

Process Guidance Note
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Process Guidance Note

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Storage, Loading and Unloading of Petrol at Terminals

ENVIRONMENT (NI) ORDER 2002
POLLUTION PREVENTION AND CONTROL REGULATIONS (NI) 2003
INDUSTRIAL POLLUTION CONTROL (NI) ORDER 1997
IPC (PRESCRIBED PROCESSES AND SUBSTANCES) REGULATIONS (NI) 1998

GUIDANCE FOR PROCESSES PRESCRIBED FOR
AIR POLLUTION CONTROL AND
AIR POLLUTION PREVENTION AND CONTROL BY
DISTRICT COUNCILS

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1 INTRODUCTION

- 1.1 This Note is issued by the Department of the Environment to give guidance on the conditions appropriate for the control of emissions into the air from the following industrial sector: storage, unloading and loading of petrol at terminals processes/ installations¹ where the total quantity of petrol loaded from stationary storage tanks into road tankers, rail tankers or inland waterway vessels in any 12 months is likely to be less than 10,000 tonnes. Petrol terminals where the quantity of petrol unloaded in any 12 months is likely to be equal to or more than 10,000 tonnes are prescribed for control by the Chief Inspector and are not the subject of this Note.
- 1.2 This is one of a series of notes giving guidance on Best Available Techniques (BAT) and Best Available Techniques Not Entailing Excessive Cost (BATNEEC)². The notes are all aimed at providing a strong framework for consistent and transparent regulation of processes and installations.
- 1.3 This note is for use under both Local Air Pollution Control (LAPC) established by the Industrial Pollution Control (NI) Order 1997, and Local Air Pollution Prevention and Control (LAPPC) established by the Environment (NI) Order 2002.³ It constitutes statutory guidance to regulators under regulation 38 of The Pollution Prevention and Control Regulations (NI) 2003. To the extent it provides guidance on techniques, it also constitutes statutory guidance to regulators under section 7(11) of the 1997 Order, and in any event regulators are expected to have regard to it. The note will be treated as one of the material considerations when determining any appeals made against a decision under either the 1997 or 2002 Orders.
- 1.4 All processes are subject to BAT/BATNEEC. In general terms, what is BAT/BATNEEC for one process in a sector is likely to be BAT/BATNEEC for a comparable process; but in each case it is in practice for regulators (subject to appeal) to decide what is BAT/BATNEEC for the individual process and the regulator should take into account variable factors (such as configuration, size and other individual characteristics or the process) and the locality (such as proximity of particularly sensitive receptors). Ultimately, therefore, what constitutes BAT/BATNEEC is site specific but this guidance note comprises guidance for the generality of processes in the sector and careful regard should be had to it, in order to maximise consistency of permits as appropriate.
- 1.5 This guidance is for:
- regulators: who (in accordance with paragraph 1.3 above) must have regard to the guidance when determining applications and reviewing extant authorisations and permits,
 - operators: who are best advised also to have regard to it when making applications, and in the subsequent operation of their process,
 - members of the public: who may be interested to know what the Department considers (in accordance with the legislation) amounts to appropriate conditions for controlling air emissions for the generality of processes in this particular industry sector.
- 1.6 The guidance is based on the state of knowledge and understanding at the time of writing of:
- storage, unloading and loading petrol at terminals processes,
 - their potential impact on the environment, and
 - what constitutes BAT/BATNEEC for preventing and reducing air emissions.
- 1.7 The note may be amended from time to time in order to keep abreast with developments in BAT/BATNEEC including improvements in techniques and new understanding of environmental impacts and risks. Such changes may be issued in a complete revision of this document, or in separate additional guidance notes which address specific issues. (It may not always be possible to issue amending guidance quickly enough to keep in absolute step with rapid changes, which is another circumstance where paragraph 1.4 above might apply.)
- 1.8 Steps will be taken to ensure that those who need to know about changes are informed. Operators (and their advisers) are, however, strongly advised to check with the regulator whether there have been any changes before relying on this note for the purposes of making an application under the 1997 or 2002 Orders or making any other decisions where BAT/BATNEEC may be a consideration.

Site Specific BAT/BATNEEC

Who is affected

¹ the term “process(es)” is used in the remainder of the note to mean both “processes” under the Industrial Pollution Control (NI) Order and “installations” and “activities” under the Environment (NI) Order 2002.

² BATNEEC is the formulation used in the Industrial Pollution Control (NI) Order and BAT is used in the Environment (NI) Order 2002. For the purposes of this guidance note, the two concepts are regarded as having essentially the same effect.

³ in accordance with Part 2 of Schedule 3 to the PPC (NI) Regulations, SR 2003/46, : storage, unloading and loading petrol at terminals processes transfer from regulation under the 1997 Order to the 2002 Order from 1 April 2005.

Consultation^{1.9} The guidance contained in this Note was determined after consultation with members of the Northern Ireland Industrial Pollution Liaison Group, and interested bodies. It is based on the state of knowledge and understanding of these processes, their potential impact on the environment, and the available control techniques at the time of publication. The guidance will be updated regularly to reflect changes in knowledge and understanding; however, it will not always be possible to revise the Notes quickly enough to keep in absolute step with rapid changes. Further, the guidance cannot take into account individual process characteristics, in particular location, which may on occasion influence the nature of the conditions that are included in an authorisation.

- 1.10 Guidance on some of the terms used in this note is contained in NI General Guidance Note 4 “Interpretation of terms used in process guidance notes” that issued in March 1998 (NIGG4).

2 TIMETABLE FOR COMPLIANCE AND REVIEWS

Existing Processes or Activities

Storage at existing installations

- 2.1 The authorisation for an existing process should contain conditions which have regard to the guidance contained in this Note.
- 2.2 Upgrading of existing **storage** to the standards in paragraphs 5.11 – 5.17 below must be completed no later than the following dates:
 - 31 December 2004 for existing petrol storage installations at terminals.

New Processes or Activities

Storage at new installations

Loading unloading and gantries at new installations

- 2.3 On and after 31st December 1998 the standards in paragraphs 5.11 – 5.17 apply, from the date of first authorisation to **storage** at all new terminals.
- 2.4 On and after 31st December 1998 the standards in paragraphs 5.19 – 5.24 and Table 1 and paragraphs 5.26 – 5.39 of this Note apply, from the date of first authorisation to **loading and unloading equipment** and **gantries** at
 - all new terminals for loading onto road tankers, rail tankers or vessels,
 - other than terminals with a throughput of less than 5,000 tonnes/year which are located in small remote islands.

Permit Reviews

Reviewing permits

- 2.5 Under LAPC the requirement is to review conditions in authorisations at least every four years. (Section 6(6) of Industrial Pollution Control (NI) Order 1997)
- 2.6 Under LAPPC the legislation requires permits to be reviewed periodically but does not specify a frequency. It is considered for the storage, unloading and loading petrol at terminals processes/ installations sector that a frequency of once every six years ought normally to be sufficient for the purposes of Regulation 15(1) of Pollution Prevention and Control Regulations (NI) 2003.

More frequent review may be necessary in individual cases for the reasons given in Regulation 15(2). Further guidance on permit reviews is contained in the General Guidance on LAPPC issued by the Department.
- 2.7 Under both LAPC and LAPPC conditions should be reviewed where complaint is attributable to the operation of the process and is, in the opinion of the regulator, justified

3 PROCESS DESCRIPTION

Regulations for local control

- 3.1 Storage, unloading and loading petrol at terminals processes/ installations with throughputs under 10,000tes/year are prescribed for:
- **Local air pollution control, LAPC**, under section 1.4 of Schedule 1 to the IPC (Prescribed Processes and Substances) Regulations 1998, SR 28 as amended by the IPC (Prescribed Processes and Substances) (Amendment) Regulations (NI) 2003 SR 96. It should be noted that the date from which authorisation is required for an existing terminal is 31 December 2004. (see Appendix 1 for the relevant extract from Regulations)
 - **Local air pollution prevention and control, LAPPC**, under section 1.2 Part C of Schedule 1 of the Pollution Prevention and Control Regulations (NI) 2003 SR 46 (see Appendix 2 for the relevant extract from Regulations).

National regulators

- 3.2 It should be noted that the Industrial Pollution & Radiochemical Inspectorate (IPRI) exercise integrated pollution control in respect of processes for the storage, loading and unloading of petrol at petrol storage terminals where these processes are carried on at the same location by the same person as a part of another process described in Part A of section 1.4 of Schedule 1 to the 1998 Regulations. Also petrol terminals of over 10,000 tes/year throughput are prescribed as Part B processes under the 1998 Regulations, as amended, for IPRI control – air pollution control only.
- 3.3 Similarly integrated pollution prevention and control is exercised by IPRI for installations under Part A of section 1.2 of Schedule 1 of the 2003 Regulations - and air pollution prevention and control is exercised by IPRI for petrol terminals of over 10,000 tes/year throughput under Part B.
- 3.4 It should also be noted that the constructional standards for mobile containers (see Appendix 3) will be dealt with by the Health & Safety Executive Northern Ireland. Authorisations issued by district councils under the Industrial Pollution Control (NI) Order therefore should not contain conditions relating to constructional standards of mobile containers.

EC Directive

- 3.5 The guidance in this Note is written so as to comply with EC Directive 94/63/EC on the Control of Volatile Organic Compound (VOC) Emissions Resulting From the Storage of Petrol and its Distribution from Terminals to Service Stations. Sections 2, 5 and 6 use the words "shall" and "must" when describing Directive requirements and the word "should" when giving guidance.

Process or activity

- 3.6 This Note relates to the storage, loading and unloading of petrol at petrol storage terminals.
- 3.7 Petrol is stored in stationary tanks which are fixed roof tanks, or tanks with either internal or external floating roofs.
- 3.8 The petrol is loaded into road tankers, rail tankers or inland waterway vessels which may be top or bottom loaded. Petrol is also transported by pipelines. This note relates to the unloading of ships, and the loading of vessels, but not the loading of ships. (see Section 8 Definitions for definition of vessel)
- 3.9 The principal emissions are associated with the escape of petrol vapour displaced by the petrol which has been loaded into the fixed or mobile tank. (Petrol contains less than 1% benzene)
- 3.10 In the context of this Note, "process" or activity comprises the whole process from receipt of raw materials via production of intermediates to dispatch of finished products, including the treating, handling and storage of all materials and wastes relating to the process.

4 POTENTIAL RELEASES

Pollutants and sources

- 4.1 The key emissions from these processes that constitute pollution for the purposes of the Industrial Pollution Control (NI) Order or the Pollution Prevention and Control Regulations (NI) 2003 and therefore warrant control are those consisting of **petrol vapour** including **benzene**. (petrol includes less than 1% benzene)
- 4.2 The following parts of the process may give rise to **petrol vapour** including **benzene**
 - Loading, and storage of petrol in stationary tanks at terminals.
 - Loading and unloading of petrol in mobile containers at terminals.

5 EMISSION LIMITS, MONITORING AND OTHER REQUIREMENTS

- 5.1 The provisions of paragraphs 5.11 – 5.17 are designed to reduce the total annual loss of petrol resulting from loading and storage at each storage installation at terminals to below a target reference value of 0.01% by weight of the throughput.
- 5.2 The provisions of paragraphs 5.19 – 5.39 and Table 1 are designed to reduce the total annual loss of petrol resulting from the loading and unloading of mobile containers at terminals to below a target reference value of 0.005% by weight of the throughput.
- 5.3 The requirements of paragraphs 5.11 – 5.17, paragraphs 5.19 – 5.39 and Table 1 are established by EC Directive 94/63/EC (see paragraph 3.5) and alternative technical measures should not be permitted.
- 5.4 The reference conditions for limits in Table 1 are 273K, 101.3kPa, without correction for water vapour. The introduction of dilution air to achieve emission concentration limits should not be permitted.

Table 1 - Emission Limits, Monitoring and Other Requirements

Row	Total Organic Carbon	Emission Limits/Requirements	Monitoring
1	All vapour recovery units and vapour incineration units	35g/Nm ³ as 1 hourly average	Each unit tested once every 3 years Use test in Appendix 4, or an alternative that complies with Annex II of EC Directive 94/63/EC See 5.6

Monitoring, investigations and recording

Log of records

- 5.5 The need for and scope of testing and the frequency and time of sampling depend on local circumstances, operational practice, and the scale of operation. As part of proper supervision the operator will monitor emissions, make tests and inspections of the process and keep records, in particular:
- The operator should keep records of inspections, tests and monitoring, including all non-continuous monitoring, inspections and visual assessments. The records should be:
 - kept on site;
 - kept by the operator for at least two years; and
 - made available for the regulator to examine.
- 5.6 The regulator needs to be informed of monitoring (as in Table 1) to be carried out and the results; the results should include process conditions at the time of monitoring (See Appendix 4)
- The process operator should provide a list of key arrestment plant and should have a written plan for dealing with its failure, in order to minimise any adverse effects.
 - The operator should notify the regulator at least 7 days before any periodic monitoring exercise to determine compliance with emission limit values. The operator should state the provisional time and date of monitoring, pollutants to be tested and the methods to be used.
 - The results of non-continuous emission testing (as in Table 1) should be forwarded to the regulator within 8 weeks of the completion of the sampling.
 - Adverse results from **any** monitoring activity (both continuous and non-continuous) should be investigated by the operator as soon as the monitoring data has been obtained/received. The operator should:
 - Identify the cause and take corrective action.
 - Record as much detail as possible regarding the cause and extent of the problem, and the action taken by the operator to rectify the situation.
 - Re-test to demonstrate compliance as soon as possible, and
 - Notify the regulator.
- 5.7 Abnormal emissions require action as described in paragraph 5.8
- 5.8 The regulator needs to be notified about certain events, whether or not there is related monitoring showing an adverse result, and the operator should respond to problems which may have an effect on emissions to air.
- In the case of abnormal emissions, malfunction or breakdown leading to abnormal emissions the operator should:
 - investigate and undertake remedial action promptly;
 - adjust the process or activity to minimise those emissions; and

Abnormal events

Sampling provisions

- promptly record the events and actions taken
- In the case of repeated failure of the vapour recovery unit, the operator should submit proposals to improve the operating efficiency of the unit and implement to a timetable.
- The regulator should be informed without delay:
 - if there is an emission that is likely to have an effect on the local community such as odour
- 5.9 Care is needed in the design and location of sampling systems in order to obtain representative samples. The operator should ensure that adequate facilities for sampling are provided on vents or ducts.
- Sampling points on **new** plant should be designed to comply with the British or equivalent standards.

Storage Installations

5.10 Paragraphs 5.11 – 5.17 apply to loading and storage in fixed tanks at existing terminals by 31 December 2004 and at all new terminals from the date of the first authorisation.

5.11 The external wall and roof of tanks above ground must be painted in a colour or colours with a total radiant heat or light reflectance of 70% or more, unless the tank is linked to a vapour recovery unit which conforms to the standards in paragraph 5.4 and Table 1 of this Note. For existing terminals repainting should be carried out within a period of three years after 31 December 2004. This paragraph should not require the replacement of tanks with internal or external floating roofs with fixed roof tanks connected to a vapour recovery unit.

Such painting should not be required where the tanks are situated in special landscape areas such as national parks and Areas of Outstanding Natural Beauty or which are visible from such an area. In any event, such matters should be discussed with the Planning Service.

5.12 Tanks with external floating roofs must be equipped with a primary seal to cover the annular space between the tank wall and the outer periphery of the floating roof and with a secondary seal fitted above the primary seal. The seals must be designed to achieve an overall containment of vapours of 95% or more as compared to a comparable fixed roof tank with no vapour containment controls (that is a fixed roof tank with only vacuum /pressure relief valve).

An external floating roof and seal system should be deemed to achieve an overall containment of vapours of 95% or more compared to a comparable fixed roof tank solely fitted with pressure/vacuum relief valves ^{1,2} if:

- the roof is fitted with both primary and secondary seals;
- the primary seal extends from the floating roof to the tank wall and the secondary seal is fitted above it; and
- the seal system is designed to accommodate variations in the gap between the floating roof and the tank wall, and the tank and the roof comply with the requirements of BS 2654 (Manufacture of Vertical Steel Welded Storage Tanks with Butt-welded shells for the Petroleum Industry) or equivalent.

Floating roofs should be landed as infrequently as possible to avoid vapour release on recommissioning.

5.13 All new storage installations at terminals where vapour recovery is needed to comply with the provisions in paragraphs 5.19 – 5.24 and Table 1, shall be either:

- fixed roof tanks connected to a vapour recovery unit in conformity with the standards in Table 1 and paragraph 5.4, or
- tanks designed with a floating roof, either external or internal, equipped with primary and secondary seals to meet the performance standards set down in paragraph 5.12 above. ²

5.14 An internal floating roof and seal system installed in a new tank should be deemed to achieve an overall containment of vapours of 95% or more compared to a comparable fixed roof tank solely fitted with pressure/ vacuum (P/V) relief valves ^{1,2} if:

- the roof is fitted with both primary and secondary seals;
- the primary seal extends from the floating roof to the tank wall and the secondary seal is fitted above it;
- the seal system is designed to accommodate variations of the gap between the floating roof and the tank wall, and the tank and the roof complies with the requirements of BS 2654 or equivalent; and
- the roof and seal system are designed and installed as per the Institute of Petroleum "Internal Floating Roof's for Oil Storage Tanks Code of Practice", August 1994³.

5.15 Existing fixed roof tanks must either:

- be connected to a vapour recovery unit in conformity with the standards in Table 1 and paragraph 5.4,
- or have an internal floating roof with a primary seal which should be designed to achieve an overall containment of vapours of 90% or more in relation to a comparable fixed roof tank with no vapour controls.

- 5.16 An internal floating roof and seal system should be deemed to achieve an overall containment of vapours of 90% or more compared to comparable fixed roof tank solely fitted with pressure/vacuum (P/V) relief valves if:
- the roof is fitted with a primary seal;
 - the seal extends from the floating roof to the tank wall;
 - the seal is designed to accommodate variations in the gap between the floating roof and the tank wall, and the tank and the roof complies with the requirements of BS 2654 or equivalent; and
 - the roof and seal are designed and installed as per the Institute of Petroleum "Internal Floating Roofs for Oil Storage Tanks Code of Practice".³
- The provisions of this clause and 5.15 should not be applied to existing horizontal tanks or to existing vertical tanks with a diameter less than 6m at terminals with a throughput of less than 10,000 tonnes per year.
- 5.17 The standards for vapour containment controls in paragraphs 5.13- 5.16 shall not apply to
- fixed roof tanks at terminals where intermediate storage of vapours is permitted under paragraph 5.21.
 - tanks which receive dumped product mixtures, such as interface tanks and slop tanks. Such mixtures contain, but are not wholly comprised of, petrol.

Loading and Unloading of Mobile Containers at Terminals

- 5.18 Paragraphs 5.19-5.24 and Table 1 apply to the loading and unloading of mobile containers at all new terminals from the date of the first authorisation.
- 5.19 Displacement vapours from the mobile container being loaded must be returned through a vapour tight connection line to a vapour recovery unit for recovery at the terminal.
- This provision does not apply to top loading tankers as long as that loading system is permitted.
- 5.20 At terminals that load petrol onto vessels, a vapour incineration unit may be substituted for a vapour recovery unit if vapour recovery is unsafe or technically unfeasible because of the volume of return vapour². The standards concerning air emissions from vapour recovery units in Table 1 and paragraph 5.4 also apply to vapour incineration units.
- 5.21 At terminals with a throughput of less than 25,000 tonnes per year, intermediate storage of vapours may be substituted for immediate vapour recovery at the terminal.
- Vapour balancing systems should be designed in accordance with the Institute of Petroleum's Guidelines for the Design and Operation of Gasoline Vapour Emission Controls.²
- Operators of terminals with intermediate vapour storage systems should have written procedures for the operation of such systems including instructions on the connection of vapour hoses or arms to mobile containers prior to the off-loading of petrol from them into any tanks used for intermediate vapour storage, and their subsequent disconnection at the completion of off-loading.
- 5.22 Vapour collection pipework, except for flexible hoses, should be tested prior to initial commissioning as follows:
- where systems are made up of prefabricated lengths joined together mechanically, each length (including any permanent attachment of the jointing mechanism) should be tested to a minimum pressure of 1 bar for a period of one hour. Assembly of mechanical joints should be subject to inspection;
 - where the systems are assembled with permanent joints (for example, welded, cemented) they should be tested to the above requirement on completion.
- In-service monitoring should comprise an annual visual examination of the system to check for integrity and alignment of the pipework and the joints.
- An annual visual examination of bellows and flexible hoses used to connect mobile containers to the vapour collection pipework should be undertaken to check for integrity; wear and security of connections.
- 5.23 If a leak occurs in the vapour collection system (including the vehicle) at a gantry during loading of an approved bottom loading vehicle, operations at that gantry shall be shut down until the leak is sealed. Equipment to facilitate such shut down operations shall be installed at the loading gantry. Operating instructions to loading personnel shall include provisions regarding the detection of leaks and reporting and shut down procedures.
- 5.24 Operators of top loading systems for petrol must have written procedures instructing loading personnel to keep the outlet of the loading arm as near to the bottom of the mobile container as practicable during loading.

Gantries

- 5.25 Paragraphs 5.26 – 5.39 apply to gantries at all new terminals from the date of the first authorisation.
- 5.26 The liquid coupler on the loading arm shall be a female coupler which should mate with a 4-inch API (101,6mm) male adapter located on the vehicle.
- 5.27 The vapour-collection coupler on the loading-gantry vapour-collection hose shall be a cam-and-groove female coupler which should mate with a 4-inch (101,6mm) cam-and-groove adapter located on the vehicle⁴.
- 5.28 The normal liquid-loading rate shall be 2,300 litres per minute (maximum 2,500 litres per minute) per loading arm.
- 5.29 When the terminal is operating at peak demand, its loading gantry vapour collection system, including the Vapour Recovery Unit, shall be allowed to generate a maximum counterpressure of 55 millibar on the vehicle side of the vapour collection adaptor, (A maximum of 45 millibar at the interface between the adaptor and coupler is likely).
- 5.30 The loading gantry shall be equipped with an overfill-detection control unit which, when connected to the vehicle, shall provide a fail-safe signal to enable loading, providing no compartment-overfill sensors detect a high level.
- 5.31 The vehicle shall be connected to the Control Unit on the gantry via a 10-pin industry-standard electrical connector. The male connector shall be mounted on the vehicle and the female connector shall be attached to a flying lead connected to the gantry-mounted Control Unit.
- 5.32 The gantry Control Unit shall be suitable for both 2-wire and 5-wire vehicle systems.
- 5.33 The vehicle shall be bonded to the gantry via the common return wire of the overfill sensors, which shall be connected to pin 10 on the male connector via the vehicle chassis. Pin 10 on the female connector shall be connected to the Control Unit enclosure which shall be connected to the gantry earth.
- 5.34 The design of the liquid-loading and vapour collection facilities on the loading gantry shall be based on the following vehicle-connection envelope:
- 5.35 The height of the centre line of the liquid adapters shall be:
- maximum 1.4 metres (unladen); minimum 0.5 metres (laden), the preferred height being 0.7 to 1.0 metres;
 - the horizontal spacing of the adapters shall not be less than 0.25 metres (preferred minimum spacing is 0.3 metres);
 - all liquid adapters shall be located within an envelope not exceeding 2.5 metres in length;
 - the vapour-collection adapter shall be located preferably to the right of the liquid adapters and at a height not exceeding 1.5 metres (unladen) and not less than 0.5 metres (laden).
- 5.36 The earth/overfill connector must be located to the right of the liquid and vapour-collection adapters and at a height not exceeding 1.5 metres (unladen) and not less than 0.5 metres (laden).
- 5.37 Loading shall not be permitted unless a permissive signal is provided by the combined earth/overfill control unit.
- 5.38 In the event of an overfill condition or the loss of vehicle earth the Control Unit on the gantry shall close the gantry-loading control valve.
- 5.39 Loading shall not be permitted unless the vapour-collection hose has been connected to the vehicle and there is a free passage for the displaced vapours to flow from the vehicle into the vapour-collection system.

6 CONTROL TECHNIQUES

Summary of Best Available Techniques

- 6.1 Table 2 provides a summary of the best available techniques that can be used to control the process or installation in order to meet the emission limits and requirements in Section 0.

Table 2 - Summary of Control Techniques

Release source	Substance	Control techniques
Petrol storage	Petrol vapours	Minimise breathing losses Good seals Connect to vapour recovery unit (or incinerate or hold vapour)
Loading fixed tanks	Petrol vapours	Connect to vapour recovery unit (or hold vapour)
Loading mobile tanks	Petrol vapours	Connect to vapour recovery unit (or incinerate or hold vapour)

Air Quality

Ambient air quality management

- 6.2 In areas where air quality standards or objectives are being breached or are in serious risk of breach and it is clear from the detailed review and assessment work under Local Air Quality Management that the Part C process itself is a significant contributor to the problem, it may be necessary to impose tighter emission limits. If the emission limit that is in danger of being exceeded is not an EC Directive requirement, then industry is not expected to go beyond BATNEEC/BAT to meet it. Decisions should be taken in the context of a district council's Local Air Quality Management action plan. For example, where a Part C process is only responsible to a very small extent for an air quality problem, the council should not unduly penalise the operator of the process by requiring disproportionate emissions reductions. More guidance on this is provided in the revised Local Air Quality Management Technical Guidance, LAQM. TG (03) and in the Environment (NI) Order 2002 Local Air Quality Management Draft Policy Guidance. Both of these documents are available from the Environment and Heritage Service website www.ehsni.gov.uk.

Benzene – Air Quality Objective and EU Limit Value

- 6.3 The EU has set a limit value for benzene levels in ambient air of $5\mu\text{g}/\text{m}^3$ as an annual mean to be achieved by 2010 (Council Directive 2000/69/EC of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air).

An air quality objective for benzene of $16\mu\text{g}/\text{m}^3$ as a running annual mean to be achieved by 31 December 2003 was published in January 2000 in the Air Quality Strategy for England, Wales, Scotland and Northern Ireland. Working Together for Clean Air January 2000. Cm4548, SE 2002/3 and NIA 7.

Government and the devolved administrations have proposed a tightening of the benzene air quality objective to $3.25\mu\text{g}/\text{m}^3$ as an annual running mean by the end of 2010. The proposal is tighter than the EU limit value. A consultation on that proposal ended on 12 December 2001. Following consultation Government and the devolved administrations published an addendum to the Air Quality Strategy in February 2003. In the addendum the proposed objective for benzene of $3.25\mu\text{g}/\text{m}^3$ as an annual running mean to be achieved by the end of 2010 has been adopted for Northern Ireland.

Terminals emitted to air about 20-30 tonnes of benzene in 1999. The UK total benzene emission to air was 29,700 tonnes in 1999.

Management

Management techniques

- 6.4 Important elements for effective control of emissions include:
- proper management, supervision and training for process operations;
 - proper use of equipment;
 - effective preventative maintenance on all plant and equipment concerned with the control of emissions to the air; and
 - it is good practice to ensure that spares and consumables are available at short notice in order to rectify breakdowns rapidly.
- Spares and consumables, in particular those subject to continual wear, should be held on site, or should be available at short notice from guaranteed local suppliers, so that plant breakdowns can be rectified rapidly.

Appropriate management systems

- 6.5 Effective management is central to environmental performance; It is an important component of BAT and of achieving compliance with permit conditions. It requires a commitment to establishing objectives, setting targets, measuring progress and revising the objectives according to results. This includes managing risks under normal operating conditions and in accidents and emergencies. It is therefore desirable that processes put in place some form of structured environmental management approach, whether by adopting published standards (ISO 14001 or the EU Eco Management and Audit Scheme [EMAS]) or by setting up an environmental management system (EMS) tailored to the nature and size of the particular process. Process operators may also find that EMS will help identify business savings.

Regulators should use their discretion, in consultation with individual process operators, in agreeing the

appropriate level of environmental management. Simple systems which ensure that LAPC considerations are taken account of in the day-to-day running of a process may well suffice, especially for small and medium-sized enterprises. While authorities may wish to encourage wider adoption of EMS, it is outside the legal scope of an LAPC authorisation/LAPPC permit to require an EMS for purposes other than LAPC/LAPPC compliance. For further information/advice on EMS refer to EMS Additional Information in Section 8.

Training

6.6 Staff at all levels need the necessary training and instruction in their duties relating to control of the process and emissions to air. In order to minimise risk of emissions, particular emphasis should be given to control procedures during start-up, shut down and abnormal conditions. Training may often sensibly be addressed in the EMS referred to in paragraph 6.5.

- Training of all staff with responsibility for operating the process should include:
 - awareness of their responsibilities under the authorisation / Permit; in particular
 - action to minimise emissions during abnormal conditions.
- The operator should maintain a statement of training requirements for each operational post and keep a record of the training received by each person whose actions may have an impact on the environment. These documents should be made available to the regulator on request.

Maintenance

6.7 Effective preventative maintenance should be employed on all aspects of the process including all plant, buildings and the equipment concerned with the control of emissions to air. In particular:

- A written maintenance programme should be provided to the regulator with respect to pollution control equipment;
- The regulator should be notified 7 days in advance of any planned maintenance of the vapour recovery unit.
- A record of such maintenance should be made available for inspection.

7 RELEVANT LEGISLATION

LAPC, LAPPC, BATNEEC, BAT

LAPC and LAPPC are similar but not identical (see the Department's General Guidance on LAPPC). Both LAPC and LAPPC only regulate emissions to air.

The objectives of LAPC and the general principles of LAPPC are set out below.

Transfer from LAPC to LAPPC

Most LAPC processes are not covered by the IPPC Directive and will remain subject to air-only LAPPC regulation under the PPC Act 1999. The transfer from LAPC to LAPPC will result in some procedural changes but no extension of regulation to other media.

The changeover will be essentially an administrative one and will not involve payment of new application fees. The timetable contained in the PPC Regulations specifies that processes move from LAPC to LAPPC in four batches, as follows:

LAPPC

- 12 months beginning 1st April 2004: combustion, cement and lime, other minerals,
- 12 months beginning 1st April 2005: ceramics, timber, petrol
- 12 months beginning 1st April 2006: incineration, coating, ferrous and non-ferrous, rubber, animal and vegetable.
- 12 months beginning 1st April 2007: manufacture of coating materials

This timetable applies to new processes as well as existing processes (see paragraph 7 of schedule 3 to the PPC Regulations (NI) 2003).

LAPC objectives

LAPC objectives are "ensuring that, in carrying on a prescribed process, the best available techniques not entailing excessive cost (**BATNEEC**) will be used:

- (i) for preventing the release of substances prescribed into the air or, where that is not practicable by such means, for reducing the release of such substances to a minimum and for rendering harmless any such substances which are so released; and
- (ii) for rendering harmless any other substances which might cause harm if released into the air". Sections 7(2)(a) and 7(5) Industrial Pollution Control (NI) Order 1997.

LAPPC principles

LAPPC principles are that "installations should be operated in such a way that

- (a) all the appropriate preventative measures are taken against pollution, in particular through the application of the best available techniques (**BAT**);
- (b) no significant pollution is caused"

BAT vs BATNEEC

BAT and BATNEEC are essentially the same.

BAT means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical sustainability of particular techniques for providing in principle the basis of emission limit values designed to prevent and where that is not practicable, generally to reduce emissions and the impact on the environment as a whole; and for the purposes of this definition:

- "**Available techniques**" means those techniques which have been developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the cost and advantages, whether or not the techniques are used or produced inside the United Kingdom, as long as they are reasonably accessible to the operator;
- "**best**" means, in relation to techniques, the most effective in achieving a high general level of protection of the environment as a whole;
- "**techniques**" includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

For Part C activities in determining best available techniques special consideration shall be given to the following matters, bearing in mind the likely costs and benefits of a measure and the principles of precaution and prevention.

- comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;
- technological advances and changes in scientific knowledge and understanding;
- the nature, effects and volume of the emissions concerned;
- the commissioning dates for new or existing installations;

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- the length of time needed to introduce the best available techniques.

An authorisation or Permit contains specific conditions and a residual condition. Where no specific condition covers an issue, then the residual condition demands that BATNEEC or BAT are used to meet the objectives or principles.

Site specific matters may influence the conditions in an authorisation or Permit. In particular more stringent conditions may be required if local air quality standards, objectives or plans are jeopardised by the emissions. See Section 6 - Air Quality for more detail.

8 DEFINITIONS

This guidance	NI Process Guidance Note 1/13 Version 1
LAPC	explained in the Purpose section of this guidance
LAPPC	explained in the Purpose section of this guidance
Permit	the written permission to operate an installation prescribed for LAPPC – (the replacement for authorisation under LAPC)
Authorisation	the written authority to operate a process prescribed for LAPC – (will be replaced by permit under LAPPC)
BAT	is defined in Section 7 with some explanation in the footnote to Section 1
BATNEEC	is defined in Section 7 with some explanation in the footnote to Section 1
Petrol	means any petroleum derivative with or without additives, having a Reid vapour pressure of 27.6kPa or more, which is intended for use as a fuel for motor vehicles, except liquefied petroleum gas (LPG).
Vapours	means any gaseous compound which evaporates from petrol.
Storage installation	means any stationary tank at a terminal used for the storage of petrol.
Terminal	means any facility which is used for the storage and loading of petrol onto road tankers, rail tankers or vessels, including all storage installations on the site of the facility
Mobile container	means any tank, transported by road, rail or waterways used for the transfer of petrol from one terminal to another or from a terminal to a service station.
Service station	means any installation where petrol is dispensed to motor vehicle fuel tanks from stationary storage tanks.
Existing	petrol storage installations and loading installations mean such installations and service stations which are in operation, or for the construction of which planning permission is granted, before 31 December 1998
New	means installations which are not covered by the definitions of "existing" installations
Vapour recovery unit (VRU)	means equipment for the recovery of petrol from vapours including any buffer reservoir systems at a terminal.
Vessel	means a vessel, other than a sea-going vessel, having a total dead weight of 15 tonnes or more
Target reference value	means the guideline given for the overall assessment of the adequacy of technical measures in the Note and is not a limit value against which the performance of individual installations, terminals and service stations would be measured.
Intermediate storage of vapours	means the intermediate storage of vapours in a fixed roof tank at a terminal for later transfer to and recovery at another terminal. The transfer of vapours from one storage installation to another at a terminal should not be considered as intermediate storage of vapour.
Loading installation	means any facility at a terminal at which petrol can be loaded onto mobile containers. Loading installations for road tankers comprise one or more gantries.
Gantry	means any structure at a terminal at which petrol can be loaded onto a single road tanker at any one time.
Approved bottom loading vehicle	means any vehicle complying with the constructional standards of Appendix 3

Health and Safety

Operators of processes and installations must protect people at work as well as the environment:

- requirements of a permit or authorisation should not put at risk the health, safety or welfare of people at work;
- equally, the authorisation must not contain conditions whose only purpose is to secure the health of people at work. That is the job of the health and safety enforcing authorities.

Where emission limits quoted in this guidance conflict with health and safety limits, the tighter limit should prevail because:

- emission limits under the Industrial Pollution Control (NI) Order and the Environment (NI) Order 2002 relate to the concentration of pollutant released into the air from prescribed processes;
- exposure limits under health and safety legislation relate to the concentration of pollutant in the air breathed by workers;
- these limits may differ since they are set according to different criteria. It will normally be quite appropriate to have different standards for the same pollutant, but in some cases they may be in conflict (for example, where air discharged from a process is breathed by workers). In such cases, the tighter limit should be applied to prevent a relaxation of control.

EMS Additional Information

Further information/advice on EMS may be found from the following:

- Envirowise at www.envirowise.gov.uk and www.energy-efficiency.gov.uk and Environment and Energy Helpline freephone 0800 585794
- ISO 14001 www.bsi.org.uk or telephone BSI information centre (020 8966 7022)
- EU Eco Management and Audit Scheme (EMAS) www.emas.uk or telephone the Institute of Environmental Management and Assessment (01522 540069)

Regulators and process operators may also like to be aware of:

Project Acorn has been developed by the British Standards Institution and the DTI with assistance from a range of partners in business to help SMEs implement an EMS by offering a five-stage approach which can lead to accreditation to one of the formal standards. The aim is to achieve an EMS standard specifically for SMEs. Contact the Project Co-ordinator at the British Standards Institution on telephone 0208 996 7665 or the web site www.bsi.org.uk

References

- 1 advice on calculating evaporative losses may be found in
 - a. API No. 2517 Evaporative loss from External Floating Roof Tanks, 3rd Edition 1989 with 1994 Addendum, £44 net
 - b. API No. 2518 Evaporative loss from Fixed Roof Tanks, 2nd Edition 1991, £35 net
 - c. API No. 2519 Evaporative loss from Internal Floating Roof Tanks, 3rd Edition, June 1983 (reaffirmed March 1990), £24 net available from ILI Sales Department, Ascot, Berkshire.
- 2 further advice may be found in "Guidelines for the Design and Operation of Gasoline Vapour Emission Controls", published by the Institute of Petroleum, 1992, ISBN 0-85293-105-0, Z; £21 net.
- 3 further advice may be found in "Internal Floating Roofs for Oil Storage Tanks Code of Practice", published by the Institute of Petroleum, 1994, ISBN 0-85293-143-3, £28 net.
- 4 API Recommended Practice 1004 Seventh Edition, November 1988. Bottom Loading and Vapour Recovery for MC0306 Tank Motor Vehicles (Section 2.1.1.1 Type of Adapter used for Bottom Loading, and Section 4.1.1.2 Vapour Recovery Adapter)

Web Addresses

Here are some web addresses that may be useful.

Some energy and environmental measures can increase industry profits. Envirowise show how at www.envirowise.gov.uk or freephone 0800 585794

The Department's Environment and Heritage Service is on the web at www.eh.sni.gov.uk/. Copies of Process Guidance Notes are available on www.eh.sni.gov.uk/environment/industrialPollution/ipc.shtml.

APPENDIX 1**LAPC – EXTRACT FROM REGULATIONS**

2003 No. 96

INDUSTRIAL POLLUTION CONTROL**The Industrial Pollution Control (Prescribed Processes and Substances)(Amendment) Regulations (Northern Ireland) 2003**

Made 25th February 2003
Coming into operation 28th March 2003

The Department of the Environment, in exercise of the powers conferred on it by Articles 3(1) to (4) of the Industrial Pollution Control (Northern Ireland) Order 1997(a) and of every other power enabling it in that behalf, hereby makes the following Regulations:

Citation and commencement

1. These Regulations may be cited as the Industrial Pollution Control (Prescribed Processes and Substances)(Amendment) Regulations 2003 and shall come into operation on 28th March 2003.

Interpretation

2. In these Regulations-

“the Order” means the Industrial Pollution Control (Northern Ireland) Order 1997; and

“the principal Regulations” means the Industrial Pollution Control (Prescribed Processes and Substances) Regulations(Northern Ireland) 1998(b);

“the amending Regulations” means the Industrial Pollution Control (Prescribed Processes and Substances)(Amendment) Regulations (Northern Ireland) 1998(c).

Amendment to the principal Regulations

3. The principal Regulations shall be amended in accordance with regulations 4 and 5;

4. In Schedule 1, Chapter 1, Section 1.4 (Petroleum processes), in Part A (a) after “(iv) if related to another process in this paragraph, any associated gas or condensate” there shall be inserted

“(v) emulsified hydrocarbons intended for use as a fuel.”

5. (a) In Schedule 1, Chapter 1, Section 1.4 (Petroleum processes) in Part B, following the words:

“The storage of petrol in stationary storage tanks at a terminal, or the loading or unloading of petrol into or from road tankers, rail tankers or inland waterway vessels at a terminal”,
there shall be inserted:

“where the quantity of petrol loaded from the stationary storage tanks into road tankers, rail tankers or inland waterway vessels in any 12 month period is likely to be equal to or greater than 10,000 tonnes.”

(a) S.I. 1997/2777(N.I.18)

(b) S.R. 1998 No.28

(c) S.R. 1998 No.268

(b) In Schedule 1, Chapter 1 Section 1.4 (Petroleum processes) in Part C, the words:

“The unloading of petrol into stationary storage tanks at a service station, if the total quantity of petrol unloaded into such tanks at the service station in any 12 month period is likely to be equal to or greater than 100m³.

Paragraph 2 of Schedule 2 shall not apply to a process described in this Part.”

shall be deleted and there shall be substituted:

“(a) The unloading of petrol into stationary storage tanks at a service station, if the total quantity of petrol unloaded into such tanks at the service station in any 12 month period is likely to be equal to or greater than 100m³.

(b) The storage of petrol in stationary storage tanks at a terminal, or the loading or unloading of petrol into or from road tankers, rail tankers or inland waterway vessels at a terminal where the quantity of petrol loaded from the stationary storage tanks into road tankers, rail tankers or inland waterways in any 12 months is likely to be less than 10,000 tonnes.

Paragraph 2 of Schedule 2 shall not apply to a process described in paragraph (a) in this Part.”

Date from which authorisation is required under Article 6 of the Order

6. The Schedule shall have effect in relation to the date from which authorisation is required under Article 6 of the Order.

Sealed with the Official Seal of the Department of the Environment on 25th February 2003

SCHEDULE

Regulation 6

DATE FROM WHICH AUTHORISATION IS REQUIRED UNDER ARTICLE 6 OF THE ORDER**Disapplication of regulation 3(3) of the principal Regulations**

1. Regulation 3(3) of the principal Regulations shall not apply to a prescribed process falling under Parts B and C of Section 1.4 in Chapter 1 of Schedule 1 to those Regulations.

Processes falling within Part B of Section 1.4

2. (1) For the purposes of regulation 3(1) of the principal Regulations, the prescribed date in respect of a process falling within Part B of Section 1.4 in Chapter 1 of Schedule 1 to those Regulations shall be-

- (a) 31st December 1998, where the process is carried on at a new terminal;
- (b) 31st December 1998, where the process is carried on at an existing terminal where the quantity of petrol loaded from the stationary storage tanks into road tankers, rail tankers or inland waterway vessels in any 12 months is likely to be equal to or greater than 25,000 tonnes;
- (c) 31st December 2004, in any other case.

(2) In this paragraph-

- (a) an “existing terminal” means one which was in operation, or for the construction of which planning permission was granted, before 31st December 1998;
- (b) a “new terminal” means one which is not an existing terminal;
- (c) expressions which are also used in Part B of Section 1.4 in Chapter 1 of Schedule 1 to the principal Regulations have the same meaning as in that Part.

Processes falling within Part C of Section 1.4

3. (1) For the purposes of regulation 3(1) of the principal Regulations, the prescribed date in respect of a process falling within paragraph (a) of Part C of Section 1.4 in Chapter 1 of Schedule 1 to those Regulations shall be as set out in paragraph 2 of the Schedule to the amending Regulations.

(2) For the purposes of regulation 3(1) of the principal Regulations, the prescribed date in respect of a process falling within paragraph (b) of Part C of section 1.4 in Chapter 1 to those Regulations shall be 31st December 2004.

LAPPC - EXTRACT FROM REGULATIONS

The Pollution Prevention and Control Regulations (NI) 2003 SR 46

SCHEDULE 1 ACTIVITIES, INSTALLATIONS AND MOBILE PLANT

PART 1: ACTIVITIES

Chapter 1 - Energy Industries

Section 1.2 - Gasification, Liquefaction and Refining Activities

Part A

- (a) Refining gas.
- (b) Reforming natural gas.
- (c) Operating coke ovens.
- (d) Coal or lignite gasification.
- (e) Producing gas from oil or other carbonaceous material or from mixtures thereof, other than from sewage, unless the production is carried out as part of an activity which is a combustion activity (whether or not that combustion activity is described in Section 1.1).
- (f) Purifying or refining any product of any of the activities falling within paragraphs (a) to (e) or converting it into a different product.
- (g) Refining mineral oils.
- (h) The loading, unloading or other handling of, the storage of, or the physical, chemical or thermal treatment of -
 - (i) crude oil;
 - (ii) stabilised crude petroleum;
 - (iii) crude shale oil;
 - (iv) where related to another activity described in this paragraph, any associated gas or condensate;
 - (v) emulsified hydrocarbons intended for use as a fuel.
- (i) The further refining, conversion or use (otherwise than as a fuel or solvent) of the product of any activity falling within paragraphs (g) or (h) in the manufacture of a chemical.
- (j) Activities involving the pyrolysis, carbonisation, distillation, liquefaction, gasification, partial oxidation, or other heat treatment of coal (other than the drying of coal), lignite, oil, other carbonaceous material or mixtures thereof otherwise than with a view to making charcoal.

Interpretation of Part A

1. Paragraph (j) does not include the use of any substance as a fuel or its incineration as a waste or any activity for the treatment of sewage.
2. In paragraph (j), the heat treatment of oil, other than distillation, does not include the heat treatment of waste oil or waste emulsions containing oil in order to recover the oil from aqueous emulsions.
3. In this Part, "carbonaceous material" includes such materials as charcoal, coke, peat, rubber and wood.

Part B

- (a) Odourising natural gas or liquefied petroleum gas, except where that activity is related to a Part A activity.
- (b) Blending odorant for use with natural gas or liquefied petroleum gas.
- (c) The storage of petrol in stationary storage tanks at a terminal, or the loading or unloading of petrol into or from road tankers, rail tankers or inland waterway vessels at a terminal, where the total quantity of petrol loaded from the stationary storage tanks into road tankers, rail tankers or inland waterway vessels in any 12 month period is likely to be equal to or greater than 10,000 tonnes.

Part C

- (a) The storage of petrol in stationary storage tanks at a terminal, or the loading or unloading of petrol into or from road tankers, rail tankers or inland waterway vessels at a terminal where the total quantity of petrol loaded from the stationary storage tanks into road tankers, rail tankers or inland waterway vessels in any 12 month period is likely to be less than 10,000 tonnes.
- (b) The unloading of petrol into stationary storage tanks at a service station, if the total quantity of petrol unloaded into such tanks at the service station in any period of 12 months is likely to be 100m³ or more.

Interpretation of Part C**1.** In this Part -

"inland waterway vessel" means a vessel, other than a sea-going vessel, having a total dead weight of 15 tonnes or more;

"petrol" means any petroleum derivative (other than liquefied petroleum gas), with or without additives, having a Reid vapour pressure of 27.6 kilopascals or more which is intended for use as a fuel for motor vehicles;

"service station" means any premises where petrol is dispensed to motor vehicle fuel tanks from stationary storage tanks;

"terminal" means any premises which are used for the storage and loading of petrol into road tankers, rail tankers or inland waterway vessels.

- 2.** Any other expressions used in this Part which are also used in Directive 94/63/EC on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations have the same meaning as in that Directive.

MOBILE CONTAINERS

Standards for mobile containers are contained within Article 5 of the Council Directive on the control of volatile organic compound emissions resulting from the storage of petrol and its distribution from terminals to service stations

As stated in paragraph 3.4, these provisions of the Directive are to be dealt with by the Health and Safety Executive Northern Ireland and not under the local air pollution control nor under the local air pollution prevention and control systems, except to the extent that they are addressed in the main body of this Note.

1. Mobile containers shall be designed and operated in accordance with the following requirements:

- (a) mobile containers shall be designed and operated so that residual vapours are retained in the container after unloading of petrol;
- (b) mobile containers which supply petrol to service stations and terminals shall be designed and operated so as to accept and retain return vapours from the storage installations at the service stations or terminals. For rail tankers this is only required if they supply petrol to service stations or to terminals where intermediate storage of vapours is used;
- (c) except for release through the pressure relief valves, the vapour mentioned in subparagraphs (a) and (b) shall be retained in the mobile container until reloading takes place at a terminal.

If after the unloading of petrol the mobile container is subsequently used for products other than petrol, in so far as vapour recovery or intermediate storage of vapours is not possible, ventilation may be permitted in a geographical area where emissions are unlikely to contribute significantly to environmental or health problems;

- (d) the Member States' competent authorities must ensure that road tankers are regularly tested for vapour tightness and that vacuum/pressure valves on all mobile containers are periodically inspected for correct functioning.

2. The provisions of paragraph 1 shall apply:

- (a) from 31 December 1995 for new road tankers, rail tankers and vessels;
- (b) 31 December 1998 for existing rail tankers and vessels if loader at a terminal to which the requirement of the Directive applies;
- (c) for existing road tankers when retrofitted for bottom loading in accordance with the specifications laid down in the Directive.

3. By way of derogation, the provisions of paragraph 1, subparagraphs (a), (b) and (c) shall not apply to losses of vapours resulting from measuring operations using dipsticks in relation to:

- (a) existing mobile containers; and
- (b) new mobile containers which come into operation before 31 December 1999.

APPENDIX 4

COMPLIANCE TEST METHOD FOR VAPOUR RECOVERY UNITS

1. TEST APPLICABILITY

This method applies to performance testing of any vapour recovery unit (VRU), installed at any gasoline terminal, as required to demonstrate that the unit is in compliance with legislation governing atmospheric emissions from such units.

2. PRINCIPLE

During the compliance test, total organic compound (TOC) vapour concentration in the VRU vent line is measured at regular intervals when there is vapour flow into the VRU. The test is conducted over at least a seven-hour period during the course of a normal working day. The mean TOC concentration in the vent line is reported for each 60-minute period of the test as mass per normal unit volume. Compliance is confirmed if the mean TOC concentration for each of the 60 minute periods reported is below the emission limit applicable to the VRU.

3. INSPECTION OF VAPOUR COLLECTION SYSTEM

Prior to any compliance test, a visual inspection of the integrity of the vapour collection system shall be carried out to check for damage or misalignment of the pipework and the joints. Any damage shall be rectified before the test is undertaken.

4. COMPLIANCE TEST

4.1 General

4.1.1 Measurement Frequency

Direct measurements of TOC concentration in the VRU vent (or vapour sampling for subsequent TOC measurement) shall be made at regular intervals, but at least once every 15 minutes, when there is vapour flow into the VRU.

The measurement frequency used should reflect the typical number and length of periods when there is vapour flow into the VRU during normal operations at the terminal. Measurements should be made during as many periods of vapour flow as is practical.

If on review of the terminal records at the end of the test it is found that measurements were made when there was no vapour flow into the VRU, for example because there was no loading at that time, those measurements shall be disregarded.

4.1.2 Duration

The duration of the test shall be at least seven hours during the course of normal working day, except for the following types of installation:

- (i) Where a vapour holding tank (VHT) is installed, the duration of the test shall be the time taken for the VRU to process the vapours generated and fed to the VHT during at least seven hours of normal operations at the terminal.
- (ii) Where a VRU is connected to storage tank vapour spaces, the duration of the test shall be a typical tank filling period of seven hours of filling where the time taken for tank filling is more than seven hours.

During the test period there shall be at least one hour in which four or more measurements of TOC concentration are made. If this condition is not met during a period of seven hours, then the test shall be extended until it is met.

4.1.3 VRU with Multiple Vents

Where a VRU has more than one vent, but vapours are emitted from only one vent at any one time (e.g. a

carbon adsorption type VRU with two carbon beds operating on a cyclic basis), a similar number of TOC concentration measurements should be made from each of the vents during the test period.

Where a VRU has more than one vent emitting vapours simultaneously then the vents should be linked into a common vent and measurement made of the TOC concentration in that common vent.

4.1.4 Vent Vapour Dilution

Where the VRU process results in exhaust vapour dilution, (e.g. for systems using direct cooling by nitrogen), the flowrates of the inlet vapours and the dilution medium shall be measured at the same time as the TOC concentration. Flow should be measured according to BS 3405 or a similar method of equivalent accuracy. Each TOC concentration measurement shall then be corrected for dilution using inlet and diluent volumes.

4.1.5 Test Report

The compliance test report shall state the average vent TOC concentration in g/Nm^3 calculated for each hour of the test. It shall also give detail of the test method and measurement equipment used.

4.2. Apparatus

If electrical equipment is to be used within a hazardous area, either suitably certified equipment should be used, or the test should be carried out under an appropriate hazardous operations "hot work" permit scheme.

The essential components of the measurement system are: -

4.2.1 Sampling Point

A sampling point must be located at a position from which a representative sample of emitted vapour can be drawn. Typically this should be at least two pipe diameters upstream from the vent opening.

Where a VRU has more than one vent (e.g. a carbon adsorption type unit with carbon beds operating on a cyclic basis), separate sampling points should be provided in each vent line.

4.2.2 Sample Line

The sample line used to connect between the sampling point and the TOC meter or sample gas bag should consist of metal, or other suitable non-permeable and non-adsorbent material. The sample line should have adequate electrical conductivity to prevent the build up of static electric charge. The sample line and the TOC meter should be earthed.

4.2.3 TOC Meter

The total organic compounds (TOC) meter must be capable of measuring the concentration of TOC vapour in air without interference from any other gases which may be present in air.

If battery powered, the meter should be capable of at least 8 hours continuous operation.

The meter should be calibrated in units of ppm of n-butane.

The meter should have a measuring range from 1000 ppm up to at least twice the expected vent TOC concentration. If this is not known, the range should be up to at least 1.5 times the emission limit.

The response of the meter to propane and n-pentane relative to that of n-butane must be known (see Annexes 3 and 5).

The overall measurement uncertainty due to the TOC meter and the calibration method must not exceed 10% of the emission limit. In order to achieve this the calibration gas should be specified as in Annex I and the TOC meter specification should be:

- repeatability should not exceed 3% of the emission limit;
- linearity of response should not exceed 5% over the measuring range;
- zero drift during use should not exceed 5% of the emission limit per hour once the meter has stabilised at its operating temperature;
- the TOC meter calibration stability should be such that calibrations made before and after measurements do not differ by more than 5%.

4.2.4 Gas Sampling Pump

A gas sampling pump is required to draw gas from the sampling point to the TOC meter or gas sampling bags. The sampling pump may be separate or an integral part of the TOC meter.

The pump should be capable of pumping at a rate which will result in the sample line volume being displaced within at least 30 seconds.

If battery operated, the pump should be capable of at least 8 hours continuous operation.

4.2.5 Gas Sampling Bags

Gas sampling bags must be made from a material which is impermeable to hydrocarbons and does not adsorb hydrocarbons onto its surface. Tedlar or similar fluorocarbon polymer is recommended. The bags should be strong enough to withstand physical handling without cracking and leaking. The filling/emptying valve should be made from inert material.

Bags should be cleaned before use by flushing with clean dry air then evacuating, three times.

4.3 Test Preparation

4.3.1 Safety.

The person(s) undertaking the test must be conversant with the Health, Safety and other appropriate regulations pertaining at the site and should comply with those regulations.

An appropriate hazardous operations "hot work" permit must be obtained if electrical equipment that is not suitably certified is to be used within a hazardous area.

4.3.2 Connection of Sample Line

Connect the sample line to the sampling point (or on-stream sampling point where the VRU has more than one vent).

Ensure that all pipe joints and connections in the sample line are leak tight.

Ensure that the sample pump flowrate is such that the sample line volume displacement time is less than 30 seconds. Where a separate pump is used, the outlet may need to be connected to a tee-piece to prevent pressurisation of the meter inlet, with one branch connected to the TOC meter and the other to a vent in a safe location.

Ensure that the TOC measurement system vent is located where the vapours can be safely dispersed. Flush the sampling line for at least 5 minutes with vapour from the VRU vent prior to the start of the compliance test

4.3.3 Pre-test Measurement System Preparation

A decision tool for determining which measurement technique should be used, depending upon the type of TOC meter, is given in Annex 5.

Set Up the TOC meter according to the manufacturers' instructions.

Switch on all equipment and allow to stabilise for the minimum period recommended by the manufacturers.

4.3.4 Pre-test Measurement System Zero Setting

When the measurement system has stabilised, but prior to the start of the compliance test, zero the TOC meter. This should be carried out according to the manufacturers' instructions.

4.3.5 Pre-test Measurement System Calibration

Calibrate the TOC meter according to the manufacturers' instructions, in units of ppm of n-butane (see also Annex 1).

4.4 Emission Measurement Test Procedure

4.4.1 TOC Concentration Measurement

Connect the TOC meter to the sampling system. If gas bag sampling is used, refer to section 4.4.5.

Record the location, date and start time of the test.

Take readings of TOC concentration from the meter at regular intervals, but at least once every 15 minutes, when there is vapour flow into the VRU.

Record time of each TOC concentration measurement.

Where a VRU has more than one vent, ensure that the sampling line is connected to the vent on-stream. Change the sampling point used as appropriate, depending upon the operation of the VRU, so that samples are always taken from the on-stream vent. Take measurements from all on-stream sampling points in approximately equal numbers over the test period.

At the end of the test, if necessary, compare the times that TOC concentration measurements were made with the terminal records. If a measurement was made when there was no vapour flow to the VRU (e.g. no loading was taking place), then that measurement should be disregarded.

If any measurement of TOC concentration is outside of the range of the TOC meter, the test must be invalidated.

4.4.2 Sampling for Measurement of Vapour Composition

A composite sample of vapour must be collected over the test period if the response factors of the TOC meter to propane and n-pentane relative to n-butane in mass concentration units are outside of the range 0.9 to 1.1 (see Annexes 3 and 5).

Collect a composite sample of vapour in a gas sampling bag over the test period by:

- either continuously pumping sample gas into the bag at a low steady flowrate over the entire test period. Sampling should be interrupted during lengthy periods when there is no vapour flow to the VRU;
- or by transferring set volumes of sample gas into the bag every 15 minutes over the test period, when there is vapour flow to the VRU.

4.4.3 TOC Meter Zero Adjustment

Immediately before starting measurements and at regular intervals throughout the test, but at least once every hour, disconnect the TOC meter from the sample line and re-introduce zero gas to the meter. When the reading has stabilised, record the reading and re-adjust the instrument to read zero.

If the zero has drifted by more than 5% of the emission limit (expressed as ppm n-butane) since the previous zero adjustment, discard all readings since the previous adjustment.

4.4.4 Post-test Calibration Drift Determination

At the end of the test period, disconnect the TOC meter from the sample line and re-introduce zero gas. Record the reading when it has stabilised.

If the zero has drifted by more than 5% of the emission limit (expressed as ppm n-butane) since the previous zero adjustment, discard all readings since the previous adjustment.

Within 24 hours of the end of the test, set the zero and recalibrate the meter as specified in Annex 1. If the calibration drift value exceeds the limit specified in section 4.2.3, re-calibrate the measurement system as specified in Annex 1 and report the results using both sets of calibration data.

4.4.5 Measurement of TOC Concentration Using Gas Bags (Where Taken)

The TOC meter, sample line, sampling pump and gas bags should meet the specifications in section 4.2.

The gas bags should be suitably cleaned (see section 4.2.5) and clearly marked before use. If bags are reused during the test they must be evacuated before each reuse.

Connect the gas bag to the sample line via a sampling pump.

Record the location, date and start time of the test.

Take samples in gas bags at regular intervals, but at least once every 15 minutes, when there is vapour flow into the VRU. The bag samples should contain sufficient vapour to permit the measurement of TOC

concentration to be repeated if necessary:

Record the time of each sampling and the sample gas bag identification.

At the end of the test, if necessary, compare the times that vapour samples were taken with the terminal loading records. If a sample was taken when there was no vapour flow to the VRU (e.g. there was no loading taking place), then that sample should be disregarded.

If the reliable bag storage time is not known, measurements should be undertaken within 2 hours of the sample being taken.

Prior to measurements being made, zero and calibrate the meter as in sections 4.3.4 and 4.3.5.

At regular intervals between gas bag sample measurements, but at least once per hour, re-zero the TOC meter as in section 4.4.3.

Following the completion of measurements on all the gas samples, recalibrate the meter and determine the drift as in section 4.4.4.

If any measurement of TOC concentration is outside of the range of the TOC meter, the test must be invalidated.

4.4.6 Analysis of Vapour Composition Sample (Where Taken)

If a composite sample was taken over the test period (section 4.4.2), obtain an analysis of the sample TOC vapour composition from a suitably accredited laboratory which should use a validated procedure meeting the following requirements:

- identification of the carbon number and the type (paraffin, olefin, naphthene, aromatic) of major components (those which make up more than 95% of the total TOC mass) either individually or by carbon number groups;
- measurement of major components with an accuracy of at least 5% of the concentration of each component.

If the reliable bag storage time is not known, undertake this analysis within 24 hours from the end of the test.

[Typically, analysis will be by gas chromatography (GC) using a temperature programmed capillary column and a flame ionisation detector].

Express results in volume % of components, normalised to 100% TOC.

Calculate the molecular weight of the TOC. An example of this calculation is given in Annex 2.

4.5 Calculations

4.5.1 Calculation of Mean Hourly Vent TOC Concentrations

Calculate the mean TOC concentration for each hourly period of the test (from the start time) from each of the readings taken from the TOC meter during that hour (or from the TOC measurements of the samples taken in gas bags during that hour) if four or more measurements have been made in that hour.

4.5.2 Concentration Correction for TOC Meter Response Factor

Divide the hourly mean TOC concentrations by the meter overall response factor. Guidance on the calculation of the factor is given in Annex 3.

4.5.3 Conversion of TOC Volume Concentrations to Mass Concentrations

Convert the hourly mean TOC volume concentrations to mass concentrations as specified in Annex 4.

5. Reporting

Report the results of the compliance test as average mass TOC per normal unit volume vented (g/Nm^3) for each hour of the test during which four or more TOC concentration measurements were made.

The report should include the following:

Location of VRU;

Site operator;

Date of test;

Start time of test,

Who undertook test;

A sketch of the sampling point location;

A copy of the test method used;

Type, make and serial number of TOC meter used;

Uncertainty of test results;

Hourly mean TOC concentration in g/Nm^3 for each hour of the test;

Emission limit applicable to the VRU.

The following information should be made available on request from the local enforcing authority:

All TOC concentration measurements (in ppm) or one minute average TOC concentration data where the frequency of measurement is in excess of once per minute;

Where vent vapour dilution occurred, all the measurements of VRU inlet vapour and diluent gas flows;

Example of a typical calculation to derive hourly mean TOC mass concentration.

Test method Annex 1 - TOC meter calibration

Appropriate care must be taken during the handling of compressed and liquefied gases.

A1.1 Calibration Procedure

The concentration of the calibration gas should be reported in ppm.

The TOC meter should be calibrated at least before and after use. Mixtures of n-butane, having a purity of at least 99%, and clean air (i.e. containing <1% of emission limit TOC concentration) or inert gas should be used (see section A1.2).

Calibrations should be made at least at two concentrations, aimed at covering the highest expected measurement concentration and half that concentration. If the highest expected measurement concentration is not known, then this should be assumed to be equal to the emission limit. A zero setting should also be made.

Calibrations made before and after measurements must not differ by more than $\pm 5\%$, (e.g. for a meter calibrated prior to the test with 10,000 ppm n-butane, the results of the calibration after the test should not differ by more than 500 ppm).

Meters should be calibrated at a similar temperature to the measurement conditions. The pressure at the sample inlet should also be similar to measurement conditions. If practical, the meter should be calibrated via the same sample connection tubing that is used for measurements. Otherwise, tubing of the same type and dimensions used to make the measurements should be employed during calibration.

Calibration should be carried out as follows, taking account of the manufacturers' instructions:

- (i) Switch the TOC meter on and allow to stabilise;
- (ii) Set the meter zero using clean air or other suitable gas containing no TOCs;
- (iii) Introduce the calibration standards, one at a time, starting with the lowest concentration, allowing the meter reading to stabilise each time and recording each stable reading;
- (iv) Following calibration with the standard having the highest concentration, repeat the calibration with the lowest concentration standard. The repeat readings should not differ by more than $\pm 3\%$ of reading.

Where measurement calculations are made manually, a calibration graph should be constructed. The graph should be a smooth curve or straight line. Where measurement calculations are made electronically, a suitable curve fitting equation should be derived that fits the calibration points within $\pm 1\%$.

A1.2 Calibration Gas Mixtures

The gas mixture used for meter calibration should be traceable to a national standard, or a certified flow meter or an absolute volumetric measurement, such that the uncertainty in the stated concentration of the gas mixture does not exceed $\pm 5\%$.

Three types of calibration gas may be used:

- purchased calibration standard mixtures;
 - dynamic volumetric mixtures blended using flow meters;
 - static volumetric mixtures in a container such as a gas bag.
- (i) The suppliers of **calibration standard mixtures** in compressed gas cylinders should provide suitable certification stating the gas composition, its accuracy and details of traceability on the method of determination of composition. It should also state a shelf life within which the composition does not vary by more than 5% of the certified value. Compressed calibration gas standards should be stored, handled and used according to the supplier's instructions.
 - (ii) **Dynamic calibration standard mixtures** can be generated using calibrated flow meters, with flow controllers, fed from compressed clean dry air and liquefied n-butane. Flow meters should be operated within their calibrated range and temperature and pressure specifications and should be re-calibrated at least annually against a certified flow meter or an absolute volumetric measurement.
 - (iii) **Static volumetric mixtures** can be prepared, typically in suitable gas bags having sufficient capacity to make at least two calibrations. If the reliable bag storage time is not known, the contents should be used within 2 hours. Bags can be filled using a dynamic mixture generated as described in ii) above or by introducing measured volumes into the bag from large gas syringes (available in volumes up to a few litres) or wet test meters.

Test method Annex 2 - Molecular weight calculation

The Molecular Weight (MW) of the TOC should be calculated as in the following example:

Component	Vol%	MW	Calculation [(Vol% ÷ 100) x MW]			
	(Note)					
C3 paraffins	6.7	44.1	0.0671	x	44.1	= 3.0
C4 paraffins	65.2	58.1	0.652	x	58.1	= 37.9
C5 paraffins	20.5	72.1	0.205	x	72.1	= 14.8
C6 paraffins	0.5	86.2	0.005	x	86.2	= 0.4
C7 paraffins	0.3	100.2	0.003	x	100.2	= 0.3
C8 paraffins	<0.1	114.2				
C9 paraffins	<0.1	128.2				
C10 paraffins	<0.1	142.3				
C3 olefins	<0.1	42.1	0.033	x	42.1	=
C4 olefins	3.3	56.1	0.019	x	56.1	= 1.9
C5 olefins	1.9	70.1	0.001	x	70.1	= 1.3
C6 olefins	0.1	84.2				0.1
C7 olefins	<0.1	98.2				
C8 olefins	<0.1	112.2				
C9 olefins	<0.1	126.2				
C10 olefins	<0.1	140.3				
C5 naphthenes	0.3	70.1	0.003	x	70.1	= 0.2
C6 naphthenes	0.3	84.2	0.003	x	84.2	= 0.3
C7 naphthenes	0.1	98.2	0.001	x	98.2	= 0.1
C8 naphthenes	<0.1	112.2				
C9 naphthenes	<0.12	126.2				
C10 naphthenes	<0.1	140.3				
C6 aromatics	0.5	78.1	0.005	x	78.1	= 0.4
C7 aromatics	0.202	92.1	0.002	x	92.1	= 0.2
C8 aromatics	0.1	106.2	0.001	x	106.2	= 0.1
C9 aromatics	<0.1	120.2				
C10 aromatics	<0.1	134.3				

Average Molecular Weight = sum = 61.0

Note: Vapour composition, normalised to 100% TOC, obtained from analysis of composite sample taken over test period (see section 4.4.6)

Test method Annex 3 - Response factor correction for TOC meters

The response of the meter to propane and n-pentane relative to n-butane should be known.

If these response factors in either mass or volume units are between 0.9 and 1.1 relative to n-butane, a meter overall response factor of 1.0 should be used (see Annex 5).

If any response factor is outside of the range 0.9 to 1.1, the meter overall response factor should be calculated based on the average vapour composition. Composition is determined as described in section 4.4.6 (normalised to 100%) from analysis of a sample collected over the measurement period. An example of the calculation of overall response factor is given below:

Component	Vapour Composition Vol % (Note)	Response Factor	Calculation [(% = 100) x response factor]
C3 plus lighter components	7	0.8 (propane)	$0.07 \times 0.8 = 0.06$
C4 components	68	1.0 (n-butane)	$0.68 \times 1.0 = 0.68$
C5 plus heavier components	25	1.2 (n-pentane)	$0.25 \times 1.2 = 0.3$
overall response factor = sum = 1.04			

Note: Vapour composition, normalised to 100% TOC, obtained from analysis of composite sample taken over test period (see section 4.4.6)

If the calculated overall response factor is between 0.9 and 1.1, a factor of 1.0 should be used.

Test method Annex 4 - Conversion from TOC volume concentration to TOC mass concentration

The mean hour TOC volume concentration in ppm should be converted to mass per normal unit volume concentration using the following equations:

Equation 1

Where TOC meter responses to propane and n-pentane relative to n-butane in g/Nm^3 are between 0.9 and 1.1

$$M = (25.9 \times V) \div 10,000$$

where:

M = average TOC concentration in g/Nm^3

V = 60 minute average TOC concentration in ppm

Equation 2

For all other TOC meters

$$M = (0.446 \times MW \times V) \div 10,000$$

where:

M = average TOC concentration in g/Nm^3

MW = average molecular weight of TOC in gas sample taken over test period (see sections 4.4.2 and 4.4.6 and Annex 2)

V = 60 minute average TOC concentration in ppm

Test method Annex 5 - Measurement Decision Tree

The procedure to measure TOC varies with the equipment used and when it is used

In this decision tree a TOC meter response is **linear** if both

TOC meter volume response factor for C3 is >0.9 relative to n-C4 and

TOC meter volume response factor for n-C5 is <1.1 relative to n-C4.

Otherwise the TOC meter response is **non-linear**

A TOC meter can be used on site as the process happens i.e. in **realtime**,

or the TOC meter can be used at a **later** time

