Methods Manual
For
Emissions Monitoring
at

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TP 1
Determination of Particulate Matter From a Stationary Source

1 Scope

This procedure outlines the reference method **BS EN 13284-1** Stationary source emissions-Determination of low range mass concentrations of dust in ducted gaseous streams in concentrations below 50mg/m^3. This method has been validated with special emphasis around 5 mg/m^3 on an average 30minute sample time.

2 Principle

A sample stream of gas is extracted from the main gas stream at representative sample points for a measured period of time, at an isokinetically controlled flow rate. Dust entrained in the gas sample is separated by a pre-weighed filter, which is then dried and re-weighed. Deposits upstream of the filter are also recovered and weighed. The increase of mass of the filter, and the deposited mass upstream of the filter are attributed to the dust collected from the sampled gas, which allows the dust concentration to be calculated.

Two different configurations of the sampling equipment may be used depending on the characteristics of the gases to be sampled.

3 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, eg. Steady state or cyclic, can affect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed and assessment made to determine compliance with BS EN 15259

Measure and record the barometric pressure.

A preliminary velocity traverse will be carried out as per TP6

Calculate the number of sample points determine nozzle size and gas stream density.

Assemble sample train as per standard method and leak check. Pre heat all relevant parts. The test apparatus consists of a Universal type Isokinetic sampling train. This system includes a pump, dry gas meter, sampling tube, S type pitot, K type thermocouples, condenser, probe and in-stack filter system.

Insert sample probe into stack at first point and seal port. Open shut of value and start pump and adjust to the isokinetic rate –5% and +15%. The sample duration should be identical at each point. Do not stop sampling when moving from point to point, and immediately adjust the flow rate for isokinetic conditions. Record the sample time and volume at each point.

On completion of sampling of all the selected points of the sample line, close the shut of valve and switch off pump, remove the sampling train from the duct and reposition it on the next sampling line.

Leak check the equipment.

Rinse all non weighed parts upstream of the filter which are in contact with the gas sample using Analytical grade acetone. and recover the deposits.

Send filter and deposits back to the laboratory for analysis.

Calculate results.

4 Standard Calculations

Particulate concentration (mg/m^3):

$$C_{mg/m3} = \frac{M_n}{V_{mstd}}$$

Particulate concentration corrected to X% O_2 (mg/m^3):

$$C_{atX\,\%} = C \times \frac{20.9 - X}{20.9 - act\%\ O_2}$$

Particulate emissions rate (g/hr):

$$E_{g/hr} = \frac{C \times Q_{std}}{1000}$$

TP 2
Determination of Combustion Gases
(Nitrogen Oxides, Carbon Monoxide, and Oxygen)

1 Scope

This procedure outlines the reference method BS EN 14789 (O_2), BS EN 15058 (CO) and BS EN 14792 (NO_x).

2 Principle

A representative volume of flue gas is extracted from the emission source for a fixed period of time at a controlled flow rate. A filter removes any dust in the sample volume before the sample is conditioned and passed to an array of analysers (3)

3. Equipment

Assemble sampling system as per schematic 1 (Gas analyser set up), indicated in blue. Pre heat all relevant parts. The system consists of a Filtered averaging probe, PTFE lined heated line and pump, chiller and Analytical analysers.

The analyser is connected to an external data logger which will be set to log data every 15 seconds, using a portable computer system.

4 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, e.g. Steady state or cyclic, may affect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed and assessment made to determine compliance with BS EN 15259

Measure and record the barometric pressure.

A preliminary velocity traverse will be carried out as per TP6

Check the calibration as per the standard and operating manual and adjust accordingly.

Insert sample probe into stack ensuring sample point is gas tight.

Cal Check after the end of each day or the end of each sample run.

TP 3
Determination of Total Organic Carbon – Continuous Flame Ionisation Detector (FID) Method

1 Scope

This procedure outlines the reference method **EN 12619 Stationary Source Emissions –** Determination of the mass concentration of total gaseous organic carbon in flue gases from solvent using processes – continuous flame ionisation detector method.

2 Principle

A representative volume of flue gas is extracted from the emission source. The measurement effect utilised by the FID is the ionisation of organically bound carbon atoms in a hydrogen flame. The ionisation current measured by the FID depends on the number of C-atoms of organic compounds burning in the fuel gas flame.

3. Equipment

Assemble sampling system as per schematic 1 (Gas analyser set up), indicated in Green. Pre heat all relevant parts. The system consists of a filtered averaging probe, PTFE lined heated line and FID analyser.

All instruments are connected to an external logger, which is set up to log data every 15 seconds and the results displayed graphically.

4 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

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Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, eg. Steady state or cyclic, may affect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed and assessment made to determine compliance with BS EN 15259

Measure and record the barometric pressure.

A preliminary velocity traverse will be carried out as per TP6.

Check the calibration as per the standard and operating manual and adjust accordingly.

Insert sample probe into stack ensuring sample point is gas tight.

Recalibrate after the end of each day or the end of each sample run.

TP 4
Determination of Hydrogen Chloride (HCl) From a Stationary Source

1 Scope

This procedure outlines the reference method **BS EN 1911** Stationary Source Emissions – Manual Method of Determination of Hydrogen Chloride (HCl)

2 Principle

A representative sample of gas is extracted from the main gas stream through a heated probe. The sampled gas is extracted at a controlled flow rate and to a measured volume. Particles and dust, which can contain solid chlorides, are removed by filtration at a controlled temperature, the gaseous chlorides are collected by dissolving in an absorption reagent (chloride free water), in accordance with EN 1911-2.

3 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, eg. Steady state or cyclic, may affect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed, and assessment made to determine compliance with BS EN 15259

Measure and record the barometric pressure.

A preliminary velocity traverse will be carried out as per TP6.

Assemble test apparatus as per schematic below. The system includes a dry gas meter, flow meter pump, silica gel tube, guard and wash bottles, sample line sampling tube, probe and in-stack filter system.

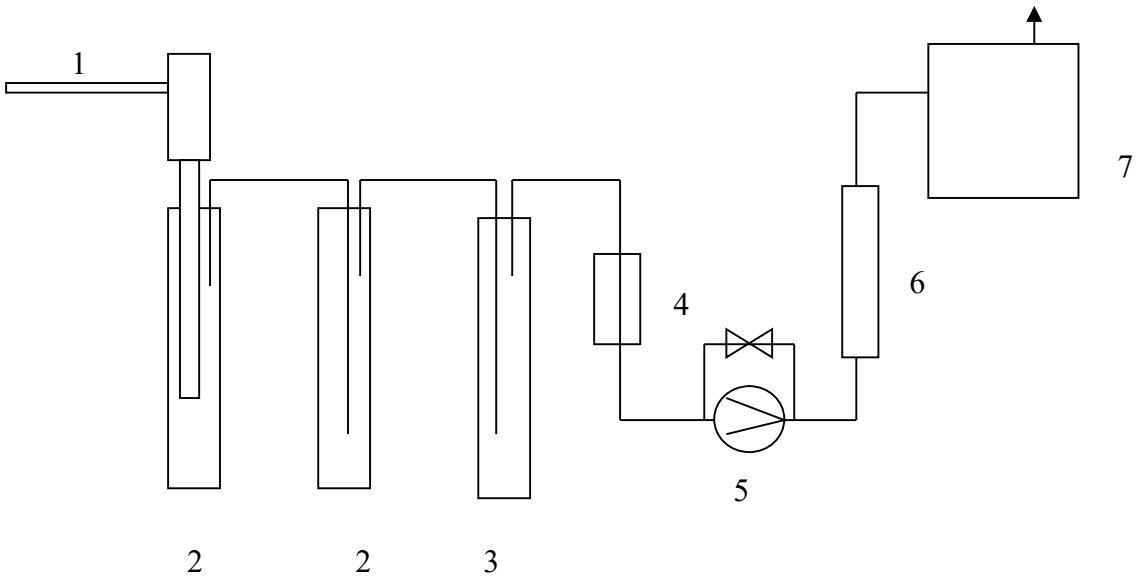
Immerse the impinger arrangement in the ice bath and leak check

Check and set the flow rate.

Insert probe into stack and start the pump, recording start time.

At the end of the test transfer the solution volume to a clean sample bottle.

Figure 1: Schematic of equipment arrangement for HCl sampling



1 Connecting line
2 Washing Bottle(s)
3 Guard Bottle (optional)
4 Silica Gel Tube
5 Pump
6 Flow meter
7 Dry gas meter

TP 5
Determination of mass concentrations of Volatile Organic Compounds – Activated carbon tube and solvent desorption method.

1 Scope

This procedure outlines the reference method **CEN TS 13649** Stationary Source Emissions Sampling for the Determination of mass concentrations of individual gaseous organic compounds- Activated carbon and solvent desorption method, Sampling without dilution.

2 Principle

A representative volume of flue gas is extracted from the emission source, at a controlled flow rate. Individual gaseous components within the sample gas are adsorbed onto activated carbon.

3. Equipment

Assemble sampling system as per schematic 1 (Gas analyser set up), indicated in Red. Please note an optional cooling system maybe used to maintain tube temperatures to below 40ºC.

4 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, eg. Steady state or cyclic, may affect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed and assessment made to determine compliance with BS EN 15259

Measure and record the barometric pressure.

A preliminary velocity traverse will be carried out as per TP6

Break open the activated carbon tube and connect into system, note directional arrow, on the side of the tube indicates flow direction.

Insert probe into the stack record the dry gas meter reading and start time switch on the pump. Monitor the flow rate through out the test. At the end of the sample run stop the pump cap the carbon tube, noting the time. Record the dry gas meter reading.

Calculate the volume of gas sampled at S.T.P

TP 6
Preliminary Velocity and Temperature Survey

1 Scope

This procedure outlines the measurement procedure as set out in Technical Guidance Document (Monitoring (M1) published by the Environment Agency and in accordance with **BS EN ISO 16911**.

2 Principle

In order to determine isokinetic sample rates and mass emission rates, stack gas temperature, velocity and effective duct diameter must be accurately determined. This survey will be made from the same location as the emissions survey, with the Plant operating under conditions that will be adhered to during the tests. Differential and static pressures are determined with S and L type Pitot tubes of various lengths, gauges and manometers.

3 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, e.g. Steady state or cyclic, may affect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed, and assessment made to determine compliance with BS EN 15259

Measure and record the barometric pressure.

As the survey must cover the full internal diameter of the stack at predetermined points dependant on the stack diameter. Accurately determine the stack diameter and mark of on the Pitot tube each traverse point excluding the region within 3% of the effective stack diameter from the wall or at least 3cm from the wall (whichever is the larger).

Carryout a 'swirl test' checking, that the gas is flowing within 15^{o} of the duct axis. The sampling position is suitable if the following conditions are met if:

1. angle of flow ≤ 15^{o}, with regard to duct axis.
2. no local negative flow.
3. minimum velocity depending on the method used (for pitot tubes a differential pressure of ≥ 5 Pa)
4. ratio of highest to lowest local gas velocities ≤ 3: 1.
5. temperature, in Kelvin's, at any point ≤ ± 5% from the mean temperature in Kelvin's.

If the gas conditional requirements 1 to 5 are not met the measurement of mass flow will not be in compliance with international standards.

TP 7
Procedure for the Optimisation of an Oven incinerator.

1 Scope

This procedure outlines the in house method by which an oven incinerator is optimised. The actual method of measurement is as TP 2, which for completeness is included below. The only notable exceptions from TP2 are that the mean CO and NOx concentrations are determined at various oven operating temperatures over 15 minute periods.

At the end of each 15 minute sampling and logging period calculate the mean CO and NOx concentration for the given set point temperature. Ensure the incinerator is raised to the next set point.

Determine the optimum operating temperature by plotting CO and NOx concentration against temperature. Issue results to NMUK staff.

2 Principle

A representative volume of flue gas is extracted from the emission source for a fixed period of time at a controlled flow rate. A filter removes any dust in the sample volume before the sample is conditioned and passed to an array of analysers (3)

3. Equipment

Assemble sampling system, pre heat all relevant parts. The system consists of a Filtered averaging probe, PTFE lined heated line and pump, chiller and Analytical analysers.

The analyseris connected to an external data logger which will be set to log data every 15 seconds, using a portable computer system.

4 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, eg. Steady state or cyclic, may effect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed and assessment made to determine compliance with TG Note M1

Measure and record the barometric pressure.

A preliminary velocity traverse will be carried out as per TP6.

Check the calibration as per the standard and operating manual and adjust accordingly.

Insert sample probe into stack ensuring sample point is gas tight.

Recalibrate after the end of each day or the end of each sample run.

TP 8
Procedure For The Assessment of Visible Smoke
- Ringelmann Chart

1 Scope

This procedure outlines the reference method BS 2742 Use of the Ringelmann and miniature smoke charts

2 Principle

The colouration of the exhaust gases are visually assessed by comparing them with the grey scale on the Ringelmann Chart.

3 Equipment

The British Ringelmann Chart is used for this assessment.

4 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, ensure the process is in operation.

Firmly mount the Ringelmann Chart on the stand with the backing holder.

Secure the chart and stand in the vertical plane between the observer and the exit point of the exhaust stack. The chart should be around 15 meters from the observer to ensure the cross-hatching on the chart merges and forms shades of grey.

The source of light (sun) should be at right angles to the line of vision and not directly behind and in front of the observer.

Compare the darkness of the exhaust gases with the grey scales on the chart. Note the shade number which is closest to that of the exhaust gases.

Cloudy, hazy, low lit conditions will reduce the accuracy of the measurement.

TP 9
Determination of Isocyanates From a Stationary Source

1 Scope

This procedure outlines the reference method CTM - 036 Method for Measurement of Isocyanate Compounds in Stack Emissions.

2 Principle

A representative sample of gas is extracted from the main gas stream. The sampled gas is extracted at a controlled flow rate and to a measured volume. The isocyanates are collected on a pre treated filter.

3 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, eg. Steady state or cyclic, may effect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed and assessment made to determine compliance with BS EN 15259

Measure and record the barometric pressure.

A preliminary velocity traverse will be carried out as per TP6

Assemble test apparatus which includes a dry gas meter, flow meter pump, silica gel tube, guard and absorption bottles, sample line sampling tube, probe and in-stack filter system and leak check.

Insert probe into stack and start the pump, recording start time.

Transfer the filter to a clean sample bottle.

TP 10
Equipment, Samples / Solutions and Sample Container Handling when Working in the Paint Shop and Bumper Paints

1 Scope

This procedure outlines the equipment, samples, solutions and sample containers handling procedure when working within the Paint Shop and Bumper paints Facilities.

2 Principle

In line with the NMUK Paint Shop / Bumper Paints Facility Contractor / Visitor Rules, equipment, samples / solutions and sample containers will be handled to prevent / reduce the risk of spillage / loss.

3 Procedure

All equipment which is taken on site will be documented.

All samples, solutions and sample containers which are taken on site will be documented. All samples, solutions and sample containers will be accounted for before leaving site.

All samples taken from sampling locations will be documented.

If any equipment, samples, solutions or containers are misplaced on site NMUK as soon as it is apparent.

3.1 On completion of the monitoring the filters, probe washing and tubes will be labelled and returned to the company vehicle.

Solutions for probe washing (water and acetone) will be kept in storage bottle and only minimum amounts will be taken to the sample location.

The probe washing will be carried out after every test (as per British Standards) in a clean area near to the sampling location and the washing will be stored in sample storage containers (125ml bottles) and labelled.

3.2 When using Silica Gel (which is used as a drying agent) the following will be adopted:

3.2.1 When working inside the Paint Shop and Bumper Paints facility, the silica gel will be set up in the glass impingers in a clean area in the company vehicle and kept sealed during transportation to the sampling location.

Once at the sampling location each impinger shall be weighed then put into the sampling system. It will remained sealed in the sampling system for the duration of the test.

Once the test is complete the impingers will be taken out of the sample system, sealed, weighed and returned into the sampling system. (this is to determine the moisture content of the sample gas which is required by British Standards)

At no point will the silica gel be removed from the glass impingers inside the Paint Shop or Bumper Paints Facility.

3.2 When other solutions are used in the sampling system, the solutions will be transferred into the impingers in a clean area and transported to the monitoring location and put into the sampling system. It will remain in the sampling system for the duration of the test. At the end of the test the impingers will be removed from the sampling system and returned to the clean area, for clean down. The solutions will be returned into the transportation containers and labelled.

TP 11
Determination of Heavy Metals From a Stationary Source

1 Scope

This procedure outlines the reference method BS EN 14385. This method specifies a manual reference method for the determination of the mass concentration of specific metallic elements in exhaust gases.

2 Principle

A known volume of flue gas is extracted isokinetically and representatively from a duct or chimney during a certain period of time at a controlled flow rate following TP 1. The dust in the sampled gas volume is collected on a filter. Thereafter, the gas stream is passed through a series of absorbers containing absorption solutions and the filter passing fractions of the specific elements are collected within these solutions.

The filter, absorption solution and rinsing solutions are recovered for analysis.

3 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, eg. Steady state or cyclic, can affect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed and assessment made to determine compliance with BS EN 15259

Measure and record the barometric pressure.

A preliminary velocity traverse will be carried out as per TP6

Calculate the number of sample points determine nozzle size and gas stream density.

Assemble sample train as per standard method and leak check, pre heat all relevant parts. The test apparatus consists of a Universal type Isokinetic sampling train. This system includes a pump, dry gas meter, sampling tube, S type pitot, K type thermocouples, condenser, impingers containing solutions, probe and in-stack filter system.

Insert sample probe into stack at first point and seal port. Open shut of value and start pump and adjust to the isokinetic rate –5% and +15%. The sample duration should be identical at each point. Do not stop sampling when moving from point to point, and immediately adjust the flow rate for isokinetic conditions. Record the sample time and volume at each point.

On completion of sampling of all the selected points of the sample line, close the shut of valve and switch off pump, remove the sampling train from the duct and reposition it on the next sampling line.

Leak check the equipment.

Recover the sample media and label.

Send all sampling media back to the laboratory for analysis.

Calculate results.

TP 12
Determination of Formaldehyde From a Stationary Source

1 Scope

This procedure outlines the reference method CEN/TS 17638. This method specifies a manual method for the determination of the mass concentration of formaldehyde in exhaust gases.

2 Principle

A known volume of flue gas is extracted representatively from a duct or chimney during a certain period of time at a controlled flow rate following TP 1. The gas stream is passed through a series of absorbers containing absorption solutions and the specific elements are collected within these solutions.

The absorption liquids and the rinsing solutions are prepared for analysis.

3 Sampling Procedure

When working on exhaust stacks in the Paint Shop and Bumper Paints Facility, the equipment, samples and supplies must be used as set out in TP 10 of this Methods Manual.

Before carrying out any measurements, the purpose of the sampling and the sampling procedure will be discussed with the plant personnel concerned. The nature of the plant process, eg. Steady state or cyclic, can affect the sampling programme. If the process can be performed in steady state, it is important that this is maintained during sampling.

Stack dimensions will be confirmed and assessment made to determine compliance with BS EN 15259

Measure and record the barometric pressure.

A preliminary velocity traverse will be carried out as per TP6

Calculate the number of sample points determine nozzle size and gas stream density.

Assemble sample train as per standard method and leak check, pre heat all relevant parts. The test apparatus consists of a Universal type Isokinetic sampling train. This system includes a pump, dry gas meter, sampling tube, S type pitot, K type thermocouples, condenser, impingers containing solutions, probe and in-stack filter system.

Insert sample probe into stack at first point and seal port.

On completion of sampling of all the selected points of the sample line, close the shut of valve and switch off pump, remove the sampling train from the duct and reposition it on the next sampling line.

Leak check the equipment.

Recover all sampling media and label bottles.

Send all sampling media back to the laboratory for analysis.

Calculate results.