awareness and environmental permit requirements, and
  - the requirement for ongoing/refresher training is identified;
- ensuring that there are site layout plans - including drainage plans - and that they are revised as required to reflect any changes;
- ensuring that there are documented procedures covering internal and external communications;
- ensuring that there are procedures in place for staff and contractors to have access

to the Permit and management system requirements; with regard to contractors, ensuring that suitable instructions are provided with regard to protecting the environment whilst working on site;

- the establishment of a documented planned preventative maintenance regime ("PPMR") to ensure that all plant and site infrastructure are kept in suitable condition and operating effectively; this PPMR details what maintenance, tests and inspections need to completed and when; this also details the measures required to ensure continuing compliance with the permit conditions during maintenance/shutdown. The PPMR also:
    - identifies known or predictable malfunctions associated with the operations and the procedures, spare parts, tools and expertise required to deal with them;
    - includes a record of spare parts held, or details on where they can be sourced from, together with an assessment of how long they would take to obtain;
    - includes a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative regime is appropriate;
    - makes sure that tanks and plant are cleaned regularly to avoid large scale decontamination activities; and
    - ensure the necessary spare parts, tools, and competent staff are available prior to commencing maintenance. The design, installation and maintenance of infrastructure, plant and equipment will be carried out by competent people, including Construction Quality Assurance where appropriate.
- ensuring that there are documented procedures covering document control;
- ensuring that there are suitable documented record-keeping arrangements in place;
- ensuring that there are documented operational procedures and work instructions covering all aspects of the Installation's operation;
- ensuring that there are documented procedures covering emissions monitoring undertaken;
- ensuring that there are documented procedures that incorporate environmental issues into the control of process/equipment/engineering change, capital approval and purchasing policy;
- ensuring that there are documented procedures to address non-conformities/non-compliances and the associated corrective and preventative action; these will detail the means by which any such non-conformities/non-compliances are reported to management and the means by which they are reported to the EA;
- ensuring that there is a documented procedure for dealing with complaints;
- ensuring that there are documented procedures covering emergency preparedness and response; these will cover such incidents as major plant failures, significant spillages of potentially polluting substances, loss of mains electrical power etc as detailed in an Accident Management Plan. The Accident Management Plan also details the measures taken to prevent the events that may lead to an accident. DEScycle will ensure that suitable measures are in place to communicate the Accident Management Plan to all employees, management and contractors who work at the site. There is an emergency co-ordinator (or deputy) who will take

the lead and responsibility for implementing the accident management plan in the event of an emergency. All staff will be trained to ensure they can perform their duties effectively and safely and know how to respond to an emergency.

- ensuring there is a documented climate change adaptation plan which addresses the risks identified;
- ensuring that there are documented procedures for carrying out internal audits; these describe how to schedule, conduct, report and manage internal audits;
- ensuring that there is a documented contingency plan in place that ensures compliance is maintained with all Permit conditions and operating procedures during maintenance/shutdown at the Installation or elsewhere.

3.4.2. The outcome of the above is evidence that day-to-day activities are taking place in accordance with the requirements of the management system and the Permit, specifically:

- that control measures and procedures are an integral part of the business operation;
- that the management system is easy for staff to access, understand and use;
- that staff are suitably trained and competent to carry out procedures and control measures; and
- that the requirements of the management system are effectively communicated to management, staff and contractors.

3.5. Check

3.5.1. This element includes:

- ensuring that all regulatory requirements in relation to monitoring and measurement are complied with, specifically:
  - the requirements relating to inspection and testing required under the applicable environmental legislation and the Installation's Environmental Permit and the associated procedures and work instructions,
  - the requirements relating to inspection and testing required under the applicable health and safety legislation and the associated procedures and work instructions, and
  - the requirements relating to the control of all inspection, measuring and test equipment relating to environmental requirements;
- ongoing evaluation of compliance with environmental legal requirements, policy requirements and objectives and targets; this will include:
  - an annual review of environmental legal register;
  - an annual review of utilities used on site and waste produced;
  - regular site inspections,
  - internal audit procedures (as detailed below);
- ensuring that non-conformities/non-compliances are properly recorded, investigated and that the appropriate corrective action is taken by the due date;
- ensuring that the necessary reporting and record-keeping required under the various Permit and consents are complied with;

- ensuring that internal audits are carried out in accordance with the documented procedures and that any audit actions are followed up; and
- ensuring that the results of all audits (internal and external) are made available to Senior Management on a regular basis.

3.5.2. The outcomes of the above will be:

- that checks are carried out to ensure that the management system is being implemented as intended, i.e. as documented; and
- the necessary preventative and corrective actions are undertaken to minimise non-compliances.

3.6. Review (Act)

3.6.1. This element includes:

- an annual management review of the management system to ensure that it is appropriate, being implemented and kept up to date, e.g. that any supplementary plans have been included into the management system;
- a management review of the management system when:
  - there are changes on site (in activities and/or plant/equipment),
  - if there is an accident, complaint, or breach of permit conditions.
- an annual review of both individual and organisational training needs;
- ensuring that all changes are properly recorded, and, if there are any major changes, the EA is informed;
- an assessment of whether the Installation's objectives, and any targets, have been met and reported;
- a review of the Installation's objectives and targets, and, where appropriate, any revisions to these so as to effect continual improvement.

3.6.2. The outcomes of the above will be:

- the management system is kept up to date, and
- the management system is continually improved.

4. OPERATING TECHNIQUES

4.1. Technical Standards

4.1.1. The following EA online guidance has been considered as part of this application:

- *Develop a management system: environmental permits;*
- *Risk assessments for your environmental permit;*
- *Control and monitor emissions for your environmental permit;*
- *Non-hazardous and inert wate: appropriate measures for permitted facilities;*
- *Waste electrical and electronic equipment (WEEE): appropriate measures for permitted facilities;*
- *Non-Ferrous Metals and the Production of Carbon and Graphite (EPR 2.03);*
- *Pollution prevention for businesses; and*
- *Monitoring stack emissions: guidance for selecting a monitoring approach.*

4.1.2. The Best Available Techniques ("BAT") Reference Document for the Non-Ferrous Metals Industries has also been followed in the preparation of this application.

4.1.3. A formal Hazard and Operability ("HAZOP") study has been undertaken as the project progressed through the process design and plant design phases.

4.2. Process Overview

4.2.1. DEScycle are developing a novel recycling process that uses a deep eutectic solvent ("DES") to extract base and precious metals from electronic waste. This involves extracting metals from the waste, recovering the metals and finally recycling the solvent.

4.2.2. It should be noted that the process operates as a batch plant and has been designed so that single pieces of equipment can undertake multiple process steps.

4.2.3. [redacted]

4.3. Waste Pre-Acceptance Arrangements

4.3.1. DEScycle will implement pre-acceptance procedures to ensure adequate information is known about a waste including composition before arrival at the Installation. This is to assess and confirm the waste can be accepted at the Installation, is technically and legally suitable for treatment, there is sufficient storage and treatment capacity and will avoid the unnecessary accumulation of waste.

4.3.2. DEScycle will obtain the following information in writing when receiving a customer query:

- details of the waste producer including organisation name, address and contact details;
- where the waste is coming from;

- full description of the waste including the quantity;
- the List of Waste code (European Waste Classification ("EWC") code);
- any hazardous properties or presence of any regulated chemicals, for example, persistent organic pollutants ("POPs");
- details of any treatment already undertaken, e.g. removal of hazardous substances.

4.3.3. Copies of any WM3 Assessments undertaken on the wastes will be obtained where relevant.

4.3.4. Verification of pre-acceptance information will be undertaken by periodic visits to the waste producer.

4.3.5. Confirmation will also be obtained that the waste does not contain any radioactive sources.

4.3.6. Records of pre-acceptance information will be kept following receipt of the waste, however if an enquiry from a waste producer does not lead to the receipt of waste, the records will be disposed of.

4.3.7. Waste pre-acceptance checks will be reassessed every 12 months or under the following circumstances, if the:

- waste changes;
- process giving rise to the waste changes; and/or
- waste received does not conform to the pre-acceptance information.

4.4. Waste Acceptance Arrangements

4.4.1. DEScycle will only accept specific, well-defined waste material from known clients. DEScycle will not accept, for example mixed metal wastes, or accept wastes from 'walk-up' clients.

4.4.2. All deliveries of waste (and any other materials) are known of in advance and the specifications of the materials that will be delivered will be known and confirmed through the pre-acceptance checks.

4.4.3. Periodic audits of waste suppliers will be undertaken and DEScycle staff will inspect the waste in advance of the material being delivered to the Installation.

4.4.4. On arrival at the Installation, wastes are inspected visually to ensure what has been delivered agrees with what was expected. Any waste that is different from what was expected, or deemed to be incompatible, hot, or poses any other kind of risk to the Installation, will be rejected taken to the quarantined area before being returned to the customer.

4.4.5. All relevant storage areas (quarantine, reception and general) and treatment processes will be checked in advance to ensure they have the physical capacity needed for the waste received in accordance with Permit conditions.

4.4.6. All waste containers and packages will be visually checked and verified against the waste

pre-acceptance information and transfer documentation before acceptance.

4.4.7. Each consignment of waste will be weighed on arrival to confirm the quantities against the accompanying paperwork and the weight recorded in the computerised waste tracking system.

4.4.8. All waste transfer documentation will be checked and validated and discrepancies will be resolved before acceptance. If it is identified that the incoming waste classification and description is wrong or incomplete, this will be addressed with the original waste producer during waste acceptance, record as a non-conformance. If it has been assessed that the waste is acceptable for on-site storage or treatment, this will also be documented.

4.4.9. After completion of the initial visual inspection and confirmatory checks, the waste containers will be offloaded into a dedicated reception or storage area.

4.4.10. Following off loading, a thorough visual check of all loads of waste received (for example, in bulk containers) will be undertaken to identify any non-conforming items.

4.4.11. Personnel undertaking the waste acceptance checks shall be trained to identify and manage any non-conformances in the loads received, complying with relevant EA online guidance documents and Permit conditions.

4.4.12. Written procedures will be developed for recording, reporting and tracking incoming wastes including non-conforming wastes and a procedure to notifying the relevant customer or waste producer to prevent reoccurrence.

Quarantine Area

4.4.13. The Installation will have a dedicated internal waste quarantine area, separated from all other storage areas, and will be clearly marked. Quarantine storage will be for a maximum of 14 days.

4.4.14. There will be a written procedures within the Installation's EMS for dealing with wastes held in quarantine, including the maximum storage volume, and where quarantined wastes can be sent.

4.5. Waste Tracking

4.5.1. A digital tracking system will be used to store information regarding the available capacity of the waste quarantine, reception, and storage areas. This will include treatment residues and end of waste product materials.

4.5.2. The waste tracking system will hold all the information generated during:

- pre-acceptance;
- acceptance;
- non-conformance and/or rejection;
- storage;
- treatment; and

- removal off site.

4.5.3. Records will be created and updated to reflect deliveries, on-site treatment and despatches. The tracking system will also operate as a waste inventory and stock control system. It will include the following as a minimum:

- the date the waste arrived on the Installation;
- the waste producer's details (or unique identifier);
- details of all previous holders;
- a unique reference number;
- waste pre-acceptance and acceptance information;
- the quantity delivered;
- the intended treatment route;
- accurate records of the nature and quantity of wastes held on site, including all hazards – and identifying the primary hazards;
- where the waste is physically located on site;
- where the waste is in the designated disposal route; and
- details of any non-conformances and rejections.

4.5.4. The tracking system will be able to report:

- the total quantity of waste present on the Installation at any one time;
- a breakdown by type of the waste quantities treated/pending treatment;
- the quantity of waste on site compared with permitted limits;
- the length of time the waste has been on site;
- the quantity of treated materials at any one time;
- when the waste has been sent off site for destruction; and
- what the treatment residues, treated components and fractions are.

4.5.5. Back-up copies of electronic documents are also stored on a SharePoint site and therefore are backed up to the cloud. Consequently, they can be readily accessible in an emergency by site personnel.

4.5.6. Pre-acceptance and acceptance records are held for a minimum of 3 years after the waste has been treated the waste and/or removed it off site.

4.6. Waste Handling and Storage

4.6.1. All waste storage areas are shown on Drawing DESC.01.01-02 – Site Layout. All incoming wastes are stored in in 1 tonne woven bags, in a fully sealed and lockable shipping container on impermeable hardstanding. All wastes received are assumed to be hazardous POP containing wastes unless there is clear evidence to the contrary in the form of a full waste classification.

4.6.2. Each area is labelled with the maximum storage capacity (tonnage and/or volume as appropriate), and these are not to be exceeded.

4.6.3. Checks are undertaken against the allowed maximum capacity and are monitored against those set out in the Installations Fire Prevention Plan (see DESC.01.01/FPP submitted with

this application.

4.6.4. Where possible, wastes are unloaded using mechanical means.

4.6.5. All waste containers are checked to ensure that they remain fit for purpose. Daily checks of all waste storage containers are undertaken and non-conformances recorded. Should any non-compliant containers be identified, they are made safe as soon as possible.

4.6.6. The waste offloading, reception and quarantine areas will benefit from an impermeable surface with self-contained drainage to prevent any spills entering the storage systems or escaping off site. All surfaces are of a type and quality that can be disinfected effectively.

4.6.7. All wastes will be treated on a first in first out basis. Generally, all wastes will be treated within a maximum of 6 months of receipt (unless stated otherwise in the Installation's FPP).

4.6.8. All waste is stored to allow easy inspection, and safe access is maintained between piles of wastes. Pedestrian and vehicular access is maintained to the whole of the storage area.

4.6.9. The wastes accepted at the Installation are not likely to attract pests and vermin.

4.6.10. All waste storage areas and stored equipment will be subject to frequent inspection to make sure that any leaks, spillages of liquids, dust or loose material are identified and managed appropriately, and fire breaks are maintained. A written record of such inspections is maintained in accordance with the EMS.

4.6.11. Any spillages of waste beyond the confines of the storage areas are dealt with immediately. Should any remedial actions be required, this is logged within the EMS. Spill kits are located at strategic locations within the installation. Any collected residues from spillages will be stored in a lidded, leakproof container and will be disposed of correctly. Any containers or surfaces affected by the spillage will be cleaned.

4.6.12. All waste storage and treatment areas, equipment and containers are regularly inspected and cleaned if required. Any residues collected during cleaning are disposed of as required.

4.6.13. Any activities that may represent a clear fire risk are not undertaken within any waste storage area. Examples include:

- smoking;
- parking of normal road vehicles except while unloading or loading; and/or
- recharging batteries.

4.6.14. An assessment in accordance with Dangerous Substances and Explosive Atmospheres ("DSEAR") Regulations 2002 has been undertaken which has identified explosive areas. Equipment used in these areas has been designed to be fit for use and protective systems are in place. A copy of the DSEAR assessment may be found in Appendix III.

4.6.15. Where relevant, all Health and Safety Executive guidance and standards are conformed with.

4.6.16. All staff will be trained in the correct handling of waste, to minimise any damage to the integrity of containers or individual items.

4.6.17. All containers stored externally are closed or stored under cover to prevent the accumulation of rainwater.

4.6.18. All containers are clearly labelled to identify their contents.

4.7. Storage of Hazardous Waste

4.7.1. Hazardous wastes are separated based on their EWC Waste code. Where it is unknown if a waste is hazardous or not, it is assumed to be hazardous.

4.7.2. All hazardous wastes are stored in in 1 tonne woven bags, in a fully sealed and lockable shipping container on impermeable hardstanding.

4.8. [redacted]

[redacted]

[redacted]

[redacted]

4.9. [redacted]

[redacted]

[redacted]

[redacted]

4.10. [redacted]

4.10.1. [redacted]

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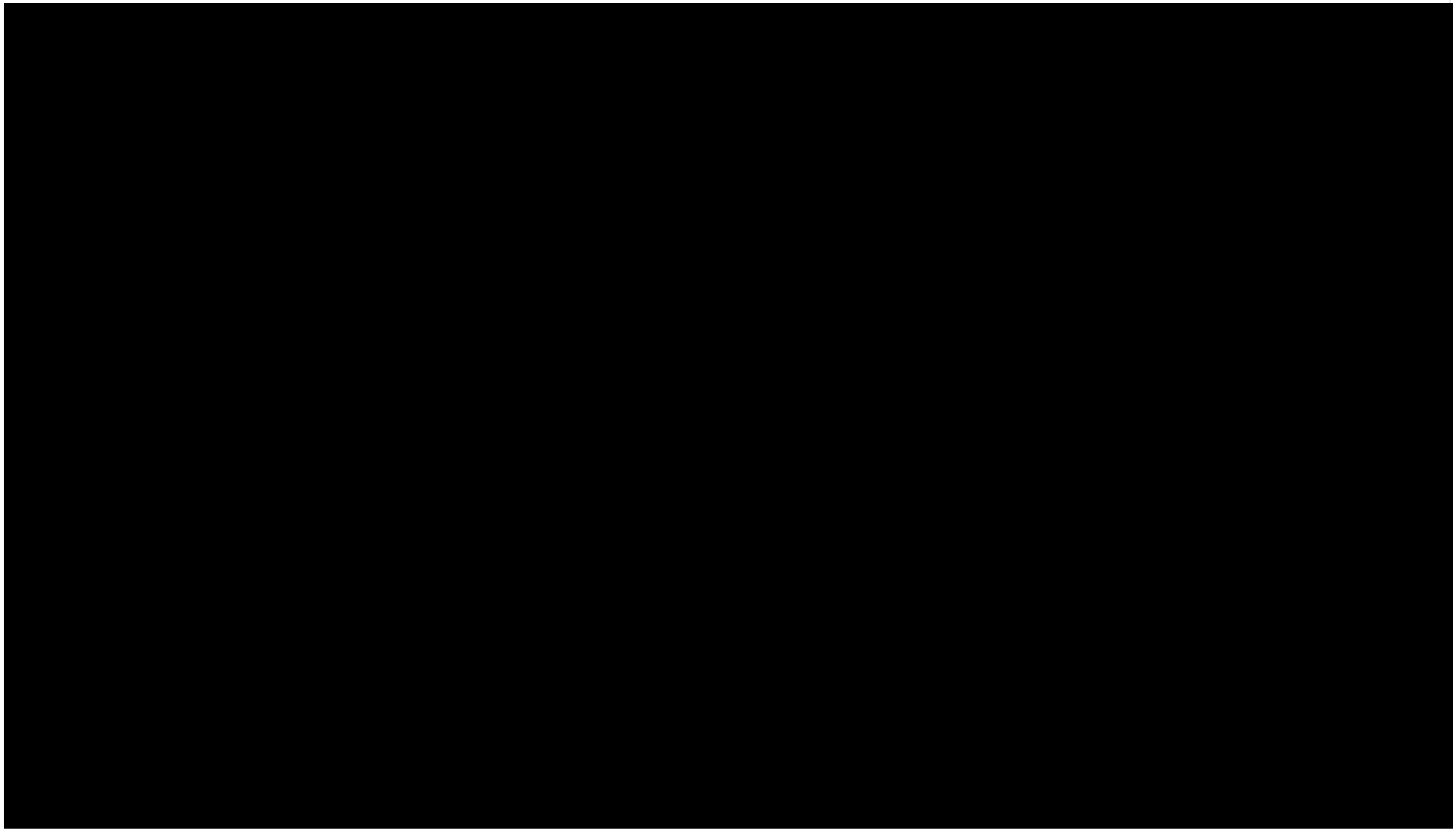
Figure 1: [redacted]

Figure 2: [redacted]



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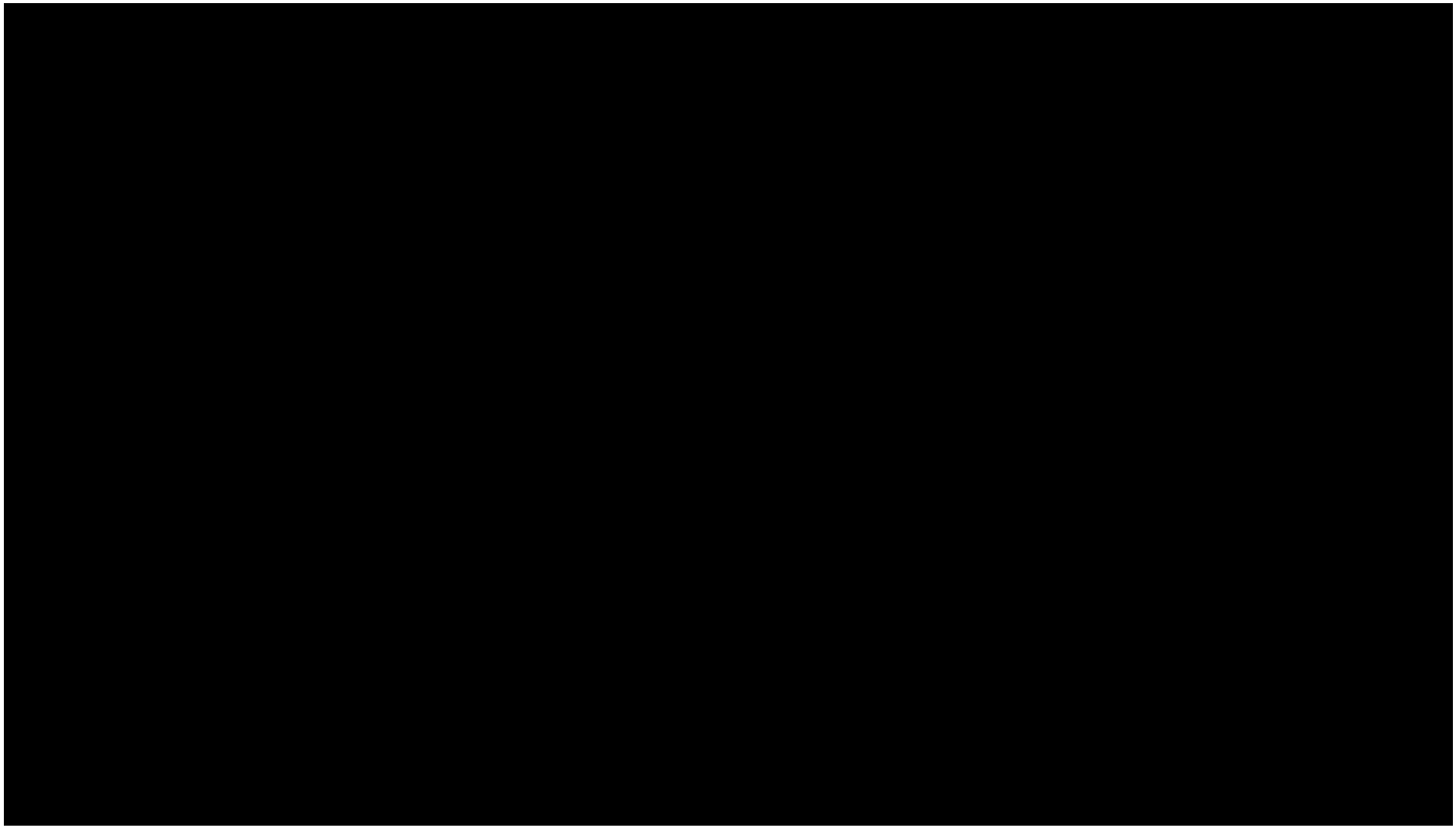


4.11. [redacted]

[redacted]

4.12. Removal of Site Generated Wastes and Waste Water Treatment

4.12.1. All wastes generated by the process will be subject to a comprehensive WM3 assessment to fully characterise the waste stream.

4.12.2. Initially all process effluent will be contained and sent off site for hazardous waste disposal. DESCycle however, request that an improvement condition be added to any permit that the EA may be minded to issue, such that process effluents can be fully characterised, and alternative disposal methods investigated.

4.12.3. Prior to any waste removal, the waste removal contractor's documentation is checked to ensure the following:

- the waste to be removed is covered by an accurately completed Waste Transfer Notes or Hazardous Waste Consignment Notes;
- the contractor has a valid Waste Carriers Licence; and
- the proposed recover/disposal site is permitted to accept the waste.

4.13. Site Security and Traffic Management

4.13.1. The Installation is located within a large industrial estate. There is perimeter fencing to a height of 2.4 metres in place to prevent unauthorised or accidental access to the Installation.

4.13.2. The Installation is covered by CCTV and the Industrial Estate has four gatehouses, two of which are manned 24/7 to control access.

4.13.3. The Installation speed limit is 5mph and is clearly signed.

4.13.4. There are marked walkways for staff to use when moving from the parking areas to the main building.

4.13.5. The speed limited is varied according to the location.

4.13.6. There are foot paths from the car parks to the buildings.

4.14. Contingency Plans

4.14.1. In the unlikely event that site operations are disrupted, contingency arrangements are in place. No further waste will be accepted at the Installation unless there is sufficient capacity or there is a clearly defined method of disposal/recovery.

4.14.2. Contracts will be in place to ensure the safe and compliant disposal of all solid waste streams, particularly those containing POPs. However, alternative disposal routes will also be investigated to ensure that there are at least two sites capable of taking the waste.

4.14.3. The Installation will continue to comply with all permit conditions and operating procedures during maintenance and/or shutdowns, this includes disruption at other facilities/installations that waste is removed off site too.

4.14.4. Should waste be required to be sent to an alternative facility or installation, checks will be undertaken to ensure that the alternative facility or installation is permitted to accept the waste.

4.15. Installation Decommissioning

4.15.1. The Installation has been designed to ensure that it can be decommissioned safely in a manner which will avoid any pollution risk and return the site to a satisfactory state. In this instance, this means returning the site to the environmental condition that prevailed prior to Environmental Permit issue as established in the Application Site Condition Report (DESC.01.01/ASCR).

4.15.2. A decommissioning plan will be developed to demonstrate that the plant can be safely decommissioned without causing pollution. In summary, the Installation will be decommissioned as follows:

- cessation of waste acceptance;
- removal of all waste from site;
- maintenance of all storage areas;
- review of all potentially polluting materials stored on site;
- knowledge transfer;
- clean down and decommissioning of all plant and equipment;
- survey and removal of storage and process areas; and

- investigate ground and groundwater conditions and return to a satisfactory state, if required.

5. RAW MATERIALS

5.1. DES Cycle Raw Materials

5.1.1. The raw materials to be used in the DES Circuit 1 and 2, together with the estimated amounts that will be used at the Installation are detailed in Table 4.

5.1.2. Regular reviews will be undertaken to investigate the availability of alternative raw materials and any suitable ones that are less hazardous or polluting will be used if suitable.

5.1.3. To ensure the quality of raw materials, the following checks are in place:

- document verification – including receipt of safety data sheets ("SDSs"), certificates of analysis and supplier documentation; and
- visual inspection – including verification of packaging integrity, correct labelling, and correct quantity.

Table 4: [redacted]

[redacted]

6. EMISSIONS

6.1. Point Source Emissions to Air

6.1.1. The emissions to air are listed in Table 5. Initial testing has been undertaken on a laboratory scale, the results of which are provided in Appendix V – the concentrations obtained from the testing are summarised in Table 5. This testing was undertaken on a laboratory bench scale reactor to ascertain the likely emissions to air and allow further detailed design to be undertaken in relation to any abatement technology that may be required.

Table 5: Point Source Emissions to Air

Emission Point	Source	Parameter	Concentration
A1	Slurry Vessel	Total aldehydes[iii]	<1.52 mg/m^3
	DES 1 Vessel	Total VOC[iii]	14.02 mg/m^3
	DES 2 Vessel	Total acids[i]	<4.51 mg/m^3
A2	Dryer, LEV, Filtration Hoods	Total aldehydes	See Note iv
		Total VOC	
		Total acids	

Note to Table

[redacted]

6.1.2. It is envisaged that an improvement condition will be contained within the Installation's permit which will require the operator to propose a monitoring programme to characterise and assess the Installation's point source emissions to air once fully operational.

6.1.3. Emissions points A1 and A2 will be fitted with appropriate abatement as required following the outcome of emissions testing as described in Paragraph 6.1.2.

6.1.4. Any abatement will be operated and maintained in accordance with the PPMR and the Installations EMS.

6.2. Point Source Emissions to Surface Water and Sewer

6.2.1. The Installation has a combined surface water and foul water drainage system which drains to the effluent treatment plant operated by Sembcorp. No process effluent will be discharged into this system until the effluent has been fully characterised.

6.2.2. It is envisaged that an improvement condition will be contained within the Installation's permit which will require the operator to propose a monitoring programme to characterise and assess the Installation's point source emissions to water once fully operational. On completion of the monitoring programme, ongoing monitoring for the Installation will be devised with appropriate emissions limit values to be agreed with the EA and fully complied with.

6.2.3. As part of the monitoring programme, the following parameters will be considered:

- hydrocarbon oil index;
- chemical oxygen demand;
- total organic carbon;
- total suspended solids;
- pH;
- arsenic;
- cadmium;
- chromium;
- copper;
- nickel;
- lead;
- zinc;
- mercury;
- perfluorooctanoic acid;
- perfluorooctanesulphonic acid;
- conductivity; and
- flow.

6.2.4. All drainage (sinks/wealfare facilities etc) from within the permitted boundary will be directed to the combined sewer as shown on Drawing DESC.01.01-05.

6.2.5. It is understood that the Sembcorp drainage network has sufficient capacity and buffer storage to contain surges and storm water flows.

6.3. Point Source Emissions to Land

6.3.1. There are no emissions to land.

6.4. Fugitive Emissions to Air

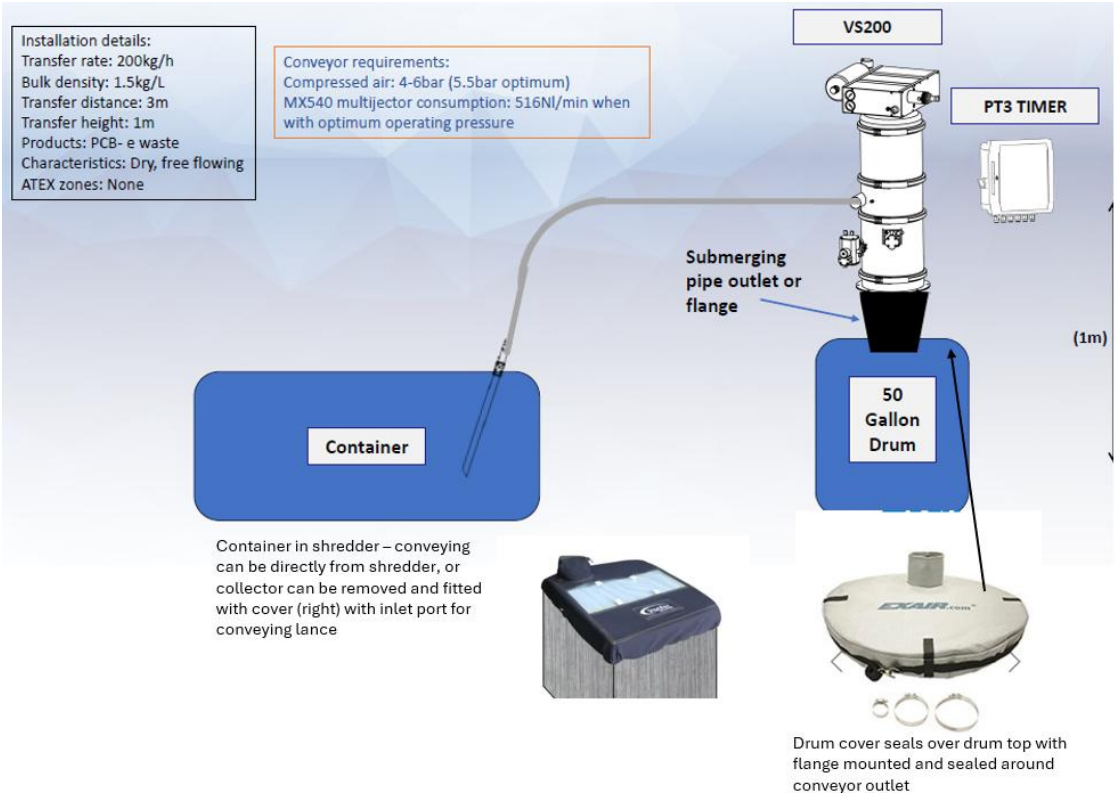
6.4.1. The wastes received at the Installation are not considered to be dusty wastes.

6.4.2. The release of diffuse emissions to air from the shredding activities is minimised by:

- carrying out the shredding and Microniser operations using enclosed equipment and both activities are undertaken within enclosed building/shipping container;
- maintaining the enclosed equipment or buildings under an appropriate pressure; and
- the shredder is equipped with a dust extraction and HEPA filtration system to prevent emission of dusts from shredding chamber. Particulate matter on the filter is removed via a positive pressure cleaning system to dislodge retained dusts. The shredder is a fully enclosed system with no point source emission to air.
- the microniser is fitted with a dust extraction and filtration system to prevent emmisions of dust from the micronisation chamber. Particulate matter on the filter is removed via a positive pressure cleaning system to dislodge retained dusts. The microniser is a fully enclosed system with no point source emission to air.

6.4.3. A vacuum transfer system is in place to convey shredded materials to drums. This system can also be used to transfer material into the Microniser. Material is drawn up by vacuum into the chamber and then dropped by gravity into collection vessel. The vacuum system is fitted with HEPA filters to prevent dust escape, and a positive pressure cleaning system to dislodge retained dusts, which are then dropped into collection drum (see Figure 4). Collection vessels are fitted with cover seals to prevent dust escape during transfer.

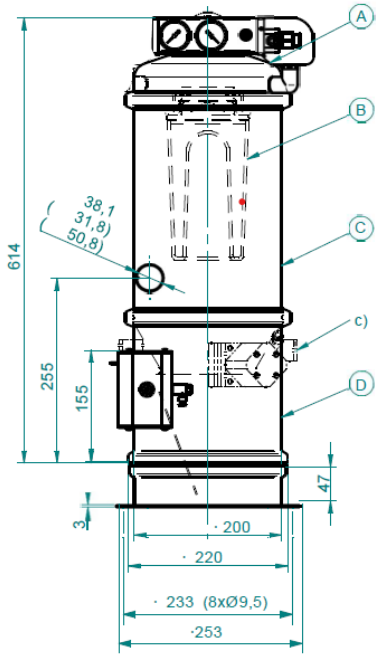
Figure 4: Vacuum Transfer System



Vacuum Conveyor VS200

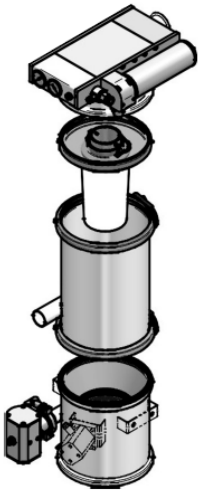
Id-No.: 106025, Type: VS200Teco-MX540-QX200

Modules: AISI 316L (1.4404/1.4435)
Gaskets: Silicone (Option: EPDM / Nitrile)
Pump: Multijector MX540
Filter: QX200, with 0.5 ltr. air shock



	PART
A	Pump cover
B	Filter module QX200
C	Suction module Eco
D	Discharge module

Options :
a) Piston vibrator
b) Exhaust air clamp 2"
c) Mounting plates



6.5. Fugitive Emissions to Surface Water, Sewer, and Groundwater

6.5.1. All proposed activities will be undertaken in areas sealed with an impervious barrier to prevent a pollution pathway to groundwater. There is also no direct connection to surface water so no pollution pathway exists to surface water.

6.5.2. The Installation benefits from a combined sealed drainage system which is part of the wider Sembcorp drainage system. Any fugitive emissions would be contained within this system and captured by the Sembcorp effluent treatment plant. A penstock valve will also be fitted to the combined drainage system from the process area (see Drawing DESC.01.01-05) to ensure that any spillages from the process can be contained within DEScycle's own drainage system.

6.5.3. All potentially polluting liquids will be appropriately bunded providing a minimum capacity of either 110% of the capacity of the largest storage vessel or 25% of the total capacity of all the storage vessels within the bund, whichever is greater.

6.5.4. All plant and equipment will be subject to regular maintenance and servicing. This will ensure all plant is in good working order to reduce the likelihood of leakage.

6.5.5. All indoor treatment areas have an impermeable surface and spill kits are located at strategic locations appropriate to the materials being handled.

6.5.6. Any spillages will be subject to the robust emergency response procedures, and any spills are dealt with immediately. This will prevent any potentially polluting materials from entering the drainage network.

6.5.7. All relevant employees are suitably trained in spill response and spill kits are strategically located around the Installation with the contents regularly inspected and maintained. The spill response plan is regularly tested.

6.6. Fugitive Emissions to Land

6.6.1. To minimise any fugitive emissions to land, all operational areas of the Installation have:

- impermeable surfacing;
- sealed construction joints; and
- spill containment kerbs.

6.6.2. All external areas have a sealed combined drainage system.

7. GENERAL REQUIREMENTS

7.1. Emissions Management

7.1.1. As discussed in Section 6., there is little likelihood of any significant emissions of dust. Consequently, a Dust Management Plan is not considered to be required.

7.2. Odour Management

7.2.1. It is not considered that there is a significant risk of odour as the wastes accepted are not odorous in nature. No odour is expected to be evolved during the process.

7.2.2. Consequently, an Odour Management Plan is not considered to be required.

7.3. Noise and Vibration Management

7.3.1. Site operations that produce noise are limited. The shredder is fully enclosed within the main building, operatives must wear hearing protection when loading the PCBs into the shredder, however, to hearing protection is required beyond the shredder area.

7.3.2. The Microniser is located externally to the main building, however, is enclosed in a shipping container.

7.3.3. The Installation will also be located within an industrial area with the nearest residential receptor located approximately 1km to the south west.

7.3.4. Consequently, it is not considered that a Noise Management Plan is required.

7.4. Fire Prevention Plan

7.4.1. As per the requirements of the EA's Fire Prevention Plan ("FPP") online guidance[2], a FPP (Document reference DESC.01.01/FPP) has been prepared and is submitted with this application.

7.5. Pest Management Plan

7.5.1. It is not considered that the activities proposed will result in any risk of pest attraction to the Installation nor nuisance being experienced by sensitive receptors in the surrounding area. Consequently, a Pest Management Plan is not required.

[2] EA 'Fire Prevention Plans: environmental permits', available online at https://www.gov.uk/government/publications/fire-prevention-plans-environmental-permits/fire-prevention-plans-environmental-permits, accessed January 2024.

8. MONITORING

8.1. Monitoring of Emissions to Air

Periodic Monitoring Arrangements for Emissions to Air

8.1.1. All periodic monitoring will be undertaken by an organisation that is suitably United Kingdom Accreditation Service ("UKAS") accredited and holds the necessary certifications under the EA's MCERTS Scheme for Manual Stack Sampling. All sampling personnel will hold the appropriate personal accreditations.

8.1.2. Any samples collected during periodic monitoring that require off-site analysis will be sent to a laboratory that is suitably UKAS accredited for that determinand and sample matrix.

8.1.3. All periodic monitoring will be undertaken to the current requirements of the relevant CEN, or ISO sampling standards and the EA online guidance 'Monitoring of stack emissions: techniques and standards for periodic monitoring' (Updated September 2021).

8.1.4. The frequency for the periodic monitoring for the determinands will be agreed with the EA, but, in any case, will not be less than twice per year.

8.2. Recording and Reporting of Emissions to Air Data

8.2.1. All emissions to air monitoring data is recorded and output in such a manner so as to allow direct comparison with relevant Emission Limit Values ("ELVs") for releases to air that will be assigned to the proposed Installation i.e., corrected to the relevant reference conditions. Monitoring data will also be reported in accordance with the relevant averaging period and percentiles specified for the ELVs, again, to allow direct comparison with the ELVs.

8.2.2. If any of these ELVs are exceeded, the EA will be informed without delay and DEScycle will take whatever action is necessary to ensure that compliance is restored within the shortest possible time.

8.2.3. All emissions monitoring data will be retained by DEScycle for a minimum of four years, or for a period otherwise agreed with the EA.

8.2.4. Emission to air data will be reported to the EA in a manner to be agreed, but in any case, in accordance with the requirements of the Installation's Permit.

8.3. Assessment of Sampling Location for Emissions to Air

8.3.1. Assessment of sampling locations will be undertaken to the current requirements of the relevant CEN, or ISO sampling standards and the EA'S online guidance *'Monitoring stack emissions: techniques and standards for periodic monitoring'* (Updated February 2021) and Technical Guidance Note (Monitoring) M1 'Sampling requirements for stack emissions monitoring' (Version 8, August 2017).

8.4. Monitoring of Surface Water and Sewer

8.4.1. It is envisaged that an improvement condition will be contained within the Installation's permit which will require the operator to propose a monitoring programme to characterise and assess the Installation's point source emissions to water once fully operational. On completion of the monitoring programme, ongoing monitoring for the Installation will be devised with appropriate emissions limit values to be agreed with the EA and fully complied with. Until such a plan is approved by the EA there will be no discharge of process effluent from operations.

8.5. Monitoring of Groundwater

8.5.1. It is considered that there will be no risk of fugitive emissions to groundwater arising from the activities that will be undertaken at the proposed Installation. However, in accordance with the European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions, groundwater monitoring will be undertaken at least every 5 years.

8.6. Process Monitoring

8.6.1. At least once a year, for every waste stream treated a mass balance exercise will be undertaken to determine and record the mass of each individual output fraction derived from a given mass of input material. The first year of operation will be used to set a baseline, and then in following years the results will be compared with previous results to monitor the performance of the Installation to ensure it is performing optimally.

8.6.2. All waste streams produced will be subject to WM3 Waste classification – Guidance on the classification and assessment of waste, as appropriate.

8.6.3. Every 6 months, the physically finest non-metallic fraction of the shredded PCBs will be sampled and tested for:

- mercury, with a limit value of 1mg/kg
- cadmium with a limit value of 100mg/kg

8.6.4. Samples of solid products will be dissolved in acid and analysed by ICP-MS to assess quality. Samples of liquid outputs will be analysed by ICP-MS to determine composition. Solid materials will be sampled and samples washed in water with conductivity measurement to determine solvent loss to solids.

8.6.5. Hydrogen detection is present with an audible alarm to alert staff to any potential explosive atmospheres.

9. RESOURCE EFFICIENCY AND CLIMATE CHANGE

9.1. Estimated Electrical Energy Ratings

9.1.1. As the plant is still in the detailed design stage the energy ratings of various components is yet to be determined. The shredder and Microniser will have that largest power ratings. Currently it is envisaged that this will be around 16kW and 50-85kW respectively.

9.1.2. Other items such as the dryer and pumps are likely to have a power rating of 2kW or less.

9.2. Estimated Annual Energy Consumption

9.2.1. Table 6 presents the estimated annual energy consumption data for each type of energy used.

Table 6: Estimated Annual Energy Consumption Data

Energy Source	Energy Consumption		
	Delivered (MWh)	Primary (MWh)[(a)]	% of Total
Mains Electricity	945.45	2,458	100

Notes to Table
(a) A conversion factor of 2.6 has been used

9.3. Energy Efficiency Arrangements

9.3.1. The plant has been designed to be energy efficient, in particular:

- the feed to the shredder is kept stable when in operation;
- all motors to be installed will be classed as IE3 – premium efficiency.

9.3.2. Regular maintenance under the Installation's PPMR programme will ensure continued high efficiency operation. The maintenance procedures will include the following:

- good maintenance and housekeeping techniques and regimes across the whole Installation;
- condition monitoring carried out on a regular basis to ensure, amongst other things, that process equipment is operating efficiently, insulation and cladding are not damaged and that there are no significant leaks of steam and hot water; and
- operators trained in energy awareness and encouraged to identify opportunities for energy efficiency improvements.

9.3.3. An energy efficiency plan will be incorporated into the Installation's EMS. The plan will be underpinned by, and reviewed regularly, as part of the EMS. The energy efficiency plan will include an energy balance record which will be updated annually.

9.3.4. During normal operation, procedures will be reviewed and amended where necessary, to include improvements in efficiency as and when proven new equipment and operating technique become available. These will be assessed on the implementation cost compared with the estimated benefits.

9.4. Climate Change Levy Agreement

9.4.1. The Installation will not be party to a Climate Change Agreement but will implement all energy saving measures as detailed in the section above.

9.5. Efficient Use of Raw and Other Materials - Water

9.5.1. The primary use of fresh mains water at the proposed Installation is as DES make up and wash water.

9.5.2. Approximately 1,000 m^3 of water will be used annually in the processes that will be undertaken at the Installation. Daily records will be kept of water consumption within the first year of operation and a water mass balance will be produced. From a review of this water balance, water efficiency objectives can be devised. Where improvements are required, timescales for the realistic implementation of the objectives will be provided.

9.5.3. All wastewater will be collected in IBCs or a dedicated wastewater tank which will be stored in on a drip tray or in a bunded area. Wastewater will be recycled and where possible reused within the process, to minimise the use of mains water. If the water cannot be used in the process (e.g. for DES makeup), investigations will be undertaken to ascertain if it can be used in another part of the Installation that has lower water quality requirements.

9.5.4. The use of water at the Installation, will be recorded annually and reviewed every 4 years to determine if there are further ways to either reduce water consumption or increase recycling of wastewater.

9.5.5. Water minimisation techniques to be used at the Installation include:

- vacuuming, scraping or mopping rather than hosing down;
- reusing wash water (or recycled water) where practicable (as described above);
- using trigger controls on all hoses, hand lances and washing equipment.

9.5.6. No specific leak detection systems are in place, however due to the small volumes stored and the fact that all liquids storage areas are visible, no further control measures are needed.

9.6. Waste/Residue Minimisation

Optimisation of Operating Conditions

9.6.1. Operating conditions for the plant will be optimised as part of the plant Commissioning Programme. In particular, this will result in operating conditions being such that the quantities of supplementary raw materials used in each stage of the process are minimised e.g. dosing rates will be optimised so that no more reagent is used than is necessary.

Residue Management

9.6.2. Any packaging will be re-used, where possible to minimise the amount of waste sent for recovery and/or disposal. Any wastes that are sent off site will be subject to the principles

of the waste hierarchy. Where waste recovery is not possible, all wastes will be disposed of correctly after being subjected to comprehensive WM3 assessment.

9.6.3. A Residue Management Plan will be implemented to minimise the generation of wastes from all activities, this will include a review of the best environmental options for waste recovery and/or disposal.

Waste Minimisation Audits

9.6.4. A waste minimisation audit will be carried out within two years of the commissioning of the proposed Installation and at least every four years thereafter. The information obtained from the audit(s) will be used to identify opportunities for improved efficiency and reduced waste production

10. COMPLIANCE WITH TECHNICAL STANDARDS

10.1. Overview

10.1.1. It is considered that the Installation will be operated in accordance with the techniques detailed in the relevant appropriate standards and will constitute appropriate measures including BAT.

10.1.2. The technical standards for the proposed application have been taken from the following:

- BAT for Waste Treatment[3];
- Waste electrical and electronic equipment (WEEE): appropriate measures for permitted facilities[4];
- Treating metal waste in shredders: appropriate measures for permitted facilities[5]
- Non-Ferrous Metals and the Production of Carbon and Graphite (EPR 2.03)[6];
- The Inorganic Chemicals Sector Guidance (EPR 4.03)[7]
- Non-ferrous Metals Industries BAT Conclusion Document[8]; and
- Speciality Inorganic Chemicals Bref[9].

10.1.3. Tables 7 - 13 provide an assessment of the application against the technical standards listed above.

10.1.4. It is considered that the techniques will be appropriate and proportionate to the scale of the activities at the Installation and the risks that are posed to the environment by the activities.

[3]https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.208.01.0038.01.ENG&toc=OJ%3AL%3A2018%3A208%3ATOC

4 https://www.gov.uk/guidance/waste-electrical-and-electronic-equipment-weee-appropriate-measures-for-permitted-facilities
5 https://www.gov.uk/guidance/treating-metal-waste-in-shredders-appropriate-measures-for-permitted-facilities/5-waste-treatment-appropriate-measures
6 https://www.gov.uk/government/publications/non-ferrous-metals-and-the-production-of-carbon-and-graphite-additional-guidance
[7]https://assets.publishing.service.gov.uk/media/5a7c343d40f0b67d0b11f8e5/geho0209bpit-e-e.pdf
8 https://eippcb.jrc.ec.europa.eu/reference/non-ferrous-metals-industries-0
9 https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/sic_bref_0907.pdf

Table 7: BAT for Waste Treatment

BATc Ref No.	BAT Requirement	Section of Supporting Documents
Overall environmental performance		
BAT1. In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the features listed in BATc for Waste		DESC.01.01/EPTR – Section 3.2. to 3.6.
BAT 2. In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.		
a.	Set up and implement waste characterisation and pre-acceptance procedures	DESC.01.01/EPTR – Section 4.3.
b.	Set up and implement waste acceptance procedures	DESC.01.01/EPTR – Section 4.4.
c.	Set up and implement a waste tracking system and inventory	DESC.01.01/EPTR – Section 4.5.
d.	Set up and implement an output quality management system	DESC.01.01/EPTR – Section 8.6.
e.	Ensure waste segregation	DESC.01.01/EPTR – Section 4.6.
f.	Ensure waste compatibility prior to mixing or blending of waste	DESC.01.01/EPTR – Section 4.4.
g.	Sort incoming solid waste	DESC.01.01/EPTR – Section 4.6
BAT 3. In order to facilitate the reduction of emissions to water and air, BAT is to establish and to maintain an inventory of waste water and waste gas streams, as part of the environmental management system (see BAT 1), incorporates all of the features listed in BATc for Waste.		DESC.01.01/EPTR – Section 6.1. and 6.2.
BAT 4. In order to reduce the environmental risk associated with the storage of waste, BAT is to use all of the techniques listed		DESC.01.01/EPTR – Section 4.6. and 4.7.
BAT 5. In order to reduce the environmental risk associated with the handling and transfer of waste, BAT is to set up and implement handling and transfer procedures.		DESC.01.01/EPTR – Section 4.6.
BAT 6. For relevant emissions to water as identified by the inventory of waste water streams (see BAT 3), BAT is to monitor key process parameters (e.g. waste water flow, pH, temperature, conductivity, BOD) at key locations (e.g. at the inlet and/or outlet of the pretreatment, at the inlet to the final treatment, at the point where the emission leaves the installation).		DESC.01.01/EPTR – Section 6.2.
BAT 7. BAT is to monitor emissions to water with at least the frequency listed, and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.		DESC.01.01/EPTR – Section 6.2.
BAT 8. BAT is to monitor channelled emissions to air with at least the frequency listed, and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality		DESC.01.01/EPTR – Section 6.1

Table 7: BAT for Waste Treatment (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
Overall environmental performance		
BAT 8.	BAT is to monitor channelled emissions to air with at least the frequency given below, and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	DESC.01.01/EPTR – Section 6.1.
BAT 9.	BAT is to monitor diffuse emissions of organic compounds to air from the regeneration of spent solvents, the decontamination of equipment containing POPs with solvents, and the physico-chemical treatment of solvents for the recovery of their calorific value, at least once per year using one or a combination of the techniques given below.	N/a – activities not undertaken
BAT 10.	BAT is to periodically monitor odour emissions	DESC.01.01/EPTR – Section 7.2. and DESC.01.01/ERA
BAT 11.	BAT is to monitor the annual consumption of water, energy and raw materials as well as the annual generation of residues and waste water, with a frequency of at least once per year.	DESC.01.01/EPTR – Section 9.2., 9.5. and 9.6.
BAT 12.	In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1)	DESC.01.01/EPTR – Section 7.2. and DESC.01.01/ERA
BAT 13.	In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to use one or a combination of the techniques given listed in BATc for Waste.	
BAT 14.	In order to prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques listed.	DESC.01.01/EPTR – Section 7.1. and 7.2. and DESC.01.01/ERA
BAT 15.	BAT is to use flaring only for safety reasons or for non-routine operating conditions (e.g. start-ups, shutdowns) by using correct plant design and plant management	N/a – no flaring
BAT 16.	In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use both of the techniques listed.	
Noise and vibrations		
BAT 17.	In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the environmental management system (see BAT 1), that includes elements listed	DESC.01.01/EPTR – Section 7.3. and DESC.01.01/ERA
BAT 18.	In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of the techniques listed.	
Emissions to water		
BAT 19.	In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques listed	DESC.01.01/EPTR – Section 6.2. and 9.5.

Table 7: BAT for Waste Treatment (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
Emissions to water		
BAT 20. In order to reduce emissions to water, BAT is to treat waste water using an appropriate combination of the techniques listed.		DESC.01.01/EPTR – Section 4.12.
Emissions from accidents and incidents		
BAT 21. In order to prevent or limit the environmental consequences of accidents and incidents, BAT is to use all of the techniques listed as part of the accident management plan (see BAT 1).		DESC.01.01/EPTR – Section 3.4.
Material efficiency		
BAT 22. In order to use materials efficiently, BAT is to substitute materials with waste		N/a – operation is to recover valuable materials from waste
Energy efficiency		
BAT 23. In order to use energy efficiently, BAT is to use both and energy efficiency plan and energy balance record.		DESC.01.01/EPTR – Sections 9.1. – 9.3.
Reuse of packaging		
BAT 24. In order to reduce the quantity of waste sent for disposal, BAT is to maximise the reuse of packaging, as part of the residues management plan (see BAT 1).		DESC.01.01/EPTR – Section 9.6.
General BAT conclusions for the mechanical treatment of waste		
BAT 25. In order to reduce emissions to air of dust, and of particulate-bound metals, PCDD/F and dioxin-like PCBs, BAT is to apply BAT 14 and to use one or a combination of the techniques given in BATc for Waste.		DESC.01.01/EPTR – Section 6.4.
BAT conclusions for the mechanical treatment in shredders of metal waste		
BAT 26. In order to improve the overall environmental performance, and to prevent emissions due to accidents and incidents, BAT is to use BAT 14g (cleaning of waste treatment and storage areas) and all of the techniques given in BAT 26 a-c BATc for Waste.		DESC.01.01/EPTR – Section 3.4. and 4.8(note: no baled waste accepted, and no treatment of containers)

Table 7: BAT for Waste Treatment (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
2.2. BAT conclusions for the mechanical treatment in shredders of metal waste		
BAT 27. In order to prevent deflagrations and to reduce emissions when deflagrations occur, BAT is to use technique a. and one or both of the techniques b. and c. given below.		
a.	Deflagration management plan	DESC.01.01/EPTR – Section 4.8.
b.	Pressure relief dampers	
c.	Pre-shredding	
BAT 28. In order to use energy efficiently, BAT is to keep the shredder feed stable.		DESC.01.01/EPTR – Section 9.3.
BAT 29 – BAT 31 (treatment of WEEE containing VFCs and/or VHCs)		N/a
BAT 32 (treatment of WEEE containing mercury)		N/a
BAT 33 - 39 (biological/aerobic/anerobic/mechanical biological treatment of waste)		N/a
4. BAT conclusions for the physico-chemical treatment of waste		
4.1. BAT conclusions for the physico-chemical treatment of solid and/or pasty waste		
BAT 40**.** In order to improve the overall environmental performance, BAT is to monitor the waste input as part of the waste pre-acceptance and acceptance procedures (see BAT 2).		DESC.01.01/EPTR – Section 4.3 and 4.4.
BAT 41. In order to reduce emissions of dust, organic compounds and NH_3 to air, BAT is to apply BAT 14d and to use one or a combination of the techniques listed.		DESC.01.01/EPTR – Section 6.1.
BAT 42 – 44 (BAT conclusions for the re-refining of waste oil)		N/a
BAT 45 (BAT conclusions for the physico-chemical treatment of waste with calorific value)		N/a
BAT 46 – 47 (BAT conclusions for the regeneration of spent solvents)		N/a
BAT 48 - 49 (BAT conclusions for the thermal treatment of spent activated carbon, waste catalysts and excavated contaminated soil)		N/a
BAT 50 (BAT conclusions for the water washing of excavated contaminated soil)		N/a
BAT 51 (BAT conclusions for the decontamination of equipment containing polychlorinated biphenyls)		N/a
BAT 52 – 53 (BAT conclusions for the treatment of water-based liquid waste)		N/a

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
General Management Appropriate Measures		
2.1 Management System		
1	You must have an up-to-date written management system, and activities at your facility must follow it. Your management system must incorporate the features listed in the guidance.	DESC.01.01/EPTR – Section 3.2. – 3.6.
2.2. Staff Competence		
1	Your site must be always operated by an adequate number of staff with appropriate qualifications and competence.	DESC.01.01/EPTR – Section 3.1.
2	The design and maintenance of infrastructure, plant and equipment must be carried out by competent people.	
3	You must have appropriately qualified managers for your waste activity who are members of a government approved technical competency scheme.	
4	Non-supervisory staff must be reliable and technically skilled. Their skills may be based on experience and relevant training.	
2.3. Accident Management Plan		
1	As part of your written management system, you must have a plan for dealing with any incidents or accidents that could result in pollution, including near misses	DESC.01.01/EPTR – Section 3.2., 3.4., 3.6. and DESC.01.01/ERA
2	The accident management plan must identify and assess the risks the facility poses to human health and the environment. Particular areas as listed in the guidance	
3	You must assess the risk of accidents and their possible consequences. You can use our risk assessment guidance to help you to do this. Risk is the combination of the likelihood that a hazard will occur and the severity of the impact resulting from that hazard.	
4	The depth and type of accident risk assessment you carry out will depend on the characteristics of your facility and its location. The main factors to take into account are the scale and nature of the accident hazard presented by the facility and its activities and risks to areas of population and the environment (the receptors)	
5	Through your accident management plan, you must also identify the roles and responsibilities of the staff involved in managing accidents. You must provide them with clear guidance on how to manage each accident scenario, for example as a result of a spillage of a potentially polluting liquid.	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
General Management Appropriate Measures		
6	You must appoint one facility employee as an emergency co-ordinator who will take lead responsibility for implementing the plan. You must train your employees so they can perform their duties effectively and safely and know how to respond to an emergency.	DESC.01.01/EPTR – Section 3.4.
7	You must train your employees so they can perform their duties effectively and safely and know how to respond to an emergency.	
2.4. Accident Prevention Measures		
1	You must have clear and detailed procedures for pre-acceptance and acceptance of waste and for rejected and quarantined wastes.	DESC.01.01/EPTR – Section 4.3. and 4.4.
2	These should be produced and maintained as set out in the waste pre-acceptance, acceptance and tracking appropriate measures section.	DESC.01.01/EPTR – Section 4.3. to 4.5.
3	You must keep apart incompatible wastes.	DESC.01.01/EPTR – Section 4.4.
4	You must make sure you contain the following (where appropriate) or route to the effluent system (where necessary): process waters site drainage waters, emergency firefighting water, oil or chemical contaminated waters, spillages of oils and chemicals	DESC.01.01/EPTR – Section 6.5. and DESC.01.01/FPP
5	You must be able to contain surges and storm water flows. You must provide enough buffer storage capacity to make sure you can achieve this. You can define this capacity using a risk-based approach	DESC.01.01/EPTR – Section 6.2.
6	You can only discharge waste water from this buffer storage after you have taken appropriate measures, to control, treat or reuse the water.	
7	You must have spill contingency procedures to minimise the risk of an accidental emission of raw materials, products and waste materials, and to prevent their entry into water.	DESC.01.01/EPTR – Section 6.5.
8	Your emergency firefighting water collection system must take account of additional firefighting water flows or firefighting foams. You may need emergency storage lagoons to prevent contaminated firefighting water reaching a receiving water body. This should be considered as part of your fire prevention plan.	DESC.01.01/FPP
9	You must consider and, if appropriate, plan for the possibility that you need to contain or abate accidental emissions from: overflows, vents, safety relief valves and bursting discs.	DESC.01.01/ERA
10	You must have security measures in place to prevent entry by vandals and intruders, damage to equipment, theft, fly-tipping and arson.	DESC.01.01/EPTR Section 4.13.

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.4. Accident Prevention Measures		
11	Facilities must use an appropriate combination of security measures.	DESC.01.01/EPTR Section 4.13.
12	There are 3 fire prevention objectives. You must: minimise the likelihood of a fire happening, aim for a fire to be extinguished within 4 hours, minimise the spread of fire within the site and to neighbouring sites.	DESC.01.01/FPP
13	You must have a fire prevention plan that meets the requirements of relevant FPP guidance.	
14	You must maintain plant control in an emergency using one or a combination of the following measures: alarms, process trips and interlocks, manual interventions	DESC.01.01/EPTR Section 3.4.
15	You must: • make sure all the measurement and control devices you would need in an emergency are easy to access and operate in an emergency situation • maintain the plant so it is in a good state of repair through a preventive maintenance programme and a control and testing programme • use techniques such as suitable barriers to prevent moving vehicles damaging equipment • have procedures in place to avoid incidents due to poor communication between operating staff during shift changes, or following maintenance or other engineering work • where relevant, use equipment and protective systems designed for use in potentially explosive atmospheres	DESC.01.01/EPTR Section 3.3., 3.4. and 4.6.
16	You must: • keep an up-to-date record of all accidents, incidents, near misses, changes to procedures, abnormal events, and the findings of maintenance inspections • carry out investigations into accidents, incidents, near misses and abnormal events and record the steps taken to prevent their reoccurrence • maintain an inventory of substances, which are present (or likely to be) and which could have environmental consequences if they escape – many apparently innocuous substances (for example, AdBlu) can damage the environment if they escape • have procedures for checking raw materials and wastes to make sure they are compatible with other substances they may accidentally come into contact with • make sure that any documents that may be needed in the event of an incident are accessible	DESC.01.01/EPTR Section 3.3. and 5.1. and DESC.01.01/FPP

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.4 Contingency Plan and Procedures		
1	You must have and implement a contingency plan and management procedures to make certain you comply with all your permit conditions and operating procedures during maintenance or shutdown at your site.	DESC.01.01/EPTR – Section 4.14.
2	Your contingency plan must also contain provisions and procedures to make sure that you: • do not exceed storage limits in your permit and you continue to apply appropriate measures for storing and handling waste • stop accepting waste unless you have a clearly defined method of recovery or disposal and enough permitted storage capacity • as far as possible, know in advance about any planned shutdowns at waste management facilities where you send waste	
3	Your contingency plan must include plans and procedures for circumstances where you cannot send your wastes to other sites due to their planned or unplanned shutdown.	
4	If you produce an end-of-waste material at your facility, your contingency planning must consider issues with storage capacity for end-of-waste products. Iron, steel, aluminium and copper produced in accordance with the end-of-waste regulations remain waste and subject to waste controls until they are passed to the next holder. You must make your customers aware of your contingency plan, and of the circumstances in which you would stop accepting waste from them.	N/a – no end of waste produced
5	You must consider whether the sites or companies you rely on in your contingency plan: • can take the waste at short notice • are authorised to do so in the quantities and types likely to be needed – in addition to carrying out their existing activities	DESC.01.01/EPTR – Section 4.14.
6	Where circumstances mean you could exceed your permitted storage limits or compromise your storage procedures, you must look for alternative disposal or recovery options. You must not discount alternative disposal or recovery options on the basis of extra cost or geographical distance.	
7	You must not include unauthorised capacity in your contingency plan. If your contingency plan includes using temporary storage for additional waste on your site, then you must: • make sure your site is authorised for this storage • have the appropriate infrastructure in place	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.4 Contingency Plan and Procedures		
8	Your management procedures and contingency plan must also: • identify known or predictable malfunctions associated with your technology and the procedures, spare parts, tools and expertise needed to deal with them • include a record of spare parts held, especially critical spares – or state where you can get them from and how long it would take to receive them • have a defined procedure to identify, review and prioritise items of plant which need preventative maintenance • include all equipment or plant whose failure could directly or indirectly affect the environment or human health • identify 'non-productive' or redundant items such as tanks, pipework, retaining walls, bunds, reusable waste containers, ducts, filters and security systems • make sure you have the spare parts, tools, and competent staff needed before you start maintenance	DESC.01.01/EPTR – Section 3.4.
9	Your management system must include procedures for auditing your performance against all these contingency measures and for reporting the audit results to the site manager.	
2.6 Plant Decommissioning		
1	You must consider the decommissioning of the facility at the design stage and make suitable plans to minimise risks during decommissioning. For existing plant, identify potential decommissioning risks and take steps to address these. You should make changes and design improvements as and when plant is upgraded, or when construction and development works are carried out at your site.	DESC.01.01/EPTR – Section 4.15.
2	You must maintain a decommissioning plan to demonstrate that: • plant can be decommissioned without causing pollution • the site will be returned to a satisfactory condition	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.6 Plant Decommissioning		
3	Your decommissioning plan should include details on: • whether you will remove or flush out pipelines and vessels (where appropriate) and how you will empty them of any potentially harmful contents • site plans showing the location of all underground pipes and vessels • how asbestos or other potentially harmful materials will be removed, unless we have agreed it is reasonable to leave such liabilities to future owners • methods for dismantling buildings and other structures, and for protecting surface water and groundwater during construction or demolition at your site • any soil testing needed to check for any pollution caused by the site activities, and information on any remediation needed to return the site to a satisfactory state when you cease activities, as defined by the initial site condition report • the measures proposed, once activities have definitively stopped, to avoid any pollution risk and to return the site of operation to a satisfactory state (including, where appropriate, measures relating to the design and construction of the plant) • clearing deposited residues, waste and any contamination resulting from the waste treatment activities	DESC.01.01/EPTR – Section 4.15.
4	You should make sure that equipment taken out of use is decontaminated and removed from the site.	
3 Waste Pre-acceptance, Acceptance and Tracking		
3.1 Waste Pre-acceptance		
1	You must implement waste pre-acceptance procedures so that you know enough about a waste (including its composition) before it arrives at your facility. You need to do this to assess and confirm the waste is technically and legally suitable for your facility and processes.	
2	Your procedures must follow a risk-based approach, considering: • the source and nature of the waste • its hazardous properties • potential risks to process safety, occupational safety and the environment	DESC.01.01/EPTR – Section 4.3.

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
3	You must get the following information in writing when you receive a customer query: • details of the waste producer including organisation name, address and contact details • the specific source of the waste – for example, ELV depollution site, general scrap metal transfer station, car manufacture, or metal from other types of manufacturing processes • a description of the waste including its composition and quantity • the List of Waste code (European Waste Classification, EWC code) • if the waste has an EWC code showing it is a non-hazardous mirror entry - you should request evidence of the assessment from the producer • any hazardous properties or whether it contains any regulated chemicals, for example, POPs • confirmation from the producer that ELVs have been depolluted to ELV directive requirements • confirmation from the producer that drums will be accompanied by a certificate of cleanliness	DESC.01.01/EPTR – Section 4.3.
4	You must also get confirmation that the waste does not contain a radioactive source. If there is a risk of radioactive contamination you must get confirmation that the waste is not radioactive, unless your facility is permitted to accept such waste.	
5	You must consider whether specific wastes, from among those you are permitted to receive, have properties that can pose unacceptable risks to the site or process, for example, due to: • a risk of deflagration • a risk of fire	DESC.01.01/EPTR – Section 4.6. and DESC.01.01/FPP
6	You should establish a list of these wastes and procedures for managing the risks from them.	
7	You must keep pre-acceptance records for at least 3 years in a computerised waste tracking system following receipt of the waste. If an enquiry from a waste producer does not lead to the receipt of waste, you do not need to keep records.	DESC.01.01/EPTR – Section 4.5.
8	You must reassess the information required at pre-acceptance if the: • waste changes • process giving rise to the waste changes • waste received does not conform to the pre-acceptance information	DESC.01.01/EPTR – Section 4.3.

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
3.1 Waste Pre-acceptance		
9	In all cases you must reassess the information required at pre-acceptance annually. The information required and the assessment made at the pre-acceptance stage is to make sure you: • only accept wastes that are suitable for the site • avoid accumulating waste • have enough storage and treatment capacity	DESC.01.01/EPTR – Section 4.3.
3.2 Waste Acceptance		
1	You must implement waste acceptance procedures to check that the characteristics of the waste received matches the information you obtained during waste pre-acceptance. This is to confirm that the waste is as expected and that you can accept it.	DESC.01.01/EPTR – Section 4.4.
2	If the waste is not as expected, you must confirm that you can accept it as a non-conforming waste, or you must reject it. If you are rejecting hazardous waste, you must follow the guidance on the procedure for rejecting hazardous waste.	
3	Procedures should be documented and auditable and must follow a risk-based approach, considering: • the source, nature and age of the waste • the waste's hazardous properties • the waste's potential to contain POPs • potential risks to process safety, occupational safety and the environment (for example, from odour and other emissions) • knowledge about the previous waste holders	
4	You must assess the load to make sure it is technically (and legally) suitable for the plant. Your checks and assessment must be risk-based	
5	All relevant storage areas (quarantine, reception and general) and treatment processes in your facility must have the physical capacity needed for the waste you receive. You must not receive wastes if this capacity is not available. The amount of waste you receive must also comply with storage limits in your permit.	
6	The waste offloading, reception and quarantine areas must have impermeable surfaces with a sealed drainage system. This system must collect all surface water runoff and channel it to a blind sump, unless you can lawfully discharge it in another way.	
7	You must clearly designate a materials reception area (or areas). Staff controlling the inspection, reception and validation of materials at the installation, must be trained in their respective roles.	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
3.2 Waste Acceptance		
8	You must weigh each load of waste on arrival to confirm the quantities against the accompanying paperwork, unless alternative reliable systems are available (for example, based upon volume). You must record the weight in the computerised waste tracking system.	DESC.01.01/EPTR – Section 4.4.
9	You must check and validate all transfer documentation and resolve discrepancies before you accept the waste. If you believe the incoming waste classification and description is incorrect or incomplete, then you must address this with the customer during waste acceptance. You must record any non-conformances. If you have assessed the waste as acceptable for on-site storage or treatment, you must document this.	
10	You must use clear criteria for rejecting non-conforming wastes. You must also have a written procedure for recording, reporting and tracking non-conforming wastes, including notifying the relevant customer or waste producer to prevent reoccurrence.	
11	You must have fixed radiation detectors on weighbridges to monitor waste delivered to the site for any radioactive substances or materials. These detectors must have both a visual and audible alarm. You must also have a hand held detector to investigate alarms generated by the fixed radiation detectors.	N/A – no radioactive wastes accepted.
12	The radiation detection equipment must include solid state scintillation detectors and have a sensitivity to gamma radiation that is consistent with the minimum performance recommended by the International Atomic Energy Agency. These are specified in Annex IV of 'Recommendations on Monitoring and Response Procedures for Radioactive Scrap Metal', UNECE, 2006.	N/A – no radioactive wastes accepted.
13	You must maintain, calibrate and test the radiation monitoring equipment in accordance with the manufacturer's specification.	
14	You must have clear procedures for responding to radiation detector alarms.	
15	You must make sure you only receive and accept drums or tanks with properties as listed.	N/A – no drums or tanks accepted
16	You must produce and follow a detailed procedure for accepting and inspecting baled material before accepting bales for processing.	N/A - No baled material accepted
17	You must carry out risk-based assessments for baled and other infeed materials. You must base your inspection and pre-processing procedures on these assessments before fragmentising. This may include, but not be limited to, different inspection frequencies for different customers, depending on risk.	
18	You must establish quarantine areas for materials that are prohibited, awaiting full inspection, or awaiting testing or removal.	DESC.01.01/EPTR – Section 4.4.
19	Quarantine storage must be for a maximum of 14 working days.	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
3.2 Waste Acceptance		
20	You must have written procedures for dealing with wastes held in quarantine, and a maximum storage volume.	DESC.01.01/EPTR – Section 4.4. and DESC.01.01/FPP
21	Quarantine storage must be separate from all other storage and clearly marked as a quarantine area.	
22	You must identify and isolate gas cylinders and other prohibited items to remove them from the waste stream. You must store gas cylinders in locked cages. Where possible, you must send prohibited items back to the appropriate owner.	N/a – not accepted
3.3 Waste Tracking		
1	You must use a computerised tracking system to hold up-to-date information about the available capacity of the waste quarantine, reception, general and bulk storage areas of your facility. This must also include treatment residues and end-of-waste product materials.	DESC.01.01/EPTR – Section 4.5.
2	Your waste tracking system must hold all the information generated during the stages listed.	
3	You must create records and update them to show deliveries, on-site treatment and despatches. Your tracking system will also operate as a waste inventory and stock control system. It must include the information listed as a minimum.	
4	The tracking system must be able to report on the information listed.	
5	You must store back-up copies of computer records off site. Records must be readily accessible in an emergency.	
6	You must hold acceptance records for a minimum of 2 years after you have treated the waste or removed it off site. You may have to keep some records for longer if they are required for other purposes, for example, hazardous waste consignment notes.	
4. Waste storage, segregation and handling appropriate measures		
4.1 Storage Locations		
1	You must store waste in locations that minimise the handling of waste. Waste handling must be carried out by competent staff using appropriate equipment.	DESC.01.01/EPTR – Section 4.6.
2	You should design and operate your facility in a way that minimises waste handling.	
3	You must store shredder non-metallic fractions under cover.	
4	Where possible, you should locate storage areas away from watercourses and sensitive boundaries (for example, those close to public rights of way, housing or schools).	
5	You must store all waste within the security protected area of your facility to prevent unauthorised access and vandalism.	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
4.2 Storage duration and capacity		
1	You must clearly establish the maximum storage capacity of the site and the designated storage areas. You must not exceed these maximum capacities.	DESC.01.01/EPTR – Section 4.6. and DESC.01.01/FPP
2	You must define capacity in pile sizes as well as tonnage. You must regularly monitor the quantity of stored waste on the site and within the designated areas to check against the allowed maximum capacity. You must also monitor the quantities and pile sizes against those set out in your fire prevention plan.	
3	You must not accumulate waste. You must treat wastes, or remove them from the site, as soon as possible. Generally all wastes must be removed within a maximum of 6 months of receipt. If you have a shorter time period as a permit condition, you must comply with that condition for that waste.	DESC.01.01/EPTR – Section 4.6.
4	You must store all waste in a way that allows easy inspection. You must maintain safe access between piles of wastes. There must be pedestrian and vehicular access (for example shovel loader, crane, grab loader) at all times to the whole of the storage area.	
5	You must store and handle waste in a way that prevents pests and vermin, see EA guidance on pest management plans. You must have specific measures and procedures in place to identify and manage any wastes that attract pests or vermin at your site.	N/A – wastes accepted are unlikely to attract pests.
6	You must inspect storage areas, containers and infrastructure daily. You must deal with any issues immediately. You must keep written records of the inspections. You must rectify and log any waste spillages.	DESC.01.01/EPTR – Section 3.4., 3.5. and 4.6.
7	You must not carry out activities that represent a clear fire risk within any storage area unless they are clear of waste.	DESC.01.01/FPP
4.3 Dangerous Substances and Explosive Atmospheres Regulation 2022 (DSEAR)		
1	You should assess areas of the site where explosive atmospheres could occur (for example, ELV depollution bays). Where appropriate, you must classify these into hazardous zones, following the Dangerous Substances and Explosive Atmospheres Regulation 2002 (DSEAR).	DESC.01.01/EPTR – Section 4.6.
4.4 Battery Storage		
1	You must check for damage and the chemistry type of any batteries: • produced through depollution activities on site • accepted as discrete loads • You must do this before allocating them to the storage area.	N/a – not accepted

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
4.4 Battery Storage		
2	You must isolate damaged batteries from other batteries.	N/A – not accepted
3	You must store batteries in either appropriate weatherproof containers, or in appropriate containers within a building.	
4	You must store: • lead acid batteries upright with terminals taped off or capped in acid proof containers to prevent leaks and short circuits • nickel metal hydride (Ni-MH) batteries in a way that will prevent them being damaged	
5	You must not mix batteries of incompatible chemistries, for example lead acid batteries with Ni-MH batteries.	
6	You must store Li-ion batteries from electric vehicles separately from other batteries. You must store them in a way that prevents them from: • coming into contact with any liquids • being damaged • being exposed to high temperatures	
5. Waste treatment appropriate measures		
5.1 General Waste Treatment		
1	Waste treatment must have a clear and defined benefit. You must fully understand, monitor and optimise the waste treatment process to make sure you treat waste effectively and efficiently. You must not treat waste to deliberately dilute it.	DESC.01.01/EPTR – Section 4.8.
2	The treated output material must meet your expectations and be suitable for its intended disposal or recovery route.	DESC.01.01/EPTR – Section 4.8. and 8.6.
3	You must identify and characterise emissions from the process and take appropriate measures to control them at source.	DESC.01.01/EPTR – Section 6.
4	You must have up-to-date written details of your treatment activities, and the abatement and control equipment you are using. This should include information about the characteristics of the waste you will treat and the waste treatment processes, including the information listed.	DESC.01.01/EPTR – Section 4.8. to 4.11
5	You must have up-to-date written details of the measures you will take during abnormal operating conditions to make sure you continue to comply with permit conditions.	DESC.01.01/EPTR – Section 4.14.

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.1 General Waste Treatment		
6	You should use material flow analysis for relevant contaminants in the waste to help identify their flow and fate. You should use the analysis to determine the appropriate treatment for the waste either directly at the site or at any subsequent treatment site	DESC.01.01/EPTR – Section 4.8.
7	You must not proceed with the treatment if your risk assessment or material flow analysis show that losses from a process will cause: • the breach of an environmental quality standard • the breach of a benchmark • a significant environmental impact	DESC.01.01/EPTR – Section 4.8 and 6.
5.2 Metal shredding plant and downstream processes		
1	The metal shredding plant and downstream plant and processes must be specifically designed, commissioned and operated to be fit for purpose.	DESC.01.01/EPTR – Section 4.8.
2	The designs need to consider physical hazards and include an assessment of the environmental risks and emissions from the plant and processes. They also need to consider prevention and protective measures and process management	DESC.01.01/ERA
3	You must process shredder non-metallic fractions under cover. You may use a range of separation technologies to further segregate and purify shredded fractions.	DESC.01.01/EPTR – Section 4.8.
4	You must sample and analyse the fractions produced by these treatment processes to accurately classify and code the waste. You should do this in accordance with the waste classification guidance.	DESC.01.01/EPTR – Section 4.12.
5	You must not use a waste code for a single material fraction, such as plastic, unless the process is specifically aimed to produce that single fraction. Contamination by other materials must be negligible.	
6	You must also fully characterise and classify process solutions and washings from density separation processes before determining suitable disposal options.	
5.3 POPs		
1	You must assess fractions containing plastic (including process solutions and washings from density separation processes) for POPs.	DESC.01.01/EPTR – Section 4.12.

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.3 POPs		
2	You must treat any POPs waste as required by article 7 of Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on POPs. This means the treatment must make sure the POP content is destroyed, or irreversibly transformed. An example would be by incineration or similar thermal treatment. You must not recycle this plastic.	DESC.01.01/EPTR – Section 4.11. and 4.13
3	You must therefore assess plastic containing fractions at each stage in the treatment process to establish whether the threshold is exceeded. See further information on identifying and disposing of POPs contaminated waste.	
4	You can treat any plastic that is POPs waste to separate the POPs containing fraction from the non-POPs containing plastic.	
5	You must fully characterise and classify the following (including for POPs) before deciding on suitable disposal options:	
5.4 Antimony trioxide		
1	Antimony trioxide has been widely used as a synergist with a range of BFRs. It is present in some plastics at concentrations which exceed the hazardous waste threshold. You must therefore consider antimony trioxide when you are classifying any plastic containing fraction.	DESC.01.01/EPTR – Section 4.11.
5.5 Minimising diffuse emissions from the process		
1	You must minimise the release of diffuse emissions to air from activities which may create them, for example shredding or granulating. You must do this by: • carrying out the activity using enclosed equipment or in a closed building • maintaining the enclosed equipment or building under an appropriate pressure • collecting and directing the emission to an appropriate abatement system • using a shredder system with water or foam injection into the mill	DESC.01.01/EPTR – Section 6.4.
2	To track and control changes to processes, you must have a written procedure for proposing, considering and approving changes to both: • technical developments • procedural or quality changes to the plant and processes	DESC.01.01/EPTR – Section 3.4. and 3.6.
3	Where you expect an emission, you must enclose all treatment plants and only vent to air using an appropriate scrubbing and abatement system (subject to deflagration relief).	DESC.01.01/EPTR – Section 6.

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.6 Record keeping for all treatment residues		
1	You must record in the computerised waste tracking system: • that a waste has been treated • what the treatment residues are and their weight • what end-of-waste products have been made and their weight	DESC.01.01/EPTR – Section 4.5.
6. Emissions control appropriate measures		
6.1 Point source emissions to air		
1	You must contain the waste treatment plant (including shredders) to make sure you collect, extract and direct all process emissions to an appropriate abatement system for treatment before release.	DESC.01.01/EPTR – Section 6.1. and 6.4.
2	You must identify the main chemical constituents of the site's point source emissions as part of the site's inventory of emissions to air. You must include the speciation of volatile organic compounds (VOCs) if you have identified them in the emissions inventory and it is practicable to do so.	DESC.01.01/EPTR – Section 6.1.
3	You must assess the fate and impact of the substances emitted to air, following the Environment Agency's air emissions risk assessment methodology.	
4	To reduce point source emissions to air (for example, dust, VOCs and odour) from waste treatment, you must use an appropriate combination of abatement techniques, including one or more of the following systems: • cyclonic filtration • fabric filters • wet scrubbing • high efficiency particulate (HEPA) filter	
5	You must assess and design vent and stack locations and heights to make sure dispersion capability is adequate.	
6	Where monitoring is required, you must install suitable monitoring points. Monitoring points will be required to meet MCERTS standards.	DESC.01.01/EPTR – Section 8.1.
7	Your procedures must make sure you correctly install, operate, monitor and maintain abatement equipment.	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
6.2 Fugitive Emissions to Air		
1	You must use appropriate measures to prevent emissions of dust, mud and litter and odour.	DESC.01.01/EPTR – Section 6.4., 7.1. and 7.2.
2	You must design, operate and maintain storage and treatment plant in a way that prevents fugitive emissions to air, including dust, organic compounds and odour. Where that is not possible, you must minimise these emissions.	
3	You must minimise the number of potential diffuse dust and particulates emission sources, using a combination of the following: • limiting the drop height of material • using wind barriers • covering conveyor belts, including enclosure of transfer points • fitting spray nozzles or rubber flaps to the inlet and outlet of the shredder mill • using misting systems and wind barriers in areas with significant dust formation • venting pipe work and ducting to an appropriate abatement system to prevent fugitive emissions	DESC.01.01/EPTR – Section 6.4.
4	To make sure fugitive emissions are collected and directed to appropriate abatement, your treatment plant must use high integrity components (for example, seals or gaskets).	
5	You must use your waste pre-acceptance, waste acceptance and site inspection checks and procedures to identify and manage wastes that could cause, or are causing, fugitive emissions to air.	DESC.01.01/EPTR – Section 3.5. and 4.6.
6	Where necessary, to prevent fugitive emissions to air from storing and handling odorous or dusty wastes, you should use a combination of the following measures (7 to 13).	
7	You should store and handle the waste within an enclosed building.	DESC.01.01/EPTR – Section 4.8 and 6.4.
8	You should use fully enclosed material transfer and storage systems and equipment	DESC.01.01/EPTR – Section 6.4.
9	You should keep enclosed buildings and equipment under adequate negative pressure with an appropriate abated air circulation and extraction system. Where possible, locate air extraction points close to potential emissions sources.	
10	You should: • use fast-acting or ‘airlock’ doors that default closed • dampen potential sources of diffuse dust emissions (such as the shredder inlet and outlet, traffic areas and open handling processes) with water or fog	N/a

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
6.2 Fugitive Emissions to Air		
11	You must fully enclose and contain pre- and post-treatment shredder plant to prevent emissions	DESC.01.01/EPTR – Section 6.4.
12	You must design and operate the shredder plant using appropriate process interlocks. The plant should not operate unless it is enclosed and contained, for example, only working when the loading door on the hopper is closed or sealed.	DESC.01.01/EPTR – Section 4.8.
13	You must contain and extract dust emissions from the shredder plant to an appropriate abatement system, for example HEPA air filtration.	DESC.01.01/EPTR – Section 6.4.
14	Where ambient dust monitoring is required it must be carried out by MCERTS qualified staff.	N/a – no ambient dust monitoring
15	You must use monitoring equipment that meets as a minimum the MCERTS Performance Standards for Indicative Ambient Particulate Monitors. You must calibrate the equipment following the manufacturer's recommendations and it must be capable of providing representative data that accurately reflect PM10 levels produced operations at the site.	
16	Where a dust management plan is required, you must develop and implement it following relevant guidance.	N/a no Dust Management Plan required.
17	You must set up a leak detection and repair programme and use it to promptly identify and mitigate any fugitive emissions from treatment plant and associated infrastructure (for example, pipework, conveyors, tanks).	DESC.01.01/EPTR – Section 4.6.
18	You must regularly inspect and clean all waste storage and treatment areas, equipment (including conveyor belts) and containers. You must contain any residues collected during cleaning.	
19	Your maintenance and cleaning schedules must make sure that tanks and plant are regularly cleaned to avoid large-scale decontamination activities.	DESC.01.01/EPTR – Section 3.4.
20	You must take measures to prevent the corrosion of plant and equipment (for example, conveyors or pipes)	N/a – process does not give rise to corrosion
21	You must have an appropriate regular maintenance programme covering all buildings, plant and equipment. This must also include protective equipment such as air ventilation and extraction systems, curtains and fast-action doors used to prevent and contain fugitive releases.	DESC.01.01/EPTR – Section 3.4.
22	If you wash out drums or containers, you must design and operate the washing process and associated equipment in a way that prevents fugitive emissions to air. For example, you could carry out this activity in a contained or enclosed system.	N/a – no drum or container washing
23-29	Odorous Wastes – N/a – no odours wastes accepted	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
30	To prevent deflagrations and to reduce emissions where deflagrations have occurred, we may require a deflagration management plan.	DESC.01.01/EPTR – Section 4.8.
6.2 Fugitive Emissions to Air		
31	You must also have one or both of the following: • pressure relief dampers, to relieve pressure waves from deflagrations that may otherwise cause damage and subsequent emissions • pre-shredding – a low speed shredder installed upstream of the main shredder	DESC.01.01/EPTR – Section 4.8.
32	Where there are a large number of deflagration incidents at a site, and other measures taken do not reduce the number, we may require you to install a pre-shredder.	N/a
6.3 Emissions of noise and vibration		N/a
6.4 Point source emissions to water and sewer		
1	You must identify the main chemical constituents of the site's point source emissions to water and sewer as part of the site's inventory of emissions.	DESC.01.01/EPTR – Section 6.2.
2	You must assess the fate and impact of the substances emitted to water and sewer following the Environment Agency's risk assessment guidance.	DESC.01.01/EPTR – Section 6.2.
3	Discharges to water or sewer must comply with the conditions of an environmental permit or trade effluent consent	DESC.01.01/EPTR – Section 6.2.
4	To reduce emissions to water and sewer, if you need to treat waste water before discharge or disposal, you must use an appropriate combination of treatment techniques, including one or more of the following: • preliminary or primary treatment – for example, physical separation • physico-chemical treatment – for example, adsorption, precipitation, chemical oxidation or reduction • solids removal – for example, coagulation, sedimentation, filtration or flotation	DESC.01.01/EPTR – Section 4.12.

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
6.5 Fugitive emissions to land and water		
1	You must use appropriate measures to control potential fugitive emissions and make sure that they do not cause pollution.	DESC.01.01/EPTR – Section 6.5.
2	You must have the following in all operational areas of the facility: • an impermeable surface • spill containment kerbs • sealed construction joints • a sealed drainage system	DESC.01.01/EPTR – Section 6.5. and DESC.01.01/FPP
3	The sealed drainage system must contain all surface water run off and channel it to a blind sump unless you can lawfully discharge it.	DESC.01.01/EPTR – Section 6.5.
4	You must collect and treat separately each water stream generated at the facility. For example, surface run-off water or process water. You must base separation on pollutant content and the treatment required. In particular, you must make sure you segregate uncontaminated water streams from those that require treatment.	DESC.01.01/EPTR – Section 4.12.
5	You must use suitable drainage infrastructure to collect surface drainage from areas of the facility where you store, handle and treat waste. Drainage must be effective to make sure waste is not stored or treated in standing water.	DESC.01.01/EPTR – Section 6.5.
6	Depending on the pollutant content, you must either: • recirculate what you have collected • discharge it in accordance with an environmental permit or trade discharge consent • send it for further treatment	DESC.01.01/EPTR – Section 6.5.
7	You must have design and maintenance provisions in place to detect and repair leaks. These must include regularly monitoring, inspecting and repairing equipment and minimising underground equipment and infrastructure.	DESC.01.01/EPTR – Section 4.6.
8	You should provide appropriate buffer storage capacity at your facility to store waste waters, taking into account: potential abnormal operating scenarios and incidents and the nature of any polluting substances and their impact on the downstream waste water treatment plant and receiving environment	DESC.01.01/EPTR – Section 4.14. and 6.2
	You must have appropriate measures in place to monitor, treat and reuse the water held in the buffer storage before discharging.	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
6.2 Fugitive Emissions to Land and Water		
10	You must take measures to prevent emissions from washing and cleaning activities	DESC.01.01/EPTR – Section 6.5.
11	Where relevant, you must have measures to prevent pollution from the on-site storage, handling and use of oils and fuels.	N/A – no oils and/or fuels
12	You must produce and implement a spillage response plan and train staff to follow it and test it.	DESC.01.01/EPTR – Section 6.5.
13	Your procedures and associated training must make sure you deal with spillages immediately.	
14	You must keep spill kits at locations close to areas where a spillage could occur and make sure relevant staff know how to use them. Make sure kits are replenished after use.	
15	You must stop spillages from entering drains, channels, gullies, watercourses and unmade ground. You must make available absorbent materials, sand or drain mats for use when required.	
16	You must make sure your spillage response plan includes information about how to recover, handle and correctly dispose of waste produced from a spillage.	DESC.01.01/EPTR – Section 4.6.
17	For subsurface structures, you must adhere to the points listed.	N/A – no subsurface structures
18	For surfacing, you must design appropriate surfacing and containment or drainage facilities for all operational areas, taking into account the points listed.	DESC.01.01/EPTR – Section 4.6., 4.7. and 6.5.
19	You must have an inspection and maintenance programme for impermeable surfaces and containment facilities.	DESC.01.01/EPTR – Section 3.4., 3.5.
20	You must bund all above-ground tanks containing liquids whose spillage could be harmful to the environment. Bunds adhere to the points listed.	DESC.01.01/EPTR – Section 6.5.
7. Emission limits, monitoring and appropriate measures		
7.1 Emissions to air		
1	Your facility's emissions inventory must include information about the relevant characteristics of point source emissions to air as listed.	DESC.01.01/EPTR – Section 6.1.
2	Monitoring locations must meet MCERTS standards. Monitoring must use MCERTS qualified accredited methods and be done by MCERTs certified staff.	DESC.01.01/EPTR – Section 8.1.

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
7.2 Emission limits and monitoring requirements		
1	You must apply the emission limits and monitoring requirements for point source emissions to air as stated in the guidance.	DESC.01.01/EPTR – Section 6.1.
2	You must comply with any other emission limits or monitoring requirements set in your environmental permit. There may be situations where we set lower emission limits for the following substances listed.	N/a – no point source emission from the shredder.
3	You must make sure dust monitoring is done every 6 months using method BS EN 13284-1.	
4	You must report results as the average value of 3 consecutive measurements of at least 30 minutes each. The 3 consecutive measurements must be representative of the dust and particulate emissions from the operations at the site.	
5	You must apply the following emission limits and monitoring requirements for point source emissions to air where they are relevant, based on your facility's emissions inventory and environmental risk assessment	DESC.01.01/EPTR – Section 6.1.
6	You must also comply with any other emission limits or monitoring requirements set in your environmental permit.	DESC.01.01/EPTR – Section 6
7.3 Emissions to water or sewer – N/A no point source emission		
1	Your facility's emissions inventory must include information about the relevant characteristics of point source emissions to water or sewer, such as: • average values and variability of flow, pH, temperature, and conductivity • average concentration and load values of relevant substances and their variability – for example, chemical oxygen demand (COD) and total organic carbon (TOC), nitrogen species, phosphorus, metals, priority substances or micro pollutants data on bio-eliminability – for example, biological oxygen demand (BOD), BOD to COD ratio, Zahn-Wellens test, biological inhibition potential, for example, inhibition of activated sludge	DESC.01.01/EPTR – Section 6.2.
2	For relevant emissions to water or sewer identified by the emissions inventory, you must monitor key process parameters (for example, waste water flow, pH, temperature, conductivity, or BOD) at key locations. For example, these could be at one of the following, the: • inlet or outlet (or both) of the pre-treatment • inlet to the final treatment • point where the emission leaves the facility boundary	
3	You must comply with any other emission limits or monitoring requirements set in your environmental permit. We may set lower emission limits for the parameters that follow	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
7.3 Emissions to water or sewer – N/A no point source emission		
4	In addition to any other parameters specified by your permit, you must monitor the following emissions to water: • hydrocarbon oil index; • total organic carbon; • chemical oxygen demand; • total suspended solids (only for direct discharge to water body)	DESC.01.01/EPTR – Section 6.2.
5	If your waste water emissions inventory identified the following parameters are relevant, then you must monitor for them: • arsenic (As) – emission limit 0.05mg/l • cadmium (Cd) – emission limit 0.05mg/l • chromium (Cr) – emission limit 0.15mg/l • copper (Cu) – emission limit 0.5mg/l • nickel (Ni) – emission limit 0.5mg/l • lead (Pb) – emission limit 0.3mg/l • zinc (Zn) – emission limit 2mg/l • mercury (Hg) – emission limit is 5µg/l • perfluorooctanoic acid and perfluorooctanesulphonic acid.	
8.1 Energy efficiency		
1	You must create and implement an energy efficiency plan at your facility.	DESC.01.01/EPTR – Section 9.3.
2	You must regularly review and update your energy efficiency plan as part of your facility's management system.	
3	You must have and maintain an energy balance record for your facility. This must provide a breakdown of your energy consumption and generation (including any energy or heat exported) by the type of source (electricity, gas, conventional liquid fuels, conventional solid fuels, and waste). You should provide Sankey diagrams or energy balances to show how energy is used in your waste treatment processes.	DESC.01.01/EPTR – Section 9.2.
4	You must regularly review and update your energy balance record as part of your facility's management system, alongside the energy efficiency plan.	DESC.01.01/EPTR – Section 9.3.
5	You must have operating, maintenance and housekeeping measures in place in relevant areas that can have an effect on energy usage.	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
8.1 Energy efficiency		
6	You must have measures in place to avoid gross energy inefficiencies	DESC.01.01/EPTR – Section 9.3.
7	You should implement additional energy efficiency measures at the facility as appropriate	
8.2 Raw materials		
1	You must maintain a list of the raw materials used at your facility and their properties. This includes auxiliary materials and other substances that could have an environmental impact.	DESC.01.01/EPTR – Section 5.1.
2	You must regularly review the availability of alternative raw materials and use any suitable ones that are less hazardous or polluting.	
3	You must justify the continued use of any substance for which there is a less hazardous alternative.	
4	You must have quality assurance procedures in place to control the content of raw materials.	
8.3 Water use		
1	You must make sure you optimise water consumption to: • reduce the volume of waste water generated • prevent or, where that is not practicable, reduce emissions to soil and water	DESC.01.01/EPTR – Section 9.5.
2	You must regularly review your water use, at least every 4 years.	
3	You must also: • produce flow diagrams and water mass balances for your activities • establish water efficiency objectives and identify constraints on reducing water use beyond a certain level (usually this will be site specific) • identify the opportunities for maximising reuse and minimising use of water • have a timetabled improvement plan for implementing additional water reduction measures	
4	To reduce water use and associated emissions to water, you should apply these general principles in sequence: • use water efficient techniques at source where possible • reuse water within the process, by treating it first if necessary – if not practicable, use it in another part of the process or facility that has a lower water quality requirement	

Table 8: AM– Treating metal waste in shredders: appropriate measures for permitted facilities (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
8.3 Water use		
5	If you cannot use uncontaminated roof and surface water in the process, you should keep it separate from other discharge streams – at least until after you have treated the contaminated streams in an effluent treatment system and have carried out final monitoring.	N/a – the Installation is located in a site that has a combined surface and foul drainage system.
6	You should establish the water quality requirements associated with each activity and identify whether you can substitute water from recycled sources. Where you can, include it in your improvement plan.	DESC.01.01/EPTR – Section 9.5.
7	Where there is scope for reuse (possibly after some form of treatment) you should keep less contaminated water streams, such as cooling waters, separate from more contaminated streams.	
8	You must minimise the volume of water you use for cleaning and washing down by: • vacuuming, scraping or mopping rather than hosing down • reusing wash water (or recycled water) where practicable • using trigger controls on all hoses, hand lances and washing equipment	
9	You must directly measure fresh water consumption and record it regularly at every significant usage point, ideally on a daily basis.	
8.4 Waste minimisation, recovery and disposal		
1	You must have and implement a residues management plan that: • minimises the generation of residues arising from waste treatment • optimises the reuse, regeneration, recycling or energy recovery of residues, including packaging • makes sure you properly dispose of residues where recovery is technically or economically impractical	DESC.01.01/EPTR – Section 9.5.
	Where you must dispose of waste, you must do a detailed assessment identifying the best environmental options for waste disposal.	
	You must regularly review your options for recovering and disposing of waste produced at the facility. You must do this as part of the management system to make sure you are still using the best environmental options and promoting the recovery of waste.	

Table 9: AM - Waste electrical and electronic equipment (WEEE)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.1 Management System		
1	You must have an up to date, written environmental management system ("EMS").	DESC.01.01/EPTR – Section 3.2. – 3.6.
2.2. Staff Competence		
1	Your site must be always operated by an adequate number of staff with appropriate qualifications and competence.	DESC.01.01/EPTR – Section 3.1.
2	The design and maintenance of infrastructure, plant and equipment must be carried out by competent people.	
3	You must have appropriately qualified managers for your waste activity who are either: • qualified under a technical competence scheme • operating under a Competence Management System approved under a technical competence scheme	
4	Non-supervisory staff must be reliable and technically skilled. Their skills may be based on experience and relevant training.	
2.3. Accident Management Plan		
1	As part of your up-to-date written management system, you must have a plan for dealing with any incidents or accidents that could result in pollution.	DESC.01.01/EPTR – Section 3.2., 3.4., 3.6. and DESC.01.01/ERA
2	The accident management plan must identify the hazards to the environment posed by the plant.	
3	Areas to consider in the accident plan may include those listed in the guidance.	
4	You must assess the risk of accidents and their possible consequences (risk is the combination of the likelihood that a hazard will occur and the severity of the impact resulting from that hazard). Having identified the hazards, you can assess the risks by addressing the six basic questions provided in the guidance.	
5	You must identify any fire risks that may be caused those areas listed in the guidance.	DESC.01.01/FPP

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.3. Accident Management Plan		
6	The depth and type of accident risk assessment you carry out will depend on the characteristics of the plant and its location. The main factors to consider are the: • scale and nature of the accident hazard presented by the plant and its activities • risks to areas of population and the environment (the receptors) • nature of the plant and complexity of the activities and how difficult it is to decide and justify adequate risk control techniques	DESC.01.01/EPTR – Section 3.2., 3.4., 3.6. and DESC.01.01/ERA
7	Through your accident management plan, you must also identify the roles and responsibilities of the staff involved in managing accidents. You must provide them with clear guidance on how to manage each accident scenario, for example, whether to use containment or dispersion to extinguish fires, or let them burn.	DESC.01.01/EPTR – Section 3.2., 3.4., 3.6., DESC.01.01/ERA and DESC.01.01/FPP
8	You must appoint one facility employee as an emergency coordinator who will take lead responsibility for implementing the plan. It is important that you train your employees so they can perform their duties effectively and safely and know how to respond to an emergency	
9	You must also: • establish how you will communicate with relevant authorities and emergency services both before, during and after an accident • put in place appropriate emergency procedures, including for safe plant shutdown and site evacuation • put in place post-accident procedures that include undertaking an assessment of the harm that may have been caused by an accident and the remediation actions you will take • test the plan by carrying out emergency drills and exercises.	
2.4. Accident Prevention Measures		
1	You must take the following measures, where appropriate, to prevent events that may lead to an accident.	
2	You must keep apart incompatible wastes.	DESC.01.01/EPTR – Section 4.4.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.4. Accident Prevention Measures		
3	You must make sure that you contain the following (where appropriate) and route to the effluent system (where necessary): • process waters • site drainage waters • emergency firefighting water • oil or chemically contaminated waters • spillages of oil or chemicals.	DESC.01.01/EPTR – Section 6.2., 6.4. and DESC.01.01/FPP
4	You must be able to contain surges and storm water flows. You must provide enough buffer storage capacity to make sure that you can achieve this. You can define this capacity using a risk-based approach, for example, by considering the: • nature of the pollutants • effects of downstream wastewater treatment • sensitivity of the receiving environment	DESC.01.01/EPTR – Section 6.2.
5	You can only discharge wastewater from this buffer storage after you have taken appropriate measures, for example, to control, treat or re-use the water.	
6	You must put spill contingency procedures in place to minimise the risk of an accidental emission of raw materials, products and waste materials and to prevent their entry into water.	DESC.01.01/EPTR – Section 6.5.
7	Your emergency firefighting water collection system must take account of additional firefighting water flows or firefighting foams. You may need emergency storage lagoons to prevent contaminated firefighting water reaching a receiving water body.	DESC.01.01/FPP
8	You must consider and, if appropriate, plan for the possibility that you may need to contain or abate accidental emissions from: vents, safety relief valves and bursting discs. If this is not advisable on safety grounds, you must focus attention on reducing the probability of the emission.	DESC.01.01/ERA

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.4. Accident Prevention Measures		
9	You must have enough security measures in place (including staff) to prevent: • entry by vandals and inadvertent intruders • damage to the equipment • theft • fly-tipping • arson	DESC.01.01/EPTR – Section 4.13.
10	Facilities must use an appropriate combination of the following measures: • security guards • total enclosure (usually with fences) • controlled entry points • adequate lighting • warning signs • 24-hour surveillance, such as CCTV.	
11	There are three fire prevention objectives. You must: minimise the likelihood of a fire happening, aim for a fire to be extinguished within 4 hours and minimise the spread of fire within the site and to neighbouring sites.	DESC.01.01/FPP
12	You must have a fire prevention plan that meets the requirements of the EA fire prevention plan guidance.	
13	You must maintain plant control in an emergency using one or a combination of: • alarms • process trips and interlocks • automatic systems • manual interventions	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.4. Accident Prevention Measures		
14	You must: • make sure all the measurement and control devices you would need in an emergency are easy to access and operate in an emergency situation • maintain the plant so it is in a good state through a preventive maintenance programme and a control and testing programme • use techniques such as suitable barriers to prevent moving vehicles damaging equipment • have procedures in place to avoid incidents due to poor communication between operating staff during shift changes and following maintenance or other engineering work • where relevant, use equipment and protective systems designed for use in potentially explosive atmospheres	DESC.01.01/EPTR Section 3.3., 3.4. and 4.6.
15	You must: • keep an up-to-date record of all accidents, incidents, near misses, changes to procedures, abnormal events, and the findings of maintenance inspections • carry out investigations into accidents, incidents, near misses and abnormal events and record the steps taken to prevent their reoccurrence • maintain an inventory of substances, which are present (or likely to be) and which could have environmental consequences if they escape – many apparently innocuous substances can damage the environment if they escape • have procedures for checking raw materials and wastes to make sure they are compatible with other substances they may accidentally come into contact with • make sure that any documents that may be needed in the event of an incident are accessible	DESC.01.01/EPTR Section 3.3. and 5.1. and DESC.01.01/FPP
2.5. Contingency Plan and Procedures		
1	You must have and implement a contingency plan and management procedures to make certain you comply with all your permit conditions and operating procedures during maintenance or shutdown at your site.	DESC.01.01/EPTR – Section 4.14.
2	Your contingency plan must also contain provisions and procedures as listed in the guidance.	
3	If you produce an end-of-waste material at your facility, your contingency planning must consider issues with storage capacity for end-of-waste products.	N/A – no end of waste

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.5. Contingency Plan and Procedure		
4	You must make your customers aware of your contingency plan, and of the circumstances in which you would stop accepting waste from them.	DESC.01.01/EPTR – Section 4.14.
5	You must consider whether the sites or companies you rely on in your contingency plan: • can take the waste at short notice • are authorised to do so in the quantities and types likely to be needed – in addition to carrying out their existing activities	
6	Where circumstances mean you could exceed your permitted storage limits or compromise your storage procedures, you must look for alternative disposal or recovery options. You must not discount alternative disposal or recovery options on the basis of extra cost or geographical distance.	
7	You must not include unauthorised capacity in your contingency plan. If your contingency plan includes using temporary storage for additional waste on your site, then you must make sure your site is authorised for this storage have the appropriate infrastructure in place	
8	Your management procedures and contingency plan must also adhere to the guidance.	
9	Your management system must include procedures for auditing your performance against all these contingency measures and for reporting the audit results to the site manager.	DESC.01.01/EPTR – Section 3.5.
2.6 Plant Decommissioning		
1	You must consider the decommissioning of the plant at the design stage and make suitable plans to minimise risks during later decommissioning.	DESC.01.01/EPTR – Section 4.15.
2	For existing plant, identify potential decommissioning risks and take steps to address these. Make changes and design improvements as and when plant is upgraded, or when construction and development works are carried out at your site.	
3	You must have and maintain a decommissioning plan to demonstrate that: • plant will be decommissioned without causing pollution • the site will be returned to a satisfactory condition	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
2.6 Plant Decommissioning		
4	Your decommissioning plan should include details on: • whether you will remove or flush out pipelines and vessels (where appropriate) and how you will empty them of any potentially harmful contents • site plans showing the location of all underground pipes and vessels • how asbestos or other potentially harmful materials will be removed, unless we have agreed it is reasonable to leave such liabilities to future owners • methods for dismantling buildings and other structures, and for protecting surface water and groundwater during construction or demolition at your site • any soil testing needed to check for any pollution caused by the site activities, and information on any remediation needed to return the site to a satisfactory state when you cease activities, as defined by the initial site condition report • the measures proposed, once activities have definitively stopped, to avoid any pollution risk and to return the site of operation to a satisfactory state (including, where appropriate, measures relating to the design and construction of the plant) • the clearing of deposited residues, waste and any contamination resulting from the waste treatment activities	DESC.01.01/EPTR – Section 4.15.
5	You should make sure that equipment taken out of use is decontaminated and removed from the site.	
3 Waste Pre-acceptance, Acceptance and Tracking		
3.1 Waste Pre-acceptance		
1	Except in the case of small one-off deliveries of WEEE, for example from tradespeople, you must implement waste pre-acceptance procedures so that you know enough about a waste before it arrives at your facility. You need to do this to assess and confirm the waste is technically and legally suitable for your facility. Your procedures must follow a risk-based approach, considering the points listed in the guidance.	DESC.01.01/EPTR – Section 4.3.
2	You must get the information listed in the guidance in writing when you receive a customer query.	
3	You should consider with your customer whether the WEEE is suitable for preparing for reuse. Where that remains a possibility, you should ensure the WEEE is handled and transported with care to avoid any damage or loss that could affect reuse.	N/a – no reuse

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
3.1 Waste Pre-acceptance		
4	You must also obtain confirmation that the WEEE does not contain a radioactive source other than domestic smoke detectors and specialist lamps such as xenon lamps. If there is a risk of radioactive contamination, for example, in certain types of medical equipment, you must obtain confirmation that the waste is not radioactive, unless your facility is permitted to accept such waste.	N/a – no radioactive wastes accepted.
5	You must consider whether specific wastes, from among those you are permitted to receive, have properties that can pose unacceptable risks to the site or process. For example, due to: • a risk of explosion (for example, from gas or aerosol canisters that may be present) • a risk of fire (for example, from WEEE containing lithium-ion batteries) You should establish a list of such wastes and procedures for managing the risks from them.	N/a – no such waste accepted
6	You must keep pre-acceptance records following receipt of the waste. If an enquiry from a waste producer does not lead to the receipt of waste, you do not need to keep records.	DESC.01.01/EPTR – Section 4.3.
7	You must reassess the information required at pre-acceptance if the: • waste changes • process giving rise to the waste changes • waste received does not conform to the pre-acceptance information	
8	In all cases you must reassess the information required at pre-acceptance on an annual basis.	
9	The information required, and the assessment made at the pre-acceptance stage is to make sure you: • only accept wastes that are suitable for the site • avoid unnecessarily accumulating waste • have enough storage and treatment capacity	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
3.2 Waste Acceptance		
1	You must implement waste acceptance procedures to check that the characteristics of the waste received matches the information you obtained during waste pre-acceptance. This is to confirm that the waste is as expected, and you can accept it. If it is not, you must confirm that you can accept it as a non-conforming waste, or you must reject it. If you are rejecting hazardous waste you must follow the guidance on the procedure for rejecting hazardous waste. Procedures should be documented and auditable.	DESC.01.01/EPTR – Section 4.4.
2	Your procedures must follow a risk-based approach, considering: • the source, nature, condition and age of the waste • any hazardous properties of the waste • any POPs content in the waste • potential risks to process safety, occupational safety and the environment (for example, the presence of lithium-ion batteries) • knowledge about the previous waste holders	
3	If, in the case of small one-off deliveries of WEEE (for example those from tradespeople) you have not received any pre-acceptance information, you must fully assess the load to make sure it is technically and legally suitable for your process.	N/a – all waste subject to pre-acceptance
4	All relevant storage areas (quarantine, reception and general) and treatment processes in your facility must have the physical capacity needed for the waste you receive. You must not receive wastes if this capacity is not available. The amount of waste you receive must also comply with storage limits in your permit.	DESC.01.01/EPTR – Section 4.6.
5	The waste offloading, reception and quarantine areas must have impermeable surfaces with a sealed drainage system. This system must collect all surface water run off and channel it to a blind sump, unless you can lawfully discharge it in another way.	DESC.01.01/EPTR – Section 4.14. and 6.5.
6	You must clearly designate a materials reception area (or areas). Staff controlling the inspection, reception and validation of materials at the installation, must be trained in their respective roles.	DESC.01.01/EPTR – Section 3.1, 3.2, 3.3, 3.4 and 4.4.
7	You must weigh each load of waste on arrival to confirm the quantities against the accompanying paperwork, unless alternative reliable systems are available (for example, based upon volume). You must record the weight in the computerised waste tracking system.	DESC.01.01/EPTR – Section 4.4.
8	You must visually check wastes and verify them against pre acceptance information and transfer documentation before you accept them on site.	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
3.2 Waste Acceptance		
9	You must check and validate all transfer documentation and resolve discrepancies before you accept the waste. If you believe the incoming waste classification and description is incorrect or incomplete, then you must address this with the customer during waste acceptance. You must record any non-conformances. If you have assessed the waste as acceptable for on-site storage or treatment, you must document this.	DESC.01.01/EPTR – Section 4.4.
10	You must use clear criteria for rejecting non-conforming wastes. You must also have a written procedure for recording, reporting and tracking non-conforming wastes, including notifying the relevant customer or waste producer to prevent reoccurrence.	
11	The person carrying out waste acceptance checks must be trained to effectively identify and manage any non-conformances in the loads received, complying with this guidance and your permit conditions.	DESC.01.01/EPTR – Section 3.1.
12	If there is a known risk of radioactive contamination other than the presence of smoke detectors and certain specialist lamps such as xenon lamps, you must check the waste to determine that it does not include radioactive material unless your site is permitted to accept that type of radioactive waste.	N/A – no radioactive wastes accepted
13	You must establish quarantine areas for WEEE and materials that are prohibited, awaiting full inspection, or awaiting assessment or removal.	DESC.01.01/EPTR – Section 4.4.
14	Quarantine storage must be for a maximum of fourteen working days.	
15	You must have written procedures in place for dealing with wastes held in quarantine, and a maximum storage volume. For some limited and specific cases (for example, the detection of radioactivity), you can extend quarantine storage time if the Environment Agency agrees.	
16	Quarantine storage must be separate from all other storage and clearly marked as a quarantine area.	
3.3 Waste Tracking		
1	You must use a waste tracking system to hold up to date information about the available capacity of the waste quarantine, reception, general and bulk storage areas of your facility. This must include treatment residues and end of waste product materials.	DESC.01.01/EPTR – Section 4.5.
2	Your waste tracking system must hold all the information generated during the stages listed. You must make this information readily available	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
3.3 Waste Tracking		
3	You must create records and update them to show deliveries, on-site treatment and despatches. Your tracking system will also operate as a waste inventory and stock control system. It must include the information listed in the guidance as a minimum.	DESC.01.01/EPTR – Section 4.5.
4	The tracking system must be able to report those areas listed in the guidance.	
5	You must store back-up copies of computer records off site. Records must be readily accessible in an emergency.	
6	You must hold acceptance records for a minimum of 2 years after you have treated the waste or removed it off site. You may have to keep some records for longer if they are required for other purposes, for example, hazardous waste consignment notes.	
4. Waste storage, segregation and handling appropriate measures		
4.1 General Waste Storage		
1	You should design and operate your facility in a way that minimises the handling of waste. Waste handling must be carried out by competent staff using appropriate equipment.	DESC.01.01/EPTR – Section 3.1. and 4.6.
2	Where possible, you should locate storage areas away from watercourses and sensitive perimeters	DESC.01.01/EPTR – Section 4.6.
3	You must store all waste within the security protected area of your facility to prevent unauthorised access and vandalism.	
4	You must clearly establish the maximum storage capacity of the site and designated storage areas and you must not exceed these maximum capacities.	DESC.01.01/FPP
5	You must define capacity in pile sizes as well as tonnage. You must regularly monitor the quantity of waste stored on the site and within the designated areas to check against the allowed maximum capacity. You must also monitor the quantities and pile sizes against those set out in your fire prevention plan.	
6	Where relevant, you must conform to Health and Safety Executive (HSE) guidance and standards	DESC.01.01/EPTR – Section 4.6.
7	You must not accumulate waste unnecessarily. You must treat wastes, or remove them from the site, as soon as possible. Generally, all wastes must be removed within a maximum of 6 months of receipt. If you have a shorter time period as a permit condition or one is specified in your fire prevention plan you must comply with that condition or the fire prevention plan.	DESC.01.01/EPTR – Section 4.6. and DESC.01.01/FPP

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
4.1 General Waste Storage		
8	You must store all waste in a way that allows easy inspection. You must maintain safe access between piles of wastes. There must always be pedestrian and vehicular access (for example, forklift) to the whole of the storage area.	DESC.01.01/EPTR – Section 4.6.
9	You must store and handle waste in a way that prevents pests and vermin, see our guidance on pest management plans. You must have specific measures and procedures in place to identify and manage any wastes that attract pests or vermin at your site.	N/A – wastes accepted are unlikely to attract pests.
10	Waste storage areas and stored equipment must be subject to frequent inspection to make sure that any leaks, spillages of liquids, dust or loose material are identified and managed appropriately, and fire breaks are maintained. You must keep written records of the inspections. You must rectify and log any spillages of waste.	DESC.01.01/EPTR – Section 3.4., 3.5. and 4.6.
11	You must not carry out activities that represent a clear fire risk within any storage area unless they are clear of waste.	DESC.01.01/FPP
12	You should assess areas of the site where explosive atmospheres could occur (for example, ELV depollution bays). Where appropriate, you must classify these into hazardous zones, following the Dangerous Substances and Explosive Atmospheres Regulation 2002 (DSEAR).	DESC.01.01/EPTR – Section 4.6.
13	Outdoor waste storage areas must have an impermeable surface with a sealed drainage system. It must collect all surface water run-off and channel it to a blind sump unless it may be lawfully discharged.	No waste is stored outside.
14	Indoor waste storage areas must have an impermeable surface and you must provide spillage collection facilities.	DESC.01.01/EPTR – Section 4.6.
15	You must use weatherproof covering to store any items that may be reused as whole appliances or may have components recovered from them for reuse. The type of covering will depend on the types and quantities of waste but must ensure the WEEE is protected from the weather. It could be as simple as a lid or cover over a container for small items but in other cases may require the construction of a roofed building.	N/a – no reuse.
16	You must also use weatherproof covering in areas used for storage of waste containing hazardous material or fluids where this is necessary to avoid contamination of surface water.	DESC.01.01/EPTR – Section 4.6.
17	Covering may still be required even if you have a consent to discharge surface water to sewer or if water is tankered away. For example, to avoid leached chemicals entering the water environment.	N/a – all storage areas are covered
18	Any spillage or leakage resulting from the storage of WEEE or processed materials must be collected without delay using equipment and procedures appropriate to the type of spillage. The collected residues must be stored in a lidded, leakproof container. Any containers or surfaces affected by the spillage must be cleaned.	DESC.01.01/EPTR – Section 4.6.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
4.1 General Waste Storage		
19	You must train forklift drivers in the handling of waste, to minimise forklift truck damage to the integrity of containers or individual appliances.	N/a – no containers nor individual appliances
20	Any liquids removed from WEEE must be collected and stored in lidded, leakproof containers. Containers must be kept closed when not being filled and must be stored within a bunded area to contain any leakage or spillage.	N/a – no liquid removal
21	You must store the following separately and securely from other WEEE in leakproof containers to prevent leakage and spillage: • batteries, capacitors and other similar components which could leak • any components which may contain residual liquids Containers must be closed or stored under cover to prevent the accumulation of rainwater.	N/a – no batteries accepted
22	You must clearly label containers to identify their contents.	
23	Where lithium-ion batteries are stored (either separately or as mixed batteries) these must be recognised as a fire hazard and marked and stored accordingly.	
4.2 Additional storage requirements for specific categories of WEEE – N/A (gas discharge lamps/flat panel displays/CRT equipment/small mixed WEEE/photovoltaic panels)		N/a – no such waste accepted
5. Waste treatment appropriate measures		
5.1 Preparing WEEE for Reuse		N/a – no reuse
5.2 General Waste Treatment		
1	Where WEEE cannot be prepared for reuse it must be treated to maximise the recycling and recovery of materials whether that is at the same facility or by further downstream processing.	DESC.01.01/EPTR – Section 4.2.
2	You must fully understand, monitor and optimise your waste treatment process to make sure you treat waste effectively and efficiently. You must not treat waste to deliberately dilute it or mix any hazardous outputs with any non-hazardous outputs.	DESC.01.01/EPTR – Section 4.8 – 4.11.
3	The treated output material must meet your expectations and you must fully classify and characterise them to ensure they are suitable for their intended disposal or recovery route.	
4	You must identify and characterise emissions from the process and take appropriate measures to control them at source.	DESC.01.01/EPTR – Section 6.1. and 6.2.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.2 General Waste Treatment		
5	You must have up-to-date written details of your treatment activities, and the abatement and control equipment you are using. This should include information about the characteristics of the waste you will treat, and the waste treatment processes, including those listed in the guidance.	DESC.01.01/EPTR – Section 4.8 – 4.11. and Section 6
6	You must have up to date written details of the measures you will take during abnormal operating conditions to make sure you continue to comply with permit conditions.	DESC.01.01/EPTR – Section 4.14.
7	You should use material flow analysis is for relevant contaminants in the waste to help identify their flow and fate. You should use the analysis to determine the appropriate treatment for the waste either directly at the site or at any subsequent treatment site.	DESC.01.01/EPTR – Section 4.8. – 4.11.
8	Material flow analysis considers the contaminant quantity in the: • waste input • different waste treatment outputs • waste treatment emissions	
9	You should use the analysis and your knowledge of the fate of the contaminants to make sure you correctly treat and either destroy or remove them.	
10	The use of material flow analysis is risk-based considering: • the hazardous properties of the waste • the restricted chemicals in the waste • the risks posed by the waste in terms of process safety • occupational safety and environmental impact • knowledge of the previous waste holders	
11	A treatment process may destroy certain substances in the waste. It could also put substances into the air, water or the ground, or produce residues which are sent for disposal. You should minimise the weight of these outputs. The treatment process may produce residues for recovery or reuse and you should maximise the weight of these outputs.	DESC.01.01/EPTR – Section 4.8 – 4.11. and 9.6.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.2 General Waste Treatment		
12	You must not proceed with the treatment if your risk assessment or material flow analysis indicates that losses from a process will cause: • the breach of an environmental quality standard • the breach of a benchmark • a significant environmental impact	DESC.01.01/ERA
13	To track and control the process of change, you must have a written procedure for proposing, considering and approving changes to technical developments, or to procedural or quality changes.	DESC.01.01/EPTR – Section 3.6.
14	You must minimise the release of diffuse emissions to air from activities which may give rise to them (for example, shredding or granulating) by: • carrying out the activity using enclosed equipment or in an enclosed building • maintaining the enclosed equipment or buildings under an appropriate pressure • collecting and directing the emissions to an appropriate abatement system	DESC.01.01/EPTR – Section 6.4.
15	Unless you are preparing it for reuse, you must remove all fluids from WEEE along with those substances, mixtures and components listed in Annex VII of the WEEE Directive.	N/a – no fluids are contained in the PCBs
16	Removal may be a staged process and may be undertaken at different facilities. You must be able to demonstrate either: • you have removed the substances, mixtures and components listed in Annex VII of the WEEE Directive from WEEE as required by the conditions of your permit • those substances, mixtures and components will be removed at a suitably authorised downstream treatment facility	
17	You must make sure that any substances, mixtures and components removed as part of your treatment process are subsequently recovered or disposed of at an appropriately permitted facility.	DESC.01.01/EPTR – Section 4.12.
18	If you transfer partially treated WEEE to another site you must properly describe it, so the recipient knows which treatments are complete and which still need to be done.	N/A – no partial treatment
19	You should no longer routinely find certain hazardous items and substances that were once used in electrical appliances but are now banned. However, they may still be present on occasions.	DESC.01.01/EPTR – Section 4.11.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.2 General Waste Treatment		
20	You must monitor and record the outputs of your treatment activity, including their weight. The monitoring must be used to provide evidence that the treatment and removal of these components and substances has been carried out to a satisfactory standard.	DESC.01.01/EPTR – Section 4.12. and 5.1.
21	When removing components, you must safely remove the whole item where breaking it up might: • pollute the recyclate or waste stream; • result in unacceptable emissions	DESC.01.01/EPTR – Section 4.8.
22	Components that you must always remove whole, that is intact and identifiable, (unless this guidance states specific circumstances where you do not need to) include those listed in the guidance.	
23	Instead of removing them as whole components, you may recover the components listed as fragments or materials using mechanical treatment.	N/a – only PCBs accepted
24	You may either: • sort batteries on site • send batteries as a mixture of chemistry types to a specialist battery treatment operator for sorting	N/a – no batteries are accepted
25	You must pack and store lithium and lithium-ion batteries removed from WEEE during treatment in a way to minimise the likelihood of electrical shorting, physical impact and overheating.	
26	All outdoor WEEE treatment areas must have an impermeable surface with a sealed drainage system. It must collect all surface water run-off and channel it to a blind sump unless it may be lawfully discharged.	DESC.01.01/EPTR – Section 4.6. and 6.5.
27	Indoor WEEE treatment areas must have an impermeable surface and you must provide spillage collection facilities appropriate to the materials being handled.	
28	WEEE treatment should take place under weatherproof covering such as a roofed building. Where this is not practicable, for example, due to the large size of the plant, appropriate measures must be taken to minimise the exposure of waste to rain and wind.	All activities are under cover.
5.3 Treatment of WEEE containing BFRs and POPs		
1	You must identify, separate and remove any plastic containing BFRs for further treatment.	DESC.01.01/EPTR – Section 4.11.
2	Some BFRs used in electrical appliances are POPs. An industry-led investigation identified the presence of decabromodiphenyl ether (deca BDE) and other polybrominated diphenyl ethers (PBDE) in some WEEE plastics.	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.3 Treatment of WEEE containing BFRs and POPs		
3	You must make sure that any items of WEEE and any component or material fractions derived from the treatment of WEEE that is POPs waste (as defined by Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants) are treated as required by that regulation. This means the treatment must make sure the POP content is destroyed or irreversibly transformed. The only known cost effective way of doing this is by incineration or similar thermal treatment. You must not recycle this plastic.	DESC.01.01/EPTR – Section 4.11.
4	POPs may be present in any WEEE category. In large domestic appliance (LDA) white goods (tumble driers, washing machines, dishwashers and cookers only) and temperature exchange equipment, POPs have been shown to be present but in insufficient quantities to make the appliances themselves POPs waste.	N/a – no large domestic appliances accepted.
5	All other categories of WEEE should be regarded as POPs waste, unless you have clear evidence of the chemical composition of the cables, printed circuit boards and plastic components in the individual devices present that demonstrates it is not.	DESC.01.01/EPTR – Section 4.11.
6	Plastic removed from WEEE that is POPs waste must be managed as POPs waste.	
7	Components that have been found to contain POPs above the POPs waste threshold include printed circuit boards and electrical cable. If you remove these and/or any other components that may be POPs waste as a separate stream from any type of WEEE you must treat them and any plastic fractions resulting from their treatment, as POPs waste unless you have clear evidence that proves they are not.	
8	The treatment of WEEE that is not POPs waste, but which may contain POPs in some components, may result in fractions where the POPs threshold is exceeded. You must assess plastic containing fractions at each stage in the treatment process to establish whether the threshold is exceeded and, where it is, manage those fractions as POPs waste.	
9	You may treat any plastic that is POPs waste to separate the POPs containing fraction from the non-POPs containing plastic. For example, density separation can be used to separate plastic containing all BFRs from that which does not. The non-BFR plastic may then be recycled. You must demonstrate that your process reliably achieves a satisfactory separation.	
10	Other hazardous chemicals may be used as flame retardants. For example, antimony trioxide has been widely used as a synergist with a range of BFRs, not just those that are POPs. It has also been widely used in polyvinyl chloride (PVC) cable even where BFRs are absent. It is present in some plastics at concentrations exceeding the hazardous waste threshold. You must consider antimony trioxide when you are classifying any WEEE or plastic containing fraction from the treatment of WEEE.	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.3 Treatment of WEEE containing BFRs and POPs		
11	You must not repair or refurbish for reuse any WEEE that is a POPs waste – it must be treated to destroy the POP.	N/a – no repair or refurbishment undertaken
12	Deca BDE was the last of the PBDEs to be banned from use in electrical equipment under the Restriction of Hazardous Substances Directive (RoHS) and came into effect during 2008. Even so, there is evidence that deca BDE is present in some appliances manufactured since then.	N/a – statement only
13	If you prepare for reuse WEEE that may be POPs waste, you can only do so if it has an original manufacture date on or after 1 January 2009 and if it is reused within the UK.	N/a – no repair or refurbishment undertaken
14	If you repair or refurbish WEEE that may be POPs waste and intend to export the equipment for reuse abroad, you must demonstrate that the equipment does not contain POPs.	
5.4 Process monitoring		
1	At least once a year, for every WEEE stream you treat, you must carry out a mass balance exercise to determine and record the mass of each individual output fraction derived from a given mass of input material. The batch size must be large enough to make sure you can assess a representative sample of typical input materials.	DESC.01.01/EPTR – Section 8.6.
2	You should compare each set of results with previous results to monitor the performance of your site and to ensure it is performing optimally.	
	Where process monitoring requires chemical analysis to be carried out on waste fractions and residues produced by your treatment process, this must be carried out by an independent accredited laboratory, using recognised accredited methods where they are available.	
	You must have, and be able to provide, a full description of the material testing and analysis procedures and methods used, which provide details of the calibration methods and reference standards used.	
	You must choose the sample containers and packaging used for storing and transporting according to the nature and requirements of the materials they will contain.	
	You must clearly label sample containers with at least the name of the treatment facility, a description of the waste material or residue contained, the waste stream it was produced from and the date of sampling.	
	You must make sure that any required sample is representative of the waste and has been taken by someone technically competent to do so.	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.4 Process monitoring		
7	You must make sure that any required sample is representative of the waste and has been taken by someone technically competent to do so.	DESC.01.01/EPTR – Section 8.6.
8	Samples must be stored in a dark, cool place and dispatched to the laboratory for analysis as soon as possible, preferably within 24 hours of being taken.	
9	You must carry out sampling under normal operating conditions unless otherwise stated.	
10	If process monitoring shows that the performance of your treatment plant does not meet any of the standards stated in this guidance, you must send a report to the Environment Agency, summarising: • the actions you will take to improve performance in order to achieve the standards given, including any additional sampling and testing • the dates you will complete these actions by, including the dates for any additional sampling and testing	
11	Wherever possible you should sample waste fractions and residues in line with relevant guidance.	
5.5 Treatment of gas discharge lamps		N/a – not accepted
5.6 Treatment of cathode ray tube (CRT) equipment		N/a – not accepted
5.7 Treatment of FPD equipment		N/a – not accepted
5.8 Treatment of SMW		
1	Small mixed waste electrical and electronic equipment (SMW) can consist of many different categories of WEEE, including those requiring specific forms of treatment such as CRT equipment, gas discharge lamps and temperature exchange equipment containing refrigerants. You must identify items such as these and remove them for appropriate treatment.	N/a – only PCBs accepted
2	If you treat separately any particular categories of small WEEE, the guidance in this section still applies subject to any category specific guidance that may exist, for example for display equipment.	
3	Some appliances found in SMW are known to contain high concentrations of POPs in plastic components such as casings, cables and printed circuit boards. You must manage SMW and all plastic containing fractions from treating SMW as POPs waste unless you can prove they are not.	DESC.01.01/EPTR – Section 4.11.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.8 Treatment of SMW		
4	You must remove the items listed from SMW before mechanical treatment:	N/a only PCBs accepted
5	You must remove capacitors the following items from SMW before mechanical treatment unless your specific process makes sure they remain whole and intact, and you have effective procedures to remove them following that treatment: • capacitors identified in Annex VII of the WEEE Directive • ink and toner cartridges	
6	You must also remove the following from SMW, but you can do this as material streams after mechanical treatment: • external electrical cables • printed circuit boards from mobile phones and from other devices if greater than 10 square centimetres in area • batteries other than those identified in measure 4, provided they remain intact and identifiable • plastics containing BFRs	
7	If you mechanically treat SMW, you must provide and use an effective dust extraction and abatement system to minimise dust release.	DESC.01.01/EPTR – Section 6.4.
8	Where you use a mechanical process to shred SMW you must sample the physically finest non-metallic fraction at least once every 6 months and test for: • mercury with a limit value of 1mg/kg • cadmium with a limit value of 100mg/kg	DESC.01.01/EPTR – Section 8.6.
5.9 Treatment of IT, telecommunications and business equipment		
1	This can consist of many different categories of WEEE including those requiring specific forms of treatment such as flat panel display equipment. You must identify items like these and remove them for appropriate treatment.	N/a only PCBs accepted
2	Some appliances found in IT, telecommunications and business equipment are known to contain high concentrations of POPs. You must manage this waste stream and all plastic containing fractions arising from the treatment of it as POPs waste, unless you can prove they are not.	DESC.01.01/EPTR – Section 4.11.
3	If you mechanically treat IT, telecommunications and business equipment, you must meet the standards for small mixed WEEE (see section 5.8).	See above

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.9 Treatment of IT, telecommunications and business equipment		
4	Where you use a mechanical process to shred IT, telecommunications and business equipment, you must sample the physically finest non-metallic fraction at least once every 6 months and test for: • mercury, with a limit value of 1mg/kg • cadmium with a limit value of 100mg/kg	DESC.01.01/EPTR – Section 8.6.
5.10 Treatment of LDA		N/a – not accepted
5.11 Treatment of photovoltaic panels		N/a – not accepted
5.12 Post shredding treatments		
1	You may use a range of separation technologies to further segregate and purify shredded fractions of WEEE. For example, eddy-current separators, electrostatic separators, and density separation, either at the shredding facility or elsewhere.	DESC.01.01/EPTR – Section 4.9. – 4.10.
2	You must fully characterise and classify fractions produced by these processes.	DESC.01.01/EPTR – Section 4.11. – 4.12.
3	Where materials originate from WEEE that was POPs waste, fractions of plastic containing brominated flame retardants must be managed as POPs waste.	DESC.01.01/EPTR – Section 4.11.
4	Where materials originate from WEEE that was not POPs waste, fractions of plastic containing brominated flame retardants must be assessed to determine if they are POPs waste.	
5	You must fully characterise and classify (including for POPs) process solutions and washings from density separation processes before determining suitable disposal options. Where these originate from the treatment of POPs waste, any POPs must be destroyed.	
6	You must only use waste codes for single material outputs, for example plastic, where the treatment involved is aimed at producing a pure material fraction. Contamination by other materials must be negligible.	DESC.01.01/EPTR – Section 4.12.
7	You must monitor at least once every 3 months how much BFR containing plastic is present in any fraction destined for recycling.	Plastic powder from the process is not sent for recycling only destruction.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
5.13 Record Keeping for all treatment residues		
1	You must record in the waste tracking system: • that the WEEE has been treated or consigned to another WEEE treatment facility • what WEEE has been prepared for reuse or has been consigned to a preparing for reuse operator • what the treatment residues, treated components and fractions are	DESC.01.01/EPTR – Section 4.5.
6. Emissions control appropriate measures		
6.1 Point source emissions to air		
1	You must contain the waste treatment plant (including shredders) to make sure you collect, extract and direct all process emissions to an appropriate abatement system for treatment before release.	DESC.01.01/EPTR – Section 6.4.
2	You must identify the main chemical constituents of the site's point source emissions as part of the site's inventory of emissions to air. You must include the speciation of volatile organic compounds (VOCs) if you have identified them in the emissions inventory and it is practicable to do so.	DESC.01.01/EPTR – Section 6.1.
3	You must assess the fate and impact of the substances emitted to air, following the Environment Agency's air emissions risk assessment methodology.	
4	To reduce point source emissions to air (for example, dust, VOCs and odour) from waste treatment, you must use an appropriate combination of abatement techniques, including one or more of the systems given in the guidance.	
5	You must assess and design vent and stack locations and heights to make sure dispersion capability is adequate.	
6	Where monitoring is required, you must install suitable monitoring points. Monitoring points will be required to meet MCERTS standards.	DESC.01.01/EPTR – Section 8.1.
7	Your procedures must make sure you correctly install, operate, monitor and maintain abatement equipment. For example, this includes monitoring and maintaining: • appropriate flow and chemical concentration of scrubber liquor • the handling and disposal or regeneration of spent scrubber or filter medium	DESC.01.01/EPTR – Section 3.4.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
6.2 Fugitive Emissions to Air (including odour)		
1	You must use appropriate measures to prevent emissions of dust, mud and litter and odour. See our guidance on suggested appropriate measures to control dust, mud and litter and to control odour.	DESC.01.01/EPTR – Section 6.4., 7.1., 7.2. and DESC.01.01/ERA
2	You must design, operate and maintain storage and treatment plant in a way that prevents fugitive emissions to air, including dust, organic compounds and odour. Where that is not possible, you must minimise these emissions.	DESC.01.01/EPTR – Section 6.4.
3	You must make sure fugitive emissions are collected and directed to appropriate abatement and your treatment plant must use high integrity components (for example, seals or gaskets).	
4	You must use your waste pre-acceptance, waste acceptance and site inspection checks and procedures to identify and manage wastes that could cause, or are causing, fugitive emissions to air. When you identify any of these wastes you must take appropriate, risk assessed measures to prevent and control emissions and prioritise their treatment or transfer	DESC.01.01/EPTR – Section 4.3. and 4.4.
5	Where necessary, to prevent fugitive emissions to air from the storage and handling of odorous or dusty wastes, you should use a combination of the measures listed in the guidance.	N/a – no odorous or dusty wastes accepted
6	Where a dust management plan is required, you must develop and implement it following relevant guidance.	N/a – no dust management plan required
7	You must set up a leak detection and repair programme and use it to promptly identify and mitigate any fugitive emissions from treatment plant and associated infrastructure (for example, pipework, conveyors, tanks).	DESC.01.01/EPTR – Section 9.5.
8	You must regularly inspect and clean all waste storage and treatment areas, equipment (including conveyor belts) and containers. You must contain any residues collected during cleaning.	DESC.01.01/EPTR – Section 4.6.
9	Your maintenance and cleaning schedules must make sure that tanks and plant are regularly cleaned to avoid large-scale decontamination activities.	DESC.01.01/EPTR – Section 3.4.
10	You must take measures to prevent the corrosion of plant and equipment (for example, conveyors or pipes)	N/a – process does not give rise to corrosion
11	You must have an appropriate regular maintenance programme covering all buildings, plant and equipment. This must also include protective equipment such as air ventilation and extraction systems, curtains and fast-action doors used to prevent and contain fugitive releases.	DESC.01.01/EPTR – Section 3.4.
12-19	Odorous Wastes	N/a – no odorous wastes accepted

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
6.3 Emissions of noise and vibration		N/a – no noise emissions
6.4 Point source emissions to water and sewer		
1	You must identify the main chemical constituents of the site's point source emissions to water and sewer as part of the site's inventory of emissions.	DESC.01.01/EPTR – Section 6.2.
2	You must assess the fate and impact of the substances emitted to water and sewer following the Environment Agency's risk assessment guidance.	
3	Except for uncontaminated surface water, for example roof drainage, discharges to water or sewer must comply with the conditions of an environmental permit or trade effluent consent.	
4	POPs may leach or wash out in particulates from some wastes, such as shredded WEEE plastic or granulated cable, if exposed to the weather. You must prevent the release of POPs to water or sewer by storing these wastes and any other shredded POPs waste under weatherproof covering.	DESC.01.01/EPTR – Section 4.7.
5	To reduce emissions to water and sewer, if you need to treat waste water before discharge or disposal, you must use an appropriate combination of treatment techniques, including one or more of the following: • preliminary or primary treatment – for example, equalisation, neutralisation or physical separation • physico-chemical treatment – for example, adsorption, distillation or rectification, precipitation, chemical oxidation or reduction, evaporation, ion exchange, or stripping • biological treatment – for example, activated sludge process or membrane bioreactor • nitrogen removal – for example, nitrification and denitrification • solids removal – for example, coagulation and flocculation, sedimentation, filtration or flotation	DESC.01.01/EPTR – Section 9.5.
6.5 Fugitive emissions to land and water		
1	You must use appropriate measures to control potential fugitive emissions and make sure that they do not cause pollution.	DESC.01.01/EPTR – Section 6.6.
2	You must have these in all operational areas of the facility: • an impermeable surface • sealed construction joints • spill containment kerbs	
3	For outdoor operational areas you must also have a sealed drainage system.	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
6.5 Fugitive emissions to land and water		
4	The sealed drainage system must contain all surface water runoff and channel it to a blind sump unless you can lawfully discharge it.	DESC.01.01/EPTR – Section 6.6.
5	You must collect and treat separately each water stream generated at the facility. For example, surface run-off water or process water. You must base separation on pollutant content and the treatment required. In particular, you must make sure you segregate uncontaminated water streams from those that require treatment.	DESC.01.01/EPTR – Section 6.2.
6	You must use suitable drainage infrastructure to collect surface drainage from areas of the facility where you store, handle and treat waste. Drainage must be effective to make sure waste is not stored or treated in standing water.	
7	Depending on the pollutant content, you must either: • recirculate what you have collected • discharge it in accordance with an environmental permit or trade discharge consent • send it for further treatment	
8	You must have design and maintenance provisions in place to detect and repair leaks. These must include regularly monitoring, inspecting and repairing equipment and minimising underground equipment and infrastructure.	DESC.01.01/EPTR – Section 9.5.
9	You should provide appropriate buffer storage capacity at your facility to store waste waters, taking into account: potential abnormal operating scenarios and incidents and the nature of any polluting substances and their impact on the downstream waste water treatment plant and receiving environment	DESC.01.01/EPTR – Section 4.14. and 6.2
10	You must have appropriate measures in place to monitor, treat and reuse the water held in the buffer storage before discharging.	
11	You must take measures to prevent emissions from washing and cleaning activities	DESC.01.01/EPTR – Section 6.5.
12	Where relevant, you must have measures to prevent pollution from the on-site storage, handling and use of oils and fuels.	N/A – no oils and/or fuels
13	You must produce and implement a spillage response plan and train staff to follow it and test it.	DESC.01.01/EPTR – Section 6.5.
14	Your procedures and associated training must make sure you deal with spillages immediately.	
15	You must keep spill kits at locations close to areas where a spillage could occur and make sure relevant staff know how to use them. Make sure kits are replenished after use.	
16	You must stop spillages from entering drains, channels, gullies, watercourses and unmade ground. You must make available absorbent materials, sand or drain mats for use when required.	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
6.5 Fugitive emissions to land and water		
17	You must make sure your spillage response plan includes information about how to recover, handle and correctly dispose of waste produced from a spillage.	DESC.01.01/EPTR – Section 6.5.
18	For subsurface structures, you must: • establish and record the routing of all site drains and subsurface pipework • identify all sub-surface sumps and storage vessels • engineer systems to minimise leakages from pipes and make sure they are detected quickly if they do occur, particularly where hazardous substances are involved, see the list of hazardous substances • provide secondary containment or leakage detection for sub-surface pipework, sumps and storage vessels • establish an inspection and maintenance programme for all subsurface structures, for example, pressure tests, leak tests, material thickness checks or CCTV	N/a – no subsurface structures
19	For surfacing, you must design appropriate surfacing and containment or drainage facilities for all operational areas, taking into account the factors listed in the guidance.	DESC.01.01/EPTR – Section 3.1., 3.4., 3.5.
20	You must have an inspection and maintenance programme for impermeable surfaces and containment facilities.	
21	You must bund all above-ground tanks containing liquids whose spillage could be harmful to the environment.	DESC.01.01/EPTR – Section 6.5.
7. Emission limits, monitoring and appropriate measures		
7.1 Point source emissions to air		
1	Your facility's emissions inventory must include information about the relevant characteristics of point source emissions to air.	DESC.01.01/EPTR – Section 6.1.
2	Monitoring locations must meet MCERTS standards. Monitoring must use MCERTS qualified accredited methods and be done by MCERTs certified staff.	DESC.01.01/EPTR – Section 8.1.
3	You must carry out emissions monitoring when the plant is operating at or near to full treatment capacity. Information regarding the plant treatment processing rate and air flow rate at the time of monitoring must be recorded and submitted with the monitoring results.	DESC.01.01/EPTR – Section 6.1.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
7.1 Point source emissions to air		
4	You must monitor point source emissions to air from your treatment plant for the following substances using the monitoring standards stated. You must monitor at the frequencies stated and meet the specified emission limits unless your permit states alternative requirements.	DESC.01.01/EPTR – Section 6.1.
7.2 Point source emissions to water or sewer – N/A		
1	Your facility's emissions inventory must include information about the relevant characteristics of point source emissions to sewer or water, such as: • average values and variability of flow, pH, temperature, and conductivity • average concentration and load values of relevant substances and their variability – for example, COD (chemical oxygen demand) and TOC (total organic carbon), nitrogen species, phosphorus, metals, priority substances or micropollutants • data on bio-eliminability – for example, BOD (biological oxygen demand), BOD to COD ratio, Zahn-Wellens test, biological inhibition potential, for example, inhibition of activated sludge	DESC.01.01/EPTR – Section 6.1.
2	For relevant emissions to water or sewer identified by the emissions inventory, you must carry out monitoring of key process parameters (for example, waste water flow, pH, temperature, conductivity, or BOD) at key locations. For example, these could either be at the: • inlet or outlet (or both) of the pre-treatment • inlet to the final treatment • point where the emission leaves the facility boundary	
3	For the listed of discharges, you must monitor point source emissions to water or sewer for the substances listed using the monitoring standards stated. You must meet the specified emission limits unless your permit states otherwise.	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
8. Process efficiency appropriate measures		
8.1 Energy efficiency		
1	You must create and implement an energy efficiency plan at your facility.	DESC.01.01/EPTR – Section 9.3.
2	You must regularly review and update your energy efficiency plan as part of your facility's management system.	
3	You must have and maintain an energy balance record for your facility. This must provide a breakdown of your energy consumption and generation (including any energy or heat exported) by the type of source (electricity, gas, conventional liquid fuels, conventional solid fuels, and waste). You should provide Sankey diagrams or energy balances to show how energy is used in your waste treatment processes.	DESC.01.01/EPTR – Section 9.2.
4	You must regularly review and update your energy balance record as part of your facility's management system, alongside the energy efficiency plan.	DESC.01.01/EPTR – Section 9.3.
5	You must have operating, maintenance and housekeeping measures in place in relevant areas that can have an effect on energy usage.	
6	You must have measures in place to avoid gross energy inefficiencies	
7	You should implement additional energy efficiency measures at the facility as appropriate	
8.2 Raw materials		
1	You must maintain a list of the raw materials used at your facility and their properties. This includes auxiliary materials and other substances that could have an environmental impact.	DESC.01.01/EPTR – Section 5.1.
2	You must regularly review the availability of alternative raw materials and use any suitable ones that are less hazardous or polluting.	
3	You must justify the continued use of any substance for which there is a less hazardous alternative.	
4	You must have quality assurance procedures in place to control the content of raw materials.	
8.3 Water use		
1	You must make sure you optimise water consumption.	DESC.01.01/EPTR – Section 9.5.

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
8.3 Water use		
2	Measures you must take include those listed in the guidance.	DESC.01.01/EPTR – Section 9.5.
3	You must regularly review your water use, at least every 4 years.	
4	You must also: • produce flow diagrams and water mass balances for your activities • establish water efficiency objectives and identify constraints on reducing water use beyond a certain level (usually this will be site specific) • identify the opportunities for maximising reuse and minimising use of water • have a timetabled improvement plan for implementing additional water reduction measures	
5	To reduce water use and associated emissions to water, you should apply these general principles in sequence: • use water efficient techniques at source where possible • reuse water within the process, by treating it first if necessary – if not practicable, use it in another part of the process or facility that has a lower water quality requirement	
6	If you cannot use uncontaminated roof and surface water in the process, you should keep it separate from other discharge streams – at least until after you have treated the contaminated streams in an effluent treatment system and have carried out final monitoring.	N/a – the Installation is located in a site that has a combined surface and foul drainage system
7	You should establish the water quality requirements associated with each activity and identify whether you can substitute water from recycled sources. Where you can, include it in your improvement plan.	DESC.01.01/EPTR – Section 9.5.
8	Where there is scope for reuse (possibly after some form of treatment) you should keep less contaminated water streams, such as cooling waters, separate from more contaminated streams.	
9	You must minimise the volume of water you use for cleaning and washing down.	
10	You must directly measure fresh water consumption and record it regularly at every significant usage point, ideally on a daily basis.	

Table 9: AM - Waste electrical and electronic equipment (WEEE) (cont)

Appropriate Measure Ref No.	Appropriate Measures Requirement	Section of Supporting Documents
8.4 Waste minimisation, recovery and disposal		
1	You must have and implement a residues management plan that: • minimises the generation of residues arising from waste treatment • optimises the reuse, regeneration, recycling or energy recovery of residues, including packaging • makes sure you properly dispose of residues where recovery is technically or economically impractical	DESC.01.01/EPTR – Section 9.5.
2	Where you must dispose of waste, you must do a detailed assessment identifying the best environmental options for waste disposal.	
3	You must regularly review your options for recovering and disposing of waste produced at the facility. You must do this as part of the management system to make sure you are still using the best environmental options and promoting the recovery of waste.	

Table 10: BAT for Non-Ferrous Metals and the Production of Carbon and Graphite (EPR 2.03)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
1. Managing your Activities		
1.1 Accident Management		
1	You should address the following in your management system: • storage and use of liquefied gases such as oxygen, chlorine and LPG; • loss of electrical supplies to control systems and to pollution abatement systems (this may lead to uncontrolled discharges to air and water); • flooding, whether caused by rainfall or due to fire fighting activities.	DESC.01.01/ERA
1.2 Energy Efficiency		
1	Produce steam and electricity from the heat raised in waste heat boilers.	N/a – not relevant for process undertaken
2	Use the heat of reaction to smelt or roast concentrates or melt scrap metals in a converter.	
3	Use hot process gases to dry feed materials.	
4	Pre-heat furnace charge using the energy content of furnace gases or hot gases from another source.	
5	Use recuperative burners for the pre-heating of combustion air.	
6	Use CO produced as a fuel gas.	
7	Consider the use of oxygen as it is recognised to have advantages in many cases and reduces the overall gas volume, allows autogenic operation and can allow smaller abatement plant.	
8	Ensure process optimisation to minimise hot metal transfers.	
1.3 Avoidance, recovery and disposal of wastes		
1	Store materials such as drosses, which may dissolve or react with water, under cover	N/a – not relevant for process undertaken
2	Apply the options listed in the table where appropriate.	

Table 10: BAT for Non-Ferrous Metals and the Production of Carbon and Graphite (EPR 2.03) (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
2. Operations		
2.4 Precious Metals		
Platinum Group Metals - Only platinum group metals BAT has been considered as silver and gold BAT relates to smelting operation which are not undertaken.		
1	Pay attention to process design and stock control so as to minimise inventories of liquefied gases and flammable solvents	DESC.01.01/FPP
2	Design your process control systems to minimise the reagent requirements and losses from the reactor of gases such as ammonia, chlorine and hydrogen chloride	DESC.01.01/EPTR – Section 5.10
3	Ensure effective procedures for identifying solid materials in process or awaiting dispatch	N/a – not relevant for process
4	Use effective dust control procedures in all areas where potentially dusty materials may be handled. You must design the procedures to be adequate for the toxicity of the materials being handled	DESC.01.01/EPTR – Section 6.4.
5	Use comprehensive treatment systems to minimise emissions into the atmosphere of acid gases, halogens, oxides of nitrogen, ammonia, metallic fume and particulate matter of any description	DESC.01.01/EPTR – Section 6.1.
6	Use comprehensive treatment systems to ensure that liquid discharges meet acceptable limits before discharge	DESC.01.01/EPTR – Section 6.2.
3. Emissions and Monitoring		
3.1 Point Source Emissions to Water		
1	Achieve as a minimum the benchmark values for point source emissions to water listed in Annex 1 of the guidance unless alternative values are justified and agreed with the Agency	DESC.01.01/EPTR – Section 6.2.
2	Apply the options as listed in the guidance table.	DESC.01.01/EPTR – Section 6.5.
3.2 Point Source Emissions to Air		
1	Demonstrate the reliable operation of control and abatement systems, including as appropriate: • temperature and pressure monitors on filtration plant and associated ductwork; • power consumption indicators on fans associated with extraction systems; • temperature monitoring on exhausts from furnaces and after-burners; • liquor flowrate and pH monitors where wet scrubbing systems are used.	DESC.01.01/EPTR – Section 6.1.
2	Where VOCs are released, identify the main chemical constituents of the emissions and assess the fate of these chemicals in the environment.	DESC.01.01/EPTR – Section 6.1.

Table 10: BAT for Non-Ferrous Metals and the Production of Carbon and Graphite (EPR 2.03) (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
3.2 Point Source Emissions to Air		
3	Achieve the benchmark values for point source emissions to air listed in Annex 1 of the guidance unless alternative values are justified and agreed with the Agency	DESC.01.01/EPTR – Section 6.1.
4	Apply the options as listed in the guidance as appropriate	
3.3 Fugitive Emissions to Air		
1	Seal furnaces and reactors.	N/a - not relevant for process undertaken
2	Minimise open molten metal transfers.	
3	Ensure adequate extraction of process exhausts designed for the maximum rate of emission.	
3.4 Noise and Vibration		
1	You should pay particular attention to the following: • movement and storage of scrap • location and sound insulation of large fans and air filtration systems; • rolling mills; • casting installations, especially billet casters; • internal transport; • electric arc furnaces.	N/a - not relevant for process undertaken
3.5 Monitoring		
1	Monitor emissions to air to demonstrate you are meeting your permit requirements.	DESC.01.01/EPTR – Section 8.1.
2	Monitoring of process effluents released to controlled waters should include at least those parameters listed in the table of the guidance.	DESC.01.01/EPTR – Section 8.4.
3	Monitoring of process effluents released to sewer waters should include at least those parameters listed in the table of the guidance.	DESC.01.01/EPTR – Section 6.1. and 8.1.
4	Monitor for the various pollutants listed in the table in the guidance at the frequency specified.	DESC.01.01/EPTR – Section 6.2. and 8.4.

Table 11: BAT for The Inorganic Chemicals Sector (EPR 4.03)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
1. Managing your Activities		
1.1 Environmental Performance Indicators		
1	Monitor and benchmark your environmental performance, and review this at least once a year.	DESC.01.01/EPTR – Section 3.2. – 3.6.
1.2. Accident Management – no additional BAT		
1.3 Energy Efficiency		
1	Assess the environmental impact of each process and choose the one with the lowest environmental impact	DESC.01.01/EPTR – Section 9.1. – 9.3.
1.4 Efficient Use of Raw Materials and Water		
1	Maximise heat transfer between process streams where water is needed for cooling. Use a recirculating system with indirect heat exchangers and a cooling tower in preference to a once-through cooling system.	N/a – not relevant to process
2	Where water is used in direct contact with process materials, recirculate the water after stripping out the absorbed substances.	DESC.01.01/EPTR – Section 4.12.
3	Use cleaning techniques that reduce the quantity of water needed.	N/a – not relevant to process
4	Establish opportunities for reuse using pinch analysis.	N/a – not relevant to process
1.5 Avoidance, recovery and disposal of wastes		
1	Demonstrate that the chosen routes for recovery or disposal represent the best environmental option. Consider avenues for recycling back into the process or reworking for another process wherever possible.	DESC.01.01/EPTR – Section 9.6.
2	Where you cannot avoid disposing of waste, provide a detailed assessment identifying the best environmental options for waste disposal.	
2. Operations		
2.1 Design of a new process		
1	Consider all potential environmental impacts from the outset in any new project for manufacturing chemicals	DESC.01.01/EPTR – Section 6.

Table 11: BAT for The Inorganic Chemicals Sector (EPR 4.03) (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
2.1 Design of a new process		
2	Undertake the appropriate stages of a formal HAZOP study as the project progresses through the process design and plant design phases.	DESC.01.01/EPTR – Section 4.1.
2.2 Storage and Handling of Raw Materials, Products and Wastes		
1	Store reactive chemicals in such a way that they remain stable, such as under a steady gas stream, for example. If chemical additions are necessary then tests should be carried out to ensure the required chemical composition is maintained. Inhibitors may be also be added to prevent reactions.	N/a – not relevant to process
2	Vent storage tanks to a safe location.	
3	Use measures to reduce the risk of contamination from large storage tanks. In addition to sealed bunds, use double-walled tanks and leak detection channels	
4	Use HAZOP studies to identify risks to the environment for all operations involving the storage and handling of chemicals and wastes. Where the risks are identified as significant, plans and timetables for improvements should be in place	DESC.01.01/EPTR – Section 4.1.
2.3 Plant Systems and Equipment		
1	Formally consider potential emissions from plant systems and equipment and have plans and timetables for improvements, where the potential for substance or noise pollution from plant systems and equipment has been identified.	DESC.01.01/EPTR – Section 6, 7 and DESC.01.01/ERA
2	Carry out systematic HAZOP studies on all plant systems and equipment to identify and quantify risks to the environment.	DESC.01.01/EPTR – Section 4.1.
3	Choose vacuum systems that are designed for the load and keep them well maintained. Install sufficient instrumentation to detect reduced performance and to warn that remedial action should be taken	DESC.01.01/EPTR – Section 6.4.
Overpressure Protection Systems		
1	Carry out a systematic HAZOP study for all relief systems, to identify and quantify significant risks to the environment from the technique chosen	DESC.01.01/EPTR – Section 4.1.
2	Identify procedures to protect against overpressure of equipment. This requires the identification of all conceivable over-pressure situations, calculation of relief rates, selection of relief method, design of the vent system, discharge and disposal considerations, and dispersion calculations. In some cases careful design can provide intrinsic protection against all conceivable over-pressure scenarios, so relief systems and their consequential emissions can be avoided.	N/a – not relevant to process
3	Maintain in a state of readiness all equipment installed in the venting system even though the system is rarely used.	N/a – not relevant to process

Table 11: BAT for The Inorganic Chemicals Sector (EPR 4.03) (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
Heat Exchangers and Cooling Systems		
1	Maintain in a state of readiness all equipment installed in the venting system even though the system is rarely used.	N/a – not relevant to process
2	If corrosion is likely, ensure methods for rapid detection of leaks are in place and a regime of corrosion monitoring in operation at critical points. Alternatively, use materials of construction that are inert to the process and heating/cooling fluids under the conditions of operation	
3	For cooling water systems, use techniques that compare favourably with relevant techniques described in the "Industrial Cooling Systems" BREF.	
Purging Facilities		
1	Assess the potential for the release to air of VOCs and other pollutants along with discharged purge gas and use abatement where necessary	DESC.01.01/EPTR – Section 6.1.
2.4 Rection Stage		
1	With a clear understanding of the physical chemistry, evaluate options for suitable reactor types using chemical engineering principles	DESC.01.01/EPTR – Section 4.9. and 4.10.
2	Select the reactor system from a number of potentially suitable reactor designs – conventional stirred tank reactor (STR), process-intensive or novel-technology - by formal comparison of costs and business risks against the assessment of raw material efficiencies and environmental impacts for each of the options.	
3	Undertake studies to review reactor design options based on process-optimisation where the activity is an existing activity and achieved raw material efficiencies and waste generation suggest there is significant potential for improvement. The studies should formally compare the costs and business risks, and raw material efficiencies and environmental impacts of the alternative systems with those of the existing system. The scope and depth of the studies should be in proportion to the potential for environmental improvement over the existing reaction system.	
4	Maximise process yields from the selected reactor design, and minimise losses and emissions, by the formalised use of optimised process control and management procedures (both manual and computerised where appropriate).	
5	Minimise the potential for the release of vapours to air from pressure relief systems and the potential for emissions of organic solvents into air or water, by formal consideration at the design stage - or formal review of the existing arrangements if that stage has passed	DESC.01.01/EPTR – Section 6.

Table 11: BAT for The Inorganic Chemicals Sector (EPR 4.03) (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
Minimisation of Liquid Losses from Reaction Systems		
6	Use the features listed that contribute to a reduction in waste arisings from clean-outs.	DESC.01.01/EPTR – Section 9.6.
Minimisation of Vapour Losses		
7	Review your operating practices and review vent flows to see if improvements need to be made.	N/a – not relevant to process
8	Consider opportunities to enhance the performance of abatement systems.	
2.5 Separation Stage		
1	Choose your separation technique following a detailed process design and HAZOP study. Follow formal operating instructions to ensure effective separation and minimisation of losses. Adhere to design conditions such as heat input, reflux flows and ratios, etc	DESC.01.01/EPTR – Section 4.1., 4.9. and 4.10.
2	Install instrumentation to warn of faults in the system, such as a temperature, pressure or low coolant-flow alarms	DESC.01.01/EPTR – Section 8.6.
Liquid-Liquid Separations		
1	Use techniques which maximise physical separation of the phases (and also aim to minimise mutual solubility) where practicable.	N/a – not relevant to process
2	When the phases are separated, use techniques which prevent (or minimise the probability and size of) breakthrough of the organics phase into a waste-water stream. This is particularly important where the environmental consequences of subsequent releases of organics to air or into controlled waters may be significant (eg. where the effluent is treated in a DAF unit or some of the organic components are resistant to biological treatment).	
3	When a separation is done by hand, use a "dead man's handle", backed-up by good management, to improve the chance of the flow being properly controlled as the phase-boundary approaches.	
4	Consider if automatic detection of the interface is practicable.	
5	Where you are discharging to drain, consider whether there should be an intermediate holding or "guard" tank to protect against accidental losses from the organics phase.	

Table 11: BAT for The Inorganic Chemicals Sector (EPR 4.03) (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
Solid-Liquid Separations		
1	Use techniques to minimise, re-use and/or recycle rinse water, and to prevent breakthrough of solids.	DESC.01.01/EPTR – Section 4.9. and 4.10
2	Install instrumentation or other means of detecting malfunction as all of the techniques are vulnerable to solids breakthrough	N/a – not relevant to process
3	Consider installing "guard" filters of smaller capacity downstream which, in the event of breakthrough, rapidly 'clog' and prevent further losses.	N/a – not relevant to process
4	Have good management procedures to minimise loss of solids, escape of volatiles to air and excessive production of waste water	DESC.01.01/EPTR – Section 6. And 9.6.
2.6 Purification Stage – no additional BAT		
2.7 Chemical Process Controls		
1	Monitor the relevant process controls and set with alarms to ensure they do not go out of the required range.	DESC.01.01/EPTR – Section 8.6.
2.8 Analysis		
1	Analyse the components and concentrations of by products and waste streams to ensure correct decisions are made regarding onward treatment or disposal. Keep detailed records of decisions based on this analysis in accordance with management systems	DESC.01.01/EPTR – Section 4.12.
3. Emissions and Monitoring		
3.1 Point Source Emissions to Air		
1	Formally consider the information and recommendations in the BREF on Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector (see Reference 1, Annex 2) as part of the assessment of BAT for point-source releases to air, in addition to the information in this note.	DESC.01.01/EPTR – Section 6.1.
2	Achieve the benchmark values for point source emissions to air listed in Annex 1 of the guidance unless alternative values are justified and agreed with the Agency	
3	Identify the main chemical constituents of the emissions, including VOC speciation where practicable.	
4	Assess vent and chimney heights for dispersion capability and assess the fate of the substances emitted to the environment.	

Table 11: BAT for The Inorganic Chemicals Sector (EPR 4.03) (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
3.2 Point Source Emissions to Water		
1	Control all emissions to avoid a breach of water quality standards as a minimum. Where another technique can deliver better results at reasonable cost it will be considered BAT and should be used.	DESC.01.01/EPTR – Section 6.1.
2	Use the measures listed to minimise water use and emissions to water.	DESC.01.01/EPTR – Section 9.6.
3.3 Point Source Emissions to Land – there are no point source emissions to land.		
3.4 Fugitive Emissions		
Fugitive Emissions to Air		
1	Identify all potential sources and develop and maintain procedures for monitoring and eliminating or minimising leaks.	DESC.01.01/EPTR – Section 6.4.
2	Choose vent systems to minimise breathing emissions (for example pressure/ vacuum valves) and, where relevant, should be fitted with knock-out pots and appropriate abatement equipment.	N/a – not relevant to process
3	Use the techniques listed (together or in any combination) to reduce losses from storage tanks at atmospheric pressure:	N/a – not relevant to process
Fugitive Emissions to Surface Water, Sewer and Groundwater		
1	Provide hard surfacing in areas where accidental spillage or leakage may occur, e.g. beneath prime movers, pumps, in storage areas, and in handling, loading and unloading areas. The surfacing should be impermeable to process liquors.	DESC.01.01/EPTR – Section 6.5 and 6.6.
2	Drain hard surfacing of areas subject to potential contamination so that potentially contaminated surface run-off does not discharge to ground.	
3	Hold stocks of suitable absorbents at appropriate locations for use in mopping up minor leaks and spills, and dispose of to leak-proof containers	
4	Take particular care in areas of inherent sensitivity to groundwater pollution. Poorly maintained drainage systems are known to be the main cause of groundwater contamination and surface/above-ground drains are preferred to facilitate leak detection (and to reduce explosion risks)	DESC.01.01/ERA
5	Additional measures could be justified in locations of particular environmental sensitivity. Decisions on the measures to be taken should take account of the risk to groundwater.	
6	Surveys of plant that may continue to contribute to leakage should also be considered, as part of an overall environmental management system. In particular, you should consider undertaking leakage tests and/or integrity surveys to confirm the containment of underground drains and tanks.	DESC.01.01/EPTR – Section 9.5.

Table 11: BAT for The Inorganic Chemicals Sector (EPR 4.03) (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
3.5 Odour – the reactions that occur do not release any odour		
3.6 Noise and Vibration		
1	Install particularly noisy machines such as compactors and pelletisers in a noise control booth or encapsulate the noise source.	DESC.01.01/EPTR – Section 7.3.
2	Where possible without compromising safety, fit suitable silencers on safety valves.	N/a – not relevant to process
3	Minimise the blow-off from boilers and air compressors, for example during start up, and provide silencers.	
3.7 Monitoring		
Monitoring and reporting emissions to air		
1	Carry out an analysis covering a broad spectrum of substances to establish that all relevant substances have been taken into account when setting the release limits. The need to repeat such a test will depend upon the potential variability in the process and, for example, the potential for contamination of raw materials. Where there is such potential, tests may be appropriate.	DESC.01.01/EPTR – Section 6.1.
2	Monitor more regularly any substances found to be of concern, or any other individual substances to which the local environment may be susceptible and upon which the operations may impact. This would particularly apply to the common pesticides and heavy metals. Using composite samples is the technique most likely to be appropriate where the concentration does not vary excessively.	
3	If there are releases of substances that are more difficult to measure and whose capacity for harm is uncertain, particularly when combined with other substances, then "whole effluent toxicity" monitoring techniques can be appropriate to provide direct measurements of harm, for example, direct toxicity assessment.	
Monitoring and Reporting of Waste Emissions		
1	Monitor and record: • the physical and chemical composition of the waste • its hazard characteristics • handling precautions and substances with which it cannot be mixed	DESC.01.01/EPTR – Section 4.12.

Table 11: BAT for The Inorganic Chemicals Sector (EPR 4.03) (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
Environmental Monitoring (beyond the Installation)		
1	Consider the following in drawing up proposals: • determinands to be monitored, standard reference methods, sampling protocols • monitoring strategy, selection of monitoring points, optimisation of monitoring approach • determination of background levels contributed by other sources • uncertainty for the employed methodologies and the resultant overall uncertainty of measurement quality assurance ("QA") and quality control ("QC") protocols, equipment calibration and maintenance, sample storage and chain of custody/audit trail • reporting procedures, data storage, interpretation and review of results, reporting format for the provision of information.	DESC.01.01/EPTR – Section 3.3 – 3.6, 6 and DESC.01.01/ERA.
Process Variables		
1	Identify those process variables that may affect the environment and monitor as appropriate.	DESC.01.01/EPTR – Section 8.6.

Table 12: BATc for the Non-Ferrous Metals Sector

BATc Ref No.	BAT Requirement	Section of Supporting Documents
BAT1.	In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the features listed in BATc for the Non-Ferrous Metals Sector	DESC.01.01/EPTR – Section 3.2 – 3.6
BAT 2.	In order to use energy efficiently, BAT is to use a combination of the techniques listed where relevant.	DESC.01.01/EPTR – Section 9.3.
BAT 3.	In order to improve overall environmental performance, BAT is to ensure stable process operation by using a process control system together with a combination of the techniques listed.	DESC.01.01/EPTR – Section 4.9., 4.10., 6., and 8.
BAT 4.	In order to reduce channelled dust and metal emissions to air, BAT is to apply a maintenance management system which especially addresses the performance of dust abatement systems as part of the environmental management system (see BAT 1).	DESC.01.01/EPTR – Section 3.4.
BAT 5.	In order to prevent or, where this is not practicable, to reduce diffuse emissions to air and water, BAT is to collect diffuse emissions as much as possible nearest to the source and treat them.	DESC.01.01/EPTR – Section 6.4.
BAT 6.	In order to prevent or, where this is not practicable, to reduce diffuse dust emissions to air, BAT is to set up and implement an action plan on diffuse dust emissions, as part of the environmental management system (see BAT 1), that incorporates both of the following measures: a. identify the most relevant diffuse dust emission sources (using e.g. EN 15445); b. define and implement appropriate actions and techniques to prevent or reduce diffuse emissions over a given time frame	DESC.01.01/EPTR – Section 7.1.
BAT 7.	In order to prevent diffuse emissions from the storage of raw materials, BAT is to use a combination of the techniques listed in the table.	DESC.01.01/EPTR – Section 6.4.
BAT 8.	In order to prevent diffuse emissions from the handling and transport of raw materials, BAT is to use a combination of the techniques given listed in the table.	
BAT 9.	In order to prevent or, where this is not practicable, to reduce diffuse emissions from metal production, BAT is to optimise the efficiency of off-gas collection and treatment by using a combination of the techniques listed.	
BAT 10.	BAT is to monitor the stack emissions to air with at least the frequency given in the table below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	N/a – no metal releases from process.
BAT 11	In order to reduce mercury emissions to air (other than those that are routed to the sulphuric acid plant) from a pyrometallurgical process, BAT is to use one or both of the techniques given below	

Table 12: BATc for the Non-Ferrous Metals Sector (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
BAT 12.	In order to reduce emissions of SO_2 from off-gases with a high SO_2 content and to avoid the generation of waste from the flue-gas cleaning system, BAT is to recover sulphur by producing sulphuric acid or liquid SO_2	N/a – no SO_2 released.
BAT 13.	In order to prevent NO_X emissions to air from a pyrometallurgical process, BAT is to use one of the techniques listed.	N/a – not a pyrometallurgical process
BAT 14.	In order to prevent or reduce the generation of waste water, BAT is to use one or a combination of the techniques listed.	DESC.01.01/EPTR – Section 6.2.
BAT 15.	In order to prevent the contamination of water and to reduce emissions to water, BAT is to segregate uncontaminated waste water streams from waste water streams requiring treatment.	
BAT 16.	BAT is to use ISO 5667 for water sampling and to monitor the emissions to water at the point where the emission leaves the installation at least once per month and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality	
BAT 17.	In order to reduce emissions to water, BAT is to treat the leakages from the storage of liquids and the waste water from non-ferrous metals production, including from the washing stage in the Waelz kiln process, and to remove metals and sulphates by using a combination of the techniques given below.	
BAT 18.	In order to reduce noise emissions, BAT is to use one or a combination of the techniques listed.	DESC.01.01/EPTR – Section 7.3.
BAT 19.	In order to reduce odour emissions, BAT is to use one or a combination of the techniques listed.	N/a – no odours materials on site.
BAT 20 – 54 – copper production		N/a – not relevant for process undertaken
BAT 55- 89 – alumina production		
BAT 90 - 107 - lead and/or tin production		
BAT 108 – 133 - zinc and/or cadmium production		
BAT 134.	In order to reduce diffuse emissions to air from a pretreatment operation (such as crushing, sieving and mixing), BAT is to use one or a combination of the techniques listed.	DESC.01.01/EPTR – Section 6.4.
BAT 135.	In order to reduce diffuse emissions to air from smelting and melting (both Doré and non-Doré operations), BAT is to use all of the techniques listed.	N/a – not relevant for process undertaken

Table 12: BATc for the Non-Ferrous Metals Sector (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
BAT 136.	In order to reduce diffuse emissions to air from leaching and gold electrolysis, BAT is to use one or a combination of the techniques listed.	N/a – not relevant for process undertaken
BAT 137.	In order to reduce diffuse emissions from a hydrometallurgical operation, BAT is to use all of the techniques listed.	DESC.01.01/EPTR – Section 6.4.
BAT 138.	In order to reduce diffuse emissions to air from incineration, calcining and drying, BAT is to use all of the techniques listed.	N/a – not relevant for process undertaken
BAT 139.	In order to reduce diffuse emissions to air from the melting of final metal products during refining, BAT is to use both of the techniques listed.	
BAT 140.	In order to reduce dust and metal emissions to air from all dusty operations, such as crushing, sieving, mixing, melting, smelting, incineration, calcining, drying and refining, BAT is to use one of the techniques listed.	DESC.01.01/EPTR – Section 6.4.
BAT 141.	In order to reduce NO_X emissions to air from a hydrometallurgical operation involving dissolving/leaching with nitric acid, BAT is to use one or both of the techniques listed.	N/a – not relevant for process undertaken
BAT 142.	In order to reduce SO_2 emissions to air (other than those that are routed to the sulphuric acid plant) from a melting and smelting operation for the production of Doré metal, including the associated incineration, calcining and drying operations, BAT is to use one or a combination of the techniques listed.	
BAT 143.	In order to reduce SO_2 emissions to air from a hydrometallurgical operation, including the associated incineration, calcining and drying operations, BAT is to use a wet scrubber.	
BAT 144.	In order to reduce HCl and Cl_2 emissions to air from a hydrometallurgical operation, including the associated incineration, calcining and drying operations, BAT is to use an alkaline scrubber	
BAT 145.	In order to reduce NH_3 emissions to air from a hydrometallurgical operation using ammonia or ammonium chloride, BAT is to use a wet scrubber with sulphuric acid	
BAT 146.	In order to reduce PCDD/F emissions to air from a drying operation where the raw materials contain organic compounds, halogens or other PCDD/F precursors, from an incineration operation, and from a calcining operation, BAT is to use one or a combination of the techniques listed.	
BAT 147.	In order to prevent soil and groundwater contamination, BAT is to use a combination of the techniques listed.	DESC.01.01/EPTR – Section 6.5. and 6.6.

Table 12: BATc for the Non-Ferrous Metals Sector (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
BAT 148.	In order to prevent the generation of waste water, BAT is to use one or both of the techniques listed.	DESC.01.01/EPTR – Section 6.2.
BAT 149.	In order to reduce the quantities of waste sent for disposal, BAT is to organise operations on site so as to facilitate process residues reuse or, failing that, process residues recycling, including by using one or a combination of the techniques listed.	DESC.01.01/EPTR – Section 9.6.
BAT 150 – 162	n/a – ferro-alloys production	N/a – not relevant for process undertaken
BAT 163 -176	n/a nickel and/or cobalt production	
BAT177 – 184	n/a carbon and /or graphite production	

Table 13: BAT for the Speciality Inorganic Chemicals Sector

BATc Ref No.	BAT Requirement	Section of Supporting Documents
Raw and auxiliary materials supply, storage, handling and preparation		
5.1	BAT is to reduce the amount of packaging materials disposed of by, e.g. recycling 'hard' and 'soft' used packaging materials unless safety or hazard considerations prevent it	DESC.01.01/EPTR – Section 9.6.
Synthesis/reaction/calcination		
5.2	BAT is to reduce emissions and the amount of residues generated by implementing one or more of the measures listed	DESC.01.01/EPTR – Section 9.6.
5.3	BAT is to optimise yields, lower emissions and reduce waste by sequencing the addition of reactants and reagents	DESC.01.01/EPTR – Section 4.9., 4.9. and 5.1.
5.4	BAT is to minimise cleaning operations by optimising the sequences for addition of raw and auxiliary materials	
Product handling and storage		
5.5	BAT is to reduce the amount of residues generated by, e.g. using returnable product transportation containers/drums	DESC.01.01/EPTR – Section 9.6.
Waste gas emissions abatement		
5.6	BAT is to minimise emissions of total dust in off-gases and achieve emission levels of 1 - 10 mg/Nm^3 by using one or more of the techniques listed	DESC.01.01/EPTR – Section 6.1.
5.7	BAT is to reduce HCN emissions and achieve emission levels of <1 mg/m^3 by scrubbing with an alkaline solution. The scrubbing medium is recycled when this is feasible.	N/a – not applicable to process undertaken
5.8	BAT is to reduce NH3 emissions and achieve emission levels of <1.2 mg/m^3 by scrubbing with an acidic solution. The scrubbing medium is recycled when this is feasible.	
5.9	BAT is to reduce HCl emissions, e.g. by wet gas scrubbing under alkaline conditions. If HCl is the main pollutant to be treated and alkali scrubbing is used, BAT is to achieve 3 – 10 mg/Nm^3 HCl	
Waste water management and water emissions abatement		
5.10	BAT is to allocate contaminated waste water streams according to their pollutant load. Inorganic waste water without relevant organic components is segregated from organic waste water and ducted to special treatment facilities	DESC.01.01/EPTR – Section 6.2.
5.11	BAT is to minimise pollution to receiving watercourses by applying all of the measures listed.	DESC.01.01/EPTR – Section 6.2. and 6.5.
Infrastructure		
5.12	BAT is to minimise diffuse dust emissions where dust may arise (in particular from the storage and handling of materials/products) by applying one or more of the following techniques	DESC.01.01/EPTR – Section 6.5.
5.13	BAT is to minimise fugitive gaseous and liquid emissions by applying (according to the substances that may require controlling) one or more of the following techniques	DESC.01.01/EPTR – Section 6.4., 6.5. and 6.6.

Table 13: BAT for the Speciality Inorganic Chemicals Sector (cont)

BATc Ref No.	BAT Requirement	Section of Supporting Documents
5.14	BAT is to use a computerised control system to operate the plant (see Section 4.5.2). However, this does not apply where safety issues do not permit automatic operations	DESC.01.01/EPTR – Section 8.6.
5.15	BAT is to have in place a closed cleaning and rinsing system where hazardous solid compounds can build up.	DESC.01.01/EPTR – Section 6.2.
Energy		
5.16	BAT is to reduce the consumption of energy by optimising plant design, construction and operation, e.g. by using pinch methodology, except if safety issues prevent it	DESC.01.01/EPTR – Section 9.2. and 9.3.
Cross boundary techniques		
5.17	BAT is to minimise soil and groundwater pollution by designing, building, operating and maintaining facilities, where substances (usually liquids) which represent a potential risk of contamination of ground and groundwater are handled, in such a way that material escapes are minimised	DESC.01.01/EPTR – Section 6.5. and 6.6
5.18	BAT is to have a high level of education and continuous training of personnel	DESC.01.01/EPTR – Section 3.1.
5.19	BAT is to apply, if available, the principles of an Industry Code	DESC.01.01/EPTR – Section 3.1.
5.20	BAT is to carry out a structured safety assessment for normal operation and to take into account effects due to deviations of the chemical process and deviations in the operation of the plant	DESC.01.01/EPTR – Section 4.1.
5.21	BAT is to apply one individual or a combination of the techniques listed to ensure the process is adequately controlled	DESC.01.01/EPTR – Section 8.6.
5.22	BAT is to implement and adhere to an Environmental Management System (EMS) that incorporates, as appropriate to individual circumstances, the features listed.	DESC.01.01/EPTR – Section 3.2. – 3.6.

APPENDIX I
EA PRE APPLIATION ADVICE

APPENDIX II
DSEAR ASSESSMENT

APPENDIX III
PROCESS FLOW DIAGRAMS

APPENDIX IV
ECL EMISSIONS TESTING REPORT P6125

2499

EMISSIONS MONITORING SURVEY

(On Behalf of DEScycle Limited)

At:

Leicester University.
Materials Laboratory
University Road
Leicester
LE1 7RH

Permit Number	**: …**
Variation Number	**: …**
Installation	**: Reaction Vessel**
Visit Details	**: Investigative Emissions – July 2025**
Job Number	**: P6125**
Report Number	**: R001**
Report Issue Date	**: 20th August 2025**
Survey Dates	**: 1st July 2025**

Prepared by:

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Report Issue:		**FINAL**	
Report Prepared by:		**Report Reviewed & Approved by:** MCERTS Level Two Technical Endorsements TE1, TE2, TE3 & TE4	
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		MCERTS No:	MM 03 235
		Signature:	
Date:	15th August 2025	***Date:***	20th August 2025

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MCERTS requirements mean that comparison of results with emissions limit values is not permitted within this report.

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PART 1 - EXECUTIVE SUMMARY

1 Monitoring Objectives

Environmental Compliance Ltd (ECL) was commissioned by DEScycle Limited to undertake an emission monitoring survey at **Leicester University**. This report presents the findings of the study.

The monitoring at this installation was carried out in accordance with our quotation reference **PC/P6125/Q002,** for investigate monitoring of emissions to air. The substances requested for monitoring at each emissions point are listed below:

Substances to be monitored	Emission Point Identification **Reaction Vessel (Materials Laboratory)**
Velocity / Flowrate	● U
Total VOCs (Tube Sampling)	●
Top 20 Speciated VOCs (Tube Sampling)	● U
Aldehydes Suite (Tube Sampling)	● U
Acids Suite (Tube Sampling)	●

● Denotes the substances to be monitored.

U **Denotes UKAS accreditation is held for monitoring that substance, but does not mean that it has been claimed which will depend on whether the testing could be completed in accordance with the Standard Reference Method.**

Special Requirements:
"*Testing to be carried out during three phases of the reaction cycle*"

1.1 Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Mass Emission **NOTE UNITS**	Expanded Uncertainty (as % of)			Reference Conditions 273 K,101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation Claimed for Test Result	Tick if non-conforming test (see Section 2)	Operating Status
						ELV	Span Value	Measured Value							
Reaction Vessel – (Materials Laboratory)	Volumetric Flowrate	…	0.00302	m³/sec	…	…	…	5	Stack Conditions	01/07/25	10:15 – 10:32	BS EN 16911-1:2013 & MID	NU	✓	Reaction Phase 1
	Volumetric Flowrate	…	0.00274	m³/sec	…	…	…	6	& Wet Gas	01/07/25	10:15 – 10:32	BS EN 16911-1:2013 & MID	NU	✓	
	Volumetric Flowrate	…	0.00438	m³/sec	…	…	…	4	Stack Conditions	01/07/25	11:45 – 11:56	BS EN 16911-1:2013 & MID	NU	✓	Reaction Phase 2
	Volumetric Flowrate	…	0.00394	m³/sec	…	…	…	5	& Wet Gas	01/07/25	11:45 – 11:56	BS EN 16911-1:2013 & MID	NU	✓	
	Volumetric Flowrate	…	0.00478	m³/sec	…	…	…	8	Stack Conditions	01/07/25	14:22 – 14:37	BS EN 16911-1:2013 & MID	UKAS / MCERTS		Reaction Phase 3
	Volumetric Flowrate	…	0.00428	m³/sec	…	…	…	9	& Wet Gas	01/07/25	14:22 – 14:37	BS EN 16911-1:2013 & MID	UKAS / MCERTS		

The mass emission values presented in the tables below are calculated using these flowrates above, measured in the ductwork at the **start** of each reaction phase.

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Mass Emission (mg/hr)	Expanded Uncertainty (as % of)			Reference Conditions 273 K,101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation Claimed for Test Result	Tick if non-conforming test (see Section 2)	Operating Status
						ELV	Span Value	Measured Value							
Reaction Vessel – (Materials Laboratory)	Formaldehyde $	...	0.098	mg/m³	0.97	...	...	50	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	UKAS / MCERTS	✓	Reaction Phase 1
	Butyraldehyde $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Acetaldehyde $	...	0.049	mg/m³	0.48	...	...	60	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Propionaldehyde $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Benzaldehyde $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Valeraldehyde $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Hexanal $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Heptanal $	...	< 0.024	mg/m³	< 0.24	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	NU	✓	
	Total Aldehydes $	...	< 0.42	mg/m³	< 4.14	...	...	30	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	NU	✓	
	Total VOC $	...	< 2.46	mg/m³	< 24.27	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	NU	✓	
	Speciated VOC $	...	< 1.23*	mg/m³	< 12.13	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	CEN/TS 13649:2014	NU	✓	
	Hydrofluoric Acid $	...	< 1.23	mg/m³	< 12.13	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	Based on CEN/TS 13649:2014	NA	✓	
	Hydrochloric Acid $	...	< 0.25	mg/m³	< 2.47	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	Based on CEN/TS 13649:2014	NA	✓	
	Nitric Acid $	...	< 0.49	mg/m³	<4.83	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	Based on CEN/TS 13649:2014	NA	✓	
	Phosphoric Acid $	...	< 1.47	mg/m³	< 14.50	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	Based on CEN/TS 13649:2014	NA	✓	
	Sulphuric Acid $	...	< 0.49	mg/m³	< 4.83	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	Based on CEN/TS 13649:2014	NA	✓	
	Hydrogen Bromide $	...	< 0.49	mg/m³	<4.83	...	...	> 100	& Wet Gas	01/07/25	10:20 – 10:50	Based on CEN/TS 13649:2014	NA	✓	
	Total Acids $	...	< 4.41	mg/m³	< 43.50	...	...	48	& Wet Gas	01/07/25	10:20 – 10:50	Based on CEN/TS 13649:2014	NA	✓	

***** There were zero peaks found on the GC-MS Scan above the 1.23 mg/m³ limit of detection

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Mass Emission (mg/hr)	Expanded Uncertainty (as % of)			Reference Conditions 273 K,101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation Claimed for Test Result	Tick if non-conforming test (see Section 2)	Operating Status
						ELV	Span Value	Measured Value							
Reaction Vessel – (Materials Laboratory)	Formaldehyde $	...	0.098	mg/m³	0.97	...	...	50	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	UKAS / MCERTS	✓	Reaction Phase 1
	Butyraldehyde $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Acetaldehyde $	...	< 0.025	mg/m³	< 0.25	...	...	> 100	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Propionaldehyde $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Benzaldehyde $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Valeraldehyde $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Hexanal $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Heptanal $	...	< 0.049	mg/m³	< 0.48	...	...	> 100	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	NU	✓	
	Total Aldehydes $	...	< 0.42	mg/m³	< 4.14	...	...	32	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	NU	✓	
	Total VOC $	...	< 2.47	mg/m³	< 24.36	...	...	> 100	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	NU	✓	
	Speciated VOC $	...	< 1.23*	mg/m³	< 12.13	...	...	> 100	& Wet Gas	01/07/25	11:00 – 11:30	CEN/TS 13649:2014	NU	✓	
	Hydrofluoric Acid $	...	< 1.25	mg/m³	< 12.33	...	...	> 100	& Wet Gas	01/07/25	11:05 – 11:35	Based on CEN/TS 13649:2014	NA	✓	
	Hydrochloric Acid $	...	< 0.25	mg/m³	< 2.47	...	...	> 100	& Wet Gas	01/07/25	11:05 – 11:35	Based on CEN/TS 13649:2014	NA	✓	
	Nitric Acid $	...	< 0.50	mg/m³	< 4.93	...	...	> 100	& Wet Gas	01/07/25	11:05 – 11:35	Based on CEN/TS 13649:2014	NA	✓	
	Phosphoric Acid $	...	< 1.50	mg/m³	< 14.80	...	...	> 100	& Wet Gas	01/07/25	11:05 – 11:35	Based on CEN/TS 13649:2014	NA	✓	
	Sulphuric Acid $	...	< 0.50	mg/m³	< 4.93	...	...	> 100	& Wet Gas	01/07/25	11:05 – 11:35	Based on CEN/TS 13649:2014	NA	✓	
	Hydrogen Bromide $	...	< 0.50	mg/m³	< 4.93	...	...	> 100	& Wet Gas	01/07/25	11:05 – 11:35	Based on CEN/TS 13649:2014	NA	✓	
	Total Acids $	...	< 4.51	mg/m³	< 44.49	...	...	48	& Wet Gas	01/07/25	11:05 – 11:35	Based on CEN/TS 13649:2014	NA	✓	

***** There were zero peaks found on the GC-MS Scan above the 1.23 mg/m³ limit of detection

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Mass Emission (mg/hr)	Expanded Uncertainty (as % of)			Reference Conditions 273 K,101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation Claimed for Test Result	Tick if non-conforming test (see Section 2)	Operating Status
						ELV	Span Value	Measured Value							
Reaction Vessel – (Materials Laboratory)	Formaldehyde $	...	0.074	mg/m³	1.05	...	...	50	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	UKAS / MCERTS	✓	Reaction Phase 2
	Butyraldehyde $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Acetaldehyde $	...	0.69	mg/m³	9.79	...	...	11	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Propionaldehyde $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Benzaldehyde $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Valeraldehyde $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Hexanal $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Heptanal $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	NU	✓	
	Total Aldehydes $	...	< 1.07	mg/m³	< 15.18	...	...	14	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	NU	✓	
	Total VOC $	...	< 2.49	mg/m³	< 35.32	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	NU	✓	
	Speciated VOC $	...	< 1.25*	mg/m³	< 17.73	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	CEN/TS 13649:2014	NU	✓	
	Hydrofluoric Acid $	...	< 1.23	mg/m³	< 17.45	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	Based on CEN/TS 13649:2014	NA	✓	
	Hydrochloric Acid $	...	< 0.25	mg/m³	< 3.55	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	Based on CEN/TS 13649:2014	NA	✓	
	Nitric Acid $	...	< 0.49	mg/m³	< 6.95	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	Based on CEN/TS 13649:2014	NA	✓	
	Phosphoric Acid $	...	< 1.48	mg/m³	< 20.99	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	Based on CEN/TS 13649:2014	NA	✓	
	Sulphuric Acid $	...	< 0.49	mg/m³	< 6.95	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	Based on CEN/TS 13649:2014	NA	✓	
	Hydrogen Bromide $	...	< 0.49	mg/m³	< 6.95	...	...	> 100	& Wet Gas	01/07/25	11:40 – 12:10	Based on CEN/TS 13649:2014	NA	✓	
	Total Acids $	...	< 4.44	mg/m³	< 62.98	...	...	48	& Wet Gas	01/07/25	11:40 – 12:10	Based on CEN/TS 13649:2014	NA	✓	

***** There were zero peaks found on the GC-MS Scan above the 1.25 mg/m³ limit of detection

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Mass Emission (mg/hr)	Expanded Uncertainty (as % of)			Reference Conditions 273 K,101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation Claimed for Test Result	Tick if non-conforming test (see Section 2)	Operating Status
						ELV	Span Value	Measured Value							
Reaction Vessel – (Materials Laboratory)	Formaldehyde $	...	0.075	mg/m³	1.06	...	...	50	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	UKAS / MCERTS	✓	Reaction Phase 2
	Butyraldehyde $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Acetaldehyde $	...	0.17	mg/m³	2.41	...	...	30	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Propionaldehyde $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Benzaldehyde $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Valeraldehyde $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Hexanal $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Heptanal $	...	< 0.050	mg/m³	< 0.71	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	NU	✓	
	Total Aldehydes $	...	<0.55	mg/m³	< 7.80	...	...	25	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	NU	✓	
	Total VOC $	...	< 2.50	mg/m³	< 35.46	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	NU	✓	
	Speciated VOC $	...	< 1.25*	mg/m³	< 17.73	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	CEN/TS 13649:2014	NU	✓	
	Hydrofluoric Acid $	...	< 1.24	mg/m³	< 17.59	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	Based on CEN/TS 13649:2014	NA	✓	
	Hydrochloric Acid $	...	< 0.25	mg/m³	< 3.55	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	Based on CEN/TS 13649:2014	NA	✓	
	Nitric Acid $	...	< 0.50	mg/m³	< 7.09	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	Based on CEN/TS 13649:2014	NA	✓	
	Phosphoric Acid $	...	< 1.49	mg/m³	< 21.13	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	Based on CEN/TS 13649:2014	NA	✓	
	Sulphuric Acid $	...	< 0.50	mg/m³	< 7.09	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	Based on CEN/TS 13649:2014	NA	✓	
	Hydrogen Bromide $	...	< 0.50	mg/m³	< 7.09	...	...	> 100	& Wet Gas	01/07/25	13:02 – 13:32	Based on CEN/TS 13649:2014	NA	✓	
	Total Acids $	...	< 4.47	mg/m³	< 63.40	...	...	48	& Wet Gas	01/07/25	13:02 – 13:32	Based on CEN/TS 13649:2014	NA	✓	

***** There were zero peaks found on the GC-MS Scan above the 1.25 mg/m³ limit of detection

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Mass Emission (mg/hr)	Expanded Uncertainty (as % of)			Reference Conditions 273 K,101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation Claimed for Test Result	Tick if non-conforming test (see Section 2)	Operating Status
						ELV	Span Value	Measured Value							
Reaction Vessel – (Materials Laboratory)	Formaldehyde $	...	0.15	mg/m³	2.31	...	...	30	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	UKAS / MCERTS	✓	Reaction Phase 3
	Butyraldehyde $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Acetaldehyde $	...	1.07	mg/m³	16.49	...	...	11	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Propionaldehyde $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Benzaldehyde $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Valeraldehyde $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Hexanal $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Heptanal $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	NU	✓	
	Total Aldehydes $	...	< 1.52	mg/m³	< 23.42	...	...	12	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	NU	✓	
	Total VOC $	...	14.02	mg/m³	216.02	...	...	11	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	NU	✓	
	Speciated VOC (Acetone) $	...	12.74*	mg/m³	196.30	...	...	11	& Wet Gas	01/07/25	14:15 – 14:45	CEN/TS 13649:2014	NU	✓	
	Hydrofluoric Acid $	...	< 1.24	mg/m³	< 19.11	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	Based on CEN/TS 13649:2014	NA	✓	
	Hydrochloric Acid $	...	< 0.25	mg/m³	< 3.85	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	Based on CEN/TS 13649:2014	NA	✓	
	Nitric Acid $	...	< 0.50	mg/m³	< 7.70	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	Based on CEN/TS 13649:2014	NA	✓	
	Phosphoric Acid $	...	< 1.49	mg/m³	< 22.96	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	Based on CEN/TS 13649:2014	NA	✓	
	Sulphuric Acid $	...	< 0.50	mg/m³	< 7.70	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	Based on CEN/TS 13649:2014	NA	✓	
	Hydrogen Bromide $	...	< 0.50	mg/m³	< 7.70	...	...	> 100	& Wet Gas	01/07/25	14:15 – 14:45	Based on CEN/TS 13649:2014	NA	✓	
	Total Acids $	...	< 4.47	mg/m³	< 68.87	...	...	48	& Wet Gas	01/07/25	14:15 – 14:45	Based on CEN/TS 13649:2014	NA	✓	

***** Acetone was the only peak found on the GC-MS Scan above the 1.25 mg/m³ limit of detection

DEScycle at Leicester University **Installation Name : Reaction Vessel**
Permit No : ... **Visit Details : Investigative Emissions – July 2025**
Variation No : ... **Survey Dates : 1st July 2025**
Report Ref : P6125 : R001 **Report Issue Date : 20th August 2025**

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Mass Emission (mg/hr)	Expanded Uncertainty (as % of)			Reference Conditions 273 K,101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation Claimed for Test Result	Tick if non-conforming test (see Section 2)	Operating Status
						ELV	Span Value	Measured Value							
Reaction Vessel – (Materials Laboratory)	Formaldehyde $	...	0.15	mg/m³	2.31	...	...	30	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	UKAS / MCERTS	✓	Reaction Phase 3
	Butyraldehyde $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Acetaldehyde $	...	0.87	mg/m³	13.40	...	...	11	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Propionaldehyde $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Benzaldehyde $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Valeraldehyde $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Hexanal $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	UKAS / MCERTS	✓	
	Heptanal $	...	< 0.050	mg/m³	< 0.77	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	NU	✓	
	Total Aldehydes $	...	< 1.31	mg/m³	< 20.18	...	...	12	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	NU	✓	
	Total VOC $	...	7.97	mg/m³	122.80	...	...	11	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	NU	✓	
	Speciated VOC (Acetone) $	...	6.65*	mg/m³	102.46	...	...	11	& Wet Gas	01/07/25	14:53 – 15:23	CEN/TS 13649:2014	NU	✓	
	Hydrofluoric Acid $	...	< 1.24	mg/m³	< 19.11	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	Based on CEN/TS 13649:2014	NA	✓	
	Hydrochloric Acid $	...	< 0.25	mg/m³	< 3.85	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	Based on CEN/TS 13649:2014	NA	✓	
	Nitric Acid $	...	< 0.49	mg/m³	< 7.55	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	Based on CEN/TS 13649:2014	NA	✓	
	Phosphoric Acid $	...	< 1.48	mg/m³	< 22.80	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	Based on CEN/TS 13649:2014	NA	✓	
	Sulphuric Acid $	...	< 0.49	mg/m³	< 7.55	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	Based on CEN/TS 13649:2014	NA	✓	
	Hydrogen Bromide $	...	< 0.49	mg/m³	< 7.55	...	...	> 100	& Wet Gas	01/07/25	14:53 – 15:23	Based on CEN/TS 13649:2014	NA	✓	
	Total Acids $	...	< 4.45	mg/m³	< 68.57	...	...	48	& Wet Gas	01/07/25	14:53 – 15:23	Based on CEN/TS 13649:2014	NA	✓	

***** Acetone was the only peak found on the GC-MS scan above the 1.25 mg/m³ limit of detection

DEScycle at Leicester University			**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**		**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**		**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125**	**: R001**	**Report Issue Date**	**: 20th August 2025**

Notes

Emission Limit Value	The emission limit value is that stated in the permit and will be expressed as a concentration or a mass emission.
Periodic Monitoring Result	The result given is expressed in the same terms and units as the emission limit value.
Uncertainty	The uncertainty associated with the quoted result is at the 95% confidence interval. The Uncertainty results **DO NOT** take into account the effect of the sample location limitations.
Reference Conditions	All results are expressed at 273 K and 101.3kPa. The oxygen and moisture corrections are stated.
Monitoring Method Reference	The method stated is in accordance with the Environment Agency Technical Guidance Note M2, or other method approved by the Environment Agency.
Accreditation for use of Method	**The details indicate the accreditation for the use of the complete monitoring method, e.g. MCERTs, UKAS. If use of the method is not accredited " NA" is stated.**
Operating Status	The details indicate the feedstock and the loading rate of the plant during monitoring.
$	Chemical Analysis on sample reagents was performed by an External Laboratory as detailed in Section 4
NU	UKAS Accreditation Held but UKAS Accreditation cannot be claimed for the test as sampling did not comply with the Standard Reference Method (SRM), see section 2 & 5
NA	**Method is NOT UKAS Accredited.**

1.2 Operating Information

Any operating information and CEMS data below has been supplied by the client.

Emission Point Reference	Process Type	Process Duration	Fuel	Feedstock	Abatement	Load	Comparison of Operator CEMS and Periodic Monitoring Results					
							Parameter	Date	Time	CEMS Results	Periodic Monitoring Results	Units
Reaction Vessel	Batch	See Below	n/a	n/a	None	Normal	...	...	...	NP	...	...

Batch Information during testing:

Reaction Phase 1 (Solvents on only – 80ºC Operating Temperature)
Tube Tests 1 & 2

Reaction Phase 2 (DES 1 E Waste 80ºC Operating Temperature)
Tube Tests 3 & 4
150g of E waste into 1.5 litres of solvent

Reaction Phase 3 (DES 1 precipitation 50ºC Operating Temperature)
Tube Tests 5 & 6
6g per minute.

Notes:

Process Type	State whether the process is a continuous or batch process.
Process Duration	If a batch process, state the duration, frequency and details of the portion of the batch sampled. If continuous state "NA"
Fuel	If applicable, state the fuel type If not applicable state "NA"
Feedstock	State the feedstock type
Abatement	State the type and whether operational during monitoring. If not applicable state "NA"
Load	State the normal load, throughput or rating of the plant
CEMS Data	Enter this data for each CEM installed if it is has been provided by operator otherwise state “NP” (NOT PROVIDED)

2 Monitoring Deviations

The objective of the survey was to measure the concentrations of pollutants from the processes / locations as detailed in Section 1.

There were modifications to the sampling procedures (TPDs) listed in section 4. these are as follows. For the acid screen samples, sampling was made based on ECL/TPD/84 but using treated silica gel tubes (226-10-03).

There were no substance deviations from the original and agreed emissions monitoring schedule.

Non-conforming tests are as follows.

The Uncertainty of the reported concentrations for these pollutant results DOES NOT take into account the effect of non-conformities or sample location limitations.

Due to the very small diameter of the sample ductwork, it was not possible to use an in-stack sinter filter for the tube sampling trains, instead a small section of rigid stainless tube attached to the inlet of the sinter was inserted into the duct and the sinter remained outside the duct.

For the first speciated VOC test during reaction phase 2, greater than 5% of the total amount of organic compounds captured were found on the back up portion of the sorbent tube, so the efficiency check requirements were not met on this test and the reported results might be an underestimate of the total values.

Volumetric Flowrate tests during reaction phases 1 & 2 are non-conforming, (and cannot hold accreditation) This is because the flowrate in this duct during these tests was below the method limit of detection (5Pa).

ECL holds UKAS/MCERTS accreditation for the sampling of Speciated VOC however commercial laboratories in the UK cannot hold analytical accreditation for Total VOC/ Hydrocarbons nor for GC-MS scans, so accreditation for the results CANNOT be claimed.

ECL holds UKAS/MCERTS accreditation for the sampling of Aldehydes, and the subcontract laboratory hold UKAS/MCERTS accreditation for the analysis of MOST of the suite (apart from Heptanal for which they hold no accreditation). This means that for all individual aldehydes (apart from Heptanal) UKAS/MCERTS accreditation can be claimed for the final results. The final results for Heptanal and for the total group cannot hold any accreditation.

ECL does not hold any accreditation for the sampling of Acids using sorbent tubes and so the final results cannot hold any accreditation. The subcontract laboratory hold UKAS but not MCERTS accreditation for the analysis of MOST of the suite (apart from Hydrofluoric Acid for which they hold no accreditation).

Homogeneity tests have not been completed for pollutants at this sampling location. Such tests are not applicable to this location (as the process is not a combustion process and the duct area is <1m^2) and were not requested by the client.

PART 2 – SUPPORTING INFORMATION

3 SAMPLING STAFF DETAILS

Site Sampling Team

Names of Site Team	Dates on Site	MCERTS No.	LEVEL	Technical Endorsements
Jon Litterick	01/07/2025	MM 03 236	2	TE1, TE2, TE3, TE4
Scott Hackett	01/07/2025	MM 07 889	2	TE1, TE2, TE3, TE4

Report Reviewer

Name	MCERTS No.	LEVEL	Technical Endorsements
Andy Barnes	MM 03 235	2	TE1, TE2, TE3, TE4

Technical Endorsement Key:-

TE1 – **Isokinetic** Particulates, Temperature & Velocity Profiles, Oxygen.
TE2 – **Isokinetic** Extractive Pollutants:- Metals, Dioxin & Furans, PAHs, PCBs, HCl, HF.
TE3 – **Non-Isokinetic** Extractive Pollutants:- Speciated VOCs, HF, HCl, Cyanide.
TE4 – **Continuous Analysers** (Combustion Gases):- TVOC, CO, NOx, SO_2.

4 SAMPLING PROTOCOLS / METHODOLOGIES

Details of the substances monitored, the standard methods used and the Environmental Compliance Limited Technical Procedures used during this survey are shown in the table below. Detailed sampling protocols are included in a separate document which will be sent with the report.

In all cases, where analysis of collected samples was required, the analysis was by a subcontract laboratory. Details of the sub-contract laboratory are shown on the analysis certificates in this report. The UKAS/MCERTs accreditation status of the analysis is also indicated on the certificates.

Any required modifications to the Technical Procedure Documents (TPDs) specified below will be detailed in section 2 of this report.

Determinand	External Reference Method	ECL Technical Procedure Number
Velocity and Flowrate	BS EN 16911-1:2013 & MID	ECL/ TPD/ 022A
Aldehydes	CEN/TS 13649:2014	ECL / TPD / 084
Total & Speciated VOC	CEN/TS 13649:2014	ECL / TPD / 084
Acids (Sorbent Tubes)	Based on CEN/TS 13649:2014	Based on ECL / TPD / 084

5 SAMPLE POINT DESCRIPTIONS

The homogeneity test is applicable to combustion processes, but may also be requested by the regulator for non-combustion processes.

Homogeneity testing has not been completed at this location.

The test is not usually required for stacks with sampling plane areas of <1m^2 (below 1.13m in diameter for circular ducts).

The Uncertainty of the reported concentrations for these pollutant results DOES NOT take into account the effect of non-conformities or sample location limitations.

The sample location that was monitored is detailed below: -

Materials Laboratory – Reaction Vessel

The sample tube diameter is 0.045m and the width back from the sampling holes to the end of the work bench is 1.0m.

The reaction vessel is situated on a laboratory work bench at approximately waist height, with the sampling holes positioned 0.8m above this bench.

Four sample holes are located on a slightly raised horizontal section of tubing, the holes are positioned in series, one after the other.

Access to the sample location was via internal concrete steps within a main office / laboratory building. All sampling was undertaken in a laboratory office environment, where the reaction vessel was situated on a bench.

EQUIPMENT IDs
(Pre site checklist from SSP)

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

PRE SITE EQUIPMENT CHECKLIST/ EQUIPMENT USED

(Completed before departure to site and when on site in full)

Equipment	Equip. Type	ID No:	ID No:	ID No:	ID No:	ID No:	ID No:	ID No:	ID No:
MST console/pump	E001								
MST Nozzle set									
MST "S" Type Pitot									
MST Probe									
MST Probe Thermocouple									
MST Hot Box									
MST Impinger Arm									
Barometer		1320							
Site Balance									
Site Check weights									
Horiba	E002								
Heated Probe / Filter									
Chiller									
MFC									
Heated Line									
FID	E003								
Heated Line									
Heated Probe / Filter									
Testo	E004								
FTIR	E005								
Heated Probe / Filter									
Heated Line									
Stackmite	E006								
"L" Type Pitot		1319							
Digital Manometer		1318							
Stack Thermocouple		1244							
Thermocouple Reader		1317							
Nozzle Set									
Workhorse / Vapex Pumps	E007	1276	1277	1278					
Stack Thermocouple									
Tube Thermocouple		1031	1033	1038					
Meter Thermocouple		1030	1028	1032					
High Vac Gauge									
Dioxin Thermocouple									

Quantity of Ice Required / Used for Survey		Bags (2kg bags)

TABLES

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Table 1 – Aldehydes (Phase 1 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	25.67
StackTemperature	°C	26.00
Sample Date	…	01/07/20255
Sample Period	…	10:20 - 10:50
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0041

Sample Tube Results		Aldehydes Test 1		Blank
Sample Reference ECL/25/2906	Units	Concentration*	Uncertainty	Concentration
Concentration of Formaldehyde	mg/m^3	0.098	50.26%	0.024
Concentration of Butyraldehyde	mg/m^3	0.049	100.13%	0.049
Concentration of Acetaldehyde	mg/m^3	0.049	60.22%	0.024
Concentration of Propionaldehyde	mg/m^3	0.049	100.13%	0.049
Concentration of Benzaldehyde	mg/m^3	0.049	100.13%	0.049
Concentration of Valeraldehyde	mg/m^3	0.049	100.13%	0.049
Concentration of Hexanal	mg/m^3	0.049	100.13%	0.049
Concentration of Heptanal	mg/m^3	0.024	100.13%	0.049
Total Aldehydes	mg/m^3	0.42	30.31%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Table 2 – Aldehydes (Phase 1 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	26.33
StackTemperature	°C	27.00
Sample Date	…	01/07/20255
Sample Period	…	11:00 - 11:30
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0041

Sample Tube Results		Aldehydes Test 2		Blank
Sample Reference ECL/25/2907	Units	Concentration*	Uncertainty	Concentration
Concentration of Formaldehyde	mg/m^3	0.098	50.26%	0.025
Concentration of Butyraldehyde	mg/m^3	0.049	100.13%	0.049
Concentration of Acetaldehyde	mg/m^3	0.025	100.13%	0.025
Concentration of Propionaldehyde	mg/m^3	0.049	100.13%	0.049
Concentration of Benzaldehyde	mg/m^3	0.049	100.13%	0.049
Concentration of Valeraldehyde	mg/m^3	0.049	100.13%	0.049
Concentration of Hexanal	mg/m^3	0.049	100.13%	0.049
Concentration of Heptanal	mg/m^3	0.049	100.13%	0.049
Total Aldehydes	mg/m^3	0.42	31.74%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Table 3 – Aldehydes (Phase 2 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	27.00
StackTemperature	°C	28.00
Sample Date	…	01/07/20255
Sample Period	…	11:40 - 12:10
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Aldehydes Test 3		Blank
Sample Reference ECL/25/2908	Units	Concentration*	Uncertainty	Concentration
Concentration of Formaldehyde	mg/m^3	0.074	50.26%	0.025
Concentration of Butyraldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Acetaldehyde	mg/m^3	0.69	11.24%	0.025
Concentration of Propionaldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Benzaldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Valeraldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Hexanal	mg/m^3	0.050	100.13%	0.050
Concentration of Heptanal	mg/m^3	0.050	100.13%	0.050
Total Aldehydes	mg/m^3	1.07	14.00%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Table 4 – Aldehydes (Phase 2 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	30.00
Sample Date	…	01/07/20255
Sample Period	…	13:02 - 13:32
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Aldehydes Test 4		Blank
Sample Reference ECL/25/2909	Units	Concentration*	Uncertainty	Concentration
Concentration of Formaldehyde	mg/m^3	0.075	50.26%	0.025
Concentration of Butyraldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Acetaldehyde	mg/m^3	0.17	30.43%	0.025
Concentration of Propionaldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Benzaldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Valeraldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Hexanal	mg/m^3	0.050	100.13%	0.050
Concentration of Heptanal	mg/m^3	0.050	100.13%	0.050
Total Aldehydes	mg/m^3	0.55	25.26%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 5 – Aldehydes (Phase 3 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	29.33
Sample Date	…	01/07/20255
Sample Period	…	14:15 - 14:45
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Aldehydes Test 5		Blank
Sample Reference ECL/25/2910	Units	Concentration*	Uncertainty	Concentration
Concentration of Formaldehyde	mg/m^3	0.15	30.43%	0.025
Concentration of Butyraldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Acetaldehyde	mg/m^3	1.07	11.23%	0.025
Concentration of Propionaldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Benzaldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Valeraldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Hexanal	mg/m^3	0.050	100.13%	0.050
Concentration of Heptanal	mg/m^3	0.050	100.13%	0.050
Total Aldehydes	mg/m^3	1.52	11.67%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 6 – Aldehydes (Phase 3 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	29.67
Sample Date	…	01/07/20255
Sample Period	…	14:53 - 15:23
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Aldehydes Test 6		Blank
Sample Reference ECL/25/2911	Units	Concentration*	Uncertainty	Concentration
Concentration of Formaldehyde	mg/m^3	0.15	30.43%	0.025
Concentration of Butyraldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Acetaldehyde	mg/m^3	0.87	11.23%	0.025
Concentration of Propionaldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Benzaldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Valeraldehyde	mg/m^3	0.050	100.13%	0.050
Concentration of Hexanal	mg/m^3	0.050	100.13%	0.050
Concentration of Heptanal	mg/m^3	0.050	100.13%	0.050
Total Aldehydes	mg/m^3	1.31	12.35%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Table 7 – Total Hydrocarbons (Phase 1 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	25.67
StackTemperature	°C	26.00
Sample Date	...	01/07/2025
Sample Period	...	10:20 - 10:50
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0041

Sample Tube Results		Total Hydrocarbons Test 1		Blank
Sample Reference ECL/25/2899	Units	Concentration*	Uncertainty	Concentration
Concentration of Total Hydrocarbons	mg/m^3	2.46	100.13%	2.46

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 8 – Total Hydrocarbons (Phase 1 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	26.33
StackTemperature	°C	27.00
Sample Date	…	01/07/2025
Sample Period	…	11:00 - 11:30
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Total Hydrocarbons Test 2		Blank
Sample Reference ECL/25/2900	Units	Concentration*	Uncertainty	Concentration
Concentration of Total Hydrocarbons	mg/m^3	2.47	100.13%	2.47

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Table 9 – Total Hydrocarbons (Phase 2 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	27.00
StackTemperature	°C	28.00
Sample Date	…	01/07/2025
Sample Period	…	11:40 - 12:10
Sample Volume (as Measured)	m^3	0.0044
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Total Hydrocarbons Test 3		Blank
Sample Reference ECL/25/2901	Units	Concentration*	Uncertainty	Concentration
Concentration of Total Hydrocarbons	mg/m^3	2.49	100.13%	2.49

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Table 10 – Total Hydrocarbons (Phase 2 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	30.00
Sample Date	…	01/07/2025
Sample Period	…	13:02 - 13:32
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Total Hydrocarbons Test 4		Blank
Sample Reference ECL/25/2902	Units	Concentration*	Uncertainty	Concentration
Concentration of Total Hydrocarbons	mg/m^3	2.50	100.13%	2.50

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Table 11 – Total Hydrocarbons (Phase 3 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	29.33
Sample Date	...	01/07/2025
Sample Period	...	14:15 - 14:45
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Total Hydrocarbons Test 5		Blank
Sample Reference ECL/25/2903	Units	Concentration*	Uncertainty	Concentration
Concentration of Total Hydrocarbons	mg/m^3	14.02	11.22%	2.50

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Table 12 – Total Hydrocarbons (Phase 3 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	29.67
Sample Date	...	01/07/2025
Sample Period	...	14:53 - 15:23
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Total Hydrocarbons Test 6		Blank
Sample Reference ECL/25/2904	Units	Concentration*	Uncertainty	Concentration
Concentration of Total Hydrocarbons	mg/m^3	7.97	11.22%	2.49

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 13 – Speciated VOC (Phase 1 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	25.67
StackTemperature	°C	26.00
Sample Date	…	01/07/2025
Sample Period	…	10:20 - 10:50
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0041

Sample Tube Results		Top 20 VOC Test 1		Blank
Sample Reference ECL/25/2899	Units	Concentration*	Uncertainty	Concentration
Concentration of Speciated VOC	mg/m^3	1.23	100.13%	1.23

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 14 – Speciated VOC (Phase 1 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	26.33
StackTemperature	°C	27.00
Sample Date	…	01/07/2025
Sample Period	…	11:00 - 11:30
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Top 20 VOC Test 2		Blank
Sample Reference ECL/25/2900	Units	Concentration*	Uncertainty	Concentration
Concentration of Speciated VOC	mg/m^3	1.23	100.13%	1.23

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 15 – Speciated VOC (Phase 2 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	27.00
StackTemperature	°C	28.00
Sample Date	…	01/07/2025
Sample Period	…	11:40 - 12:10
Sample Volume (as Measured)	m^3	0.0044
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Top 20 VOC Test 3		Blank
Sample Reference ECL/25/2901	Units	Concentration*	Uncertainty	Concentration
Concentration of Speciated VOC	mg/m^3	1.25	100.13%	1.25

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 16 – Speciated VOC (Phase 2 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	30.00
Sample Date	…	01/07/2025
Sample Period	…	13:02 - 13:32
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Top 20 VOC Test 4		Blank
Sample Reference ECL/25/2902	Units	Concentration*	Uncertainty	Concentration
Concentration of Speciated VOC	mg/m^3	1.25	100.13%	1.25

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 17 – Speciated VOC (Phase 3 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	29.33
Sample Date	…	01/07/2025
Sample Period	…	14:15 - 14:45
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Top 20 VOC Test 5		Blank
Sample Reference ECL/25/2903	Units	Concentration*	Uncertainty	Concentration
Concentration of Acetone	mg/m^3	12.74	11.22%	1.25

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 18 – Speciated VOC (Phase 3 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	29.67
Sample Date	…	01/07/2025
Sample Period	…	14:53 - 15:23
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Top 20 VOC Test 6		Blank
Sample Reference ECL/25/2904	Units	Concentration*	Uncertainty	Concentration
Concentration of Acetone	mg/m^3	6.65	11.22%	1.25

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 19 – Acids Screen (Phase 1 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	25.67
StackTemperature	°C	26.00
Sample Date	…	01/07/2025
Sample Period	…	10:20 - 10:50
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0041

Sample Tube Results		Acids Screen Test 1		Blank
Sample Reference ECL/25/2913	Units	Concentration*	Uncertainty	Concentration
Concentration of Hydrofluoric Acid	mg/m^3	1.23	100.13%	1.23
Concentration of Hydrochloric Acid	mg/m^3	0.25	100.13%	0.25
Concentration of Nitric Acid	mg/m^3	0.49	100.13%	0.49
Concentration of Phosphoric Acid	mg/m^3	1.47	100.13%	1.47
Concentration of Sulphuric Acid	mg/m^3	0.49	100.13%	0.49
Concentration of Hydrogen Bromide	mg/m^3	0.49	100.13%	0.49
Total Acids	mg/m^3	4.41	47.85%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 20 – Acids Screen (Phase 1 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	26.33
StackTemperature	°C	27.00
Sample Date	…	01/07/2025
Sample Period	…	11:05 - 11:35
Sample Volume (as Measured)	m^3	0.0044
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Acids Screen Test 2		Blank
Sample Reference ECL/25/2914	Units	Concentration*	Uncertainty	Concentration
Concentration of Hydrofluoric Acid	mg/m^3	1.25	100.13%	1.25
Concentration of Hydrochloric Acid	mg/m^3	0.25	100.13%	0.25
Concentration of Nitric Acid	mg/m^3	0.50	100.13%	0.50
Concentration of Phosphoric Acid	mg/m^3	1.50	100.13%	1.50
Concentration of Sulphuric Acid	mg/m^3	0.50	100.13%	0.50
Concentration of Hydrogen Bromide	mg/m^3	0.50	100.13%	0.50
Total Acids	mg/m^3	4.51	47.85%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 21 – Acids Screen (Phase 2 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	27.00
StackTemperature	°C	28.00
Sample Date	…	01/07/2025
Sample Period	…	11:40 - 12:10
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0041

Sample Tube Results		Acids Screen Test 3		Blank
Sample Reference ECL/25/2915	Units	Concentration*	Uncertainty	Concentration
Concentration of Hydrofluoric Acid	mg/m^3	1.23	100.13%	1.23
Concentration of Hydrochloric Acid	mg/m^3	0.25	100.13%	0.25
Concentration of Nitric Acid	mg/m^3	0.49	100.13%	0.49
Concentration of Phosphoric Acid	mg/m^3	1.48	100.13%	1.48
Concentration of Sulphuric Acid	mg/m^3	0.49	100.13%	0.49
Concentration of Hydrogen Bromide	mg/m^3	0.49	100.13%	0.49
Total Acids	mg/m^3	4.44	47.85%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 22 – Acids Screen (Phase 2 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	30.00
Sample Date	…	01/07/2025
Sample Period	…	13:02 - 13:32
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Acids Screen Test 4		Blank
Sample Reference ECL/25/2916	Units	Concentration*	Uncertainty	Concentration
Concentration of Hydrofluoric Acid	mg/m^3	1.24	100.13%	1.24
Concentration of Hydrochloric Acid	mg/m^3	0.25	100.13%	0.25
Concentration of Nitric Acid	mg/m^3	0.50	100.13%	0.50
Concentration of Phosphoric Acid	mg/m^3	1.49	100.13%	1.49
Concentration of Sulphuric Acid	mg/m^3	0.50	100.13%	0.50
Concentration of Hydrogen Bromide	mg/m^3	0.50	100.13%	0.50
Total Acids	mg/m^3	4.47	47.85%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 23 – Acids Screen (Phase 3 – Test 1)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	29.33
Sample Date	…	01/07/2025
Sample Period	…	14:15 - 14:45
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Acids Screen Test 5		Blank
Sample Reference ECL/25/2917	Units	Concentration*	Uncertainty	Concentration
Concentration of Hydrofluoric Acid	mg/m^3	1.24	100.13%	1.24
Concentration of Hydrochloric Acid	mg/m^3	0.25	100.13%	0.25
Concentration of Nitric Acid	mg/m^3	0.50	100.13%	0.50
Concentration of Phosphoric Acid	mg/m^3	1.49	100.13%	1.49
Concentration of Sulphuric Acid	mg/m^3	0.50	100.13%	0.50
Concentration of Hydrogen Bromide	mg/m^3	0.50	100.13%	0.50
Total Acids	mg/m^3	4.47	47.85%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

Table 24 – Acids Screen (Phase 3 – Test 2)

Descycle Ltd

Leicester University Materials Laboratory Reaction Vessel

Emission Parameter	Units	Value
Stack Diameter	mm	45
Area of Sample Plane	m^2	0.002
Measured Oxygen (Dry)	%Vol	20.90
Meter Temperature	°C	29.00
StackTemperature	°C	29.67
Sample Date	…	01/07/2025
Sample Period	…	14:53 - 15:23
Sample Volume (as Measured)	m^3	0.0045
Sample Volume (reference Conditions)	m^3*	0.0040

Sample Tube Results		Acids Screen Test 6		Blank
Sample Reference ECL/25/2918	Units	Concentration*	Uncertainty	Concentration
Concentration of Hydrofluoric Acid	mg/m^3	1.24	100.13%	1.24
Concentration of Hydrochloric Acid	mg/m^3	0.25	100.13%	0.25
Concentration of Nitric Acid	mg/m^3	0.49	100.13%	0.49
Concentration of Phosphoric Acid	mg/m^3	1.48	100.13%	1.48
Concentration of Sulphuric Acid	mg/m^3	0.49	100.13%	0.49
Concentration of Hydrogen Bromide	mg/m^3	0.49	100.13%	0.49
Total Acids	mg/m^3	4.45	47.85%	…

***Reference Conditions: 273 K, 101.3 kPa, Wet Gas**

VELOCITY TRAVERSE PROFILES

Environmental Compliance Limited

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Environmental Compliance Limited	Traverse Data Profoma	Date of Measurement	01/07/2025

Company	Descycle Ltd	Stack Diameter Port A (mm)	45	Average Stack Diameter (mm)	45	Pitot tube coefficient	0.99
Site	Leicester University	Stack Diameter Port B (mm)		Port Length (mm)	3	Pitot Id	1319
Location	Materials Laboratory	Duct Length Port A (mm)		Average Duct Length (mm) L		Stack Thermocouple ID	1244
Stack	Reaction Vessel	Duct Length Port B (mm)		Duct width (mm) B		Stack Temp Reader ID	1317
Job No	P6125	Duct Length Port C (mm)		Barometric Pressure. (mb)	1006	Manometer ID	1318
Operators	SH & JL	Duct Length Port D (mm)		Ave Static Press. (mm H_20)	0.05	Barometer ID	1320

Pre - Traverse Checks Carried Out	Time	Pass/ Fail
Pre - Traverse PITOT Visual Inspection	10:15:00	Pass
Pre - Traverse PITOT Leak Check	10:17:00	Pass

Smooth Walls

Static Pressure Readings (Pascals)			
Port A	Port B	Port C	Port D
0.50			

Port/ Point	Distance to Point (mm)	Time	Temperature Readings (°C)			(ΔP) Pitot Readings (Pa)			Average Temp. (°C)	Average (ΔP) (Pa)	Swirl Test ° From Reference
			1	2	3	1	2	3			
A1	23	10:25:00	26.3	26.3	26.3	2.2	2.2	2.1	26.3	2.2	0
Blockage Check @ A1 (L-Type Pitot Only)		10:28:00	26.3	26.4	26.4	2.2	2.2	2.1	26.3	2.2	Total
			Mean		26.4	Mean		2.2	26.3	2.2	Max
			Difference <5% from Initial ?		0.02	Difference <5% from Initial ?		0.00	26.3	2.2	Min
									26.3	2.2	Average

Stagnation Check (S-type Pitot Only)	Time	Reading
Static Pressure Via Positive Leg (Pa)		
Static Pressure Via Negative Leg (Pa)		
Difference (Pa) < 10Pa ?		

Post - Traverse Checks Carried Out	Time	Pass/ Fail
Post - Traverse Visual Inspection	10:30:00	Pass
Post - Traverse PITOT Leak Check	10:32:00	Pass

Average temp (K)	299.300

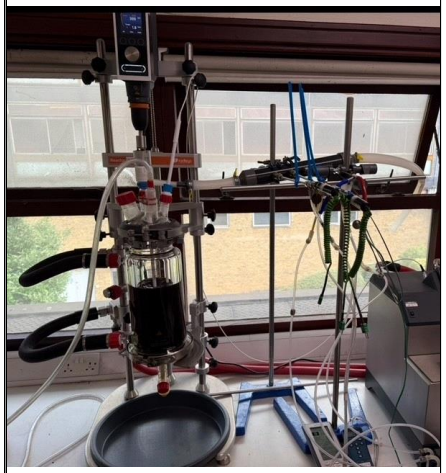
Suitability of Sampling Position	Actual Stack Conditions
Highest:lowest flow pressure ratio < 9:1?	1.02:1
Maximum deviation of flow from axis <15° ?	0
X-sectional area for stacks= πr2	0.00 m^2
X-sectional area for ducts = L x B	m^2
Suitability of Position for Sampling	OK

Stack Moisture	0.1	%	Gas Velocity (as Measured) Adjusted for Smooth Walls	1.89892	m/sec
Measured Oxygen	20.90	%	Gas Velocity (Reference Conditions) Adjusted for Smooth Walls	1.72010	m/sec*
Measured Carbon Dioxide	0.04	%	Volumetric Flowrate (as Measured) Adjusted for Smooth Walls	0.00302	m^3/sec
Dry Gas Molecular Weight	28.84240	g/g mole	Volumetric Flowrate (Ref Cond) Adjusted for Smooth Walls	0.00274	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, Wet Gas

NOTE: Velocity / volume flowrate calculations exclude contributions from the measurement point(s) where swirl >15°

Diagram/ Description of Cross Section of Stack/Duct



Notes
Including expected or actual deviations from procedures / non-conformities

Flow recorded below 5Pa method LOD

Reaction Phase 1

Compliance With Positional Requirements?

Height of sample ports from Platform	0.8m
Number of sample ports	4
Width of platform (port back to handrail)	1.0m

Nearest downstream disturbance	Diameter Change Nozzle	0.13m
Nearest upstream disturbance	Diameter Change Nozzle	0.10m
Disturbances are classed as bends, fans or diameter variations		

Environmental Compliance Limited

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Environmental Compliance Limited	Traverse Data Profoma	Date of Measurement	01/07/2025

Company	Descycle Ltd	Stack Diameter Port A (mm)	45	Average Stack Diameter (mm)	45	Pitot tube coefficient	0.99
Site	Leicester University	Stack Diameter Port B (mm)		Port Length (mm)	3	Pitot Id	1319
Location	Materials Laboratory	Duct Length Port A (mm)		Average Duct Length (mm) L		Stack Thermocouple ID	1244
Stack	Reaction Vessel	Duct Length Port B (mm)		Duct width (mm) B		Stack Temp Reader ID	1317
Job No	P6125	Duct Length Port C (mm)		Barometric Pressure. (mb)	1006	Manometer ID	1318
Operators	SH & JL	Duct Length Port D (mm)		Ave Static Press. (mm H_20)	0.05	Barometer ID	1320

Pre - Traverse Checks Carried Out	Time	Pass/ Fail
Pre - Traverse PITOT Visual Inspection	11:45:00	Pass
Pre - Traverse PITOT Leak Check	11:47:00	Pass

Smooth Walls

Static Pressure Readings (Pascals)			
Port A	Port B	Port C	Port D
0.50			

Port/ Point	Distance to Point (mm)	Time	Temperature Readings (°C) 1	2	3	(ΔP) Pitot Readings (Pa) 1	2	3	Average Temp. (°C)	Average (ΔP) (Pa)	Swirl Test ° From Reference
A1	23	11:50:00	28.4	28.4	28.3	4.6	4.5	4.5	28.4	4.5	0
Blockage Check @ A1 (L-Type Pitot Only)		11:52:00	28.3	28.4	28.5	4.5	4.6	4.6	28.4	4.5	Total
			Mean		28.4	Mean		4.6	28.4	4.5	Max
			Difference <5% from Initial ?		0.01	Difference <5% from Initial ?		0.74	28.4	4.5	Min
									28.4	4.5	Average

Stagnation Check (S-type Pitot Only)	Time	Reading
Static Pressure Via Positive Leg (Pa)		
Static Pressure Via Negative Leg (Pa)		
Difference (Pa) < 10Pa ?		

Post - Traverse Checks Carried Out	Time	Pass/ Fail
Post - Traverse Visual Inspection	11:54:00	Pass
Post - Traverse PITOT Leak Check	11:56:00	Pass

Average temp (K)	301.367

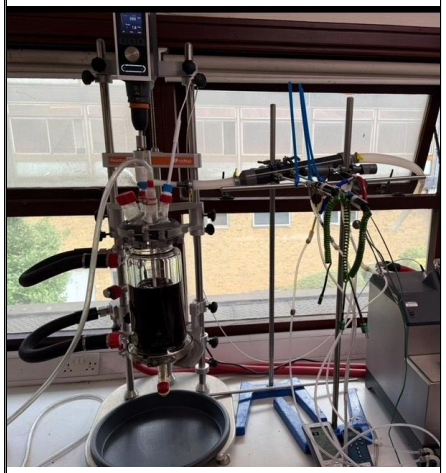
Suitability of Sampling Position	Actual Stack Conditions
Highest:lowest flow pressure ratio < 9:1?	1.01:1
Maximum deviation of flow from axis <15° ?	0
X-sectional area for stacks= πr2	0.00 m^2
X-sectional area for ducts = L x B	m^2
Suitability of Position for Sampling	OK

Stack Moisture	0.1	%	Gas Velocity (as Measured) Adjusted for Smooth Walls	2.75622	m/sec
Measured Oxygen	20.90	%	Gas Velocity (Reference Conditions) Adjusted for Smooth Walls	2.47954	m/sec*
Measured Carbon Dioxide	0.04	%	Volumetric Flowrate (as Measured) Adjusted for Smooth Walls	0.00438	m^3/sec
Dry Gas Molecular Weight	28.84240	g/g mole	Volumetric Flowrate (Ref Cond) Adjusted for Smooth Walls	0.00394	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, Wet Gas

NOTE: Velocity / volume flowrate calculations exclude contributions from the measurement point(s) where swirl >15°

Diagram/ Description of Cross Section of Stack/Duct



Notes
Including expected or actual deviations from procedures / non-conformities

Flow recorded below 5Pa method LOD

Reaction Phase 2

Compliance With Positional Requirements?

Height of sample ports from Platform	0.8m
Number of sample ports	4
Width of platform (port back to handrail)	1.0m

Nearest downstream disturbance	Diameter Change Nozzle	0.13m
Nearest upstream disturbance	Diameter Change Nozzle	0.10m
Disturbances are classed as bends, fans or diameter variations		

Environmental Compliance Limited

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Environmental Compliance Limited	Traverse Data Profoma	Date of Measurement	01/07/2025

Company	Descycle Ltd	Stack Diameter Port A (mm)	45	Average Stack Diameter (mm)	45	Pitot tube coefficient	0.99
Site	Leicester University	Stack Diameter Port B (mm)		Port Length (mm)	3	Pitot Id	1319
Location	Materials Laboratory	Duct Length Port A (mm)		Average Duct Length (mm) L		Stack Thermocouple ID	1244
Stack	Reaction Vessel	Duct Length Port B (mm)		Duct width (mm) B		Stack Temp Reader ID	1317
Job No	P6125	Duct Length Port C (mm)		Barometric Pressure. (mb)	1006	Manometer ID	1318
Operators	SH & JL	Duct Length Port D (mm)		Ave Static Press. (mm H_20)	0.05	Barometer ID	1320

Pre - Traverse Checks Carried Out	Time	Pass/ Fail
Pre - Traverse PITOT Visual Inspection	14:22:00	Pass
Pre - Traverse PITOT Leak Check	14:24:00	Pass

Smooth Walls

Static Pressure Readings (Pascals)			
Port A	Port B	Port C	Port D
0.50			

Port/ Point	Distance to Point (mm)	Time	Temperature Readings (°C) 1	2	3	(ΔP) Pitot Readings (Pa) 1	2	3	Average Temp. (°C)	Average (ΔP) (Pa)	Swirl Test ° From Reference
A1	23	14:30:00	29.8	29.6	29.5	5.4	5.6	5.1	29.6	5.4	0
Blockage Check @ A1 (L-Type Pitot Only)		14:33:00	29.5	29.4	29.4	5.2	5.4	5.3	29.6	5.4	Total
			Mean		29.4	Mean		5.3	29.6	5.4	Max
			Difference <5% from Initial ?		-0.07	Difference <5% from Initial ?		-1.24	29.6	5.4	Min
									29.6	5.4	Average

Stagnation Check (S-type Pitot Only)	Time	Reading
Static Pressure Via Positive Leg (Pa)		
Static Pressure Via Negative Leg (Pa)		
Difference (Pa) < 10Pa ?		

Post - Traverse Checks Carried Out	Time	Pass/ Fail
Post - Traverse Visual Inspection	14:35:00	Pass
Post - Traverse PITOT Leak Check	14:37:00	Pass

Average temp (K)	302.633

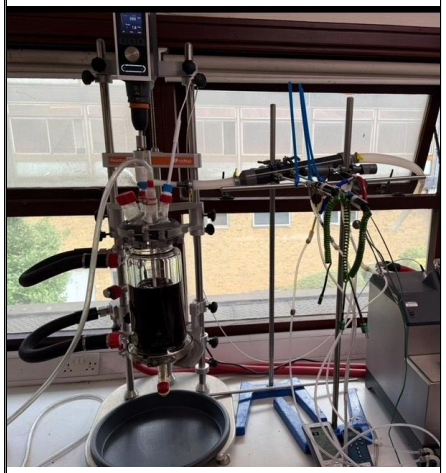
Suitability of Sampling Position	Actual Stack Conditions
Highest:lowest flow pressure ratio < 9:1?	1.01:1
Maximum deviation of flow from axis <15° ?	0
X-sectional area for stacks= πr2	0.00 m^2
X-sectional area for ducts = L x B	m^2
Suitability of Position for Sampling	OK

Stack Moisture	0.1	%	Gas Velocity (as Measured) Adjusted for Smooth Walls	3.00516	m/sec
Measured Oxygen	20.90	%	Gas Velocity (Reference Conditions) Adjusted for Smooth Walls	2.69218	m/sec*
Measured Carbon Dioxide	0.04	%	Volumetric Flowrate (as Measured) Adjusted for Smooth Walls	0.00478	m^3/sec
Dry Gas Molecular Weight	28.84240	g/g mole	Volumetric Flowrate (Ref Cond) Adjusted for Smooth Walls	0.00428	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, Wet Gas

NOTE: Velocity / volume flowrate calculations exclude contributions from the measurement point(s) where swirl >15°

Diagram/ Description of Cross Section of Stack/Duct



Notes
Including expected or actual deviations from procedures / non-conformities

Reaction Phase 3

Compliance With Positional Requirements?

Height of sample ports from Platform	0.8m
Number of sample ports	4
Width of platform (port back to handrail)	1.0m

Nearest downstream disturbance	Diameter Change Nozzle	0.13m
Nearest upstream disturbance	Diameter Change Nozzle	0.10m
Disturbances are classed as bends, fans or diameter variations		

FIELD SAMPLING DATA

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1276
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Aldehydes Test 1	Barometric Pressure (mb)	1006	Meter Yd	0.994
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1031		
Barometer ID	1320	Meter Thermocouple ID	1030	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/20255
Sample Start Time	10:20
Sample End Time	10:50
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	10:08:00	Time	10:53:00	
Final Volume	4.54	Reading (ml/min)	19	Reading (ml/min)	20	
Total Volume	4.53	% Leak	4.2	% Leak	4.4	4.53
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	25	26	26	
Stack Temp °C	26	26	26	
Meter Temp °C	25	26	26	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1276
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Aldehydes Test 2	Barometric Pressure (mb)	1006	Meter Yd	0.994
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1031		
Barometer ID	1320	Meter Thermocouple ID	1030	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/20255
Sample Start Time	11:00
Sample End Time	11:30
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	10:57:00	Time	11:34:00	
Final Volume	4.53	Reading (ml/min)	20	Reading (ml/min)	21	
Total Volume	4.52	% Leak	4.4	% Leak	4.7	4.52
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	26	26	27	
Stack Temp °C	27	27	27	
Meter Temp °C	26	26	27	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1276
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Aldehydes Test 3	Barometric Pressure (mb)	1006	Meter Yd	0.994
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1031		
Barometer ID	1320	Meter Thermocouple ID	1030	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/20255
Sample Start Time	11:40
Sample End Time	12:10
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

Sample		Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	11:38:00	Time	12:12:00	
Final Volume	4.50	Reading (ml/min)	20	Reading (ml/min)	20	
Total Volume	4.49	% Leak	4.4	% Leak	4.4	4.49
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	27	27	27	
Stack Temp °C	28	28	28	
Meter Temp °C	27	27	27	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1276
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Aldehydes Test 4	Barometric Pressure (mb)	1006	Meter Yd	0.994
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1031		
Barometer ID	1320	Meter Thermocouple ID	1030	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/20255
Sample Start Time	13:02
Sample End Time	13:32
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

Sample		Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	12:16:00	Time	13:33:00	
Final Volume	4.51	Reading (ml/min)	20	Reading (ml/min)	21	
Total Volume	4.50	% Leak	4.4	% Leak	4.7	4.50
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	29	29	29	
Stack Temp °C	30	30	30	
Meter Temp °C	29	29	29	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1276
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Aldehydes Test 5	Barometric Pressure (mb)	1006	Meter Yd	0.994
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1031		
Barometer ID	1320	Meter Thermocouple ID	1030	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/20255
Sample Start Time	14:15
Sample End Time	14:45
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

Sample		Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	13:39:00	Time	14:47:00	
Final Volume	4.51	Reading (ml/min)	21	Reading (ml/min)	20	
Total Volume	4.50	% Leak	4.7	% Leak	4.4	4.50
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	29	29	29	
Stack Temp °C	30	29	29	
Meter Temp °C	29	29	29	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1276
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Aldehydes Test 6	Barometric Pressure (mb)	1006	Meter Yd	0.994
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1031		
Barometer ID	1320	Meter Thermocouple ID	1030	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/20255
Sample Start Time	14:53
Sample End Time	15:23
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

Sample		Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	14:48:00	Time	15:24:00	
Final Volume	4.53	Reading (ml/min)	20	Reading (ml/min)	20	
Total Volume	4.52	% Leak	4.4	% Leak	4.4	4.52
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	29	29	29	
Stack Temp °C	30	29	30	
Meter Temp °C	29	29	29	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1278
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Top 20 & Total VOC Test 1	Barometric Pressure (mb)	1006	Meter Yd	0.989
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1035		
Barometer ID	1320	Meter Thermocouple ID	1032	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/2025
Sample Start Time	10:20
Sample End Time	10:50
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	10:10:00	Time	10:55:00	
Final Volume	4.53	Reading (ml/min)	22	Reading (ml/min)	21	
Total Volume	4.52	% Leak	4.9	% Leak	4.7	4.52
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	25	26	26	
Stack Temp °C	26	26	26	
Meter Temp °C	25	26	26	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1278
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Top 20 & Total VOC Test 2	Barometric Pressure (mb)	1006	Meter Yd	0.989
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1035		
Barometer ID	1320	Meter Thermocouple ID	1032	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/2025
Sample Start Time	11:00
Sample End Time	11:30
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	10:57:00	Time	11:35:00	
Final Volume	4.53	Reading (ml/min)	20	Reading (ml/min)	20	
Total Volume	4.52	% Leak	4.4	% Leak	4.4	4.52
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	26	26	27	
Stack Temp °C	27	27	27	
Meter Temp °C	26	26	27	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited

DEScycle at Leicester University		Installation Name	: Reaction Vessel
Permit No	: ...	Visit Details	: Investigative Emissions – July 2025
Variation No	: ...	Survey Dates	: 1st July 2025
Report Ref	: P6125 : R001	Report Issue Date	: 20th August 2025

Environmental Compliance Limited	SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)

Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1278	Date of Test	01/07/2025
Site	Leicester University	Stack Diameter (mm)	45			Sample Start Time	11:40
Location	Materials Laboratory					Sample End Time	12:10
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002			Duration	30
Test No	Top 20 & Total VOC Test 3	Barometric Pressure (mb)	1006	Meter Yd	0.989	Measured O2	20.90
Job No	P6125	Stack Thermocouple ID	1244			O2 Uncertainty %Vol	1.25
ECL Site Staff	SH & JL	Tube Thermocouple ID	1035			Meter Start Time	0:00:00
Barometer ID	1320	Meter Thermocouple ID	1032	Vapex Sampling Rate (ml/min)	150	Meter End Time	0:30:00
		In-Stack Sinter Used (Y/N)	Y			Meter Elapsed Time	0:30:00
						Impinger 1	None Used

Meter Units ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total		
Start Volume	0.00	Time	11:36:00	Time	12:13:00		Start Weight (g)	
Final Volume	4.50	Reading (ml/min)	21	Reading (ml/min)	21		End Weight (g)	
Total Volume	4.49	% Leak	4.7	% Leak	4.7	4.49	Total weight (g)	0
Sample Train Internal Volume	0.010	Litres						

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1		Impinger 2
Time/ point (mins)	0 - 10	10 - 20	20 - 30		
Tube Temp °C	27	27	27		Start Weight (g)
Stack Temp °C	28	28	28		
Meter Temp °C	27	27	27		End Weight (g)
Pump Flowrate (ml/min)	150	150	150		Total weight (g) 0

Sample Point					Impinger3
Time/ point (mins)					
Tube Temp °C					Start Weight (g)
Stack Temp °C					
Meter Temp °C					End Weight (g)
Pump Flowrate (ml/min)					Total weight (g) 0

Sample Point					Silica (IF USED)
Time/ point (mins)					<50% Spent at end Y/N? Yes
Tube Temp °C					Sample train upstream of sorbent tube condensation free for entire sample (Y/N) Yes
Stack Temp °C					
Meter Temp °C					
Pump Flowrate (ml/min)					

Environmental Compliance Limited	SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)

Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1278	Date of Test	01/07/2025
Site	Leicester University	Stack Diameter (mm)	45			Sample Start Time	13:02
Location	Materials Laboratory					Sample End Time	13:32
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002			Duration	30
Test No	Top 20 & Total VOC Test 4	Barometric Pressure (mb)	1006	Meter Yd	0.989	Measured O2	20.90
Job No	P6125	Stack Thermocouple ID	1244			O2 Uncertainty %Vol	1.25
ECL Site Staff	SH & JL	Tube Thermocouple ID	1035			Meter Start Time	0:00:00
Barometer ID	1320	Meter Thermocouple ID	1032	Vapex Sampling Rate (ml/min)	150	Meter End Time	0:30:00
		In-Stack Sinter Used (Y/N)	Y			Meter Elapsed Time	0:30:00
						Impinger 1	None Used

Meter Units ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total		
Start Volume	0.00	Time	12:15:00	Time	13:34:00		Start Weight (g)	
Final Volume	4.51	Reading (ml/min)	19	Reading (ml/min)	20		End Weight (g)	
Total Volume	4.50	% Leak	4.2	% Leak	4.4	4.50	Total weight (g)	0
Sample Train Internal Volume	0.010	Litres						

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1		Impinger 2
Time/ point (mins)	0 - 10	10 - 20	20 - 30		
Tube Temp °C	29	29	29		Start Weight (g)
Stack Temp °C	30	30	30		
Meter Temp °C	29	29	29		End Weight (g)
Pump Flowrate (ml/min)	150	150	150		Total weight (g) 0

Sample Point					Impinger3
Time/ point (mins)					
Tube Temp °C					Start Weight (g)
Stack Temp °C					
Meter Temp °C					End Weight (g)
Pump Flowrate (ml/min)					Total weight (g) 0

Sample Point					Silica (IF USED)
Time/ point (mins)					<50% Spent at end Y/N? Yes
Tube Temp °C					Sample train upstream of sorbent tube condensation free for entire sample (Y/N) Yes
Stack Temp °C					
Meter Temp °C					
Pump Flowrate (ml/min)					

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1278
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Top 20 & Total VOC Test 5	Barometric Pressure (mb)	1006	Meter Yd	0.989
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1035		
Barometer ID	1320	Meter Thermocouple ID	1032	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/2025
Sample Start Time	14:15
Sample End Time	14:45
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

Sample		Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	13:38:00	Time	14:46:00	
Final Volume	4.51	Reading (ml/min)	20	Reading (ml/min)	21	
Total Volume	4.50	% Leak	4.4	% Leak	4.7	4.50
Sample Train Internal Volume	0.010	Litres	Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%			

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	29	29	29	
Stack Temp °C	30	29	29	
Meter Temp °C	29	29	29	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1278
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Top 20 & Total VOC Test 6	Barometric Pressure (mb)	1006	Meter Yd	0.989
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1035		
Barometer ID	1320	Meter Thermocouple ID	1032	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/2025
Sample Start Time	14:53
Sample End Time	15:23
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

Sample		Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	14:49:00	Time	15:25:00	
Final Volume	4.53	Reading (ml/min)	19	Reading (ml/min)	21	
Total Volume	4.52	% Leak	4.2	% Leak	4.7	4.52
Sample Train Internal Volume	0.010	Litres	Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%			

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	29	29	29	
Stack Temp °C	30	29	30	
Meter Temp °C	29	29	29	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited

DEScycle at Leicester University		Installation Name	: Reaction Vessel
Permit No	: ...	Visit Details	: Investigative Emissions – July 2025
Variation No	: ...	Survey Dates	: 1st July 2025
Report Ref	: P6125 : R001	Report Issue Date	: 20th August 2025

Environmental Compliance Limited	SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)

Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1277	Date of Test	01/07/2025
Site	Leicester University	Stack Diameter (mm)	45			Sample Start Time	10:20
Location	Materials Laboratory					Sample End Time	10:50
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002			Duration	30
Test No	Acids Screen Test 1	Barometric Pressure (mb)	1006	Meter Yd	0.996	Measured O2	20.90
Job No	P6125	Stack Thermocouple ID	1244			O2 Uncertainty %Vol	1.25
ECL Site Staff	SH & JL	Tube Thermocouple ID	1033			Meter Start Time	0:00:00
Barometer ID	1320	Meter Thermocouple ID	1028	Vapex Sampling Rate (ml/min)	150	Meter End Time	0:30:00
		In-Stack Sinter Used (Y/N)	Y			Meter Elapsed Time	0:30:00

Meter Units ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	10:05:00	Time	10:52:00	
Final Volume	4.52	Reading (ml/min)	21	Reading (ml/min)	22	
Total Volume	4.51	% Leak	4.7	% Leak	4.9	4.51
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1		
Time/ point (mins)	0 - 10	10 - 20	20 - 30		
Tube Temp °C	25	26	26		
Stack Temp °C	26	26	26		
Meter Temp °C	25	26	26		
Pump Flowrate (ml/min)	150	150	150		

Sample Point					
Time/ point (mins)					
Tube Temp °C					
Stack Temp °C					
Meter Temp °C					
Pump Flowrate (ml/min)					

Sample Point					
Time/ point (mins)					
Tube Temp °C					
Stack Temp °C					
Meter Temp °C					
Pump Flowrate (ml/min)					

Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0
Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0
Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0
Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited	SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)

Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1277	Date of Test	01/07/2025
Site	Leicester University	Stack Diameter (mm)	45			Sample Start Time	11:05
Location	Materials Laboratory					Sample End Time	11:35
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002			Duration	30
Test No	Acids Screen Test 2	Barometric Pressure (mb)	1006	Meter Yd	0.996	Measured O2	20.90
Job No	P6125	Stack Thermocouple ID	1244			O2 Uncertainty %Vol	1.25
ECL Site Staff	SH & JL	Tube Thermocouple ID	1033			Meter Start Time	0:00:00
Barometer ID	1320	Meter Thermocouple ID	1028	Vapex Sampling Rate (ml/min)	150	Meter End Time	0:30:00
		In-Stack Sinter Used (Y/N)	Y			Meter Elapsed Time	0:30:00

Meter Units ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	10:58:00	Time	11:37:00	
Final Volume	4.43	Reading (ml/min)	20	Reading (ml/min)	19	
Total Volume	4.42	% Leak	4.4	% Leak	4.2	4.42
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1		
Time/ point (mins)	0 - 10	10 - 20	20 - 30		
Tube Temp °C	26	26	27		
Stack Temp °C	27	27	27		
Meter Temp °C	26	26	27		
Pump Flowrate (ml/min)	150	150	150		

Sample Point					
Time/ point (mins)					
Tube Temp °C					
Stack Temp °C					
Meter Temp °C					
Pump Flowrate (ml/min)					

Sample Point					
Time/ point (mins)					
Tube Temp °C					
Stack Temp °C					
Meter Temp °C					
Pump Flowrate (ml/min)					

Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0
Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0
Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0
Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited

DEScycle at Leicester University — Installation Name : Reaction Vessel
Permit No : ... — Visit Details : Investigative Emissions – July 2025
Variation No : ... — Survey Dates : 1st July 2025
Report Ref : P6125 : R001 — Report Issue Date : 20th August 2025

Environmental Compliance Limited	SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)

Client	Descycle Ltd	◉ Circular ○ Rectangular	○ Elipse	Vapex Pump ID	1277	Date of Test	01/07/2025
Site	Leicester University	Stack Diameter (mm)	45			Sample Start Time	11:40
Location	Materials Laboratory					Sample End Time	12:10
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002			Duration	30
Test No	Acids Screen Test 3	Barometric Pressure (mb)	1006	Meter Yd	0.996	Measured O2	20.90
Job No	P6125	Stack Thermocouple ID	1244			O2 Uncertainty %Vol	1.25
ECL Site Staff	SH & JL	Tube Thermocouple ID	1033			Meter Start Time	0:00:00
Barometer ID	1320	Meter Thermocouple ID	1028	Vapex Sampling Rate (ml/min)	150	Meter End Time	0:30:00
		In-Stack Sinter Used (Y/N)	Y			Meter Elapsed Time	0:30:00
						Impinger 1	None Used

Meter Units: ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total		
Start Volume	0.00	Time	11:38:00	Time	12:14:00		Start Weight (g)	
Final Volume	4.51	Reading (ml/min)	21	Reading (ml/min)	20		End Weight (g)	
Total Volume	4.50	% Leak	4.7	% Leak	4.4	4.50	Total weight (g)	0
Sample Train Internal Volume	0.010	Litres						

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1		Impinger 2	
Time/ point (mins)	0 - 10	10 - 20	20 - 30			
Tube Temp °C	27	27	27		Start Weight (g)	
Stack Temp °C	28	28	28			
Meter Temp °C	27	27	27		End Weight (g)	
Pump Flowrate (ml/min)	150	150	150		Total weight (g)	0

Sample Point					Impinger3	
Time/ point (mins)						
Tube Temp °C					Start Weight (g)	
Stack Temp °C						
Meter Temp °C					End Weight (g)	
Pump Flowrate (ml/min)					Total weight (g)	0

Sample Point					Silica	(IF USED)
Time/ point (mins)					<50% Spent at end Y/N?	Yes
Tube Temp °C					Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes
Stack Temp °C						
Meter Temp °C						
Pump Flowrate (ml/min)						

Environmental Compliance Limited	SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)

Client	Descycle Ltd	◉ Circular ○ Rectangular	○ Elipse	Vapex Pump ID	1277	Date of Test	01/07/2025
Site	Leicester University	Stack Diameter (mm)	45			Sample Start Time	13:02
Location	Materials Laboratory					Sample End Time	13:32
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002			Duration	30
Test No	Acids Screen Test 4	Barometric Pressure (mb)	1006	Meter Yd	0.996	Measured O2	20.90
Job No	P6125	Stack Thermocouple ID	1244			O2 Uncertainty %Vol	1.25
ECL Site Staff	SH & JL	Tube Thermocouple ID	1033			Meter Start Time	0:00:00
Barometer ID	1320	Meter Thermocouple ID	1028	Vapex Sampling Rate (ml/min)	150	Meter End Time	0:30:00
		In-Stack Sinter Used (Y/N)	Y			Meter Elapsed Time	0:30:00
						Impinger 1	None Used

Meter Units: ◉ litres

	Sample	Pre-test Leak Check		Post-test Leak Check		Total		
Start Volume	0.00	Time	12:16:00	Time	13:34:00		Start Weight (g)	
Final Volume	4.51	Reading (ml/min)	20	Reading (ml/min)	20		End Weight (g)	
Total Volume	4.50	% Leak	4.4	% Leak	4.4	4.50	Total weight (g)	0
Sample Train Internal Volume	0.010	Litres						

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1		Impinger 2	
Time/ point (mins)	0 - 10	10 - 20	20 - 30			
Tube Temp °C	29	29	29		Start Weight (g)	
Stack Temp °C	30	30	30			
Meter Temp °C	29	29	29		End Weight (g)	
Pump Flowrate (ml/min)	150	150	150		Total weight (g)	0

Sample Point					Impinger3	
Time/ point (mins)						
Tube Temp °C					Start Weight (g)	
Stack Temp °C						
Meter Temp °C					End Weight (g)	
Pump Flowrate (ml/min)					Total weight (g)	0

Sample Point					Silica	(IF USED)
Time/ point (mins)					<50% Spent at end Y/N?	Yes
Tube Temp °C					Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes
Stack Temp °C						
Meter Temp °C						
Pump Flowrate (ml/min)						

Environmental Compliance Limited

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1277
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Acids Screen Test 5	Barometric Pressure (mb)	1006	Meter Yd	0.996
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1033		
Barometer ID	1320	Meter Thermocouple ID	1028	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/2025
Sample Start Time	14:15
Sample End Time	14:45
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

Sample		Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	13:40:00	Time	14:47:00	
Final Volume	4.51	Reading (ml/min)	21	Reading (ml/min)	20	
Total Volume	4.50	% Leak	4.7	% Leak	4.4	4.50
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	29	29	29	
Stack Temp °C	30	29	29	
Meter Temp °C	29	29	29	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

Environmental Compliance Limited				SAMPLE TUBE DATA SAMPLING PROFORMA (VAPEX ONLY)	
Client	Descycle Ltd	◉ Circular ○ Rectangular ○ Elipse		Vapex Pump ID	1277
Site	Leicester University	Stack Diameter (mm)	45		
Location	Materials Laboratory				
Stack ID	Reaction Vessel	Stack Area (m^2)	0.002		
Test No	Acids Screen Test 6	Barometric Pressure (mb)	1006	Meter Yd	0.996
Job No	P6125	Stack Thermocouple ID	1244		
ECL Site Staff	SH & JL	Tube Thermocouple ID	1033		
Barometer ID	1320	Meter Thermocouple ID	1028	Vapex Sampling Rate (ml/min)	150
		In-Stack Sinter Used (Y/N)	Y		

Date of Test	01/07/2025
Sample Start Time	14:53
Sample End Time	15:23
Duration	30
Measured O2	20.90
O2 Uncertainty %Vol	1.25
Meter Start Time	0:00:00
Meter End Time	0:30:00
Meter Elapsed Time	0:30:00
Impinger 1	None Used
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Meter Units: ◉ litres

Sample		Pre-test Leak Check		Post-test Leak Check		Total
Start Volume	0.00	Time	14:49:00	Time	15:26:00	
Final Volume	4.53	Reading (ml/min)	21	Reading (ml/min)	20	
Total Volume	4.52	% Leak	4.7	% Leak	4.4	4.52
Sample Train Internal Volume	0.010	Litres				

Pre and post test leak checks are mandatory. The pump must be set to 450 ml/min during leak checks. Pass rate in CEN TS 13649 is 5%

Sample Point	A1	A1	A1	
Time/ point (mins)	0 - 10	10 - 20	20 - 30	
Tube Temp °C	29	29	29	
Stack Temp °C	30	29	30	
Meter Temp °C	29	29	29	
Pump Flowrate (ml/min)	150	150	150	

Impinger 2	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Impinger3	
Start Weight (g)	
End Weight (g)	
Total weight (g)	0

Sample Point				
Time/ point (mins)				
Tube Temp °C				
Stack Temp °C				
Meter Temp °C				
Pump Flowrate (ml/min)				

Silica	(IF USED)
<50% Spent at end Y/N?	Yes
Sample train upstream of sorbent tube condensation free for entire sample (Y/N)	Yes

LABORATORY ANALYSIS RESULTS

Laboratory analysis was subcontracted to RPS laboratories, a UKAS Accredited Testing Laboratory, Number 0605.

RPS holds UKAS & MCERTS accreditation for some of this analysis but not others.

As required by the MCERTS Performance Standard for Organisations, the analysis results are shown below.

The accreditation status of each analysis result is also shown below, with the following key code

UM = UKAS & MCERTS accredited.
U = UKAS but NOT MCERTS accredited.
N = No accreditation held.

Environmental Compliance Limited

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Customer Sample No	ECL/25/2906	ECL/25/2907	ECL/25/2908	ECL/25/2909	ECL/25/2910	ECL/25/2911	ECL/25/2912
RPS Sample No	310536	310537	310538	310539	310540	310541	310542
Sample Matrix	TUBE	TUBE	TUBE	TUBE	TUBE	TUBE	TUBE
Sampling Date	01/07/2025	01/07/2025	01/07/2025	01/07/2025	01/07/2025	01/07/2025	01/07/2025

Determinand	CAS No	Codes	SOP	RL	Units							
formaldehyde FRONT	50-00-0	UM	A40	0.1	ug	0.3	0.3	0.3	0.3	0.5	0.5	0.1
butyraldehyde FRONT	123-72-8	UM	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
acetaldehyde FRONT	75-07-0	UM	A40	0.1	ug	0.2	< 0.1	2.8	0.7	3.7	3.3	< 0.1
propionaldehyde FRONT	123-38-6	UM	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
benzaldehyde FRONT	100-52-7	UM	A40	0.2	ug	< 0.2	< 0.2	0.2	< 0.2	0.2	< 0.2	< 0.2
valeraldehyde FRONT	110-62-3	UM	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
hexanal FRONT	66-25-1	UM	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
heptanal FRONT	111-71-7	N	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
formaldehyde BACK	50-00-0	UM	A40	0.1	ug	0.1	0.1	< 0.1	< 0.1	0.1	0.1	< 0.1
butyraldehyde BACK	123-72-8	UM	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
acetaldehyde BACK	75-07-0	UM	A40	0.1	ug	< 0.1	< 0.1	< 0.1	< 0.1	0.6	0.2	< 0.1
propionaldehyde BACK	123-38-6	UM	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
benzaldehyde BACK	100-52-7	UM	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
valeraldehyde BACK	110-62-3	UM	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
hexanal BACK	66-25-1	UM	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
heptanal BACK	111-71-7	N	A40	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2

DEScycle at Leicester University
Permit No : ...
Variation No : ...
Report Ref : P6125 : R001

Installation Name : Reaction Vessel
Visit Details : Investigative Emissions – July 2025
Survey Dates : 1st July 2025
Report Issue Date : 20th August 2025

Customer Sample No	ECL/25/2913	ECL/25/2914	ECL/25/2915	ECL/25/2916	ECL/25/2917	ECL/25/2918	ECL/25/2919
RPS Sample No	310556	310557	310558	310559	310560	310561	310562
Sample Matrix	TUBE	TUBE	TUBE	TUBE	TUBE	TUBE	TUBE
Sampling Date	01/07/2025	01/07/2025	01/07/2025	01/07/2025	01/07/2025	01/07/2025	01/07/2025

Determinand	CAS No	Codes	SOP	RL	Units							
hydrofluoric acid	7664-39-3	N	C27	5	ug	< 5	< 5	< 5	< 5	< 5	< 5	< 5
hydrochloric acid	7647-01-0	U	C27	1	ug	< 1	< 1	< 1	< 1	< 1	< 1	< 1
nitric acid	7697-37-2	U	C27	2	ug	< 2	< 2	< 2	< 2	< 2	< 2	< 2
phosphoric acid	7664-38-2	U	C27	6	ug	< 6	< 6	< 6	< 6	< 6	< 6	< 6
sulphuric acid	7664-93-9	U	C27	2	ug	< 2	< 2	< 2	< 2	< 2	< 2	< 2
hydrogen bromide	10035-10-6	U	C27	2	ug	< 2	< 2	< 2	< 2	< 2	< 2	< 2

Customer Sample No	ECL/25/2899	ECL/25/2900	ECL/25/2901	ECL/25/2902	ECL/25/2903	ECL/25/2904	ECL/25/2905
RPS Sample No	310529	310530	310531	310532	310533	310534	310535
Sample Matrix	TUBE	TUBE	TUBE	TUBE	TUBE	TUBE	TUBE
Sampling Date	01/07/2025	01/07/2025	01/07/2025	01/07/2025	01/07/2025	01/07/2025	01/07/2025

Determinand	CAS No	Codes	SOP	RL	Units							
total hydrocarbons FRONT		N	M104	10	ug	< 10	< 10	< 10	< 10	30	32	< 10
total hydrocarbons BACK		N	M104	10	ug	< 10	< 10	< 10	< 10	26	< 10	< 10
GC-MS screen (20) FRONT		N	M109	5	ug	S/C	S/C	S/C	S/C	S/C	S/C	S/C
GC-MS screen (20) BACK		N	M109	5	ug	S/C	S/C	S/C	S/C	S/C	S/C	S/C

S/C – See comments on next page

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
Variation No	: ...		Survey Dates	: 1st July 2025
Report Ref	: P6125	: R001	Report Issue Date	: 20th August 2025

Comments

Report No.: 25-05624-1

Customer Reference: 2025 Stack Preferential Rates

Customer Order No: E2570 P6125

RPS Sample Number	Customer Number	Sample Comments
310529	ECL/25/2899	VOC Screen Front: VOCs <5µg Back: VOCs <5µg
310530	ECL/25/2900	VOC Screen Front: VOCs <5µg Back: VOCs <5µg
310531	ECL/25/2901	VOC Screen Front: VOCs <5µg Back: VOCs <5µg
310532	ECL/25/2902	VOC Screen Front: VOCs <5µg Back: VOCs <5µg
310533	ECL/25/2903	VOC Screen Front: Acetone 27.5µg Back: Acetone 23.4µg
310534	ECL/25/2904	VOC Screen Front: Acetone 26.7µg Back: VOCs <5µg
310535	ECL/25/2905	VOC Screen Front: VOCs <5µg Back: VOCs <5µg

UNCERTAINTY CALCULATIONS

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
Variation No	: ...		Survey Dates	: 1st July 2025
Report Ref	: P6125	: R001	Report Issue Date	: 20th August 2025

Flowrate Uncertainty – Reaction Phase 1

Stack Reference Reaction Vessel

Measurement Uncertainty Calculations - Velocity at Stack Conditions

Contribution From	Standard u/c (Pa)	
Pitot Calibration Uncertainty Contribution	0.01	A
Manometer Calibration Uncertainty Contribution	0.010833333	B
Variation in Actual Pitot reading at sample points	0.05	C
Combined u/c (Pa) =	**Combined u/c (Pa)**	
SQRT $(A/\sqrt{3})^2 + (B/\sqrt{3})^2 + (C/\sqrt{3})^2$	0.03	
Expanded Uncertainty of Flow Measurements Pa	**0.06**	
	Standard u/c (K)	
Temperature Calibration (K)	1.50	D
Variation in Actual Temp reading at sample points	0.00	E
Combined u/c of Temp (K)	**Combined u/c (K)**	
SQRT $((D/\sqrt{3^2}) + (E/\sqrt{3})^2)$	0.86	
Expanded Uncertainty of Temp Measurements (K)	**1.73**	
Measured Average Velocity (m/s) at Stack Conds	1.91	
Maximum Average Velocity (m/s) at Stack Conds	1.94	
Standard Uncertainty Velocity at Stack Conditions (%)	1.68	
Expanded Uncertainty Velocity (at Stack Conditions)	**3.35 (%)**	

Measurement Uncertainty Calculations - Flowrate at Stack Conditions

Contribution From	Standard u/c (m^2)
Area (m2)	0.00002
Measured Average Flowrate (m^3/s) at Stack Conds	0.00
Maximum Average Flowrate (m^3/s) at Stack Conds	0.00
Standard Uncertainty Flowrate (m^3/s) at Stack Conditions (%)	2.69
Expanded Uncertainty Flowrate (m^3/s) at Stack Conditions	**5.39 (%)**

Measurement Uncertainty Calculations - Flowrate at STP & Wet Gas

Contribution From	Standard u/c (%)
Temperature Calibration (K)	0.5
Barometer Calibration	0.5
Measured Average Flowrate (m^3/s) at STP Wet	0.00
Maximum Average Flowrate (m^3/s) at STP Wet	0.00
Standard Uncertainty Flowrate (m^3/s) at STP Wet	3.16
Expanded Uncertainty Flowrate (m^3/s) at STP Wet	**6.32 (%)**

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
Variation No	: ...		Survey Dates	: 1st July 2025
Report Ref	: P6125	: R001	Report Issue Date	: 20th August 2025

Flowrate Uncertainty – Reaction Phase 2

Stack Reference Reaction Vessel

Measurement Uncertainty Calculations - Velocity at Stack Conditions

Contribution From	Standard u/c (Pa)	
Pitot Calibration Uncertainty Contribution	0.02	A
Manometer Calibration Uncertainty Contribution	0.022666667	B
Variation in Actual Pitot reading at sample points	0.05	C
Combined u/c (Pa) =	**Combined u/c (Pa)**	
SQRT $(A/\sqrt{3})^2 + (B/\sqrt{3})^2 + (C/\sqrt{3})^2$	0.03	
Expanded Uncertainty of Flow Measurements Pa	**0.07**	
	Standard u/c (K)	
Temperature Calibration (K)	1.51	D
Variation in Actual Temp reading at sample points	0.05	E
Combined u/c of Temp (K)	**Combined u/c (K)**	
SQRT $((D/\sqrt{3^2}) + (E/\sqrt{3})^2)$	0.87	
Expanded Uncertainty of Temp Measurements (K)	**1.74**	
Measured Average Velocity (m/s) at Stack Conds	2.77	
Maximum Average Velocity (m/s) at Stack Conds	2.80	
Standard Uncertainty Velocity at Stack Conditions (%)	1.04	
Expanded Uncertainty Velocity (at Stack Conditions)	**2.09 (%)**	

Measurement Uncertainty Calculations - Flowrate at Stack Conditions

Contribution From	Standard u/c (m^2)
Area (m2)	0.00002
Measured Average Flowrate (m^3/s) at Stack Conds	0.00
Maximum Average Flowrate (m^3/s) at Stack Conds	0.00
Standard Uncertainty Flowrate (m^3/s) at Stack Conditions (%)	2.05
Expanded Uncertainty Flowrate (m^3/s) at Stack Conditions	**4.11 (%)**

Measurement Uncertainty Calculations - Flowrate at STP & Wet Gas

Contribution From	Standard u/c (%)
Temperature Calibration (K)	0.5
Barometer Calibration	0.5
Measured Average Flowrate (m^3/s) at STP Wet	0.00
Maximum Average Flowrate (m^3/s) at STP Wet	0.00
Standard Uncertainty Flowrate (m^3/s) at STP Wet	2.52
Expanded Uncertainty Flowrate (m^3/s) at STP Wet	**5.03 (%)**

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
Variation No	: ...		Survey Dates	: 1st July 2025
Report Ref	: P6125	: R001	Report Issue Date	: 20th August 2025

Flowrate Uncertainty – Reaction Phase 3

Stack Reference Reaction Vessel

Measurement Uncertainty Calculations - Velocity at Stack Conditions

Contribution From	Standard u/c (Pa)	
Pitot Calibration Uncertainty Contribution	0.03	A
Manometer Calibration Uncertainty Contribution	0.026833333	B
Variation in Actual Pitot reading at sample points	0.25	C
Combined u/c (Pa) =	**Combined u/c (Pa)**	
SQRT $(A/\sqrt{3})^2 + (B/\sqrt{3})^2 + (C/\sqrt{3})^2$	0.15	
Expanded Uncertainty of Flow Measurements Pa	**0.29**	
	Standard u/c (K)	
Temperature Calibration (K)	1.51	D
Variation in Actual Temp reading at sample points	0.15	E
Combined u/c of Temp (K)	**Combined u/c (K)**	
SQRT $((D/\sqrt{3^2}) + (E/\sqrt{3})^2)$	0.88	
Expanded Uncertainty of Temp Measurements (K)	**1.76**	
Measured Average Velocity (m/s) at Stack Conds	3.02	
Maximum Average Velocity (m/s) at Stack Conds	3.11	
Standard Uncertainty Velocity at Stack Conditions (%)	2.98	
Expanded Uncertainty Velocity (at Stack Conditions)	**5.96 (%)**	

Measurement Uncertainty Calculations - Flowrate at Stack Conditions

Contribution From	Standard u/c (m^2)
Area (m2)	0.00002
Measured Average Flowrate (m^3/s) at Stack Conds	0.00
Maximum Average Flowrate (m^3/s) at Stack Conds	0.00
Standard Uncertainty Flowrate (m^3/s) at Stack Conditions (%)	4.01
Expanded Uncertainty Flowrate (m^3/s) at Stack Conditions	**8.02 (%)**

Measurement Uncertainty Calculations - Flowrate at STP & Wet Gas

Contribution From	Standard u/c (%)
Temperature Calibration (K)	0.5
Barometer Calibration	0.5
Measured Average Flowrate (m^3/s) at STP Wet	0.00
Maximum Average Flowrate (m^3/s) at STP Wet	0.00
Standard Uncertainty Flowrate (m^3/s) at STP Wet	4.48
Expanded Uncertainty Flowrate (m^3/s) at STP Wet	**8.96 (%)**

DEScycle at Leicester University | Installation Name : Reaction Vessel
Permit No : ... | Visit Details : Investigative Emissions – July 2025
Variation No : ... | Survey Dates : 1st July 2025
Report Ref : P6125 : R001 | Report Issue Date : 20th August 2025

Aldehydes Uncertainty – Reaction Phase 1 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

				Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00453	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.994	...	...	...	...
Meter Temperature	T_m	298.67	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes				
Determinand	Recovered Mass		Standard Uncertainty	
Formaldehyde	0.40	µg	uM	0.10 µg
Butyraldehyde	0.20	µg	uM	0.10 µg
Acetaldehyde	0.20	µg	uM	0.0600 µg
Propionaldehyde	0.20	µg	uM	0.10 µg
Benzaldehyde	0.20	µg	uM	0.10 µg
Valeraldehyde	0.20	µg	uM	0.10 µg
Hexanal	0.20	µg	uM	0.10 µg
Heptanal	0.10	µg	uM	0.0500 µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.91$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000471	0.00471
uT_m	0.91	0.90	0.00304	0.00456
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00574$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00409$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00411	0.00406	0.00450	0.0000258
Effect of uV_m	0.00419	0.00399	0.90	0.000102

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000940$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Formaldehyde	0.00113	...
Butyraldehyde	0.000565	...
Acetaldehyde	0.000565	...
Propionaldehyde	0.000565	...
Benzaldehyde	0.000565	...
Valeraldehyde	0.000565	...
Hexanal	0.000565	...
Heptanal	0.000282	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Formaldehyde	0.12	0.0734	244.65	0.0245
Butyraldehyde	0.0734	0.0245	244.65	0.0245
Acetaldehyde	0.0636	0.0343	244.65	0.0147
Propionaldehyde	0.0734	0.0245	244.65	0.0245
Benzaldehyde	0.0734	0.0245	244.65	0.0245
Valeraldehyde	0.0734	0.0245	244.65	0.0245
Hexanal	0.0734	0.0245	244.65	0.0245
Heptanal	0.0367	0.0122	244.65	0.0122

Condensate Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Formaldehyde				
Butyraldehyde				
Acetaldehyde				
Propionaldehyde				
Benzaldehyde				
Valeraldehyde				
Hexanal				
Heptanal				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Formaldehyde	0.10	0.0957	23.95	0.00225
Butyraldehyde	0.0501	0.0478	11.98	0.00113
Acetaldehyde	0.0501	0.0478	11.98	0.00113
Propionaldehyde	0.0501	0.0478	11.98	0.00113
Benzaldehyde	0.0501	0.0478	11.98	0.00113
Valeraldehyde	0.0501	0.0478	11.98	0.00113
Hexanal	0.0501	0.0478	11.98	0.00113
Heptanal	0.0250	0.0239	5.99	0.000563

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Formaldehyde	0.0246	0.0492	0.0979	50.26
Butyraldehyde	0.0245	0.0490	0.0489	100.13
Acetaldehyde	0.0147	0.0295	0.0489	60.22
Propionaldehyde	0.0245	0.0490	0.0489	100.13
Benzaldehyde	0.0245	0.0490	0.0489	100.13
Valeraldehyde	0.0245	0.0490	0.0489	100.13
Hexanal	0.0245	0.0490	0.0489	100.13
Heptanal	0.0122	0.0245	0.0245	100.13

DEScycle at Leicester University | **Installation Name** : Reaction Vessel
Permit No : ... | **Visit Details** : Investigative Emissions – July 2025
Variation No : ... | **Survey Dates** : 1st July 2025
Report Ref : P6125 : R001 | **Report Issue Date** : 20th August 2025

Aldehydes Uncertainty – Reaction Phase 1 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

				Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00452	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.994	...	...	...	...
Meter Temperature	T_m	299.33	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass		Standard Uncertainty		
Formaldehyde	0.40	µg	uM	0.10	µg
Butyraldehyde	0.20	µg	uM	0.10	µg
Acetaldehyde	0.10	µg	uM	0.0500	µg
Propionaldehyde	0.20	µg	uM	0.10	µg
Benzaldehyde	0.20	µg	uM	0.10	µg
Valeraldehyde	0.20	µg	uM	0.10	µg
Hexanal	0.20	µg	uM	0.10	µg
Heptanal	0.20	µg	uM	0.10	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using: $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by, where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.91$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000471	0.00471
uT_m	0.91	0.90	0.00303	0.00454
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{up_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00570$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00407$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00410	0.00404	0.00449	0.0000256
Effect of uV_m	0.00417	0.00397	0.90	0.000102

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000934$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm^3	Condensate uL mg/Nm^3
Formaldehyde	0.00113	...
Butyraldehyde	0.000567	...
Acetaldehyde	0.000284	...
Propionaldehyde	0.000567	...
Benzaldehyde	0.000567	...
Valeraldehyde	0.000567	...
Hexanal	0.000567	...
Heptanal	0.000567	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results

	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Formaldehyde	0.12	0.0737	245.73	0.0246
Butyraldehyde	0.0737	0.0246	245.73	0.0246
Acetaldehyde	0.0369	0.0123	245.73	0.0123
Propionaldehyde	0.0737	0.0246	245.73	0.0246
Benzaldehyde	0.0737	0.0246	245.73	0.0246
Valeraldehyde	0.0737	0.0246	245.73	0.0246
Hexanal	0.0737	0.0246	245.73	0.0246
Heptanal	0.0737	0.0246	245.73	0.0246

Condensate Results

	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Formaldehyde				
Butyraldehyde				
Acetaldehyde				
Propionaldehyde				
Benzaldehyde				
Valeraldehyde				
Hexanal				
Heptanal				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results

	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Formaldehyde	0.10	0.0961	24.17	0.00226
Butyraldehyde	0.0503	0.0480	12.08	0.00113
Acetaldehyde	0.0252	0.0240	6.04	0.000564
Propionaldehyde	0.0503	0.0480	12.08	0.00113
Benzaldehyde	0.0503	0.0480	12.08	0.00113
Valeraldehyde	0.0503	0.0480	12.08	0.00113
Hexanal	0.0503	0.0480	12.08	0.00113
Heptanal	0.0503	0.0480	12.08	0.00113

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{up})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm^3	Expanded Uncertainty mg/Nm^3	Measured Concentration mg/Nm^3	Percent of Measured Concentration
Formaldehyde	0.0247	0.0494	0.0983	50.26
Butyraldehyde	0.0246	0.0492	0.0491	100.13
Acetaldehyde	0.0123	0.0246	0.0246	100.13
Propionaldehyde	0.0246	0.0492	0.0491	100.13
Benzaldehyde	0.0246	0.0492	0.0491	100.13
Valeraldehyde	0.0246	0.0492	0.0491	100.13
Hexanal	0.0246	0.0492	0.0491	100.13
Heptanal	0.0246	0.0492	0.0491	100.13

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Aldehydes Uncertainty – Reaction Phase 2 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%	
Sampled Volume	V_m	0.00449	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.994	...	...	...	...
Meter Temperature	T_m	300.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes				
Determinand	**Recovered Mass**		**Standard Uncertainty**	
Formaldehyde	0.30	µg	**uM** 0.0750	µg
Butyraldehyde	0.20	µg	**uM** 0.10	µg
Acetaldehyde	2.80	µg	**uM** 0.14	µg
Propionaldehyde	0.20	µg	**uM** 0.10	µg
Benzaldehyde	0.20	µg	**uM** 0.10	µg
Valeraldehyde	0.20	µg	**uM** 0.10	µg
Hexanal	0.20	µg	**uM** 0.10	µg
Heptanal	0.20	µg	**uM** 0.10	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by Cu_i **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV$_m$, uT$_m$ etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT$_m$) & measured moisture (uH$_2$O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.90$$

	Maximum	**Minimum**	**Sensitivity**	**ufstp**
up$_b$	0.48	0.47	0.000470	0.00470
uT$_m$	0.91	0.90	0.00301	0.00452
uH$_2$O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00567$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00403$$

	Maximum m^3	**Minimum m^3**	**Sensitivity**	**Standard Uncertainty m^3**
Effect of uf$_s$	0.00406	0.00401	0.00446	0.0000253
Effect of uV$_m$	0.00413	0.00393	0.90	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000924$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm^3	**Condensate uL mg/Nm^3**
Formaldehyde	0.000859	...
Butyraldehyde	0.000573	...
Acetaldehyde	0.00802	...
Propionaldehyde	0.000573	...
Benzaldehyde	0.000573	...
Valeraldehyde	0.000573	...
Hexanal	0.000573	...
Heptanal	0.000573	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times fo_s}$$

Uncertainty in final measurement @ Reference Conditions due to uM$_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Formaldehyde	0.0930	0.0558	247.93	0.0186
Butyraldehyde	0.0744	0.0248	247.93	0.0248
Acetaldehyde	0.73	0.66	247.93	0.0347
Propionaldehyde	0.0744	0.0248	247.93	0.0248
Benzaldehyde	0.0744	0.0248	247.93	0.0248
Valeraldehyde	0.0744	0.0248	247.93	0.0248
Hexanal	0.0744	0.0248	247.93	0.0248
Heptanal	0.0744	0.0248	247.93	0.0248

Condensate Results				
	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Formaldehyde				
Butyraldehyde				
Acetaldehyde				
Propionaldehyde				
Benzaldehyde				
Valeraldehyde				
Hexanal				
Heptanal				

Uncertainty in final measurement @ Reference Conditions due to uV$_{STD}$

Charcoal Tube Results				
	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Formaldehyde	0.0761	0.0727	18.45	0.00170
Butyraldehyde	0.0507	0.0485	12.30	0.00114
Acetaldehyde	0.71	0.68	172.20	0.0159
Propionaldehyde	0.0507	0.0485	12.30	0.00114
Benzaldehyde	0.0507	0.0485	12.30	0.00114
Valeraldehyde	0.0507	0.0485	12.30	0.00114
Hexanal	0.0507	0.0485	12.30	0.00114
Heptanal	0.0507	0.0485	12.30	0.00114

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	**Combined Uncertainty mg/Nm^3**	**Expanded Uncertainty mg/Nm^3**	**Measured Concentration mg/Nm^3**	**Percent of Measured Concentration**
Formaldehyde	0.0187	0.0374	0.0744	50.26
Butyraldehyde	0.0248	0.0497	0.0496	100.13
Acetaldehyde	0.0390	0.0780	0.69	11.24
Propionaldehyde	0.0248	0.0497	0.0496	100.13
Benzaldehyde	0.0248	0.0497	0.0496	100.13
Valeraldehyde	0.0248	0.0497	0.0496	100.13
Hexanal	0.0248	0.0497	0.0496	100.13
Heptanal	0.0248	0.0497	0.0496	100.13

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Aldehydes Uncertainty – Reaction Phase 2 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00450	m^3		uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.994	...		...	...	...
Meter Temperature	T_m	302.00	k		uT_m	1.5	k
Barometric Pressure	p_b	1006.00	mBar			10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol		$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol		uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**			**Standard Uncertainty**	
Formaldehyde	0.30	µg	**uM**	0.0750	µg
Butyraldehyde	0.20	µg	**uM**	0.10	µg
Acetaldehyde	0.70	µg	**uM**	0.11	µg
Propionaldehyde	0.20	µg	**uM**	0.10	µg
Benzaldehyde	0.20	µg	**uM**	0.10	µg
Valeraldehyde	0.20	µg	**uM**	0.10	µg
Hexanal	0.20	µg	**uM**	0.10	µg
Heptanal	0.20	µg	**uM**	0.10	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV$_m$, uT$_m$ etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT$_m$) & measured moisture (uH$_2$O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.90$$

	Maximum	**Minimum**	**Sensitivity**	**ufstp**
up$_b$	0.48	0.47	0.000469	0.00469
uT$_m$	0.90	0.89	0.00297	0.00446
uH$_2$O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00402$$

	Maximum m^3	**Minimum m^3**	**Sensitivity**	**Standard Uncertainty m^3**
Effect of uf$_s$	0.00404	0.00399	0.00447	0.0000249
Effect of uV$_m$	0.00412	0.00392	0.89	0.000100

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000914$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm^3	**Condensate uL mg/Nm^3**
Formaldehyde	0.000863	...
Butyraldehyde	0.000575	...
Acetaldehyde	0.00201	...
Propionaldehyde	0.000575	...
Benzaldehyde	0.000575	...
Valeraldehyde	0.000575	...
Hexanal	0.000575	...
Heptanal	0.000575	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to uM$_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Formaldehyde	0.0934	0.0560	249.02	0.0187
Butyraldehyde	0.0747	0.0249	249.02	0.0249
Acetaldehyde	0.20	0.15	249.02	0.0261
Propionaldehyde	0.0747	0.0249	249.02	0.0249
Benzaldehyde	0.0747	0.0249	249.02	0.0249
Valeraldehyde	0.0747	0.0249	249.02	0.0249
Hexanal	0.0747	0.0249	249.02	0.0249
Heptanal	0.0747	0.0249	249.02	0.0249

Condensate Results				
	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Formaldehyde				
Butyraldehyde				
Acetaldehyde				
Propionaldehyde				
Benzaldehyde				
Valeraldehyde				
Hexanal				
Heptanal				

Uncertainty in final measurement @ Reference Conditions due to uV$_{STD}$

Charcoal Tube Results				
	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Formaldehyde	0.0764	0.0730	18.61	0.00170
Butyraldehyde	0.0510	0.0487	12.41	0.00113
Acetaldehyde	0.18	0.17	43.43	0.00397
Propionaldehyde	0.0510	0.0487	12.41	0.00113
Benzaldehyde	0.0510	0.0487	12.41	0.00113
Valeraldehyde	0.0510	0.0487	12.41	0.00113
Hexanal	0.0510	0.0487	12.41	0.00113
Heptanal	0.0510	0.0487	12.41	0.00113

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{sp})^2}$$

Charcoal Tubes: Determinand	**Combined Uncertainty mg/Nm^3**	**Expanded Uncertainty mg/Nm^3**	**Measured Concentration mg/Nm^3**	**Percent of Measured Concentration**
Formaldehyde	0.0188	0.0375	0.0747	50.26
Butyraldehyde	0.0249	0.0499	0.0498	100.13
Acetaldehyde	0.0265	0.0530	0.17	30.43
Propionaldehyde	0.0249	0.0499	0.0498	100.13
Benzaldehyde	0.0249	0.0499	0.0498	100.13
Valeraldehyde	0.0249	0.0499	0.0498	100.13
Hexanal	0.0249	0.0499	0.0498	100.13
Heptanal	0.0249	0.0499	0.0498	100.13

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Aldehydes Uncertainty – Reaction Phase 3 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00450	m^3		uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.994	...		...	...	...
Meter Temperature	T_m	302.00	k		uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar			10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol		$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol		uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**			**Standard Uncertainty**	
Formaldehyde	0.60	µg		**uM**	0.0900 µg
Butyraldehyde	0.20	µg		**uM**	0.10 µg
Acetaldehyde	4.30	µg		**uM**	0.22 µg
Propionaldehyde	0.20	µg		**uM**	0.10 µg
Benzaldehyde	0.20	µg		**uM**	0.10 µg
Valeraldehyde	0.20	µg		**uM**	0.10 µg
Hexanal	0.20	µg		**uM**	0.10 µg
Heptanal	0.20	µg		**uM**	0.10 µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by Cu_i **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (up$_b$), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.90$$

	Maximum	**Minimum**	**Sensitivity**	**ufstp**
up$_b$	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00402$$

	Maximum m^3	**Minimum m^3**	**Sensitivity**	**Standard Uncertainty m^3**
Effect of uf$_s$	0.00404	0.00399	0.00447	0.0000249
Effect of uV$_m$	0.00412	0.00392	0.89	0.000100

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000914$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm^3	**Condensate uL mg/Nm^3**
Formaldehyde	0.00173	...
Butyraldehyde	0.000575	...
Acetaldehyde	0.0124	...
Propionaldehyde	0.000575	...
Benzaldehyde	0.000575	...
Valeraldehyde	0.000575	...
Hexanal	0.000575	...
Heptanal	0.000575	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to uM$_{Recovered}$

Charcoal Tube Results

	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Formaldehyde	0.17	0.13	249.02	0.0224
Butyraldehyde	0.0747	0.0249	249.02	0.0249
Acetaldehyde	1.12	1.02	249.02	0.0535
Propionaldehyde	0.0747	0.0249	249.02	0.0249
Benzaldehyde	0.0747	0.0249	249.02	0.0249
Valeraldehyde	0.0747	0.0249	249.02	0.0249
Hexanal	0.0747	0.0249	249.02	0.0249
Heptanal	0.0747	0.0249	249.02	0.0249

Condensate Results

	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Formaldehyde				
Butyraldehyde				
Acetaldehyde				
Propionaldehyde				
Benzaldehyde				
Valeraldehyde				
Hexanal				
Heptanal				

Uncertainty in final measurement @ Reference Conditions due to uV$_{STD}$

Charcoal Tube Results

	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Formaldehyde	0.15	0.15	37.23	0.00340
Butyraldehyde	0.0510	0.0487	12.41	0.00113
Acetaldehyde	1.10	1.05	266.80	0.0244
Propionaldehyde	0.0510	0.0487	12.41	0.00113
Benzaldehyde	0.0510	0.0487	12.41	0.00113
Valeraldehyde	0.0510	0.0487	12.41	0.00113
Hexanal	0.0510	0.0487	12.41	0.00113
Heptanal	0.0510	0.0487	12.41	0.00113

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	**Combined Uncertainty mg/Nm^3**	**Expanded Uncertainty mg/Nm^3**	**Measured Concentration mg/Nm^3**	**Percent of Measured Concentration**
Formaldehyde	0.0227	0.0455	0.15	30.43
Butyraldehyde	0.0249	0.0499	0.0498	100.13
Acetaldehyde	0.0601	0.12	1.07	11.23
Propionaldehyde	0.0249	0.0499	0.0498	100.13
Benzaldehyde	0.0249	0.0499	0.0498	100.13
Valeraldehyde	0.0249	0.0499	0.0498	100.13
Hexanal	0.0249	0.0499	0.0498	100.13
Heptanal	0.0249	0.0499	0.0498	100.13

DEScycle at Leicester University | **Installation Name** : Reaction Vessel
Permit No : ... | **Visit Details** : Investigative Emissions – July 2025
Variation No : ... | **Survey Dates** : 1st July 2025
Report Ref : P6125 : R001 | **Report Issue Date** : 20th August 2025

Aldehydes Uncertainty – Reaction Phase 3 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00452	m^3		uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.994	...		...	...	...
Meter Temperature	T_m	302.00	k		uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar			10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol		$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol		uH_2O		%Vol

Tubes

Determinand	Recovered Mass		Standard Uncertainty		
Formaldehyde	0.60	µg	uM	0.0900	µg
Butyraldehyde	0.20	µg	uM	0.10	µg
Acetaldehyde	3.50	µg	uM	0.18	µg
Propionaldehyde	0.20	µg	uM	0.10	µg
Benzaldehyde	0.20	µg	uM	0.10	µg
Valeraldehyde	0.20	µg	uM	0.10	µg
Hexanal	0.20	µg	uM	0.10	µg
Heptanal	0.20	µg	uM	0.10	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using: $C_{x_i} = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i=uV$_m$, uT$_m$ etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT$_m$) & measured moisture (uH$_2$O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{up_b}{(p_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00403$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00406	0.00401	0.00449	0.0000250
Effect of uV_m	0.00413	0.00393	0.89	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000918$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm^3	Condensate uL mg/Nm^3
Formaldehyde	0.00172	...
Butyraldehyde	0.000573	...
Acetaldehyde	0.0100	...
Propionaldehyde	0.000573	...
Benzaldehyde	0.000573	...
Valeraldehyde	0.000573	...
Hexanal	0.000573	...
Heptanal	0.000573	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to uM$_{Recovered}$

Charcoal Tube Results

	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Formaldehyde	0.17	0.13	247.92	0.0223
Butyraldehyde	0.0744	0.0248	247.92	0.0248
Acetaldehyde	0.91	0.82	247.92	0.0434
Propionaldehyde	0.0744	0.0248	247.92	0.0248
Benzaldehyde	0.0744	0.0248	247.92	0.0248
Valeraldehyde	0.0744	0.0248	247.92	0.0248
Hexanal	0.0744	0.0248	247.92	0.0248
Heptanal	0.0744	0.0248	247.92	0.0248

Condensate Results

	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Formaldehyde				
Butyraldehyde				
Acetaldehyde				
Propionaldehyde				
Benzaldehyde				
Valeraldehyde				
Hexanal				
Heptanal				

Uncertainty in final measurement @ Reference Conditions due to uV$_{STD}$

Charcoal Tube Results

	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Formaldehyde	0.15	0.15	36.90	0.00339
Butyraldehyde	0.0507	0.0485	12.30	0.00113
Acetaldehyde	0.89	0.85	215.24	0.0198
Propionaldehyde	0.0507	0.0485	12.30	0.00113
Benzaldehyde	0.0507	0.0485	12.30	0.00113
Valeraldehyde	0.0507	0.0485	12.30	0.00113
Hexanal	0.0507	0.0485	12.30	0.00113
Heptanal	0.0507	0.0485	12.30	0.00113

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{up})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm^3	Expanded Uncertainty mg/Nm^3	Measured Concentration mg/Nm^3	Percent of Measured Concentration
Formaldehyde	0.0226	0.0453	0.15	30.43
Butyraldehyde	0.0248	0.0496	0.0496	100.13
Acetaldehyde	0.0487	0.0974	0.87	11.23
Propionaldehyde	0.0248	0.0496	0.0496	100.13
Benzaldehyde	0.0248	0.0496	0.0496	100.13
Valeraldehyde	0.0248	0.0496	0.0496	100.13
Hexanal	0.0248	0.0496	0.0496	100.13
Heptanal	0.0248	0.0496	0.0496	100.13

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
Variation No	: ...		Survey Dates	: 1st July 2025
Report Ref	: P6125	: R001	Report Issue Date	: 20th August 2025

Total Hydrocarbons Uncertainty – Reaction Phase 1 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

				Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00452	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.989	...	...	...	...
Meter Temperature	T_m	298.67	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass			Standard Uncertainty	
Total Hydrocarbons	10.00	µg	uM	5.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by Cu_i where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component ($u\rho b$), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.91$$

	Maximum	Minimum	Sensitivity	ufstp
$u\rho_b$	0.48	0.47	0.000471	0.00471
uT_m	0.91	0.90	0.00304	0.00456
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00574$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00406$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00408	0.00403	0.00447	0.0000256
Effect of uV_m	0.00416	0.00396	0.90	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000929$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Total Hydrocarbons	0.0285	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons	3.70	1.23	246.43	1.23

Condensate Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons	2.52	2.41	607.58	0.0564

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Total Hydrocarbons	1.23	2.47	2.46	100.13

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
Variation No	: ...		Survey Dates	: 1st July 2025
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Total Hydrocarbons Uncertainty – Reaction Phase 1 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

				Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00452	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.989	...	...	...	...
Meter Temperature	T_m	299.33	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass			Standard Uncertainty	
Total Hydrocarbons	10.00	µg	uM	5.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.91$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000471	0.00471
uT_m	0.91	0.90	0.00303	0.00454
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00570$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00405$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00407	0.00402	0.00447	0.0000255
Effect of uV_m	0.00415	0.00395	0.90	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000925$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Total Hydrocarbons	0.0285	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons	3.70	1.23	246.98	1.23
Condensate Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons	2.53	2.41	610.29	0.0564

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Total Hydrocarbons	1.24	2.47	2.47	100.13

DEScycle at Leicester University			Installation Name	: Reaction Vessel
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Total Hydrocarbons Uncertainty – Reaction Phase 2 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

				Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00449	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.989	...	...	...	...
Meter Temperature	T_m	300.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass			Standard Uncertainty	
Total Hydrocarbons	10.00	µg	uM	5.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (up_b), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000470	0.00470
uT_m	0.91	0.90	0.00301	0.00452
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00567$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00401$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00404	0.00399	0.00444	0.0000252
Effect of uV_m	0.00411	0.00391	0.89	0.000100

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000914$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm^3	Condensate uL mg/Nm^3
Total Hydrocarbons	0.0288	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Total Hydrocarbons	3.74	1.25	249.18	1.25
Condensate Results				
	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Total Hydrocarbons				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Total Hydrocarbons	2.55	2.44	621.23	0.0568

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm^3	Expanded Uncertainty mg/Nm^3	Measured Concentration mg/Nm^3	Percent of Measured Concentration
Total Hydrocarbons	1.25	2.50	2.49	100.13

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
Variation No	: ...		Survey Dates	: 1st July 2025
Report Ref	: P6125	: R001	Report Issue Date	: 20th August 2025

Total Hydrocarbons Uncertainty – Reaction Phase 2 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00450	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.989	...	...	...	...
Meter Temperature	T_m	302.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass			Standard Uncertainty	
Total Hydrocarbons	10.00	µg	uM	5.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using: $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by Cu_i where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00400$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00402	0.00397	0.00445	0.0000248
Effect of uV_m	0.00410	0.00390	0.89	0.0000999

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000904$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Total Hydrocarbons	0.0289	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons	3.75	1.25	250.28	1.25
Condensate Results	**Maximum mg/Nm³**	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Total Hydrocarbons				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons	2.56	2.45	626.74	0.0567

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Total Hydrocarbons	1.25	2.51	2.50	100.13

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Total Hydrocarbons Uncertainty – Reaction Phase 3 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%	
Sampled Volume	V_m	0.00450	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.989	...	...	...	...
Meter Temperature	T_m	302.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**			**Standard Uncertainty**	
Total Hydrocarbons	56.00	µg	**uM**	2.80	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00400$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00402	0.00397	0.00445	0.0000248
Effect of uV_m	0.00410	0.00390	0.89	0.0000999

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000904$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Total Hydrocarbons	0.16	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Total Hydrocarbons	14.72	13.32	250.28	0.70

Condensate Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Total Hydrocarbons				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Total Hydrocarbons	14.34	13.71	3509.75	0.32

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Total Hydrocarbons	0.79	1.57	14.02	11.22

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
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Total Hydrocarbons Uncertainty – Reaction Phase 3 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00452	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.989	...	...	...	...
Meter Temperature	T_m	302.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass		Standard Uncertainty		
Total Hydrocarbons	32.00	µg	uM	1.60	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ **where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.q. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (uρb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
$u\rho_b$	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00401$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00404	0.00399	0.00447	0.0000249
Effect of uV_m	0.00411	0.00391	0.89	0.000100

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000909$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Total Hydrocarbons	0.0921	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons	8.37	7.57	249.18	0.40

Condensate Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Total Hydrocarbons	8.16	7.80	1987.86	0.18

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Total Hydrocarbons	0.45	0.89	7.97	11.22

DEScycle at Leicester University			**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**		**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**		**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125**	**: R001**	**Report Issue Date**	**: 20th August 2025**

Speciated VOC Uncertainty – Reaction Phase 1 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

				Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00452	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.989	...	...	...	...
Meter Temperature	T_m	298.67	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**			**Standard Uncertainty**	
Speciated VOC	5.00	µg	**uM**	2.50	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using: $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.91$$

	Maximum	**Minimum**	**Sensitivity**	**ufstp**
$u\rho_b$	0.48	0.47	0.000471	0.00471
uT_m	0.91	0.90	0.00304	0.00456
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00574$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00406$$

	Maximum m^3	**Minimum m^3**	**Sensitivity**	**Standard Uncertainty m^3**
Effect of uf_s	0.00408	0.00403	0.00447	0.0000256
Effect of uV_m	0.00416	0.00396	0.90	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000929$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	**Condensate uL mg/Nm³**
Speciated VOC	0.0142	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Speciated VOC	1.85	0.62	246.43	0.62
Condensate Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Speciated VOC				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Speciated VOC	1.26	1.20	303.79	0.0282

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	**Combined Uncertainty mg/Nm³**	**Expanded Uncertainty mg/Nm³**	**Measured Concentration mg/Nm³**	**Percent of Measured Concentration**
Speciated VOC	0.62	1.23	1.23	100.13

DEScycle at Leicester University			**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**		**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**		**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125**	**: R001**	**Report Issue Date**	**: 20th August 2025**

Speciated VOC Uncertainty – Reaction Phase 1 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00452	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.989	...	...	...	...
Meter Temperature	T_m	299.33	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**			**Standard Uncertainty**	
Speciated VOC	5.00	µg	**uM**	2.50	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by Cu_i **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV$_m$, uT$_m$ etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (uρb), measured temperature of dry gas uncertainty component (uT$_m$) & measured moisture (uH$_2$O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.91$$

	Maximum	**Minimum**	**Sensitivity**	**ufstp**
uρ$_b$	0.48	0.47	0.000471	0.00471
uT$_m$	0.91	0.90	0.00303	0.00454
uH$_2$O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00570$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00405$$

	Maximum m^3	**Minimum m^3**	**Sensitivity**	**Standard Uncertainty m^3**
Effect of uf$_s$	0.00407	0.00402	0.00447	0.0000255
Effect of uV$_m$	0.00415	0.00395	0.90	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000925$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm^3	**Condensate uL mg/Nm^3**
Speciated VOC	0.0143	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to uM$_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Speciated VOC	1.85	0.62	246.98	0.62
Condensate Results				
	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Speciated VOC				

Uncertainty in final measurement @ Reference Conditions due to uV$_{STD}$

Charcoal Tube Results				
	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Speciated VOC	1.26	1.21	305.15	0.0282

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	**Combined Uncertainty mg/Nm^3**	**Expanded Uncertainty mg/Nm^3**	**Measured Concentration mg/Nm^3**	**Percent of Measured Concentration**
Speciated VOC	0.62	1.24	1.23	100.13

DEScycle at Leicester University			**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**		**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**		**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125**	**: R001**	**Report Issue Date**	**: 20th August 2025**

Speciated VOC Uncertainty – Reaction Phase 2 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00449	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.989	...	...	...	...
Meter Temperature	T_m	300.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**			**Standard Uncertainty**	
Speciated VOC	5.00	µg	**uM**	2.50	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by Cu_i **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (up_b), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000470	0.00470
uT_m	0.91	0.90	0.00301	0.00452
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00567$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00401$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00404	0.00399	0.00444	0.0000252
Effect of uV_m	0.00411	0.00391	0.89	0.000100

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000914$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Speciated VOC	0.0144	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Speciated VOC	1.87	0.62	249.18	0.62

Condensate Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Speciated VOC				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Speciated VOC	1.27	1.22	310.61	0.0284

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Speciated VOC	0.62	1.25	1.25	100.13

DEScycle at Leicester University			**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**		**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**		**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125**	**: R001**	**Report Issue Date**	**: 20th August 2025**

Speciated VOC Uncertainty – Reaction Phase 2 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00450	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.989	...	...	...	...
Meter Temperature	T_m	302.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**			**Standard Uncertainty**	
Speciated VOC	5.00	µg	**uM**	2.50	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using: $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C u_i$ **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component ($u\rho b$), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
$u\rho_b$	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00400$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00402	0.00397	0.00445	0.0000248
Effect of uV_m	0.00410	0.00390	0.89	0.0000999

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000904$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Speciated VOC	0.0145	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Speciated VOC	1.88	0.63	250.28	0.63
Condensate Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Speciated VOC				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Speciated VOC	1.28	1.22	313.37	0.0283

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Speciated VOC	0.63	1.25	1.25	100.13

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
Variation No	: ...		Survey Dates	: 1st July 2025
Report Ref	: P6125	: R001	Report Issue Date	: 20th August 2025

Speciated VOC Uncertainty – Reaction Phase 3 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00450	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.989	...	...	...	...
Meter Temperature	T_m	302.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass			Standard Uncertainty	
Acetone	50.90	µg	uM	2.55	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (up_b), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00400$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00402	0.00397	0.00445	0.0000248
Effect of uV_m	0.00410	0.00390	0.89	0.0000999

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000904$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Acetone	0.15	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Acetone	13.38	12.10	250.28	0.64
Condensate Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Acetone				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Acetone	13.03	12.46	3190.11	0.29

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Acetone	0.71	1.43	12.74	11.22

DEScycle at Leicester University			Installation Name	: Reaction Vessel
Permit No	: ...		Visit Details	: Investigative Emissions – July 2025
Variation No	: ...		Survey Dates	: 1st July 2025
Report Ref	: P6125	: R001	Report Issue Date	: 20th August 2025

Speciated VOC Uncertainty – Reaction Phase 3 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00452	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.989	...	...	...	...
Meter Temperature	T_m	302.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass			Standard Uncertainty	
Acetone	26.70	µg	uM	1.34	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by Cu_i **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (up_b), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00401$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00404	0.00399	0.00447	0.0000249
Effect of uV_m	0.00411	0.00391	0.89	0.000100

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000909$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Acetone	0.0768	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Acetone	6.99	6.32	249.18	0.33
Condensate Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Acetone				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Acetone	6.81	6.51	1658.62	0.15

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Acetone	0.37	0.75	6.65	11.22

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Acids Screen Uncertainty – Reaction Phase 1 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00451	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.996	...	...	...	...
Meter Temperature	T_m	298.67	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass			Standard Uncertainty	
Hydrofluoric Acid	5.00	µg	uM	2.50	µg
Hydrochloric Acid	1.00	µg	uM	0.50	µg
Nitric Acid	2.00	µg	uM	1.00	µg
Phosphoric Acid	6.00	µg	uM	3.00	µg
Sulphuric Acid	2.00	µg	uM	1.00	µg
Hydrogen Bromide	2.00	µg	uM	1.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by Cu_i **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV$_m$, uT$_m$ etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT$_m$) & measured moisture (uH$_2$O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.91$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000471	0.00471
uT_m	0.91	0.90	0.00304	0.00456
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{up_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00574$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00408$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf$_s$	0.00410	0.00405	0.00449	0.0000258
Effect of uV$_m$	0.00418	0.00398	0.90	0.000102

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000940$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm^3	Condensate uL mg/Nm^3
Hydrofluoric Acid	0.0142	...
Hydrochloric Acid	0.00283	...
Nitric Acid	0.00566	...
Phosphoric Acid	0.0170	...
Sulphuric Acid	0.00566	...
Hydrogen Bromide	0.00566	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to uM$_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Hydrofluoric Acid	1.84	0.61	245.24	0.61
Hydrochloric Acid	0.37	0.12	245.24	0.12
Nitric Acid	0.74	0.25	245.24	0.25
Phosphoric Acid	2.21	0.74	245.24	0.74
Sulphuric Acid	0.74	0.25	245.24	0.25
Hydrogen Bromide	0.74	0.25	245.24	0.25

Condensate Results				
	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Hydrofluoric Acid				
Hydrochloric Acid				
Nitric Acid				
Phosphoric Acid				
Sulphuric Acid				
Hydrogen Bromide				

Uncertainty in final measurement @ Reference Conditions due to uV$_{STD}$

Charcoal Tube Results				
	Maximum mg/Nm^3	Minimum mg/Nm^3	Sensitivity	Standard Uncertainty mg/Nm^3
Hydrofluoric Acid	1.26	1.20	300.87	0.0283
Hydrochloric Acid	0.25	0.24	60.17	0.00565
Nitric Acid	0.50	0.48	120.35	0.0113
Phosphoric Acid	1.51	1.44	361.04	0.0339
Sulphuric Acid	0.50	0.48	120.35	0.0113
Hydrogen Bromide	0.50	0.48	120.35	0.0113

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm^3	Expanded Uncertainty mg/Nm^3	Measured Concentration mg/Nm^3	Percent of Measured Concentration
Hydrofluoric Acid	0.61	1.23	1.23	100.13
Hydrochloric Acid	0.12	0.25	0.25	100.13
Nitric Acid	0.25	0.49	0.49	100.13
Phosphoric Acid	0.74	1.47	1.47	100.13
Sulphuric Acid	0.25	0.49	0.49	100.13
Hydrogen Bromide	0.25	0.49	0.49	100.13

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Acids Screen Uncertainty – Reaction Phase 1 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

				Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00442	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	Yd	0.996	...	...	...	...
Meter Temperature	T_m	299.33	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	Recovered Mass			Standard Uncertainty	
Hydrofluoric Acid	5.00	µg	uM	2.50	µg
Hydrochloric Acid	1.00	µg	uM	0.50	µg
Nitric Acid	2.00	µg	uM	1.00	µg
Phosphoric Acid	6.00	µg	uM	3.00	µg
Sulphuric Acid	2.00	µg	uM	1.00	µg
Hydrogen Bromide	2.00	µg	uM	1.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using: $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (uρb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.91$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000471	0.00471
uT_m	0.91	0.90	0.00303	0.00454
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00570$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00399$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty m^3
Effect of uf_s	0.00401	0.00396	0.00440	0.0000251
Effect of uV_m	0.00409	0.00389	0.90	0.0000997

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000916$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Hydrofluoric Acid	0.0145	...
Hydrochloric Acid	0.00290	...
Nitric Acid	0.00579	...
Phosphoric Acid	0.0174	...
Sulphuric Acid	0.00579	...
Hydrogen Bromide	0.00579	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Hydrofluoric Acid	1.88	0.63	250.79	0.63
Hydrochloric Acid	0.38	0.13	250.79	0.13
Nitric Acid	0.75	0.25	250.79	0.25
Phosphoric Acid	2.26	0.75	250.79	0.75
Sulphuric Acid	0.75	0.25	250.79	0.25
Hydrogen Bromide	0.75	0.25	250.79	0.25

Condensate Results

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Hydrofluoric Acid				
Hydrochloric Acid				
Nitric Acid				
Phosphoric Acid				
Sulphuric Acid				
Hydrogen Bromide				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Hydrofluoric Acid	1.28	1.23	314.64	0.0288
Hydrochloric Acid	0.26	0.25	62.93	0.00577
Nitric Acid	0.51	0.49	125.86	0.0115
Phosphoric Acid	1.54	1.47	377.57	0.0346
Sulphuric Acid	0.51	0.49	125.86	0.0115
Hydrogen Bromide	0.51	0.49	125.86	0.0115

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Hydrofluoric Acid	0.63	1.26	1.25	100.13
Hydrochloric Acid	0.13	0.25	0.25	100.13
Nitric Acid	0.25	0.50	0.50	100.13
Phosphoric Acid	0.75	1.51	1.50	100.13
Sulphuric Acid	0.25	0.50	0.50	100.13
Hydrogen Bromide	0.25	0.50	0.50	100.13

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Acids Screen Uncertainty – Reaction Phase 2 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00450	m³		uV_m	0.0001	m³
Meter Correction Factor or ml/count	Yd	0.996	...		...	...	...
Meter Temperature	T_m	300.00	k		uT_m	1.5	k
Barometric Pressure	p_b	1006.00	mBar			10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol		$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol		uH_2O		%Vol

Tubes					
Determinand	Recovered Mass		Standard Uncertainty		
Hydrofluoric Acid	5.00	µg	uM	2.50	µg
Hydrochloric Acid	1.00	µg	uM	0.50	µg
Nitric Acid	2.00	µg	uM	1.00	µg
Phosphoric Acid	6.00	µg	uM	3.00	µg
Sulphuric Acid	2.00	µg	uM	1.00	µg
Hydrogen Bromide	2.00	µg	uM	1.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $u_i = C_i u_i$ where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.90$$

	Maximum	Minimum	Sensitivity	ufstp
up_b	0.48	0.47	0.000470	0.00470
uT_m	0.91	0.90	0.00301	0.00452
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{up_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00567$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00405$$

	Maximum m³	Minimum m³	Sensitivity	Standard Uncertainty m³
Effect of uf_s	0.00408	0.00403	0.00448	0.0000254
Effect of uV_m	0.00415	0.00395	0.90	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000929$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	Condensate uL mg/Nm³
Hydrofluoric Acid	0.0143	...
Hydrochloric Acid	0.00285	...
Nitric Acid	0.00570	...
Phosphoric Acid	0.0171	...
Sulphuric Acid	0.00570	...
Hydrogen Bromide	0.00570	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Hydrofluoric Acid	1.85	0.62	246.88	0.62
Hydrochloric Acid	0.37	0.12	246.88	0.12
Nitric Acid	0.74	0.25	246.88	0.25
Phosphoric Acid	2.22	0.74	246.88	0.74
Sulphuric Acid	0.74	0.25	246.88	0.25
Hydrogen Bromide	0.74	0.25	246.88	0.25

Condensate Results

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Hydrofluoric Acid				
Hydrochloric Acid				
Nitric Acid				
Phosphoric Acid				
Sulphuric Acid				
Hydrogen Bromide				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	Standard Uncertainty mg/Nm³
Hydrofluoric Acid	1.26	1.21	304.91	0.0283
Hydrochloric Acid	0.25	0.24	60.98	0.00567
Nitric Acid	0.51	0.48	121.96	0.0113
Phosphoric Acid	1.52	1.45	365.89	0.0340
Sulphuric Acid	0.51	0.48	121.96	0.0113
Hydrogen Bromide	0.51	0.48	121.96	0.0113

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration
Hydrofluoric Acid	0.62	1.24	1.23	100.13
Hydrochloric Acid	0.12	0.25	0.25	100.13
Nitric Acid	0.25	0.49	0.49	100.13
Phosphoric Acid	0.74	1.48	1.48	100.13
Sulphuric Acid	0.25	0.49	0.49	100.13
Hydrogen Bromide	0.25	0.49	0.49	100.13

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Acids Screen Uncertainty – Reaction Phase 2 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00450	m^3		uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.996	...		...	...	...
Meter Temperature	T_m	302.00	k		uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar			10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol		$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol		uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**		**Standard Uncertainty**		
Hydrofluoric Acid	5.00	µg	**uM**	2.50	µg
Hydrochloric Acid	1.00	µg	**uM**	0.50	µg
Nitric Acid	2.00	µg	**uM**	1.00	µg
Phosphoric Acid	6.00	µg	**uM**	3.00	µg
Sulphuric Acid	2.00	µg	**uM**	1.00	µg
Hydrogen Bromide	2.00	µg	**uM**	1.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.90$$

	Maximum	**Minimum**	**Sensitivity**	**ufstp**
up_b	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00402$$

	Maximum m^3	**Minimum m^3**	**Sensitivity**	**Standard Uncertainty m^3**
Effect of uf_s	0.00405	0.00400	0.00448	0.0000250
Effect of uV_m	0.00412	0.00392	0.89	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000917$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	**Condensate uL mg/Nm³**
Hydrofluoric Acid	0.0143	...
Hydrochloric Acid	0.00287	...
Nitric Acid	0.00574	...
Phosphoric Acid	0.0172	...
Sulphuric Acid	0.00574	...
Hydrogen Bromide	0.00574	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to $uM_{Recovered}$

Charcoal Tube Results

	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Hydrofluoric Acid	1.86	0.62	248.52	0.62
Hydrochloric Acid	0.37	0.12	248.52	0.12
Nitric Acid	0.75	0.25	248.52	0.25
Phosphoric Acid	2.24	0.75	248.52	0.75
Sulphuric Acid	0.75	0.25	248.52	0.25
Hydrogen Bromide	0.75	0.25	248.52	0.25

Condensate Results

	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Hydrofluoric Acid				
Hydrochloric Acid				
Nitric Acid				
Phosphoric Acid				
Sulphuric Acid				
Hydrogen Bromide				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results

	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Hydrofluoric Acid	1.27	1.21	308.98	0.0283
Hydrochloric Acid	0.25	0.24	61.80	0.00567
Nitric Acid	0.51	0.49	123.59	0.0113
Phosphoric Acid	1.53	1.46	370.78	0.0340
Sulphuric Acid	0.51	0.49	123.59	0.0113
Hydrogen Bromide	0.51	0.49	123.59	0.0113

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	**Combined Uncertainty mg/Nm³**	**Expanded Uncertainty mg/Nm³**	**Measured Concentration mg/Nm³**	**Percent of Measured Concentration**
Hydrofluoric Acid	0.62	1.24	1.24	100.13
Hydrochloric Acid	0.12	0.25	0.25	100.13
Nitric Acid	0.25	0.50	0.50	100.13
Phosphoric Acid	0.75	1.49	1.49	100.13
Sulphuric Acid	0.25	0.50	0.50	100.13
Hydrogen Bromide	0.25	0.50	0.50	100.13

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Acids Screen Uncertainty – Reaction Phase 3 – Test 1

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00450	m³	uV_m	0.0001	m³
Meter Correction Factor or ml/count	**Yd**	0.996	...	...	...	...
Meter Temperature	T_m	302.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**			**Standard Uncertainty**	
Hydrofluoric Acid	5.00	µg	**uM**	2.50	µg
Hydrochloric Acid	1.00	µg	**uM**	0.50	µg
Nitric Acid	2.00	µg	**uM**	1.00	µg
Phosphoric Acid	6.00	µg	**uM**	3.00	µg
Sulphuric Acid	2.00	µg	**uM**	1.00	µg
Hydrogen Bromide	2.00	µg	**uM**	1.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV_m, uT_m etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (up$_b$), measured temperature of dry gas uncertainty component (uT_m) & measured moisture (uH_2O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = 0.90$$

	Maximum	**Minimum**	**Sensitivity**	**ufstp**
up$_b$	0.48	0.47	0.000469	0.00469
uT_m	0.90	0.89	0.00297	0.00446
uH_2O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.00402$$

	Maximum m³	**Minimum m³**	**Sensitivity**	**Standard Uncertainty m³**
Effect of uf_s	0.00405	0.00400	0.00448	0.0000250
Effect of uV_m	0.00412	0.00392	0.89	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.0000917$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm³	**Condensate uL mg/Nm³**
Hydrofluoric Acid	0.0143	...
Hydrochloric Acid	0.00287	...
Nitric Acid	0.00574	...
Phosphoric Acid	0.0172	...
Sulphuric Acid	0.00574	...
Hydrogen Bromide	0.00574	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to u$M_{Recovered}$

Charcoal Tube Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Hydrofluoric Acid	1.86	0.62	248.52	0.62
Hydrochloric Acid	0.37	0.12	248.52	0.12
Nitric Acid	0.75	0.25	248.52	0.25
Phosphoric Acid	2.24	0.75	248.52	0.75
Sulphuric Acid	0.75	0.25	248.52	0.25
Hydrogen Bromide	0.75	0.25	248.52	0.25
Condensate Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Hydrofluoric Acid				
Hydrochloric Acid				
Nitric Acid				
Phosphoric Acid				
Sulphuric Acid				
Hydrogen Bromide				

Uncertainty in final measurement @ Reference Conditions due to uV_{STD}

Charcoal Tube Results				
	Maximum mg/Nm³	**Minimum mg/Nm³**	**Sensitivity**	**Standard Uncertainty mg/Nm³**
Hydrofluoric Acid	1.27	1.21	308.98	0.0283
Hydrochloric Acid	0.25	0.24	61.80	0.00567
Nitric Acid	0.51	0.49	123.59	0.0113
Phosphoric Acid	1.53	1.46	370.78	0.0340
Sulphuric Acid	0.51	0.49	123.59	0.0113
Hydrogen Bromide	0.51	0.49	123.59	0.0113

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	**Combined Uncertainty mg/Nm³**	**Expanded Uncertainty mg/Nm³**	**Measured Concentration mg/Nm³**	**Percent of Measured Concentration**
Hydrofluoric Acid	0.62	1.24	1.24	100.13
Hydrochloric Acid	0.12	0.25	0.25	100.13
Nitric Acid	0.25	0.50	0.50	100.13
Phosphoric Acid	0.75	1.49	1.49	100.13
Sulphuric Acid	0.25	0.50	0.50	100.13
Hydrogen Bromide	0.25	0.50	0.50	100.13

DEScycle at Leicester University		**Installation Name**	**: Reaction Vessel**
Permit No	**: ...**	**Visit Details**	**: Investigative Emissions – July 2025**
Variation No	**: ...**	**Survey Dates**	**: 1st July 2025**
Report Ref	**: P6125 : R001**	**Report Issue Date**	**: 20th August 2025**

Acids Screen Uncertainty – Reaction Phase 3 – Test 2

Site: Descycle Ltd, Leicester University
Location: Materials Laboratory , Stack ID:Reaction Vessel

					Standard Uncertainty @ 95%		
Sampled Volume	V_m	0.00452	m^3	uV_m	0.0001	m^3
Meter Correction Factor or ml/count	**Yd**	0.996	...	...	...	...
Meter Temperature	T_m	302.00	k	uT_m	1.5	k
Barometric Pressure	ρ_b	1006.00	mBar		10.0	mBar
Oxygen content	$O_{2,m}$	20.90	%Vol	$uO_{2,m}$	1.25	%Vol
Moisture	H_2O	0.00	%Vol	uH_2O		%Vol

Tubes					
Determinand	**Recovered Mass**			**Standard Uncertainty**	
Hydrofluoric Acid	5.00	µg	**uM**	2.50	µg
Hydrochloric Acid	1.00	µg	**uM**	0.50	µg
Nitric Acid	2.00	µg	**uM**	1.00	µg
Phosphoric Acid	6.00	µg	**uM**	3.00	µg
Sulphuric Acid	2.00	µg	**uM**	1.00	µg
Hydrogen Bromide	2.00	µg	**uM**	1.00	µg

Note: In the following calculations, the sensitivity coefficient (C) is estimated using $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ **where** C **is the sensitivity coefficient,** u **is the standard uncertainty and** i **is the index identifying the contributing factor e.g. i=uV$_m$, uT$_m$ etc.**

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.00$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured temperature of dry gas uncertainty component (uT$_m$) & measured moisture (uH$_2$O)

$$f_s = \frac{273}{T_m} \times \frac{\rho}{101.3} = \quad 0.90$$

	Maximum	**Minimum**	**Sensitivity**	**ufstp**
up$_b$	0.48	0.47	0.000469	0.00469
uT$_m$	0.90	0.89	0.00297	0.00446
uH$_2$O	...	...	...	...

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{uP_b}{(P_b/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00557$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.00404$$

	Maximum m^3	**Minimum m^3**	**Sensitivity**	**Standard Uncertainty m^3**
Effect of uf$_s$	0.00407	0.00402	0.00450	0.0000251
Effect of uV$_m$	0.00414	0.00394	0.89	0.000101

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uf_s}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.0000922$$

Uncertainty of correction factor to reference conditions (excluding oxygen contribution) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$uL = \frac{Conc \times \frac{2}{100}}{\sqrt{3}}$$

	Tubes uL mg/Nm^3	**Condensate uL mg/Nm^3**
Hydrofluoric Acid	0.0143	...
Hydrochloric Acid	0.00286	...
Nitric Acid	0.00571	...
Phosphoric Acid	0.0171	...
Sulphuric Acid	0.00571	...
Hydrogen Bromide	0.00571	...

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}}$$

Uncertainty in final measurement @ Reference Conditions due to uM$_{Recovered}$

Charcoal Tube Results

	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Hydrofluoric Acid	1.86	0.62	247.43	0.62
Hydrochloric Acid	0.37	0.12	247.43	0.12
Nitric Acid	0.74	0.25	247.43	0.25
Phosphoric Acid	2.23	0.74	247.43	0.74
Sulphuric Acid	0.74	0.25	247.43	0.25
Hydrogen Bromide	0.74	0.25	247.43	0.25

Condensate Results

	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Hydrofluoric Acid				
Hydrochloric Acid				
Nitric Acid				
Phosphoric Acid				
Sulphuric Acid				
Hydrogen Bromide				

Uncertainty in final measurement @ Reference Conditions due to uV$_{STD}$

Charcoal Tube Results

	Maximum mg/Nm^3	**Minimum mg/Nm^3**	**Sensitivity**	**Standard Uncertainty mg/Nm^3**
Hydrofluoric Acid	1.27	1.21	306.26	0.0282
Hydrochloric Acid	0.25	0.24	61.25	0.00564
Nitric Acid	0.51	0.48	122.50	0.0113
Phosphoric Acid	1.52	1.45	367.51	0.0339
Sulphuric Acid	0.51	0.48	122.50	0.0113
Hydrogen Bromide	0.51	0.48	122.50	0.0113

Combined Uncertainty (excluding Oxygen contribution)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Charcoal Tubes: Determinand	**Combined Uncertainty mg/Nm^3**	**Expanded Uncertainty mg/Nm^3**	**Measured Concentration mg/Nm^3**	**Percent of Measured Concentration**
Hydrofluoric Acid	0.62	1.24	1.24	100.13
Hydrochloric Acid	0.12	0.25	0.25	100.13
Nitric Acid	0.25	0.50	0.49	100.13
Phosphoric Acid	0.74	1.49	1.48	100.13
Sulphuric Acid	0.25	0.50	0.49	100.13
Hydrogen Bromide	0.25	0.50	0.49	100.13