

Directive 2005/55/EC of the European Parliament and of the Council of 28 September 2005 on the approximation of the laws of the Member States relating to the measures to be taken against the emission of gaseous and particulate pollutants from compression-ignition engines for use in vehicles, and the emission of gaseous pollutants from positive-ignition engines fuelled with natural gas or liquefied petroleum gas for use in vehicles (Text with EEA relevance) (repealed)

|            |   |
|------------|---|
| Article 1  | For the purposes of this Directive the following definitions shall... |
| Article 2  | Obligations of the Member States                                      |
| Article 3  | Durability of emission control systems                                |
| Article 4  | On-board diagnostic systems   |
| Article 5  | Emission control systems using consumable reagents                    |
| Article 6  | Tax incentives  |
| Article 7  | Implementation measures and amendments                                |
| Article 8  | Review and reports  |
| Article 9  | Transposition   |
| Article 10 | Repeal  |
| Article 11 | Entry into force  |
| Article 12 | Addressees  |

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## ANNEX I

### SCOPE, DEFINITIONS AND ABBREVIATIONS, APPLICATION FOR EC TYPE-APPROVAL, SPECIFICATIONS AND TESTS AND CONFORMITY OF PRODUCTION

1. SCOPE
2. DEFINITIONS
  - 2.1. For the purposes of this Directive, the following definitions shall...
  - 2.2. Symbols, abbreviations and international standards
    - 2.2.1. Symbols for test parameters
    - 2.2.2. Symbols for chemical components
    - 2.2.3. Abbreviations
    - 2.2.4. Symbols for the fuel composition
    - 2.2.5. Standards referenced by this Directive
3. APPLICATION FOR EC TYPE-APPROVAL
  - 3.1. Application for EC type-approval for a type of engine or...
    - 3.1.1. The application for approval of an engine type or engine...
    - 3.1.2. It shall be accompanied by the undermentioned documents in triplicate...
      - 3.1.2.1. A description of the engine type or engine family, if...
    - 3.1.3. An engine conforming to the 'engine type' or 'parent engine'...
  - 3.2. Application for EC type-approval for a vehicle type in respect...
    - 3.2.1. The application for approval of a vehicle with regard to...
    - 3.2.2. It shall be accompanied by the undermentioned documents in triplicate...

- 3.2.2.1. A description of the vehicle type, of the engine-related vehicle...
    - 3.2.3. The manufacturer shall provide a description of the malfunction indicator...
  - 3.3. Application for EC type-approval for a vehicle type with an...
    - 3.3.1. The application for approval of a vehicle with regard to...
    - 3.3.2. It shall be accompanied by the undermentioned documents in triplicate...
      - 3.3.2.1. a description of the vehicle type and of engine-related vehicle...
    - 3.3.3. The manufacturer shall provide a description of the malfunction indicator...
  - 3.4. On-board diagnostic systems
    - 3.4.1. The application for approval of an engine equipped with an...
      - 3.4.1.1. Detailed written information fully describing the functional operation characteristics of...
      - 3.4.1.2. Where applicable, a declaration by the manufacturer of the parameters...
        - 3.4.1.2.1. The manufacturer shall provide the technical service with a description...
      - 3.4.1.3. Where applicable, a description of the communication interface (hardware and messages)...
      - 3.4.1.4. Where appropriate, copies of other type-approvals with the relevant data...
      - 3.4.1.5. If applicable, the particulars of the engine family as referred...
      - 3.4.1.6. The manufacturer must describe provisions taken to prevent tampering with...
- 4. EC TYPE-APPROVAL
  - 4.1. Granting of a universal fuel EC type-approval
    - 4.1.1. In the case of diesel fuel the parent engine meets...
    - 4.1.2. In the case of natural gas the parent engine should...
      - 4.1.2.1. On the manufacturer's request the engine may be tested on...
    - 4.1.3. In the case of an engine fuelled with natural gas...
      - 4.1.3.1. At the manufacturer's request the engine may be tested on...
    - 4.1.4. In the case of natural gas engines, the ratio of...
    - 4.1.5. In the case of LPG the parent engine should demonstrate...
      - 4.1.5.1. The ratio of emission results 'r' shall be determined for...
  - 4.2. Granting of a fuel range restricted EC type-approval
    - 4.2.1. Exhaust emissions approval of an engine running on natural gas...
      - 4.2.1.1. At the manufacturer's request the engine may be tested on...
      - 4.2.1.2. The ratio of emission results 'r' shall be determined for...
      - 4.2.1.3. On delivery to the customer the engine shall bear a...
    - 4.2.2. Exhaust emissions approval of an engine running on natural gas...
      - 4.2.2.1. The parent engine shall meet the emission requirements on the...
        - 4.2.2.2. At the manufacturer's request the engine may be tested on...
        - 4.2.2.3. On delivery to the customer the engine shall bear a...
  - 4.3. Exhaust emissions approval of a member of a family
    - 4.3.1. With the exception of the case mentioned in paragraph 4.3.2,...
    - 4.3.2. Secondary test engine
  - 4.4. Type-approval certificate
  - 4.5. At the request of the manufacturer, the type approval of...

## 5. ENGINE MARKINGS

- 5.1. The engine approved as a technical unit must bear:
  - 5.1.1. the trademark or trade name of the manufacturer of the...
  - 5.1.2. the manufacturer's commercial description;
  - 5.1.3. the EC type-approval number preceded by the distinctive letter(s) or...
  - 5.1.4. in case of an NG engine one of the following...
  - 5.1.5. Labels
    - 5.1.5.1. Content  
Note:
      - 5.1.5.2. Properties
      - 5.1.5.3. Placing
- 5.2. In case of an application for EC type-approval for a...
- 5.3. In case of an application for EC type-approval for a...

## 6. SPECIFICATIONS AND TESTS

- 6.1. General
  - 6.1.1. Emission control equipment
    - 6.1.1.1. The components liable to affect, where appropriate, the emission of...
  - 6.1.2. The use of a defeat strategy is forbidden.
    - 6.1.2.1. The use of a multi-setting engine is forbidden until appropriate...
  - 6.1.3. Emission control strategy
    - 6.1.3.1. Any element of design and emission control strategy (ECS) liable...
  - 6.1.4. Requirements for base emission control strategy
    - 6.1.4.1. The base emission control strategy (BECS) shall be so designed...
  - 6.1.5. Requirements for auxiliary emission control strategy
    - 6.1.5.1. An auxiliary emission control strategy (AECS) may be installed to...
    - 6.1.5.2. An auxiliary emission control strategy (AECS) that operates within the...
    - 6.1.5.3. An auxiliary emission control strategy (AECS) that operates outside the...
    - 6.1.5.4. As provided for in section 6.1.5.1, the following conditions of use...
    - 6.1.5.5. An auxiliary emission control strategy (AECS) may be installed to...
    - 6.1.5.6. The AECS is activated:
  - 6.1.6. Requirements for torque limiters
    - 6.1.6.1. A torque limiter will be permitted if it complies with...
    - 6.1.6.2. A torque limiter may be installed to an engine, or...
  - 6.1.7. Special requirements for electronic emission control systems
    - 6.1.7.1. Documentation requirements
  - 6.1.8. Specifically for the type-approval of engines according to row A...
    - 6.1.8.1. To verify whether any strategy or measure should be considered...
    - 6.1.8.2. In verifying whether any strategy or measure should be considered...
  - 6.1.9. The transitional provisions for extension of type-approval are given in...
  - 6.1.10. Provisions for electronic system security

- 6.1.10.1 Any vehicle with an Emission Control Unit must include features...
- 6.1.10.2 Computer-coded engine operating parameters must not be changeable without the...
- 6.1.10.3 Manufacturers must take adequate steps to protect the maximum fuel...
- 6.1.10.4 Manufacturers may apply to the approval authority for an exemption...
- 6.1.10.5 Manufacturers using programmable computer code systems (e.g. electrical erasable programmable...
- 6.2. Specifications Concerning the Emission of Gaseous and Particulate Pollutants and...
  - 6.2.1. Limit values
  - 6.2.2. Hydrocarbon measurement for diesel and gas fuelled engines
    - 6.2.2.1. A manufacturer may choose to measure the mass of total...
  - 6.2.3. Specific requirements for diesel engines
    - 6.2.3.1. The specific mass of the oxides of nitrogen measured at...
    - 6.2.3.2. The smoke value on the random test speed of the...
- 6.3. Durability and deterioration factors
  - 6.3.1. For the purposes of this Directive, the manufacturer shall determine...
  - 6.3.2. The procedures for demonstrating the compliance of an engine or...
- 6.4. On-Board Diagnostic (OBD) system
  - 6.4.1. As laid down in Articles 4(1) and 4(2) of this Directive, diesel...
  - 6.4.2. Small batch engine production
- 6.5. Requirements to ensure correct operation of NO<sub>x</sub> control measures...
  - 6.5.1. General
    - 6.5.1.1. This section is applicable to compression-ignition engine systems irrespective of...
    - 6.5.1.2. Application dates
    - 6.5.1.3. Any engine system covered by this section shall be designed,...
    - 6.5.1.4. Information that fully describes the functional operational characteristics of an...
    - 6.5.1.5. In its application for type-approval, if the engine system requires...
    - 6.5.1.6. Subject to requirements set out in section 6.1, any engine...
    - 6.5.1.7. For the purpose of type-approval, the manufacturer shall demonstrate to...
    - 6.5.1.8. For engine systems requiring a reagent, each separate reagent tank...
  - 6.5.2. Maintenance requirements
    - 6.5.2.1. The manufacturer shall furnish or cause to be furnished to...
    - 6.5.2.2. The instructions will indicate requirements for the proper use and...
    - 6.5.2.3. The instructions shall be written in clear and non-technical language...
    - 6.5.2.4. The instructions shall specify if consumable reagents have to be...
    - 6.5.2.5. The instructions shall specify that use of and refilling of...
    - 6.5.2.6. The instructions shall state that it may be a criminal...
  - 6.5.3. Engine system NO<sub>x</sub> control
    - 6.5.3.1. Incorrect operation of the engine system with respect to NO...
    - 6.5.3.2. Any deviation in NO<sub>x</sub> level more than 1,5 g/kWh...

- 6.5.3.3. In addition, a non-erasable fault code identifying the reason why...
- 6.5.3.4. If the NO<sub>x</sub> level exceeds the OBD threshold limit...
- 6.5.3.5. In the case of engine systems that rely on the...
- 6.5.4. Reagent control
  - 6.5.4.1. For vehicles that require the use of a reagent to...
  - 6.5.4.2. The driver shall be informed, according to the requirements of...
  - 6.5.4.3. As soon as the reagent tank becomes empty, the requirements...
  - 6.5.4.4. A manufacturer may choose to comply with the sections 6.5.4.5...
  - 6.5.4.5. Engine systems shall include a means of determining that a...
  - 6.5.4.6. If the fluid in the reagent tank does not correspond...
  - 6.5.4.7. Engine systems shall include a means for determining reagent consumption...
  - 6.5.4.8. Average reagent consumption and average demanded reagent consumption by the...
  - 6.5.4.9. In order to monitor reagent consumption, at least the following...
  - 6.5.4.10 Any deviation more than 50 % in average reagent consumption and...
  - 6.5.4.11 In the case of interruption in reagent dosing activity the...
  - 6.5.4.12 Any failure detected with respect to sections 6.5.4.6, 6.5.4.10 or...
- 6.5.5. Measures to discourage tampering of exhaust aftertreatment systems
  - 6.5.5.1. Any engine system covered by this section shall include a...
  - 6.5.5.2. The torque limiter shall be activated when the vehicle becomes...
  - 6.5.5.3. Where the torque limiter comes into effect, the engine torque...
  - 6.5.5.4. Requirements for documentation and the torque limiter are set out...
  - 6.5.5.5. Detailed written information fully describing the functional operation characteristics of...
  - 6.5.5.6. The torque limiter shall be deactivated when the engine speed...
  - 6.5.5.7. Deactivation of the torque limiter shall not be feasible by...
  - 6.5.5.8. The torque limiter shall not apply to engines or vehicles...
- 6.5.6. Operating conditions of the emission control monitoring system
  - 6.5.6.1. The emission control monitoring system shall be operational,
  - 6.5.6.2. The emission control monitoring system may be deactivated when a...
  - 6.5.6.3. If an emission default mode is active, the emission control...
  - 6.5.6.4. The incorrect operation of NO<sub>x</sub> control measures shall be...
  - 6.5.6.5. Algorithms used by the ECU for relating the actual NO...
  - 6.5.6.6. If an AECS that has been approved by the type-approval...
- 6.5.7. Failure of the emission control monitoring system
  - 6.5.7.1. The emission control monitoring system shall be monitored for electrical...
  - 6.5.7.2. If a failure of the emission control monitoring system is...
  - 6.5.7.3. The torque limiter shall be activated in accordance with section...
  - 6.5.7.4. When the emission control monitoring system has determined the failure...

- 6.5.7.5. In the case of the removal or deactivation of elements...
- 6.5.8. Demonstration of the emission control monitoring system
  - 6.5.8.1. As part of the application for type-approval provided for in...
  - 6.5.8.2. The compliance of an engine family or an OBD engine...
  - 6.5.8.3. The testing of the emission control monitoring system consists of...
    - 6.5.8.3.1. For the selection phase, the manufacturer shall provide the type...
    - 6.5.8.3.2. For the qualification phase, the NO x emissions shall be...
    - 6.5.8.3.3. For the demonstration phase, the engine shall be run over...
    - 6.5.8.3.4. Prior to starting the test sequence of section 6.5.8.3.3, the...
    - 6.5.8.3.5. Depending on the NO x level selected, the system shall...
  - 6.5.8.4. In the case of an emission control monitoring system principally...
  - 6.5.8.5. The level of torque reduction required in section 6.5.5.3 by...
  - 6.5.8.6. As an alternative to sections 6.5.8.3.3 to 6.5.8.3.5, the demonstration...
  - 6.5.8.7. If the storage in the computer memory of a non-erasable...
- 7. INSTALLATION ON THE VEHICLE
  - 7.1. The engine installation on the vehicle shall comply with the...
    - 7.1.1. intake depression shall not exceed that specified for the type-approved...
    - 7.1.2. exhaust back pressure shall not exceed that specified for the...
    - 7.1.3. the exhaust system volume shall not differ by more than...
    - 7.1.4. power absorbed by the auxiliaries needed for operating the engine...
- 8. ENGINE FAMILY
  - 8.1. Parameters defining the engine family
  - 8.2. Choice of the parent engine
    - 8.2.1. Diesel engines
    - 8.2.2. Gas engines
  - 8.3. Parameters for defining an OBD-engine family
- 9. PRODUCTION CONFORMITY
  - 9.1. Measures to ensure production conformity must be taken in accordance...
    - 9.1.1. If emissions of pollutants are to be measured and an...
      - 9.1.1.1. Conformity of the engine subjected to a pollutant test:
        - 9.1.1.1.1. Three engines are randomly taken in the series. Engines that...
          - 9.1.1.1.2. The tests are carried out according to Appendix 1 to...
          - 9.1.1.1.3. On the basis of a test of the engine by...
        - 9.1.1.2. The tests will be carried out on newly manufactured engines....
          - 9.1.1.2.1. However, at the request of the manufacturer, the tests may...
          - 9.1.1.2.2. When the manufacturer asks to conduct a running-in procedure in...
          - 9.1.1.2.3. For diesel and LPG fuelled engines, all these tests may...

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- 9.1.1.2.4 For NG fuelled engines, all these tests may be conducted...
  - 9.1.1.2.5 In the case of dispute caused by the non-compliance of...
  - 9.1.1.2.6 Tests for conformity of production of a gas fuelled engine...
  - 9.1.2. On-Board Diagnostics (OBD)
    - 9.1.2.1. If a verification of the conformity of production of the...
    - 9.1.2.2. When the approval authority determines that the quality of production...
    - 9.1.2.3. The production is deemed to conform if this engine meets the...
    - 9.1.2.4 If the engine taken from the series does not satisfy...
    - 9.1.2.5. The production is deemed to conform if at least three engines...
10. CONFORMITY OF IN-SERVICE VEHICLES/ENGINES
- 10.1. For the purpose of this Directive, the conformity of in-service...
  - 10.2. With reference to type-approvals granted for emissions, additional measures are...
  - 10.3. The procedures to be followed regarding the conformity of in-service...

#### Appendix 1

##### PROCEDURE FOR PRODUCTION CONFORMITY TESTING WHEN STANDARD DEVIATION IS SATISFACTORY

This Appendix describes the procedure to be used to verify...

#### Appendix 2

##### PROCEDURE FOR PRODUCTION CONFORMITY TESTING WHEN STANDARD DEVIATION IS UNSATISFACTORY OR UNAVAILABLE

This Appendix describes the procedure to be used to verify...

#### Appendix 3

##### PROCEDURE FOR PRODUCTION CONFORMITY TESTING AT MANUFACTURER'S REQUEST

This Appendix describes the procedure to be used to verify,...

#### Appendix 4

##### DETERMINATION OF SYSTEM EQUIVALENCE

The determination of system equivalency according to section 6.2 of this...

This statistical method examines the hypothesis that the population standard...

The following procedure shall be followed. The subscripts R and C...

Conduct at least 7 tests with the candidate and reference...

## ANNEX II

### Appendix 1

### Appendix 2

#### ESSENTIAL CHARACTERISTICS OF THE ENGINE FAMILY

### Appendix 3

### Appendix 4

#### CHARACTERISTICS OF THE ENGINE-RELATED VEHICLE PARTS

### Appendix 5

#### OBD-RELATED INFORMATION

1. In accordance with the provisions of section 5 of Annex IV to...
  - 1.1. A description of the type and number of the pre-conditioning...
  - 1.2. A description of the type of the OBD demonstration cycle...
  - 1.3. A comprehensive document describing all sensed components with the strategy...



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- 1.3.1. The information required by this section may, for example, be...
- 1.3.2. The information required by this Appendix may be limited to...
- 1.3.3. The information required by this section shall be repeated in...

## Appendix 6

### Information required for roadworthiness testing

- A. Measurement of carbon monoxide emissions
  - 3.2.1.6. Normal engine idling speed (including tolerance) ... min<sup>-1</sup>
  - 3.2.1.6. High engine idling speed (including tolerance) ... min<sup>-1</sup>
  - 3.2.1.7. Carbon monoxide content by volume in the exhaust gas with...
- B. Measurement of smoke opacity
  - 3.2.13. Location of the absorption coefficient symbol (compression ignition engines only):...
- 4. TRANSMISSION (v)
  - 4.3. Moment of inertia of engine flywheel: ...
    - 4.3.1. Additional moment of inertia with no gear engaged: ...

## ANNEX III

### TEST PROCEDURE

- 1. INTRODUCTION
  - 1.1. This Annex describes the methods of determining emissions of gaseous...
  - 1.2. The test shall be carried out with the engine mounted...
  - 1.3. Measurement principle
    - 1.3.1. ESC Test
    - 1.3.2. ELR test
    - 1.3.3. ETC Test
- 2. TEST CONDITIONS
  - 2.1. Engine Test Conditions
    - 2.1.1. The absolute temperature ( T a ) of the engine...
    - 2.1.2. Test Validity
  - 2.2. Engines with charge air cooling
  - 2.3. Engine air intake system
  - 2.4. Engine exhaust system
  - 2.5. Cooling system
  - 2.6. Lubricating oil
  - 2.7. Fuel
  - 2.8. If the engine is equipped with an exhaust aftertreatment system, ...
    - 2.8.1. For an exhaust aftertreatment system based on a continuous regeneration...
    - 2.8.2. For an exhaust aftertreatment based on a periodic regeneration process,...

## Appendix 1

### ESC AND ELR TEST CYCLES

1. ENGINE AND DYNAMOMETER SETTINGS
  - 1.1. Determination of engine speeds A, B and C
  - 1.2. Determination of dynamometer settings
2. ESC TEST RUN
  - 2.1. Preparation of the Sampling Filter
  - 2.2. Installation of the measuring equipment
  - 2.3. Starting the dilution system and the engine
  - 2.4. Starting the particulate sampling system
  - 2.5. Adjustment of the dilution ratio
  - 2.6. Checking the analysers
  - 2.7. Test cycle
    - 2.7.1. The following 13-mode cycle shall be followed in dynamometer operation...
    - 2.7.2. Test sequence
    - 2.7.3. Analyser response
    - 2.7.4. Particulate sampling
    - 2.7.5. Engine conditions
    - 2.7.6. NO<sub>x</sub> check within the control area
    - 2.7.7. Rechecking the analysers
3. ELR TEST RUN
  - 3.1. Installation of the measuring equipment
  - 3.2. Checking of the opacimeter
  - 3.3. Test cycle
    - 3.3.1. Conditioning of the engine
    - 3.3.2. Test sequence
  - 3.4. Cycle validation
  - 3.5. Rechecking of the opacimeter
4. CALCULATION OF THE EXHAUST GAS FLOW
  - 4.1. Determination of Raw Exhaust Gas Mass Flow
    - 4.1.1. Direct measurement method
    - 4.1.2. Air and fuel measurement method
  - 4.2. Determination of Diluted Exhaust Gas Mass Flow
5. CALCULATION OF THE GASEOUS EMISSIONS
  - 5.1. Data Evaluation
  - 5.2. Dry/Wet Correction
  - 5.3. NO<sub>x</sub> correction for humidity and temperature
  - 5.4. Calculation of the emission mass flow rates
  - 5.5. Calculation of the specific emissions
  - 5.6. Calculation of the area control values
    - 5.6.1. Calculation of the Specific Emission
    - 5.6.2. Determination of the Emission Value from the Test Cycle
    - 5.6.3. Comparison of NO<sub>x</sub> Emission Values
6. CALCULATION OF THE PARTICULATE EMISSIONS
  - 6.1. Data Evaluation

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- 6.2. Partial Flow Dilution System
    - 6.2.1. Isokinetic systems
    - 6.2.2. Systems with measurement of CO<sub>2</sub> or NO<sub>x</sub> concentration...
    - 6.2.3. Systems with CO<sub>2</sub> measurement and carbon balance method
    - 6.2.4. Systems with flow measurement
  - 6.3. Full Flow Dilution System
  - 6.4. Calculation of the Particulate Mass Flow Rate
  - 6.5. Calculation of the specific emission
  - 6.6. Calculation of the specific emission
7. CALCULATION OF THE SMOKE VALUES
- 7.1. Bessel algorithm
    - 7.1.1. Calculation of filter response time and Bessel constants
    - 7.1.2. Calculation of the Bessel algorithm
  - 7.2. Data evaluation
  - 7.3. Determination of smoke
    - 7.3.1. Data conversion
    - 7.3.2. Calculation of Bessel averaged smoke
    - 7.3.3. Final result

## Appendix 2

### ETC TEST CYCLE

- 1. ENGINE MAPPING PROCEDURE
  - 1.1. Determination of the mapping speed range
  - 1.2. Performing the engine power map
  - 1.3. Mapping curve generation
  - 1.4. Alternate mapping
  - 1.5. Replicate tests
- 2. GENERATION OF THE REFERENCE TEST CYCLE
  - 2.1. Actual speed
  - 2.2. Actual torque
  - 2.3. Example of the unnormalisation procedure
- 3. EMISSIONS TEST RUN
  - 3.1. Preparation of the sampling filters (if applicable)
  - 3.2. Installation of the measuring equipment
  - 3.3. Starting the dilution system and the engine
  - 3.4. Starting the particulate sampling system (diesel engines only)
  - 3.5. Adjustment of the dilution system
  - 3.6. Checking the analysers
  - 3.7. Engine starting procedure
  - 3.8. Test cycle
    - 3.8.1. Test sequence
    - 3.8.2. Gaseous emissions measurement
      - 3.8.2.1. Full flow dilution system
      - 3.8.2.2. Raw exhaust measurement
    - 3.8.3. Particulate sampling (if applicable)
      - 3.8.3.1. Full flow dilution system
      - 3.8.3.2. Partial flow dilution system

- 3.8.4. Engine stalling
    - 3.8.5. Operations after test
  - 3.9. Verification of the test run
    - 3.9.1. Data shift
    - 3.9.2. Calculation of the cycle work
    - 3.9.3. Validation statistics of the test cycle
- 4. CALCULATION OF THE EXHAUST GAS FLOW
  - 4.1. Determination of the diluted exhaust gas flow
  - 4.2. Determination of raw exhaust gas mass flow
    - 4.2.1. Response time
    - 4.2.2. Direct measurement method
    - 4.2.3. Air and fuel measurement method
    - 4.2.4. Tracer measurement method
    - 4.2.5. Air flow and air-to-fuel ratio measurement method
- 5. CALCULATION OF THE GASEOUS EMISSIONS
  - 5.1. Data evaluation
  - 5.2. Dry/wet correction
  - 5.3. NO<sub>x</sub> correction for humidity and temperature
  - 5.4. Calculation of the emission mass flow rates
    - 5.4.1. Determination of the background corrected concentrations (full flow dilution system,...
  - 5.5. Calculation of the specific emissions
    - 5.5.1. In case of a periodic exhaust aftertreatment system, the emissions...
- 6. CALCULATION OF THE PARTICULATE EMISSION (IF APPLICABLE)
  - 6.1. Data evaluation
  - 6.2. Calculation of the mass flow
    - 6.2.1. Full flow dilution system
    - 6.2.2. Partial flow dilution system
  - 6.3. Calculation of the Specific Emission
    - 6.3.1. In case of a periodic regeneration aftertreatment system, the emissions...

### Appendix 3

A graphical display of the ETC dynamometer schedule is shown...

### Appendix 4

#### MEASUREMENT AND SAMPLING PROCEDURES

- 1. INTRODUCTION
- 2. DYNAMOMETER AND TEST CELL EQUIPMENT
  - 2.1. Engine dynamometer
  - 2.2. Other instruments
  - 2.3. Exhaust gas flow

- 2.4. Diluted exhaust gas flow
- 3. DETERMINATION OF THE GASEOUS COMPONENTS
  - 3.1. General analyser specifications
    - 3.1.1. Accuracy
    - 3.1.2. Precision
    - 3.1.3. Noise
    - 3.1.4. Zero drift
    - 3.1.5. Span drift
    - 3.1.6. Rise time
  - 3.2. Gas drying
  - 3.3. Analysers
    - 3.3.1. Carbon monoxide (CO) analysis
    - 3.3.2. Carbon dioxide (CO<sub>2</sub>) analysis
    - 3.3.3. Hydrocarbon (HC) analysis
    - 3.3.4. Non-Methane Hydrocarbon (NMHC) analysis (NG fuelled gas engines only)
      - 3.3.4.1. Gas chromatographic (GC) method
      - 3.3.4.2. Non-Methane Cutter (NMC) method
    - 3.3.5. Oxides of Nitrogen (NO<sub>x</sub>) analysis
    - 3.3.6. Air-to-fuel measurement
  - 3.4. Sampling of Gaseous Emissions
    - 3.4.1. Raw exhaust gas
    - 3.4.2. Diluted exhaust gas
- 4. DETERMINATION OF THE PARTICULATES
  - 4.1. Particulate sampling filters
    - 4.1.1. Filter specification
    - 4.1.2. Filter size
    - 4.1.3. Filter face velocity
    - 4.1.4. Filter loading
    - 4.1.5. Filter holder
  - 4.2. Weighing chamber and analytical balance specifications
    - 4.2.1. Weighing chamber conditions
    - 4.2.2. Reference filter weighing
    - 4.2.3. Analytical balance
    - 4.2.4. Elimination of static electricity effects
    - 4.2.5. Specifications for flow measurement
      - 4.2.5.1. General requirements
      - 4.2.5.2. Special provisions for partial flow dilution systems
- 5. DETERMINATION OF SMOKE
  - 5.1. General requirements
  - 5.2. Specific requirements
    - 5.2.1. Linearity
    - 5.2.2. Zero drift
    - 5.2.3. Opacimeter display and range
    - 5.2.4. Instrument response time
    - 5.2.5. Neutral density filters

## Appendix 5

## CALIBRATION PROCEDURE

1. CALIBRATION OF THE ANALYTICAL INSTRUMENTS
  - 1.1. Introduction
  - 1.2. Calibration gases
    - 1.2.1. Pure gases
    - 1.2.2. Calibration and span gases
    - 1.2.3. Use of precision blending devices
  - 1.3. Operating procedure for analysers and sampling system
  - 1.4. Leakage test
  - 1.5. Response time check of analytical system
  - 1.6. Calibration
    - 1.6.1. Instrument assembly
    - 1.6.2. Warming-up time
    - 1.6.3. NDIR and HFID analyser
    - 1.6.4. Establishment of the calibration curve
    - 1.6.5. Alternative methods
    - 1.6.6. Calibration of tracer gas analyser for exhaust flow measurement
    - 1.6.7. Verification of the calibration
  - 1.7. Efficiency test of the NO<sub>x</sub> converter
    - 1.7.1. Test set-up
    - 1.7.2. Calibration
    - 1.7.3. Calculation
    - 1.7.4. Adding of oxygen
    - 1.7.5. Activation of the ozonator
    - 1.7.6. NO<sub>x</sub> mode
    - 1.7.7. Deactivation of the ozonator
    - 1.7.8. NO mode
    - 1.7.9. Test interval
    - 1.7.10. Efficiency requirement

Note:
  - 1.8. Adjustment of the FID
    - 1.8.1. Optimisation of the detector response
    - 1.8.2. Hydrocarbon response factors
    - 1.8.3. Oxygen interference check
    - 1.8.4. Efficiency of the non-methane cutter (NMC, for NG fuelled gas...
      - 1.8.4.1. Methane efficiency
      - 1.8.4.2. Ethane efficiency
  - 1.9. Interference effects with CO, CO<sub>2</sub>, and NO<sub>x</sub> analysers
    - 1.9.1. CO analyser interference check
    - 1.9.2. NO<sub>x</sub> analyser quench checks
      - 1.9.2.1. CO<sub>2</sub> quench check
      - 1.9.2.2. Water quench check

Note:
  - 1.10. Calibration intervals
2. CALIBRATION OF THE CVS-SYSTEM
  - 2.1. General
  - 2.2. Calibration of the Positive Displacement Pump (PDP)
    - 2.2.1. Data analysis
  - 2.3. Calibration of the Critical Flow Venturi (CFV)

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- 2.3.1. Data analysis
- 2.4. Calibration of the Subsonic Venturi (SSV)
  - 2.4.1. Data analysis
- 2.5. Total system verification
  - 2.5.1. Metering with a critical flow orifice
  - 2.5.2. Metering by means of a gravimetric technique
- 3. CALIBRATION OF THE PARTICULATE MEASURING SYSTEM
  - 3.1. Introduction
  - 3.2. Flow measurement
    - 3.2.1. Periodical calibration
    - 3.2.2. Carbon flow check
    - 3.2.3. Pre-test check
  - 3.3. Determination of transformation time (for partial flow dilution systems on...
  - 3.4. Checking the partial flow conditions
  - 3.5. Calibration intervals
- 4. CALIBRATION OF THE SMOKE MEASUREMENT EQUIPMENT
  - 4.1. Introduction
  - 4.2. Calibration procedure
    - 4.2.1. Warming-up time
    - 4.2.2. Establishment of the linearity response
  - 4.3. Calibration intervals

## Appendix 6

### CARBON FLOW CHECK

- 1. INTRODUCTION
- 2. CALCULATIONS
  - 2.1. Carbon flow rate into the engine (location 1)
  - 2.2. Carbon flow rate in the raw exhaust (location 2)
  - 2.3. Carbon flow rate in the dilution system (location 3)
  - 2.4. The molecular mass ( $M_{re}$ ) of the exhaust gas...

## ANNEX IV

### TECHNICAL CHARACTERISTICS OF REFERENCE FUEL PRESCRIBED FOR APPROVAL TESTS AND TO VERIFY CONFORMITY OF PRODUCTION

- 1.2. Diesel reference fuel for testing engines to the emission limits...
- 2. NATURAL GAS (NG)
- 3. TECHNICAL DATA OF THE LPG REFERENCE FUELS
  - A. Technical data of the LPG reference fuels used for testing...
  - B. Technical data of the LPG reference fuels used for testing...

## ANNEX V

## ANALYTICAL AND SAMPLING SYSTEMS

1. DETERMINATION OF THE GASEOUS EMISSIONS
  - 1.1. Introduction
  - 1.2. Description of the analytical system
    - 1.2.1. Components of Figures 7 and 8
      - EP Exhaust pipe
      - Exhaust gas sampling probe (Figure 7 only)
      - SP2 Diluted exhaust gas HC sampling probe (Figure 8 only)...
      - SP3 Diluted exhaust gas CO, CO<sub>2</sub>, NO<sub>x</sub> sampling probe (Figure...)
      - HSL1 Heated sampling line
      - HSL2 Heated NO<sub>x</sub> sampling line
      - SL Sampling line for CO and CO<sub>2</sub>
      - BK Background bag (optional; Figure 8 only)
      - BG Sample bag (optional; Figure 8 CO and CO<sub>2</sub> only)...
      - F1 Heated pre-filter (optional)
      - F2 Heated filter
      - P Heated sampling pump
      - HC
      - CO, CO<sub>2</sub>
      - NO
      - C Converter
      - B Cooling bath (optional)
      - T1, T2, T3 Temperature sensor
      - T4 Temperature sensor
      - T5 Temperature sensor
      - G1, G2, G3 Pressure gauge
      - R1, R2 Pressure regulator
      - R3, R4, R5 Pressure regulator
      - FL1, FL2, FL3 Flowmeter
      - FL4 to FL6 Flowmeter (optional)
      - V1 to V5 Selector valve
      - V6, V7 Solenoid valve
      - V8 Needle valve
      - V9, V10 Needle valve
      - V11, V12 Toggle valve (optional)
    - 1.3. NMHC analysis (NG fuelled gas engines only)
      - 1.3.1. Gas chromatographic method (GC, Figure 9)
        - Components of Figure 9
        - PC Porapak column
        - MSC Molecular sieve column
        - OV Oven
        - SLP Sample loop
        - P Pump
        - D Dryer
        - HC
        - V1 Sample injection valve
        - V3 Selector valve
        - V2, V4, V5, V6, V7, V8 Needle valve
        - R1, R2, R3 Pressure regulator



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- FC Flow capillary
- G1, G2, G3 Pressure gauge
- F1, F2, F3, F4, F5 Filter
- FL1
- 1.3.2. Non-methane cutter method (NMC, Figure 10)
  - Components of Figure 10
    - NMC Non-methane cutter
    - HC
    - V1 Selector valve
    - V2, V3 Solenoid valve
    - V4 Needle valve
    - R1 Pressure regulator
    - FL1 Flowmeter
- 2. EXHAUST GAS DILUTION AND DETERMINATION OF THE PARTICULATES
  - 2.1. Introduction
  - 2.2. Partial flow dilution system
    - Isokinetic systems (Figures 11, 12)
    - Flow controlled systems with concentration measurement (Figures 13 to 17)...
    - Flow controlled systems with flow measurement (Figures 18, 19)
    - 2.2.1. Components of Figures 11 to 19
      - EP Exhaust pipe
      - SP Sampling probe (Figures 10, 14, 15, 16, 18, 19)...
      - ISP Isokinetic sampling probe (Figures 11, 12)
      - FD1, FD2 Flow divider (Figure 16)
      - FD3 Flow divider (Figure 17)
      - EGA Exhaust gas analyser (Figures 13, 14, 15, 16, 17)...
      - TT Transfer tube (Figures 11 to 19)
      - DPT Differential pressure transducer (Figures 11, 12, 17)
      - FC1 Flow controller (Figures 11, 12, 17)
      - PCV1, PCV2 Pressure control valve (Figure 16)
      - DC Damping chamber (Figure 17)
      - VN Venturi (Figure 15)
      - FC2 Flow controller (Figures 13, 14, 18, 19, optional)
      - FM1 Flow measurement device (Figures 11, 12, 18, 19)
      - FM2 Flow measurement device (Figure 19)
      - PB Pressures blower (Figures 11, 12, 13, 14, 15, 16, ...)
      - SB Suction blower (Figures 11, 12, 13, 16, 17, 19)...
      - DAF Dilution air filter (Figures 11 to 19)
      - DT Dilution tunnel (Figures 11 to 19)
      - Note:
        - HE Heat exchanger (Figures 16, 17)
  - 2.3. Full flow dilution system
    - 2.3.1. Components of Figure 20
      - EP Exhaust pipe
      - PDP Positive displacement pump
      - CFV Critical Flow Venturi
      - HE Heat exchanger (optional, if EFC is used)
      - EFC Electronic flow compensation (optional, if HE is used)
      - DT Dilution tunnel
      - DAF Dilution air filter
      - PSP Particulate sampling probe

- 2.4. Particulate sampling system
    - 2.4.1. Components of Figures 21 and 22
      - PTT Particulate transfer tube (Figures 21, 22)
      - SDT Secondary dilution tunnel (Figure 22)
      - FH Filter holder(s) (Figures 21, 22)
      - P Sampling pump (Figures 21, 22)
      - DP Dilution air pump (Figure 22)
      - FC3 Flow controller (Figures 21, 22)
      - FM3 Flow measurement device (Figures 21, 22)
      - FM4 Flow measurement device (Figure 22)
      - BV Ball valve (optional)
    - Note:
- 
3. DETERMINATION OF SMOKE
  - 3.1. Introduction
  - 3.2. Full flow opacimeter
    - 3.2.1. Components of Figure 23
      - EP Exhaust Pipe
      - OPL Optical Path Length
      - LS Light source
      - LD Light detector
      - CL Collimating lens
      - T1 Temperature sensor (optional)
  - 3.3. Partial flow opacimeter
    - 3.3.1. Components of Figure 24
      - EP Exhaust pipe
      - SP Sampling probe
      - TT Transfer tube
      - FM Flow measurement device
      - MC Measuring chamber
      - OPL Optical path length
      - LS Light source
      - LD Light detector
      - CL Collimating lens
      - T1 Temperature sensor
      - P Sampling pump (optional)

## ANNEX VI

### Appendix 1

to EC type-approval certificate No ... concerning the type  
approval of a vehicle/separate technical unit/component

- 1.4. Emission levels of the engine/parent engine :
  - 1.4.1. ESC test:
  - 1.4.2. ELR test:
  - 1.4.3. ETC test:

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- 1.5. Crankcase emissions test results: ...
- 1.6. Carbon monoxide emissions test results
- 1.7. Smoke opacity test results
  - 1.7.1. At steady speeds:
  - 1.7.2. Free acceleration tests
    - 1.7.2.1. Engine test in accordance with Section 4.3 of Annex VI...
    - 1.7.2.2. Under free acceleration
      - 1.7.2.2.1. Measured value of the absorption coefficient: ... m<sup>-1</sup>
      - 1.7.2.2.2. Corrected value of the absorption coefficient: ... m<sup>-1</sup>
      - 1.7.2.2.3. Location of the absorption coefficient symbol on the vehicle:  
.....
    - 1.7.2.3. Vehicle test according to section 3 of Annex VI to...
      - 1.7.2.3.1. Corrected absorption value: ... m<sup>-1</sup>
      - 1.7.2.3.2. Rpm at start: ... rpm
  - 1.7.3. Stated net maximum power ... kW at ... rpm
  - 1.7.4. Make and type of opacimeter: ...
  - 1.7.5. Principal characteristics of engine type
    - 1.7.5.1. Engine working principle: four-stroke/two-stroke
    - 1.7.5.2. Number and layout of cylinders: ...
    - 1.7.5.3. Cylinder capacity: ... cm<sup>3</sup>
    - 1.7.5.4. Fuel feed: direct injection/indirect injection
    - 1.7.5.5. Supercharging equipment YES/NO

## Appendix 2

### OBD RELATED INFORMATION

As noted in Appendix 5 of Annex II to this Directive, the...  
Upon request, this appendix will be made available to any...  
In compliance with the provisions of section 1.3.3 of Appendix 5  
to...  
A description of the type and number of the pre-conditioning...

## ANNEX VII

### EXAMPLE OF CALCULATION PROCEDURE

- 1. ESC TEST
  - 1.1. Gaseous emissions
    - Calculation of the dry to wet correction factor  $K_{W,r}$  (Annex...)
    - Calculation of the wet concentrations:
    - Calculation of the NO<sub>x</sub> humidity correction factor  $K_{H,D}$  (Annex III,...)
    - Calculation of the emission mass flow rates (Annex III, Appendix...)
    - Calculation of the specific emissions (Annex III, Appendix 1, Section...)
    - Calculation of the specific NO<sub>x</sub> emission of the random point...
    - Determination of the emission value from the test cycle (Annex...)
    - Comparison of the NO<sub>x</sub> emission values (Annex III, Appendix 1,...)
  - 1.2. Particulate emissions
    - Calculation of GEDF (Annex III, Appendix 1, Sections 5.2.3 and...)
    - Calculation of the mass flow rate (Annex III, Appendix 1,...)

Background correction (optional)  
 Calculation of the specific emission (Annex III, Appendix 1, Section...  
 Calculation of the specific weighting factor (Annex III, Appendix 1,...

2. ELR TEST
  - 2.1. General remarks on the Bessel filter
  - 2.2. Calculation of the Bessel algorithm
    - Step 1 Required Bessel filter response time tF:
    - Step 2 Estimation of cut-off frequency and calculation of Bessel constants E,...
    - Step 3 Application of Bessel filter on step input:
    - Step 4 Filter response time of first iteration cycle:
    - Step 5 Deviation between required and obtained filter response time of first...
    - Step 6 Checking the iteration criteria:
    - Step 7 Final Bessel algorithm:
  - 2.3. Calculation of the smoke values
    - Calculation of the k-value (Annex III, Appendix 1, Section 6.3.1):...
    - Calculation of Bessel averaged smoke (Annex III, Appendix 1, Section...)
    - Calculation of the final smoke value (Annex III, Appendix 1,...
    - Cycle validation (Annex III, Appendix 1, Section 3.4)
3. ETC TEST
  - 3.1. Gaseous emissions (diesel engine)
    - Calculation of the diluted exhaust gas flow (Annex III, Appendix...)
    - Calculation of the NO<sub>x</sub> correction factor (Annex III, Appendix 2,...)
    - Calculation of the background corrected concentrations (Annex III, Appendix 2,...)
    - Calculation of the emissions mass flow (Annex III, Appendix 2,...)
    - Calculation of the specific emissions (Annex III, Appendix 2, Section...)
  - 3.2. Particulate emissions (diesel engine)
    - Calculation of the mass emission (Annex III, Appendix 2, Section...)
    - Calculation of the background corrected mass emission (Annex III, Appendix...)
    - Calculation of the specific emission (Annex III, Appendix 2, Section...)
  - 3.3. Gaseous emissions (CNG engine)
    - Calculation of the NO<sub>x</sub>, correction factor (Annex III, Appendix 2,...)
    - Calculation of the NMHC concentration (Annex III, Appendix 2, Section...)
    - Calculation of the background corrected concentrations (Annex III, Appendix 2,...)
    - For NMHC, the background concentration is the difference between HCconcd...
    - Calculation of the emissions mass flow (Annex III, Appendix 2,...)
    - Calculation of the specific emissions (Annex III, Appendix 2, Section...)
4. λ-SHIFT FACTOR (S<sub>λ</sub>)
  - 4.1. Calculation of the λ-shift factor (S<sub>λ</sub>)
  - 4.2. Examples for the calculation of the λ-shift factor S<sub>λ</sub>
    - Example G25: CH<sub>4</sub> = 86 %, N<sub>2</sub> = 14 % (by volume)
    - Example CR: CH<sub>4</sub> = 87 %, C<sub>2</sub>H<sub>6</sub> = 13 % (by vol)
    - Example CA: CH<sub>4</sub> = 89 %, C<sub>2</sub>H<sub>6</sub> = 4,5 %, C<sub>3</sub>H<sub>8</sub> = 2,3 %,...

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## ANNEX VIII

### SPECIFIC TECHNICAL REQUIREMENTS RELATING TO ETHANOL-FUELLED DIESEL ENGINES

In the case of ethanol-fuelled diesel engines, the following specific...

IN ANNEX III, APPENDIX 1:

- 4.2. Dry/wet correction
- 4.3. NO<sub>x</sub> correction for humidity and temperature
- 4.4. Calculation of the emission mass flow rates

IN ANNEX III, APPENDIX 2:

- 4.2. The conditions for the test should be arranged so that...
- 4.3. Calculation of the emission mass flow
  - 4.3.1 Systems with constant mass flow
    - 4.3.1.1. Determination of the background corrected concentrations
  - 4.3.2. Systems with flow compensation
- 4.4. Calculation of the specific emissions

## ANNEX IX

### TIME-LIMITS FOR THE TRANSPOSITION OF THE REPEALED DIRECTIVES INTO NATIONAL LAWS

Part A Repealed Directives Directives Official Journal Directive  
88/77/EEC L...

## ANNEX X

### CORRELATION TABLE

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- (1) [OJ C 108, 30.4.2004, p. 32.](#)
- (2) Opinion of the European Parliament of 9 March 2004 ([OJ C 102 E, 28.4.2004, p. 272](#)) and Council Decision of 19 September 2005.
- (3) [OJ L 36, 9.2.1988, p. 33.](#) Directive as last amended by the 2003 Act of Accession.
- (4) [OJ L 42, 23.2.1970, p. 1.](#) Directive as last amended by Commission Directive 2005/49/EC ([OJ L 194, 26.7.2005, p. 12](#)).
- (5) [OJ L 295, 25.10.1991, p. 1.](#)
- (6) [OJ L 44, 16.2.2000, p. 1.](#)
- (7) [OJ L 107, 18.4.2001, p. 10.](#)
- (8) [OJ L 76, 6.4.1970, p. 1.](#) Directive as last amended by Commission Directive 2003/76/EC ([OJ L 206, 15.8.2003, p. 29](#)).
- (9) [OJ L 184, 17.7.1999, p. 23.](#)