Environmental Permit

Pollution Prevention and Control Act 1999
Environmental Permitting (England and Wales) Regulations 2016

BP Oil UK Limited
Buncefield Terminal
Green Lane
Hemel Hempstead
Hertfordshire
HP2 7JA

Regulated activity:
Storage, unloading and loading petrol at terminals.

Permit Number:
DBC/EP/101

Permit Issued by:

Environmental and Community Protection
Environmental Health
Dacorum Borough Council
The Forum, Marlowes
Hemel Hempstead
Hertfordshire
HP1 1DN

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The address for all correspondence in relation to this permit

Contents

Permit Status Log

Permit Reference	Date	Comment
DBC/EP/101	*7th Audust 2020*	*Issued*
MAU 8072	*3rd October 2005*	*Issued*
	September 1999	*Application received*

Introductory Note

These introductory notes are not Environmental Permit conditions; however they do provide useful information about the Environmental Permitting Regulations:

The following Permit is issued under Regulation 13(1) of the Environmental Permitting (England and Wales) Regulations 2016 (S.I 2016 No.1154), ("the EPR") to operate a scheduled installation carrying out an activity, or activities covered by the description in section 3.1B(b) of Part 2 to Schedule 1 of the EPR, to the extent authorised by the Permit.

Conditions within this Permit detail Best Available Techniques (BAT), for the management and operation of the installation, to prevent, or where that is not practicable, to reduce emissions.

In determining BAT, the Operator should pay particular attention to relevant sections of the LAPPC Process Guidance note (PG1/13(13)), and any other relevant guidance. Techniques include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

Note that the Permit requires the submission of certain information to the Regulator, and in addition, the Regulator has the power to seek further information at any time under Regulation 61 of the EPR Regulations provided that the request is reasonable.

Public Registers

Information relating to Permits, including the application, is available on public registers in accordance with the EPR. Certain information may be withheld from the public registers where it is commercially confidential, or if it is in the interest of national security to do so.

Variations to the Permit

The Regulator may vary the Permit in the future, by serving a variation notice on the Operator. Should the Operator want any of the conditions of the Permit to be changed, a formal application must be submitted to the Regulator (the relevant forms are available from the Regulator). The Status Log includes a summary of the Permits and variations issued up to that point in time and state whether a consolidated version of the Permit has been issued.

Transfer of the Permit or part of the Permit

Before the Permit can be wholly or partially transferred to another Operator, an application to transfer the Permit has to be made jointly by the existing and proposed Operators. A transfer will not be approved if the Regulator is not satisfied that the proposed Permit holder will be the person having control over the operation of the installation, or will not comply with the conditions of the transferred Permit. In addition, if the Permit authorises the Operator to carry out a specified waste management activity, the transfer will not be approved if the Regulator does not consider the proposed Permit holder to be a 'fit and proper person' as required by the EPR.

Talking to us

Please quote the permit number if you contact the Regulator about this permit. To give a notification under this permit, please use the contact details on the front cover.

Description of the installation and regulated activity

This description of the installation and the regulated activity are not environmental permit conditions, however they do provide useful information about the installation and the activities undertaken. It also provides a reference point in relation to any substantial or non-substantial changes.

BP Oil UK Limited operates a fuel storage terminal for the storage of petrol and for the unloading of petrol into mobile containers.

"Petrol" means any petroleum derivative (other than liquefied petroleum gas), with or without additives, having a Reid vapour pressure of 27.6 or more kilopascals, which is intended for use as a fuel for motor vehicles. The unloading and storage of diesel and aviation fuels do not meet the definition of petrol and are not covered by environmental permitting. The terms 'petrol' and 'gasoline' are interchangeable in this permit.

Gasoline is delivered to the terminal by underground pipeline and is stored in any of 7 stationary storage tanks, with fixed or floating roofs:

Tank No.	Type:	Notes
1	Fixed with internal floating roof	Slops tank
2	Fixed with internal floating roof	Gasoline duty
3	Fixed with internal floating roof	Gasoline duty
4	Fixed with internal floating roof	Gasoline duty
5	Fixed with external floating roof	Gasoline duty
6	Fixed with external floating roof	Diesel duty
7	Fixed with external floating roof	Diesel duty

All storage tanks are painted in a finish that is at least 70% heat reflective, and each floating roof is fitted with a primary and secondary seal meeting the requirements of PG1/13(04) in order to minimise gasoline vapour losses, and achieve the overall containment of vapours of 95% or more.

All tanks are equipped with tank level indicators, overfill protection and hydraulically operated Remotely Operated Safety Shut Off Valves (ROSOVs) meeting the design and installation requirements of HSG244 and the Process Safety Leadership Group report recommendations.

Petrol is loaded into mobile containers (road tankers) via the gantry. A liquid coupler on the gantry arm mates with the corresponding adapter on the road tanker. The 'Scully' system which controls loading operations will only give permission to proceed when all connectors are correctly located and the vapour recovery system is operational.

Petrol vapours displaced during the loading of road tankers are collected in the Vapour Recovery Unit (VRU). The VRU comprises two activated carbon adsorption columns to capture and recover petrol vapours as follows:

- One column operates in the adsorption phase, where gasoline vapour becomes a liquid as it adsorbs onto the surface of the carbon, and the displaced air is released to atmosphere
- The other column acts in the regeneration phase, and gasoline vapour is condensed back to liquid and returned to the gasoline storage tank.

Emissions from the VRU exhaust stack are continuously indicatively monitored on the SCADA system.

Permit [redacted]

Permit Reference Number:
DBC/EP/101

The ***Dacorum Borough Council*** ("the Regulator") in exercise of its powers under Regulation 13(1) of the Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No 1154) as amended, hereby authorises ***BP Oil UK Limited*** ("the Operator").

Whose company registration number is: ***00446915***

To operate an installation at:

BP Oil UK Limited
Buncefield Terminal
Green Lane
Hemel Hempstead
Hertfordshire
HP2 7JA

To carry out the following activities and associated activities to the extent authorised by and subject to the conditions of this Permit:

1. The storage of petrol in stationary storage tanks at a terminal (Chapter 1, section 1.2, 'gasification, liquefaction and refining activities') of the Environmental Permitting (England and Wales) Regulations 2016) ('the EPR') as described, and in accordance with the conditions contained in this permit.

This Permit shall be subject to replacement, variation or amendment as may be considered appropriate by Dacorum Borough Council, at any time, according to the provisions of Regulation 20 of the EPR.

* Nothing in this Permit grants or implies any consent under the Town and Country Planning Act, or environmental permitting regulated by the Environment Agency.

[redacted]

Dated this day

7th August 2020

David Carr
Lead Scientific Officer - Environmental and Community Protection Team

Conditions

The following Environmental Permit conditions are legal requirements.

Emission limits and monitoring

1. The limits for emissions to air shall be monitored for the parameters and at the monitoring frequency set out in the following table. The emission limits shall not be exceeded.

Source	Parameter	Emission limit	Type of monitoring	Monitoring frequency
Vapour recovery unit (VRU)	Total organic carbon	35 g/Nm^3 a 1 hourly average	Use test methods stated in Appendix 1 to this Permit	Each unit tested once every three years

2. All pollutant concentrations shall be expressed at reference conditions 273K, 101kPa, without correction for water vapour.

3. The introduction of dilution air to achieve emission concentration limits listed in condition 1 is not permitted.

4. Sampling systems shall be designed and located in order to obtain representative samples for all release points. In particular:
   a) Sampling points on new plant shall be designed to comply with the British or equivalent standards; and,
   b) The Operator shall ensure that relevant stacks or ducts are fitted with facilities for sampling which allow compliance with the sampling standards.

Monitoring, investigating and reporting

5. The Operator shall keep records of inspections, tests and monitoring, including all non-continuous monitoring, inspections and visual assessments. All records shall be kept onsite for two years, and made available to an authorised officer of Dacorum Borough Council. If any records are kept off-site they should be made available for inspection within one working week of any request by the Regulator.

Information required by the Regulator

6. The Operator shall notify Dacorum Borough Council at least 7 days before any periodic monitoring exercise to determine compliance with the emission limit in Condition 1. The Operator shall state the provisional time and date of the monitoring, and the test method to be used.

7. The results of non-continuous emissions testing shall be forwarded to Dacorum Borough Council within 8 weeks of the completion of the sampling.

8. Adverse results from any monitoring activity shall be investigated by the operator as soon as the data has been received. The operator shall:
   a) Identify the cause and take corrective action.
   b) Record as much detail as possible regarding the cause and extent of the problem, and the action taken to rectify the situation.
   c) Re test to demonstrate compliance as soon as possible: and notify Dacorum Borough Council.

9. Dacorum Borough Council shall be notified 7 days in advance of any planned shut-down of the Vapour Recovery Unit (VRU). Details of the proposed works shall be recorded in the logbook and made available on request.

Abnormal events

10. The Operator shall have a written procedure for dealing with the failure of the VRU.

11. Any malfunctions or breakdown leading to abnormal emissions shall be dealt with promptly and any such malfunction shall be recorded in the records file required by Condition 4. Dacorum Borough Council shall be notified within a period of no longer than twelve hours if the vapour recovery unit is likely to be out of operation for more than six working hours. The notification shall state the fault, the likely downtime of the unit, and the remedial action proposed.

12. In the event of repeated failure of the VRU, the operator shall submit, and implement to a timetable, proposals to improve the operating efficiency of the unit. Any failure in the VRU shall be recorded in the records files as required in Condition 4.

13. Dacorum Borough Council shall be informed without delay if there is an emission that is likely to have an effect on the local community.

Continuous monitoring

14. The VRU stack shall be equipped with a continuous indicative monitor measuring % hydrocarbons as Butane. The value shall give an indication of emissions which shall be converted to mg/m^3 based on the average molecular weight of the outlet gases. The continuous indicative monitor shall:
    a) Be on clear display to appropriately trained operating staff; and,
    b) Activate audible and visual alarms, situated appropriately to warn the Operator of arrestment plant failure or malfunction where emissions exceed $25mg/m^3$; and,
    c) Automatically record alarm activations; and,

15. Where the monitor required by condition 13 provides hourly averaged emissions output, trend data shall be automatically recorded.

16. All continuous monitors should be operated, maintained and calibrated (or referenced, in the case of indicative monitors) in accordance with the manufacturers' instructions, which should be made available for inspection by the Regulator.

17. The relevant maintenance and calibration (or referencing, in the case of indicative monitors) should be recorded, and in particular:
    a) Emission concentrations may be reported as zero when the plant is off and there is no flow from the stack. If required a competent person should confirm that zero is more appropriate than the measured stack concentration if there is no flow; and,
    b) Any continuous quantitative monitor used should provide reliable data >95% of the operating time, (i.e. availability >95%). A manual or automatic procedure should be in place to detect instrument malfunction and to monitor instrument availability.

Storage installations

18. The external wall and roof of all tanks above ground shall be painted in a colour with a total radiant heat reflectance of 70% or more.

19. All 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).

20. An external floating roof and seal system shall 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 if
    a) The roof is fitted with both primary and secondary seals;
    b) The primary seal extends from the floating roof to the tank wall and the secondary seal is fitted above it; and
    c) 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 EN14015 (Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above) or equivalent.

21. **Existing** fixed roof tanks must either:
    a) be connected to a vapour recovery unit; or
    b) 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.

22. An internal floating roof and seal system shall 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:
    a) the roof is fitted with a primary seal;
    b) the seal extends from the floating roof to the tank wall;
    c) 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 EN14015 or equivalent; and
    d) the roof and seal are designed and installed as per the API Standard 620: Design and construction of large, welded, low-pressure storage tanks."

23. All **new** storage installations at terminals where vapour recovery is needed to comply, shall be either:
    a) Tanks designed with a floating roof, either external or internal, equipped with primary and secondary seals; or
    b) Fixed roof tanks connected to a vapour recovery unit.

24. An internal floating roof and seal system installed in a **new** tank shall 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 if:

    a) The roof is fitted with both primary and secondary seals;

    b) The primary seal extends from the floating roof to the tank wall and the secondary seal is fitted above it;

    c) 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 EN14015 or equivalent; and

    d) The roof and seal system are designed and installed as per as per the API Standard 620: Design and construction of large, welded, low-pressure storage tanks.

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

26. The standards for vapour containment controls shall not apply to 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 mobile containers at terminals

27. 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.

28. Vapour balancing systems shall be designed in accordance with the Institute of Petroleum's Guidelines for the Design and Operation of Gasoline Vapour Emission Controls.

29. In-service monitoring shall comprise an annual visual examination of the system to check for integrity and alignment of the pipework and the joints.

30. An annual visual examination of flexible hoses used to connect mobile containers to the vapour collection pipework shall be undertaken to check for integrity; wear and security of connections.

31. All new and replacement vapour collection pipework, except for flexible hoses, must be tested prior to initial commissioning as follows:

    a) where systems are made up of prefabricated lengths joined together mechanically, each length (including any permanent attachment of the jointing mechanism) shall be tested to a minimum pressure of 1 bar for a period of one hour. Assembly of mechanical joints shall also be subject to inspection;

    b) where the systems are assembled with permanent joints (for example, welded, cemented) they shall be tested to the above requirement on completion.

32. 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.

Gantries

33. The liquid coupler on the loading arm shall be a female coupler which must mate with a 4-inch API (101.6mm) male adapter located on the vehicle.

34. The vapour-collection coupler on the loading-gantry vapour-collection hose shall be a cam-and-groove female coupler which must mate with a 4-inch (101.6mm) cam and-groove male adapter located on the vehicle.

35. The liquid-loading rate shall not exceed 2,500 litres per minute per loading arm.

36. 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 adapter, (This is equivalent to a maximum counterpressure of 45 millibar at the interface between the adaptor and coupler).

37. 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.

38. 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.

39. The gantry Control Unit shall be suitable for both 2-wire and 5-wire vehicle systems.

40. 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.

41. The design of the liquid-loading and vapour collection facilities on the loading gantry shall be based on the following vehicle-connection envelope. The height of the centre line of the liquid adapters shall be:

    a) Maximum 1.4 metres (unladen); minimum 0.5 metres (laden), the preferred height being 0.7 to 1.0 metres;

    b) The horizontal spacing of the adapters shall not be less than 0.25 metres (preferred minimum spacing is 0.3 metres);

    c) All liquid adapters shall be located within an envelope not exceeding 2.5 metres in length;

    d) 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).

42. The earth/overfill connector shall 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).

43. Loading shall not be permitted unless a permissive signal is provided by the combined earth/overfill control unit (Scully System).

44. 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.

45. 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.

Management & training

46. Spares and consumables, in particular those subject to continual wear, shall be available at short notice from suppliers, so that plant breakdowns can be rectified rapidly.

47. Training of terminal staff with responsibility for operating the process shall include:
    a) Awareness of their responsibilities under the permit
    b) Action to minimise emissions during abnormal conditions

48. The training required in relation to Condition 48 shall be recorded, and all written training documents shall be made available to an authorised officer of Dacorum Borough Council.

49. A record of all maintenance shall be made available for inspection.

50. The operator shall set up and implement an Environmental Management System (EMS) to monitor, implement and demonstrate compliance with the conditions contained in the permit. The EMS shall be in writing and made available to Dacorum Borough Council upon request.

Best Available Techniques

51. The best available techniques shall be used to prevent or, where that is not practicable, reduce emissions from the installation in relation to any aspect of the operation of the installation which is not regulated by any other condition of this permit.

52. If the operator proposes to make a change in operation of the installation, he must, at least 14 days before making the change, notify the regulator in writing. The notification must contain a description of the proposed change in operation. It is not necessary to make such a notification if an application to vary this permit has been made and the application contains a description of the proposed change. In this condition 'change in operation' means a change in the nature or functioning, or an extension, of the installation, which may have consequences for the environment.

Interpretations and Explanatory Notes

These interpretations and explanatory notes does not form part of your Environmental Permit conditions, however they do provide useful information about the Environmental Permitting Regulations:

In relation to this Permit, the following expressions shall have the following meanings:

"Activity"	An activity listed in Part 2 of Schedule 1 to the EP Regulations which will form part of an EP installation or be a mobile plant
"The EPR / EP Regulation*"*	Means the Environmental Permitting (England and Wales) Regulations 2016 S.I. 2016 No.1154 (as amended) and words and expressions defined in the EPR shall have the same meanings when used in this Permit save to the extent they are explicitly defined in this Permit.
"Change in Operation"	In relation to an installation or mobile plant, a change in its nature or functioning or an extension which may have consequences for the environment.
"Enforcement notice"	A notice served by a local authority to enforce compliance with the permit conditions or require remediation of any harm following a breach of any condition.
"Installation"	A stationary technical unit where one or more activities listed in Part 2 of Schedule 1 to the EP Regulations are carried out and any other location on the same site where any other directly-associated activities are carried out. and any activities that are technically linked. The terms 'regulated facility' and 'installation' are, in effect, interchangeable for A(2) and B activities.
"Operator"	The person who has control over the operation of the installation/regulated facility (EP Regulation 7).
"Permit"	A permit granted under EP Regulation 13 by a local authority allowing the operation of an installation subject to certain conditions.
"Pollution"	Any emission as a result of human activity which may be harmful to human health or the quality of the environment, cause offence to any human senses, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment (EP Regulation 2(1)).
"Revocation notice"	A notice served by the Regulator under EP regulation 22 revoking all or part of a permit.
"Permitted Installation"	Means the activities and the limits to those activities described in this Permit.
"Monitoring"	Includes the taking and analysis of samples, instrumental measurements (periodic and continual), calibrations, examinations, tests and surveys.
"MCERTS"	Means the Environment Agency's Monitoring Certification Scheme.
"Fugitive Emission"	Means an emission to air or water (including sewer) from the Permitted installation that is not controlled by an emission limit imposed by a condition of this Permit.
"Regulator"	Means any officer of Dacorum Borough Council who is authorised under Section 108(1) of the Environment Act 1995 to exercise, in accordance with the terms of any such authorisation, any power specified in Section 108(1) of that Act.
"Best Available Techniques (BAT)"	Best available techniques means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent, and where that is not practical, generally to reduce emissions and the impact on the environment as a whole. For those purposes: "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. Schedule 2 of the Regulations shall have effect in relation to the determination of best available techniques.

Where any condition of this Permit refers to the whole or parts of different documents, in the event of any conflict between the wording of such documents, the document with the most recent publication date shall be taken to be the most appropriate document to be used.

Any person who is aggrieved by the conditions attached to a Permit can appeal to the Secretary of State for Environment, Food & Rural Affairs. Appeals must be received by the Secretary of State no later than 6 months from the date of the decision (the date of the Permit).

Appeals relating to installations in England should be received by the Secretary of State for Environment, Food & Rural Affairs. The address is as follows;

The Planning Inspectorate
Environment Team, Major and Specialist Casework
Room 4/04 – Kite Wing
Temple Quay House
2 The Square
Temple Quay
Bristol, BS1 PN

The appeal must be in the form of a written notice or letter stating that the person wishes to appeal and listing the condition(s) which is/are being appealed against. The following five items must be included;

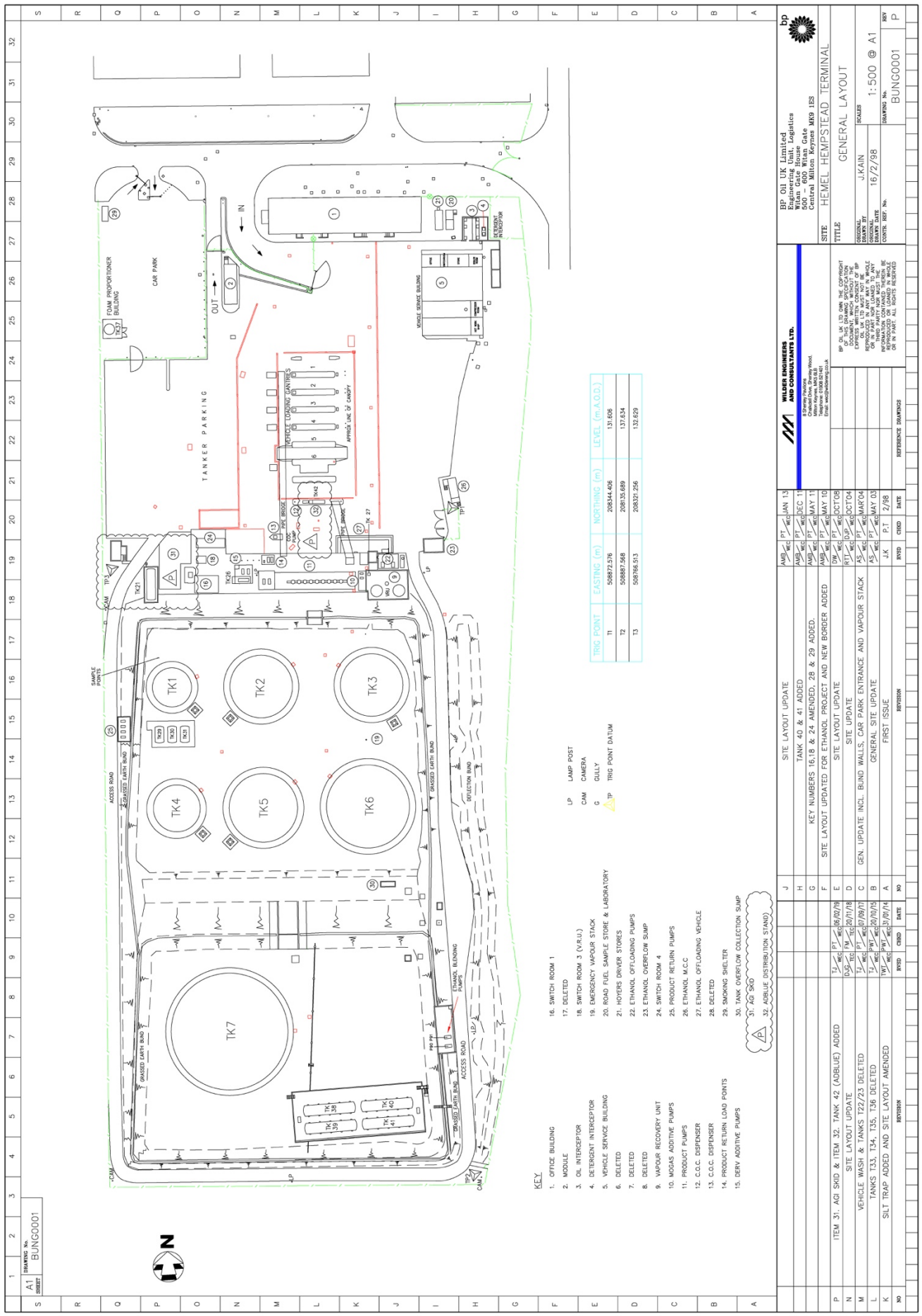
(a) A statement of the ground of appeal;
(b) A copy of any relevant application;
(c) A copy of any relevant Permit;
(d) A copy of any relevant correspondence between the person making the appeal ("the appellant") and the Council;
(e) A statement indicating whether the appellant wishes the appeal to be dealt with.

- By a hearing attended by both parties and conducted by an inspector appointed by the Secretary of State; or
- By both parties sending the Secretary of State written statements of their case (and having the opportunity to comment upon one another's statements).

At the same time, the notice of appeal and documents (a) and (e) must be sent to the Council, and the person making the appeal should inform the appropriate Secretary of State that this has been done.

- An appeal will not suspend the effect of the conditions appealed against; the conditions must still be complied with.
- In determining an appeal against one or more conditions, the Act allows the Secretary of State in addition to quash any of the other conditions not subject to the appeal and to direct the local authority to either vary any of these conditions or to add new conditions.

Schedule 1: Site Plan



Appendix 1:
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 petrol 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 as stated in Table 4.1 of PGN.

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. For VRUs which operate in batch mode (e.g. carbon adsorption type VRUs) the interval should be set so that at least two measurements are made (or samples are collected) within each VRU 'batch' cycle time (e.g. carbon bed cycle times).

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/Nm3 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 (see Paragraph 4.12 of PGN).

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 nonadsorbent 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. It should be noted that although use of oxygen deficiency instruments is a valid and well-established technique to determine the total hydrocarbon concentration at the VRU inlet, this technique cannot be used to derive VRU vent emissions. The measurement cannot provide sufficient accuracy, due to the fundamental limits of resolution and repeatability achievable. For activated carbon adsorption systems, there is also the further possibility of oxygen depletion by the carbon causing erroneous measurements.

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 1 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 obtain 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 this 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 onstream 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 nbutane) 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 nbutane) 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. For VRUs which operate in batch mode (e.g. carbon adsorption type VRUs) the interval should be set so that at least two samples are collected within each VRU 'batch' cycle time (e.g. carbon bed cycle times).

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 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 nbutane, 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 A2).

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 ± 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 ± 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 ± 1%.

A2 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 ± 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 in the following example:

Table A - Molecular weight calculation

Component	Vol%	MW		Calculation (Vol% 100) x MW	
C3 paraffins	6.7	44.1		0.67 x 44.1 =	0.30
C4 paraffins	65.2	65.2		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 =	00.4
C7 paraffins	0.3	100.2		0.003 x 100.2 =	00.3
C8 paraffins	0.1	114.2			
C9 paraffins	<0.1	128.2			
C10 paraffins	<0.1	142.3			
C3 olefins	<0.1	42.1			
C4 olefins	3.3	56.1		0.033 x 56.1 =	01.9
C5 olefins	1.9	70.1		0.001 x 70.1 =	01.3
C6 olefins	0.1	84.2		0.001 x 84.2 =	00.1
C7 olefins	<0.1	98.2			
C8 olefins	<0.1	112.3			
C9 olefins	<0.1	126.2			
C10 olefins	<0.1	140.3			
C5 napthenes	0.3	70.1		0.003 x 70.1 =	00.2
C6 napthenes	0.3	84.2		0.003 x 84.2 =	00.3
C7 napthenes	0.1	98.2		0.001 x 98.2 =	00.1
C8 napthenes	<0.1	112.2			
C9 napthenes	<0.1	126.2			
C10 napthenes	<0.1	140.3			
C6 aromatics	0.5	78.1		0.005 x 78.1 =	00.4
C7 aromatics	0.2	92.1		0.002 x 92.1 =	00.2
C8 aromatics	0.1	106.2		0.001 x 106.2 =	00.1
C9 aromatics	<0.1	120.2			
C10 aromatics <0.1134.3	<0.1	134.3			
		Average Molecular Weight = sum =			61.0

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:

Table B – Calculation of overall response factor

Component	Vapour composition Vol% (Note)	Response factor	Calculation (% / 100) x response factor	
C3 plus lighter components	7	0.8 (propane)	0.07 x 0.8 =	0.06
C4 components	68	1.0 (n-butane)	0.68 x 1.0 =	0.68
C5 plus heavier components	25	1.2 (n-pentane)	0.25 x 1.2 =	0.30
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 x V) ÷ 10,000

where:

M = average TOC concentration in g/Nm3

V = 60 minute average TOC concentration in ppm

Equation 2

For all other TOC meters

M = (0.446 x MW x V) ÷ 10,000
where:

M = average TOC concentration in g/Nm3

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

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 real-time, or the TOC meter can be used at a later time.