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<sup>(1)</sup> Text with EEA relevance.

EN

Acts whose titles are printed in light type are those relating to day-to-day management of agricultural matters, and are generally valid for a limited period.

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## II

*(Non-legislative acts)*

## REGULATIONS

## COMMISSION DELEGATED REGULATION (EU) 2018/985

of 12 February 2018

**supplementing Regulation (EU) No 167/2013 of the European Parliament and of the Council as regards environmental and propulsion unit performance requirements for agricultural and forestry vehicles and their engines and repealing Commission Delegated Regulation (EU) 2015/96****(Text with EEA relevance)**

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) No 167/2013 of the European Parliament and of the Council of 5 February 2013 on the approval and market surveillance of agricultural and forestry vehicles <sup>(1)</sup>, and in particular Articles 19(6) and 20(8), 28(6) and 53(12), thereof,

Whereas:

- (1) Having regard to the European strategy on clean and energy efficient vehicles <sup>(2)</sup>, the detailed technical requirements for the type-approval of agricultural and forestry vehicles with regard to their environmental and propulsion unit performance should aim at improving the environmental performance of such vehicles and at the same time strengthening the competitiveness of the Union's automotive industry.
- (2) A considerable reduction in hydrocarbon emissions from agricultural and forestry vehicles is necessary to improve air quality and comply with limit values for pollution. That objective should be achieved not only by reducing the hydrocarbon tailpipe and evaporative emissions from these vehicles, but also by helping to reduce volatile particle levels.
- (3) Given the application of the provisions of Regulation (EU) 2016/1628 of the European Parliament and of the Council <sup>(3)</sup> — on engine categories, exhaust emission limits, test cycles, emission durability periods, exhaust emission requirements, the monitoring of emissions of in-service engines and the conduct of measurements and tests, as well as the transitional provisions and provisions allowing the early EU type-approval and the placing on the market of Stage V engines — to the environmental performance of agricultural and forestry vehicles, the provisions of this Regulation covering the remaining aspects of such approval should be closely modelled on those contained in Regulation (EU) 2016/1628.
- (4) For the purposes of the engine pollutant emission stage for agricultural and forestry vehicle engines, referred to as 'Stage V', that will succeed the one laid down in Commission Delegated Regulation (EU) 2015/96 <sup>(4)</sup>, ambitious gaseous and particulate matter pollutant emission limits should be set while aligning with international standards in order to reduce emissions of particulate matter and ozone precursors such as nitrogen oxides and hydrocarbons.

<sup>(1)</sup> OJ L 60, 2.3.2013, p. 1.

<sup>(2)</sup> COM(2010) 186 final, 28.4.2010.

<sup>(3)</sup> Regulation (EU) 2016/1628 of the European Parliament and of the Council of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations (EU) No 1024/2012 and (EU) No 167/2013, and amending and repealing Directive 97/68/EC (OJ L 252, 16.9.2016, p. 53).

<sup>(4)</sup> Commission Delegated Regulation (EU) 2015/96 of 1 October 2014 supplementing Regulation (EU) No 167/2013 of the European Parliament and of the Council as regards environmental and propulsion unit performance requirements of agricultural and forestry vehicles (OJ L 16, 23.1.2015, p. 1).

- (5) A standardised method of measuring fuel consumption and carbon dioxide emissions of agricultural and forestry vehicle engines is necessary to ensure that no technical barriers to trade arise between the Member States. For the same reason, it is also appropriate to ensure that customers and users are supplied with objective and precise information regarding the same subjects.
- (6) In order to ensure that new vehicles, components and separate technical units placed on the market provide a high level of environmental protection, equipment or parts that can be fitted to agricultural and forestry vehicles and which are capable of significantly impairing the functioning of systems that are essential in terms of environmental protection should be subject to prior control by an approval authority before they are placed on the market. For that purpose, technical provisions concerning the requirements that those parts or equipment have to comply with should be laid down.
- (7) Technical progress and high-level environmental protection require prescribing technical requirements for the introduction of Stage V in relation to agricultural and forestry vehicles, replacing the previous engine pollutant emission stages laid down in Delegated Regulation (EU) 2015/96. The necessary technical requirements concerning in particular engine categories, limit values and implementation dates in this Regulation, should be aligned to the ones in Regulation (EU) 2016/1628.
- (8) By Council Decision 97/836/EC <sup>(1)</sup>, the Union has acceded to the Agreement of the United Nations Economic Commission for Europe (UNECE) concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted to and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions (Revised 1958 Agreement). In its communication 'CARS 2020: Action Plan for a competitive and sustainable automotive industry in Europe' <sup>(2)</sup>, the Commission stressed that the acceptance of international regulations under the 1958 UNECE Agreement is the best way to remove non-tariff barriers to trade. Therefore, references to the corresponding UNECE regulations should be used, where appropriate, for the purposes of laying down requirements for EU type-approval. That possibility is provided for in Regulation (EU) No 167/2013.
- (9) Concerning environmental and propulsion unit performance requirements of agricultural and forestry vehicles, UNECE regulations should be used on an equal basis to Union legislation in order to avoid duplication not only of technical requirements but also of certification and administrative procedures. Type-approval should be based directly on internationally agreed standards because that approach can improve market access in third countries, in particular in those which are contracting parties to the Revised 1958 Agreement, thus enhancing the Union industry's competitiveness.
- (10) It should be possible for engines which before the entry into force of this Regulation were not subject to pollutant emission-related type-approval at Union level and for vehicles equipped with such engines to be placed on the market until the mandatory dates of application of Regulation (EU) 2016/1628 for the placing on the market of the corresponding engine category, provided they comply with applicable national rules.
- (11) Union legislation should not lay down technical requirements which cannot be reasonably met in time. The industry should be provided sufficient lead time as regards the application of Stage V engine pollutant emission limits to agricultural and forestry vehicles. Therefore, it is necessary to lay down transitional measures allowing for the granting of EU type-approvals and exemptions in accordance with the legislation applicable before the day of entry into force of this Regulation during a limited period of time. In particular, it is necessary to permit for a limited period of time the application of engine pollutant emission stages preceding Stage V in parallel with the latter due to technical difficulties of certain vehicle categories, mainly narrow-track tractors, in complying with Stage V from the mandatory dates of application of Regulation (EU) 2016/1628 for the placing on the market of engines.
- (12) In order to take account of logistic supply constraints and to allow for 'just in time' production flow, and to avoid unnecessary costs and administrative burden, an engine manufacturer should, with the consent of the vehicle manufacturer, be allowed to deliver an engine based on an approved type separately from its exhaust after-treatment system.

<sup>(1)</sup> Council Decision 97/836/EC of 27 November 1997 with a view to accession by the European Community to the Agreement of the United Nations Economic Commission for Europe concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted to and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions ('Revised 1958 Agreement') (OJ L 346, 17.12.1997, p. 78).

<sup>(2)</sup> COM(2012) 636 final of 8 November 2012.

- (13) The provisions on the engine pollutant emission stages preceding Stage V are laid down in Delegated Regulation (EU) 2015/96. Those provisions, concerning type-approval or placing on the market of tractors, should only apply until the mandatory dates of application of Regulation (EU) 2016/1628 for the EU type-approval of engines or for their placing on the market, respectively, or beyond those dates in accordance with the transitional provisions. Delegated Regulation (EU) 2015/96 should therefore be repealed from the entry into force of this Regulation,

HAS ADOPTED THIS REGULATION:

#### CHAPTER I

### SUBJECT MATTER AND DEFINITIONS

#### *Article 1*

#### **Subject matter**

This Regulation establishes

- (a) the detailed technical requirements on the environmental and propulsion unit performance and permissible external sound levels for the approval of:
  - (i) agricultural and forestry vehicles;
  - (ii) engines with regard to their installation and the impact this has on engine performance;
  - (iii) their systems, components and separate technical units; and
- (b) the test procedures necessary to assess the compliance with the requirements referred to in point (a).

This Regulation also establishes the detailed requirements with regard to type-approval procedures and conformity of production.

#### *Article 2*

#### **Definitions**

For the purposes of this Regulation, the following definitions shall apply:

- (1) ‘engine’ means an energy converter, other than a gas turbine, designed to transform chemical energy (input) into mechanical energy (output) with an internal combustion process; it includes, where they have been installed, the emission control system and the communication interface (hardware and messages) between the engine’s electronic control unit(s) and any other powertrain or vehicle control unit necessary to comply with Chapters II and III of Regulation (EU) 2016/1628;
- (2) ‘engine type’ means a group of engines which do not differ in essential engine characteristics;
- (3) ‘engine family’ means a manufacturer’s grouping of engine types which, through their design, have similar exhaust emission characteristics, and respect the applicable emission limit values;
- (4) ‘parent engine’ means an engine type selected from an engine family in such a way that its emissions characteristics are representative of that engine family;
- (5) ‘replacement engine’ means an engine that meets both of the following criteria:
  - (a) it is exclusively used to replace an engine already placed on the market and installed in an agricultural and forestry vehicle;
  - (b) it complies with an emission stage which is lower than that applicable on the date of the engine’s replacement;
- (6) ‘net power’ means the engine power in kW obtained on a test bench at the end of the crankshaft, or its equivalent, measured in accordance with the method of measuring the power of engines specified in UNECE Regulation No 120 <sup>(1)</sup> using a reference fuel or fuel combination laid down in Article 25(2) of Regulation (EU) 2016/1628;

<sup>(1)</sup> Regulation No 120 of the Economic Commission for Europe of the United Nations (UNECE) — Uniform provisions concerning the approval of internal combustion engines to be installed in agricultural and forestry tractors and in non-road mobile machinery, with regard to the measurement of the net power, net torque and specific fuel consumption [2015/1000] (OJ L 166, 30.6.2015, p. 170).

- (7) 'transition engine' means an engine that has an engine production date that is prior to the date laid down in Annex III to Regulation (EU) 2016/1628 in respect of the placing on the market of Stage V engines and that meets at least one of the following conditions:
  - (a) it complies with the latest applicable emission limits laid down in the relevant legislation applicable on 20 July 2018;
  - (b) it falls within a power range, or is used or intended to be used in an application that was not subject to pollutant emission related type-approval in accordance with Delegated Regulation (EU) 2015/96 on 20 July 2018;
  - (c) it is an engine in the power range 56-130 kW, meeting the Stage IIIB requirements and installed or intended to be installed in a tractor of categories T2, T4.1 or C2;
- (8) 'exhaust after-treatment system' means a catalyst, particulate filter, deNOx system, combined deNOx particulate filter or any other emission-reducing device, with the exception of exhaust gas recirculation and turbochargers, that is part of the emission control system but is installed downstream of the engine exhaust ports;
- (9) 'external noise-abatement device' means a component, system or separate technical unit which is part of the exhaust and the silencing system, including the exhaust system, the air intake system, the silencer or any systems, components, and separate technical units with a relevance to the permissible external sound levels emitted by the agricultural or forestry vehicle, of a type fitted to the vehicle at the time of type-approval or extension of type-approval;
- (10) 'SI engine' means an engine that works on the spark-ignition ('SI') principle;
- (11) 'track belt' means a continuous flexible rubber like belt, reinforced internally to enable the tractive forces;
- (12) 'track chain' means a continuous metallic chain which engages with the track driver and where each link is with a transversal metallic track shoe, the latter optionally padded with a rubber strip for road surface protection;
- (13) 'in-service engine' means an engine that is operated in agricultural and forestry vehicle over its normal operating patterns, conditions and payloads, and is used to perform the emission monitoring tests as referred to in Article 19 of Regulation (EU) 2016/1628;
- (14) 'maximum net power' means the highest value of the net power on the nominal full-load power curve for the engine type;
- (15) 'engine production date' means the date, expressed as the month and year, on which the engine passes the final check, after it has left the production line, and is ready to be delivered or to be put into stock;
- (16) 'vehicle production date' means the month and year in which an agricultural and forestry vehicle passes the final check after it has left the production line and which are indicated on the statutory marking of that vehicle;
- (17) 'end-user' means any natural or legal person, other than the manufacturer, vehicle manufacturer, importer or distributor, that is responsible for operating the engine installed in agricultural and forestry vehicles;
- (18) 'exhaust gas recirculation' or 'EGR' means a technical device that is part of the emission control system and reduces emissions by routing exhaust gases that have been expelled from the combustion chamber(s) back into the engine to be mixed with incoming air before or during combustion, except for the use of valve timing to increase the amount of residual exhaust gas in the combustion chamber(s) that is mixed with incoming air before or during combustion;
- (19) 'tampering' means inactivation, adjustment or modification of the emission control system, including any software or other logical control elements of such a system, that has the effect, whether intended or not, of worsening the emissions performance of the engine;
- (20) 'pollution control device' means a component, system or separate technical unit which is part of the exhaust after-treatment system;
- (21) 'initial entry into service' means:
  - (a) where the registration of agricultural or forestry vehicles is compulsory, the first registration in a Member State;
  - (b) where the registration of agricultural or forestry vehicles is compulsory only for road circulation or is not compulsory in a Member State, the placing on the market.

## CHAPTER II

## SUBSTANTIVE REQUIREMENTS

## Article 3

**Pollutant emissions**

The manufacturer shall ensure that agricultural and forestry vehicles and the engines installed in them are designed, constructed and assembled so as to comply with the provisions applicable to engine categories NRE or NRS laid down in Regulation (EU) 2016/1628 and in the delegated and implementing acts adopted pursuant thereto, with the adaptations laid down in Part 1 of Annex I to this Regulation; the specific requirements laid down in Part 2 of Annex I to this Regulation shall be also complied with.

Alternatively, agricultural and forestry vehicles and the engines installed in them may be designed, constructed and assembled so as to comply with the provisions applicable to engine category ATS laid down in Regulation (EU) 2016/1628 and in the delegated and implementing acts adopted pursuant thereto, with the adaptations laid down in Part 1 of Annex I to this Regulation, where such vehicles are equipped with a SI engine and fulfil either of the following conditions:

- (a) are equipped with a straddle seat and handlebar;
- (b) are equipped with a steering wheel and bench seats or bucket seats in one or more rows and achieve a maximum design speed greater than or equal to 25 km/h.

The specific requirements laid down in Part 2 of Annex I to this Regulation shall be also complied with.

## Article 4

**External sound levels**

In order to meet the requirements of Article 19(4) of Regulation (EU) No 167/2013, the manufacturer shall ensure that agricultural and forestry vehicles and their systems, components and separate technical units that may affect the vehicle's external sound levels are designed, constructed and assembled, and that their external sound levels are measured so as to comply with the requirements laid down in Annex II.

## Article 5

**Propulsion performance**

For the purposes of the evaluation of propulsion unit performance of agricultural and forestry vehicles, the measurements of net power, engine torque and specific fuel consumption shall be carried out by the manufacturer in accordance with paragraph 5 of UNECE Regulation No 120, 01 series of amendments. During those measurements, the presence of the approval authority or technical service representatives is not necessary.

Instead of performing the measurements laid down in the first paragraph, a vehicle or engine manufacturer may attest the fulfilment of the requirements of the first paragraph by submitting, to the approval authority, an approval issued under the UNECE Regulation No 120, 01 series of amendments.

## CHAPTER III

## TYPE-APPROVAL PROCEDURES

## Article 6

**EU type-approval of an agricultural and forestry vehicle with regard to pollutant emissions**

1. EU type-approval in accordance with Regulation (EU) No 167/2013 shall only be granted to an agricultural and forestry vehicle, where it complies with the requirements with regard to pollutant emissions laid down in Regulation (EU) 2016/1628 and in the delegated and implementing acts adopted pursuant thereto with the adaptations laid down in Part 1 of Annex I to this Regulation; the specific requirements laid down in Part 2 of Annex I to this Regulation shall be also complied with.

2. In addition to the requirements under Regulation (EU) No 167/2013 and Commission Implementing Regulation (EU) 2015/504 <sup>(1)</sup>, an application for EU type-approval of an agricultural and forestry vehicle with an approved engine type or family shall be accompanied by a copy of the EU type-approval certificate or an approval certificate issued in accordance with the provisions referred to in Article 11 of this Regulation for the engine type or engine family and, where applicable, for the systems, components and separate technical units which are installed in the agricultural and forestry vehicle.

<sup>(1)</sup> Commission Implementing Regulation (EU) 2015/504 of 11 March 2015 implementing Regulation (EU) No 167/2013 of the European Parliament and of the Council with regard to the administrative requirements for the approval and market surveillance of agricultural and forestry vehicles (OJ L 85, 28.3.2015, p. 1).

3. In addition to the requirements under Regulation (EU) No 167/2013 and Implementing Regulation (EU) 2015/504, an application for EU type-approval of an agricultural and forestry vehicle without an approved engine type or family shall be accompanied by an information document relating to EU type-approval of a type of (or a type of a vehicle with regard to) an installation of an engine/engine family system in accordance with Appendix 1 to Annex I to Implementing Regulation (EU) 2015/504 and an information document relating to EU type-approval of an engine, engine family as a component or a separate technical unit in accordance with Appendix 3 to Annex I to Implementing Regulation (EU) 2015/504.

For the purposes of such an application, the manufacturer shall submit to the technical service responsible for conducting the approval tests an agricultural and forestry vehicle engine conforming to the characteristics of the engine type or, where applicable, parent engine.

#### *Article 7*

### **EU type-approval of an engine or an engine family with regard to pollutant emissions**

EU type-approval in accordance with Regulation (EU) No 167/2013 shall only be granted to an engine type or an engine family where it complies with the requirements with regard to pollutant emissions laid down in Regulation (EU) 2016/1628 and in the delegated and implementing acts adopted pursuant thereto with the adaptations laid down in Part 1 of Annex I to this Regulation; the specific requirements laid down in Part 2 of Annex I to this Regulation shall be also complied with. The application for EU type-approval shall be accompanied by the information folder in accordance with Article 2 of Implementing Regulation (EU) 2015/504.

#### *Article 8*

### **EU type-approval of an agricultural and forestry vehicle with regard to external sound levels**

1. EU type-approval in accordance with Regulation (EU) No 167/2013 shall only be granted to an agricultural and forestry vehicle where it complies with the requirements with regard to external sound levels laid down in paragraphs 2 to 5 and in Annex II to this Regulation.

2. The technical services shall measure the external sound level of agricultural and forestry vehicles of category T equipped with pneumatic tyres and of category C equipped with track belts in motion, for type-approval purposes, in accordance with the test conditions and methods laid down in point 1.3.1 of Annex II.

3. The technical services shall measure the external sound level of stationary agricultural and forestry vehicles of categories T and C equipped with track belts, for type-approval purposes, in accordance with the test conditions and methods laid down in point 1.3.2 of Annex II. They shall record the results in accordance with the provisions laid down in point 1.3.2.4 of Annex II.

4. The technical services shall measure the external sound level of agricultural and forestry vehicles of category C equipped with track chains, for type-approval purposes, in accordance with the stationary test conditions and methods laid down in point 1.3.2 of Annex II.

5. The technical services shall measure the external sound level of agricultural and forestry vehicles of category C equipped with track chains in motion, for the type-approval purposes, in accordance with the test conditions and methods laid down in point 1.3.3 of Annex II. They shall record the results.

6. The application for type-approval shall be accompanied by the information folder in accordance with Article 2 of Implementing Regulation (EU) 2015/504.

#### *Article 9*

### **Extension of EU type-approvals**

The EU type-approval regarding pollutant emissions and external sound level requirements may be extended by the type-approval authorities to different vehicle variants, versions and engine types and families, provided that those vehicle variants, versions, engine types and families satisfy the requirements on pollutant emissions and external sound levels set out in Article 19(3) and (4) of Regulation (EU) No 167/2013.



*Article 10***Subsequent changes affecting the environmental and propulsion unit performance**

The manufacturer shall notify to the approval authority without delay any changes to systems, components and separate technical units that may affect the environmental and propulsion unit performance of the agricultural and forestry vehicles of the approved type placed on the market in accordance with Article 19 of Regulation (EU) No 167/2013.

The notification referred to in the first paragraph shall include the following:

- (a) evidence that the changes referred to in the first paragraph do not deteriorate the environmental performance of a vehicle compared to the environmental performance demonstrated at type-approval;
- (b) description of the engine type or the engine family, including the exhaust after-treatment system, in accordance with Article 11 of and Annex IX to Commission Implementing Regulation (EU) 2017/656 <sup>(1)</sup>;
- (c) information in accordance with Appendix 2 to Annex I to Implementing Regulation (EU) 2015/504.

## CHAPTER IV

**EQUIVALENCE***Article 11***Equivalence of alternative type-approvals**

1. EU type-approvals and the corresponding statutory markings of engine types or engine families granted on the basis of Regulation (EU) 2016/1628 shall be recognised as equivalent to type-approvals and approval marks granted to engines in accordance with this Regulation.
2. A statement of conformity granted on the basis of Article 31 of Regulation (EU) 2016/1628 shall be accepted by national authorities for the purposes of EU type-approval, under this Regulation, of agricultural and forestry vehicles equipped with engines bearing that statement of conformity.
3. Type-approvals granted to engines and the corresponding statutory markings that are in conformity with UNECE regulations referred to in Article 42(2) of Regulation (EU) 2016/1628 as well as EU type-approvals granted to engines on the basis of the Union acts referred to in Article 42(3) of that Regulation shall be recognised as equivalent to the EU type-approvals granted to engines in accordance with this Regulation and to the corresponding statutory markings required in accordance with Implementing Regulation (EU) 2015/504 provided that the requirements of Annex XIII to Commission Delegated Regulation (EU) 2017/654 <sup>(2)</sup> are met.

## CHAPTER V

**ACCESS TO VEHICLE REPAIR AND MAINTENANCE INFORMATION***Article 12***Obligation on engine manufacturers**

For the purposes of fulfilling the obligations laid down in Articles 53 to 56 of Regulation (EU) No 167/2013 and Article 8 of Commission Delegated Regulation (EU) No 1322/2014 <sup>(3)</sup>, where the manufacturer of an agricultural or forestry vehicle is not the engine manufacturer, the engine manufacturer shall make available to the vehicle manufacturer the information necessary to fulfil those obligations.

<sup>(1)</sup> Commission Implementing Regulation (EU) 2017/656 of 19 December 2016 laying down the administrative requirements relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council (OJ L 102, 13.4.2017, p. 364).

<sup>(2)</sup> Commission Delegated Regulation (EU) 2017/654 of 19 December 2016 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to technical and general requirements relating to emission limits and type-approval for internal combustion engines for non-road mobile machinery (OJ L 102, 13.4.2017, p. 1).

<sup>(3)</sup> Commission Delegated Regulation (EU) No 1322/2014 of 19 September 2014 supplementing and amending Regulation (EU) No 167/2013 of the European Parliament and of the Council with regard to vehicle construction and general requirements for the approval of agricultural and forestry vehicles (OJ L 364, 18.12.2014, p. 1).

## CHAPTER VI

## FINAL PROVISIONS

## Article 13

## Transitional provisions

1. From 21 July 2018:

- (a) the approval authorities shall not refuse to grant an EU type-approval or a national type-approval to a new engine type or new engine family where that engine type or engine family complies with Articles 3, 5 and 7;
- (b) the approval authorities shall not refuse to grant an EU type-approval or a national type-approval to a new vehicle type where that vehicle type complies with Articles 3 to 6 and Article 8;
- (c) the Member States shall permit the placing on the market, sale and entry into service of engines complying with Articles 3, 5 and 7 or with Article 11 and the placing on the market, sale, registration and entry into service of agricultural and forestry vehicles complying with Articles 3 to 6 and Article 8.

2. Until the mandatory date of application of Regulation (EU) 2016/1628 in respect of EU type-approval of the engine category concerned, as laid down in Annex III to that Regulation, approval authorities shall continue to grant EU type-approvals and exemptions to agricultural and forestry vehicle types or engine types and engine families in accordance with Delegated Regulation (EU) 2015/96, in its version applicable on 20 July 2018.

3. As of the mandatory dates of application of Regulation (EU) 2016/1628 in respect of the placing on the market of the engine category concerned, as laid down in Annex III to that Regulation, the Member States shall no longer permit the placing on the market, sale, registration or entry into service of vehicles or the placing on the market, sale or entry into service of engines type-approved on the basis of Delegated Regulation (EU) 2015/96.

Until those dates, Member States may permit the placing on the market, sale, registration or entry into service of vehicles or the placing on the market, sale or entry into service of engines in accordance with the requirements laid down in Delegated Regulation (EU) 2015/96. The flexibility scheme provided for in Article 14 of that Delegated Regulation shall apply only to agricultural and forestry vehicles fitted with engines approved in accordance with the requirements of the emission limits stage immediately preceding the applicable one.

4. Engines that were not subject to pollutant emission related type-approval in accordance with Delegated Regulation (EU) 2015/96 on 20 July 2018 may continue to be placed on the market, sold or to enter into service until the mandatory date of application of Regulation (EU) 2016/1628 in respect of the placing on the market of the engine category concerned, as laid down in Annex III to that Regulation, on the basis of the national rules in force.

Agricultural and forestry vehicles type-approved in accordance with Regulation (EU) No 167/2013 and equipped with those engines may continue to be placed on the market, sold, registered or to enter into service until the same dates.

5. Transition engines may continue to be placed on the market, sold or to enter into service during the 24 months following the mandatory date of application of Regulation (EU) 2016/1628 in respect of the placing on the market of the engine category concerned, as laid down in Annex III to that Regulation.

Agricultural and forestry vehicles equipped with transition engines may be placed on the market, sold, registered or enter into service during the 24 months following the mandatory date of application of Regulation (EU) 2016/1628 in respect of the placing on the market of the engine category concerned, as laid down in Annex III to that Regulation, provided that those vehicles fulfil both of the following conditions:

- (a) they have a production date not later than 18 months following the mandatory date of application of Regulation (EU) 2016/1628 in respect of the placing on the market of the engine category concerned, as laid down in Annex III to that Regulation;
- (b) they are marked in accordance with the requirements in point 2.1 of Part 2 in Annex I to this Regulation.

For engines of category NRE, Member States shall authorise the extension of the 24-month period and of the 18-month period referred to in the first and second subparagraphs by additional 12 months for vehicle manufacturers with a total yearly production of less than 100 units of agricultural and forestry vehicles equipped with an engine. For the purposes of the calculation of that total yearly production, all vehicle manufacturers under the control of the same natural or legal person shall be considered to be a single vehicle manufacturer.

6. For the purposes of the placing on the market of replacement engines for agricultural and forestry vehicles in accordance with paragraphs 10 and 11 of Article 58 of Regulation (EU) 2016/1628, manufacturers shall ensure that the replacement engines comply with the marking requirements referred to in point 6 of Annex XX to Commission Delegated Regulation (EU) 2015/208 <sup>(1)</sup>, Article 32(2)(e) of Regulation (EU) 2016/1628 and points 1 and 5.4 of Annex IV to Implementing Regulation (EU) 2015/504.

#### Article 14

### Exemptions

1. With the consent of the vehicle manufacturer, an engine manufacturer may deliver to that vehicle manufacturer an engine separately from its exhaust after-treatment system in accordance with the provisions laid down in Annex X to Delegated Regulation (EU) 2017/654.

2. Member States may authorise the temporary placing on the market, for the purposes of field testing in accordance with the provisions of Annex XI to Delegated Regulation (EU) 2017/654, of engines that have not been EU type-approved in accordance with Articles 3, 5 and 7 of this Regulation.

#### Article 15

### Repeal

Delegated Regulation (EU) 2015/96 is repealed.

#### Article 16

### Entry into force and application

This Regulation shall enter into force on the third day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 12 February 2018.

*For the Commission*

*The President*

Jean-Claude JUNCKER

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<sup>(1)</sup> Commission Delegated Regulation (EU) 2015/208 of 8 December 2014 supplementing Regulation (EU) No 167/2013 of the European Parliament and of the Council with regard to vehicle functional safety requirements for the approval of agricultural and forestry vehicles (OJ L 42, 17.2.2015, p. 1).

## ANNEX I

**Requirements for EU type-approval regarding pollutant emissions**

## PART 1

***Adaptation to the requirements laid down in Regulation (EU) 2016/1628***

1. For the purposes of granting an EU type-approval regarding pollutant emissions, in accordance with the provisions of Regulation (EU) No 167/2013, of an agricultural and forestry vehicle or an engine type or an engine family as a component, the following adaptations to the provisions of Regulation (EU) 2016/1628 applicable pursuant to Article 19(3) of Regulation (EU) No 167/2013 shall be taken into account:
  - 1.1. The references to 'non-road mobile machinery' in Regulation (EU) 2016/1628 shall be read as references to 'agricultural and forestry vehicle'.
  - 1.2. The references to the 'original equipment manufacturer' or 'OEM' in Regulation (EU) 2016/1628 shall be read as references to the 'vehicle manufacturer'.
  - 1.3. The dates of application for placing on the market of engines referred to in Annex III to Regulation (EU) 2016/1628 shall be read as dates of application for initial entry into service of engines and vehicles.
  - 1.4. The dates for EU type-approval of engines, or, where applicable, the dates for type-approval of an engine type or engine family laid down in Annex III to Regulation (EU) 2016/1628 shall be read as dates for EU type-approval of a vehicle type or, where applicable, an engine type or an engine family.
2. Engine manufacturers shall use the parameters laid down in Annex IX to Implementing Regulation (EU) 2017/656 when defining engine types and engine families and their operation modes.

## PART 2

***Specific requirements***

1. In addition to the provisions of Article 28 of Regulation (EU) No 167/2013 and Article 7 of Delegated Regulation (EU) No 1322/2014, the conformity of production of engines shall be checked in accordance with the provisions of Article 26 of Regulation (EU) 2016/1628 and those of Article 3 of Delegated Regulation (EU) 2017/654.
2. Marking
  - 2.1. The engine shall bear a statutory marking in accordance with Annex IV to Implementing Regulation (EU) 2015/504.
3. Monitoring of emissions of in-service engines
  - 3.1. Engine manufacturers shall comply with the requirements on monitoring of emissions of in-service engines laid down in Article 19 of Regulation (EU) 2016/1628 and Commission Delegated Regulation (EU) 2017/655 <sup>(1)</sup>.
4. Engine installation in the vehicle
  - 4.1. The engine installed in an agricultural and forestry vehicle shall present the same pollutant emissions performance as it did at type-approval.
  - 4.2. The engine installation in an agricultural and forestry vehicle shall comply with the requirements included in the information and instructions that the engine manufacturer shall provide to the vehicle manufacturer, as laid down in point 4.3.
  - 4.3. The engine manufacturer shall provide to the vehicle manufacturer all the information and instructions to ensure that the engine conforms to the approved engine type when installed in the vehicle. Instructions for this purpose shall be clearly identified to the vehicle manufacturer in conformity with the requirements laid down in Article 43(2) of Regulation (EU) 2016/1628 and Article 17 of Delegated Regulation (EU) 2017/654.

<sup>(1)</sup> Commission Delegated Regulation (EU) 2017/655 of 19 December 2016 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to monitoring of gaseous pollutant emissions from in-service internal combustion engines installed in non-road mobile machinery (OJ L 102, 13.4.2017, p. 334).

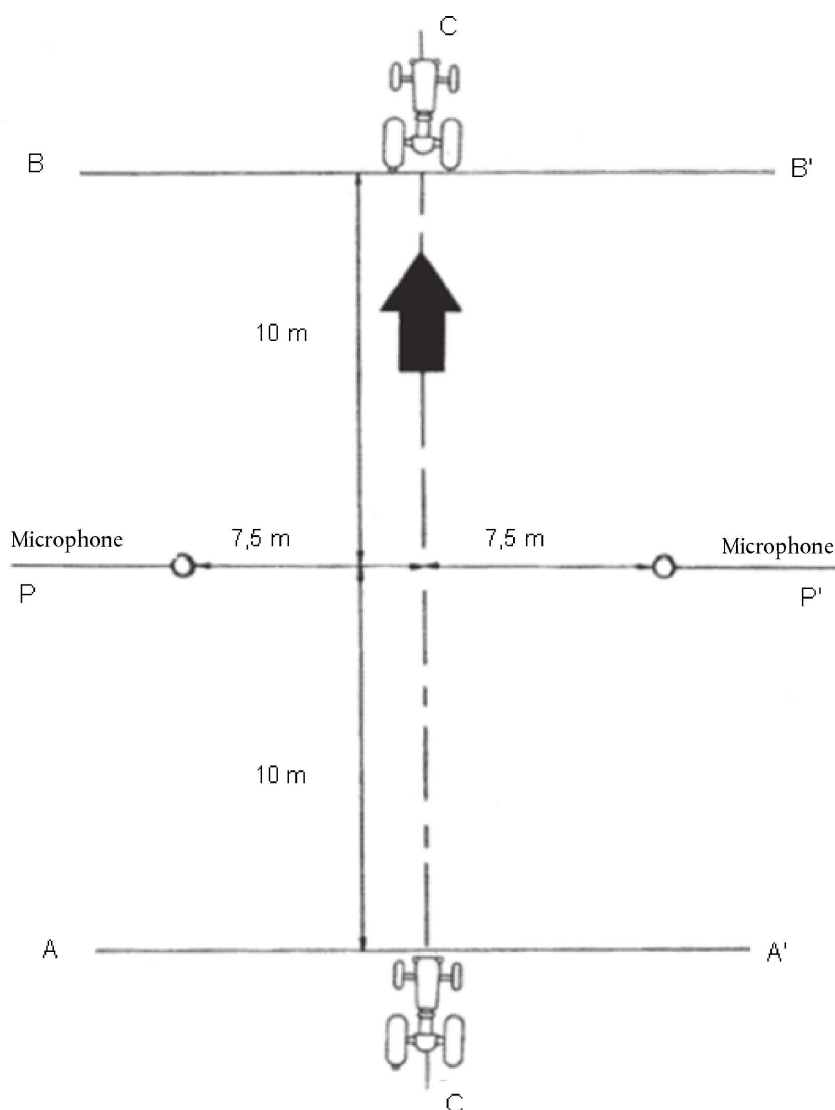
5. The engine manufacturer shall make available to the vehicle manufacturer all the relevant information and necessary instructions intended for the end-user, as laid down in Article 43(3) and (4) of Regulation (EU) 2016/1628 and Article 18 of Delegated Regulation (EU) 2017/654.
  6. Prevention of tampering
  - 6.1. Engine manufacturers shall apply the provisions concerning technical details laid down in Annex X to Implementing Regulation (EU) 2017/656 for the prevention of tampering.
-

## ANNEX II

**Requirements for external sound emissions**

1. Permissible external sound levels
  - 1.1. The instrumentation system, including the microphones, cables and windscreen shall meet the requirements for a Class 1 instrument laid down in IEC 61672-1:2013. The filters shall meet the requirements for a Class 1 instrument given in IEC 61260:1995.
  - 1.2. Conditions of measurement
    - 1.2.1. Measurements shall be made on agricultural and forestry vehicles with their unladen mass in running order in a sufficiently silent and open area (ambient noise and wind noise at least 10 dB(A) below the external sound level being measured).
    - 1.2.2. This area may take the form, for instance, of an open space of 50 metres radius having a central part of at least 20 metres radius which is practically level; it may be surfaced with concrete, asphalt, or similar material and may not be covered with powdery snow, tall grass, loose soil or ashes.
    - 1.2.3. The surface of the test track shall be such as not to cause excessive tyre noise. This condition applies only to measurement of the external sound made by agricultural and forestry vehicles in motion.
    - 1.2.4. Measurement shall be carried out in fine weather with little wind. No person other than the observer taking the readings from the apparatus may remain near the agricultural and forestry vehicle or the microphone, as the presence of spectators near either the agricultural and forestry vehicle or the microphone may considerably affect the readings from the apparatus. Marked fluctuations of the pointer which appear to be unrelated to the characteristics of the general sound level shall be ignored in taking readings.
  - 1.3. Method of measurement
    - 1.3.1. Measurement of external sound level of agricultural and forestry vehicles in motion
      - 1.3.1.1. At least two measurements shall be made on each side of the agricultural and forestry vehicle. Preliminary measurements may be made for adjustment purposes but shall be disregarded.
      - 1.3.1.2. The microphone shall be situated 1,2 metres above ground level at a distance of 7,5 metres from the path of the agricultural and forestry vehicle's centre line, CC, measured along the perpendicular PP' to that line (figure 1).
      - 1.3.1.3. Two lines AA' and BB', parallel to line PP' and situated respectively 10 metres forward and 10 metres rearward of the line, shall be marked out on the test track. Agricultural and forestry vehicles shall approach line AA' at a steady speed, as specified below. The throttle shall then be fully opened as rapidly as practicable and held in the fully opened position until the rear of the agricultural and forestry vehicles crosses line BB'; the throttle shall then be closed again as rapidly as possible. Where the agricultural or forestry vehicle is coupled to a trailer, this shall not be taken into account in determining when line BB' is crossed.
      - 1.3.1.4. The maximum sound level recorded shall constitute the result of the measurement.

Figure 1



1.3.1.5. The steady speed before approaching line AA' shall be three quarters of the maximum design speed ( $v_{\max}$ ) as declared by the manufacturer which can be attained in the highest gear used for road movement.

#### 1.3.1.6. Interpretation of results

1.3.1.6.1. To take account of inaccuracies in the measuring instruments, the result obtained from each measurement shall be determined by deducting 1 dB(A) from the meter reading.

1.3.1.6.2. Measurements shall be considered valid where the difference between two consecutive measurements on the same side of the agricultural and forestry vehicle does not exceed 2 dB(A).

1.3.1.6.3. The highest sound level measured shall constitute the test result. Should that result exceed the maximum permissible sound level for the category of agricultural and forestry vehicle tested by at least 1 dB(A), two further measurements shall be made. Three of the four measurements thus obtained must fall within the prescribed limits.

#### 1.3.2. Measurement of external sound with agricultural and forestry vehicle stationary

##### 1.3.2.1. Position of sound-level meter

Measurements shall be made at point X (shown in figure 2) at a distance of 7 metres from the nearest surface of the agricultural and forestry vehicle. The microphone shall be situated 1,2 metres above ground level.

1.3.2.2. Number of measurements: at least two measurements shall be made.

### 1.3.2.3. Agricultural and forestry vehicle test conditions

1.3.2.3.1. The engine of an agricultural and forestry vehicle without a speed governor shall be run at three quarters of the rpm speed at which, in accordance with the agricultural and forestry vehicle manufacturer, it develops its maximum net power. The rpm speed of the engine shall be measured by means of an independent instrument, e.g. a roller bed and a tachometer. Where the engine is fitted with a governor preventing the engine from exceeding the speed at which it develops its maximum net power, it shall be run at the maximum speed permitted by the governor.

1.3.2.3.2. Before taking any measurements, the engine shall be brought to its normal running temperature.

### 1.3.2.4. Interpretation of results

1.3.2.4.1. All external sound-level readings recorded shall be given in the report. The engine speed shall be recorded in accordance with the provisions of Article 8. The state of loading of the agricultural and forestry vehicle shall also be recorded.

1.3.2.4.2. The measurements shall be considered valid where the difference between two consecutive measurements on the same side of the agricultural and forestry vehicle does not exceed 2 dB(A).

1.3.2.4.3. The maximum figure recorded shall constitute the result of the measurement.

### 1.3.3. External sound testing provisions for C-category vehicles with track chains in motion

For agricultural and forestry vehicles of C category equipped with track chains, the noise in motion shall be measured with vehicles with their unladen mass in running order travelling at a constant speed of 5 km/h ( $\pm 0,5$  km/h), with the engine at rated speed over a layer of humid sand as specified by paragraph 5.3.2 of ISO 6395:2008. The microphone shall be situated in accordance with the provisions of point 1.3.1. The measured noise value shall be recorded in the test report.

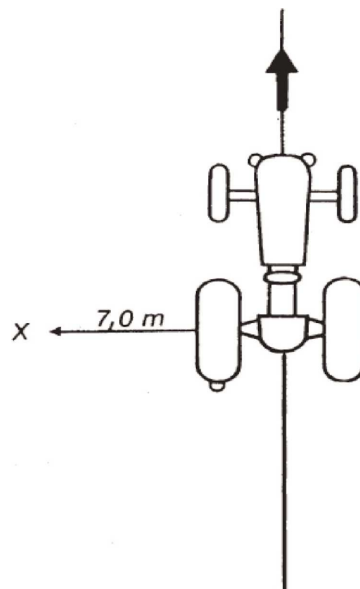
## 2. Exhaust system (Silencer)

2.1. Where the agricultural and forestry vehicle is fitted with a device designed to reduce the exhaust noise (silencer), the requirements of this section shall apply. Where the inlet of the engine is fitted with an air filter which is necessary in order to ensure compliance with the permissible sound level, the filter shall be considered to be part of the silencer, and the requirements of this point 2 shall also apply to that filter.

The exhaust tailpipe must be positioned in such a way that the exhaust gases cannot penetrate inside the cab.

Figure 2

### Measuring positions for stationary agricultural and forestry vehicles





- 
- 2.2. A drawing of the exhaust system must be annexed to the agricultural and forestry vehicle type-approval certificate.
  - 2.3. The silencer must be marked with a reference to its make and type which is clearly legible and indelible.
  - 2.4. The use of fibrous absorbent material is permitted in the construction of silencers only where the following conditions are fulfilled:
    - 2.4.1. the fibrous absorbent material may not be placed in those parts of the silencer through which gases pass;
    - 2.4.2. suitable devices must ensure that the fibrous absorbent material is kept in place for the whole time that the silencer is being used;
    - 2.4.3. the fibrous absorbent material must be resistant to a temperature at least 20 % higher than the operating temperature (degrees C) which may occur in the region of the silencer where those fibrous absorbent materials are situated.
-

**COMMISSION IMPLEMENTING REGULATION (EU) 2018/986****of 3 April 2018****amending Implementing Regulation (EU) 2015/504 as regards the adaptation of the administrative provisions for the approval and market surveillance of agricultural and forestry vehicles to Stage V emission limits****(Text with EEA relevance)**

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) No 167/2013 of the European Parliament and of the Council of 5 February 2013 on the approval and market surveillance of agricultural or forestry vehicles <sup>(1)</sup>, and in particular Article 22(4), paragraphs 2, 3 and 6 of Article 25, Article 27(1), Article 33(2) and Article 34(3) thereof,

Whereas:

- (1) Commission Implementing Regulation (EU) 2015/504 <sup>(2)</sup> lays down, inter alia, the templates for certain documents to be drawn up in the context of the approval and market surveillance of agricultural and forestry vehicles.
- (2) Regulation (EU) 2016/1628 of the European Parliament and of the Council <sup>(3)</sup> repeals Directive 97/68/EC of the European Parliament and of the Council <sup>(4)</sup> and introduces new gaseous and particulate pollutant emission limits (Stage V) for internal combustion engines for non-road mobile machinery.
- (3) In accordance with Article 19 of Regulation (EU) No 167/2013, the Stage V emission limits set out in Annex II to Regulation (EU) 2016/1628 will also apply to agricultural and forestry vehicles. The application of those limits is deferred in accordance with the timetable set out in Annex III to Regulation (EU) 2016/1628.
- (4) It is, therefore, necessary to amend the templates set out in Implementing Regulation (EU) 2015/504 in order to adapt those templates and align them with those set out in Commission Implementing Regulation (EU) 2017/656 <sup>(5)</sup>.
- (5) For the purposes of refining the administrative requirements, additional minor amendments to Implementing Regulation (EU) 2015/504 should be made to allow for the approval of electrical/electronic sub-assemblies as a component and to require more comprehensive information for the purposes of the type-approval of the transmission and the braking devices for towed vehicles.
- (6) The measures provided for in this Regulation are in accordance with the opinion of the committee referred to in Article 69(1) of Regulation (EU) No 167/2013,

<sup>(1)</sup> OJ L 60, 2.3.2013, p. 1.

<sup>(2)</sup> Commission Implementing Regulation (EU) 2015/504 of 11 March 2015 implementing Regulation (EU) No 167/2013 of the European Parliament and of the Council with regard to the administrative requirements for the approval and market surveillance of agricultural and forestry vehicles (OJ L 85, 28.3.2015, p. 1).

<sup>(3)</sup> Regulation (EU) 2016/1628 of the European Parliament and of the Council of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations (EU) No 1024/2012 and (EU) No 167/2013 and amending and repealing Directive 97/68/EC (OJ L 252, 16.9.2016, p. 53).

<sup>(4)</sup> Directive 97/68/EC of the European Parliament and of the Council of 16 December 1997 on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery (OJ L 59, 27.2.1998, p. 1).

<sup>(5)</sup> Commission Implementing Regulation (EU) 2017/656 of 19 December 2016 laying down the administrative requirements relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council (OJ L 102, 13.4.2017, p. 364).

HAS ADOPTED THIS REGULATION:

#### Article 1

Implementing Regulation (EU) 2015/504 is amended as follows:

(1) The following Article 12a is inserted:

*'Article 12a*

#### **Transitional provisions in respect of engines**

With respect to engines type-approved before 1 January 2018, or before 1 January 2019 in the case of engines of sub-categories NRE-v-5 and NRE-c-5, the following provisions of this Regulation, in its version applicable on 6 August 2018, shall continue to apply:

- Annex I, Part A;
- Annex I, Part B, point 4.2.;
- Annex I, Part B, point 5, entries 2.2.2., 2.5. to 2.5.4.2., 5.2. to 5.5. and 6. to 8.22.4.2.;
- Annex I, Appendices 1 to 9;
- Annex I, Appendix 10, entry 2.2.2.;
- Annex I, Appendices 11 to 14;
- Annex I, Appendix 15, entry 2.2.2.;
- Annex I, Appendices 16 to 23;
- Annex I, explanatory notes relating to the information document (6), (7), (9), (12), (24), (26), (29), (39), (40), (49) and (56);
- Annex II, point 2.1.1.;
- Annex II, explanatory note relating to Annex II (4);
- Annex III, Appendix 1, Model 1 of Section 2, the entries under the heading 'General powertrain characteristics';
- Annex III, Appendix 1, Model 1 of Section 2, the entries under the heading 'Engine';
- Annex III, Appendix 1, Model 1 of Section 2, the text under the heading 'Results of exhaust emission tests (inclusive of Deterioration Factor)', the second and fourth indents of the first paragraph;
- Annex III, Appendix 1, Model 1 of Section 2, the text under the heading 'Results of exhaust emission tests (inclusive of Deterioration Factor)', the table;
- Annex III, Appendix 1, explanatory notes relating to Appendix 1, with the exception of explanatory note (32);
- Annex IV;
- Annex V, Appendix 2, explanatory notes relating to Appendix 2;
- Annex V, Appendix 4;
- Annex V, Appendix 5;
- Annex VII, Appendix 1, with the exception of point 1. and the first indent of the text under point 2.;
- Annex VIII, with the exception of point 3.2., table 8-1, second row.;

(2) Annex I is amended in accordance with Annex I to this Regulation;

(3) Annex II is amended in accordance with Annex II to this Regulation;

(4) Appendix 1 to Annex III is amended in accordance with Annex III to this Regulation;

(5) Annex IV is amended in accordance with Annex IV to this Regulation;

- (6) Annex V is amended in accordance with Annex V to this Regulation;
- (7) Annex VI is amended in accordance with Annex VI to this Regulation;
- (8) Appendix 1 to Annex VII is amended in accordance with Annex VII to this Regulation;
- (9) Annex VIII is amended in accordance with Annex VIII to this Regulation.

*Article 2*

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 3 April 2018.

*For the Commission*  
*The President*  
Jean-Claude JUNCKER

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## ANNEX I

Annex I to Implementing Regulation (EU) 2015/504 is amended as follows:

- (1) in the list of appendices, the row relating to Appendix 10 is replaced by the following:

'10	Model information document relating to EU type-approval of electro-magnetic compatibility of electrical/electronic sub-assemblies as a component/STU'	
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- (2) Part A is amended as follows:

- (a) the following point 1.4 is inserted:

'1.4. For engines, the information folder and the information document required in Annex I to Commission Implementing Regulation (EU) 2017/656 (\*) shall be provided.

(\*) Commission Implementing Regulation (EU) 2017/656 of 19 December 2016 laying down the administrative requirements relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council (OJ L 102, 13.4.2017, p. 364).';

- (b) point 2 is amended as follows:

- (i) in the template of the information folder sheet, entry 2.5.2 is deleted;
- (ii) in the explanatory notes relating to the information folder sheet, explanatory note (°) is replaced by the following
- '(°) For engines, indicate the engine type designation or, in case of engine types within an engine family, the Family Type (FT) in accordance with point 4 of Part B of Annex I to Commission Implementing Regulation (EU) 2017/656.';

- (3) Part B is amended as follows:

- (a) in point 3.1, Table 1-1 is amended as follows:

- (i) List I is replaced by the following:

<b>LIST I — Environmental and propulsion unit performance requirements</b>			
Appendix	System or component/separate technical unit (STU)	Commission Delegated Regulation (EU) 2018/985 (*) Annex number	As amended by and/or at the stage of implementation
1	System: installation of an engine/engine family	I	
2	System: external sound level	II	
3	Component/STU: engine/engine family	I	

(\*) Commission Delegated Regulation (EU) 2018/985 of 12 February 2018 supplementing Regulation (EU) No 167/2013 of the European Parliament and of the Council as regards environmental and propulsion unit performance requirements for agricultural and forestry vehicles and their engines and repealing Commission Delegated Regulation (EU) 2015/96 (OJ L 182; 18.7.2018, p. 1);

- (ii) in List II, row 10 is replaced by the following

'10	Component/STU: electro-magnetic compatibility of electrical / electronic sub-assemblies	XV'	
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(b) point 4.2 is replaced by the following:

‘4.2. For those subjects referred to in Annex I to Regulation (EU) No 167/2013 whose approvals have been granted in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council (\*), Regulation (EC) No 595/2009 of the European Parliament and of the Council (\*\*) or the UNECE regulations referred to in Article 49 of Regulation (EU) No 167/2013 (UNECE approvals), or are based on complete test reports issued on the basis of the OECD standard Codes as an alternative to the test reports drawn up under that Regulation and the delegated acts adopted pursuant to it, the manufacturer shall supply the information required in point 5 only if it is not already provided in the correspondent approval certificate and/or test report. However, the information referred to in the certificate of conformity (Annex III to this Regulation) shall be supplied in any case.

(\*) Regulation (EU) 2016/1628 of the European Parliament and of the Council of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations (EU) No 1024/2012 and (EU) No 167/2013, and amending and repealing Directive 97/68/EC (OJ L 252, 16.9.2016, p. 53)

(\*\*) Regulation (EC) No 595/2009 of the European Parliament and of the Council of 18 June 2009 on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI) and on access to vehicle repair and maintenance information and amending Regulation (EC) No 715/2007 and Directive 2007/46/EC and repealing Directives 80/1269/EEC, 2005/55/EC and 2005/78/EC (OJ L 188, 18.7.2009, p. 1).;

(c) point 5 is amended as follows:

(i) entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(ii) entries 2.5 to 2.5.4.2 are deleted;

(iii) entries 5.2 to 5.5 are deleted;

(iv) entries 6 to 8.22.4.2 are replaced by the following:

‘6. ESSENTIAL CHARACTERISTICS OF THE ENGINE

6.1.7. Category and sub-category of the engine <sup>(7)</sup>: ...

6.2.1. Combustion Cycle: four stroke cycle/two stroke cycle/rotary/other (specify) <sup>(4)</sup>: ...

6.2.2. Ignition Type: Compression ignition/spark ignition <sup>(4)</sup>

6.2.3.1. Cylinders' number: ... and configuration <sup>(26)</sup>:

6.2.8. Fuel

6.2.8.1. Fuel Type <sup>(9)</sup>: ...

6.2.8.3. List of additional fuels, fuel mixtures or emulsions compatible with use by the engine declared by the manufacturer in accordance with point 1.4 of Annex I to Delegated Regulation (EU) 2017/654 (provide reference to recognised standard or specification): .....

6.3.2.1. Declared rated speed: ... rpm

6.3.2.1.2. Declared rated net power: ... kW

6.3.2.2. Maximum power speed: ... rpm

6.3.2.2.2. Maximum net power: ... kW

6.3.6.4. Engine total swept volume: ... cm<sup>3</sup>;

(v) entry 10.4.2 is replaced by the following:

‘10.4.2. Description and/or drawing of the elements of the exhaust system that are not part of the engine: .....’;

(vi) entries 11.1 to 11.2.3 are replaced by the following:

‘11.1. Brief description and schematic drawing of the vehicle drive-train and its control system (transmission ratio change system, clutch control or any other element of drive-train): ...’

## 11.2. Transmission

11.2.1. Brief description and schematic drawing of transmission ratio change system(s) and its control: ...

11.2.2. Diagram and or drawing of the power transmission: ...

11.2.3. Type of power transmission: Gear (including planetary gear sets) / belt / hydrostatic / electric / other <sup>(4)</sup> (if other, specify: ...);

(vii) entry 11.2.8 is replaced by the following:

‘11.2.8. Type of transmission ratio change system: Mechanical (gear change) / Double clutch (gear change) / Semi-automatic (gear change) / Automatic (gear change) / Continuously Variable Transmission/ hydrostatic / not applicable / other <sup>(4)</sup> (if other, specify: ...);’

(viii) entry 43.2 is replaced by the following:

‘43.2. Specifications of the vehicle with respect to the control circuits of the pneumatic, hydraulic and/or electric control lines of the braking system(s) and a list of the supported messages and parameters: .....’;

(ix) entries 43.5 and 43.5.1 are replaced by the following:

‘43.5. Braking transmission (on towing vehicle)

43.5.1. Braking transmission of the service braking system on towing vehicle: mechanical/pneumatic/hydraulic/hydrostatic/without power assistance/power-assisted/fully powered transmission <sup>(4)</sup>;

(x) entry 43.5.3 is replaced by the following:

‘43.5.3. Locking of left and right braking controls: yes/no <sup>(4)</sup>;

(xi) entry 43.6 is replaced by the following:

‘43.6. Towed vehicle braking control devices (on towing vehicle);’

(xii) entries 43.6.2 to 43.6.5 are deleted.

(xiii) the following entries 43.6.2 to 43.7.3.2.1 are inserted:

‘43.6.2. Description of the connectors, couplings and safety devices (including drawings, sketches and the identification of any electronic parts): .....’

43.6.2.1. Pneumatic connection type: Two lines/None <sup>(4)</sup>

43.6.2.1.1. Pneumatic supply pressure (two lines): ... kPa

43.6.2.1.2. Electrical control line: yes/no <sup>(4)</sup>

43.6.2.2. Hydraulic connection type: Single line / Two lines / None <sup>(4)</sup>

43.6.2.2.1. Hydraulic supply pressure: Single line: ... kPa Two lines: ... kPa

43.6.2.2.2. Presence of ISO 7638:2003 connector <sup>(15)</sup>: yes/no <sup>(4)</sup>

43.7. Towed vehicle braking devices (on towed vehicle)

43.7.1. Towed vehicle braking control system technology: Hydraulic / Pneumatic / Electric/ Inertia / None <sup>(4)</sup>

43.7.2. Towed vehicle-brake actuating device: Drum / Disc / Other <sup>(4)</sup>

43.7.2.1. Description and characteristics: .....’

43.7.3. Description of the connectors, couplings and safety devices (including drawings, sketches and the identification of any electronic parts): .....’

43.7.3.1. Pneumatic connection type: Two lines/None <sup>(4)</sup>

43.7.3.1.1. Electrical control line: yes/no <sup>(4)</sup>

43.7.3.2. Hydraulic connection type: Two lines / None <sup>(4)</sup>

43.7.3.2.1. Presence of ISO 7638:2003 connector <sup>(15)</sup>: yes/no <sup>(4)</sup>;

(4) Appendix 1 is amended as follows:

(a) entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(b) entries 2.5 to 2.5.4.2 are deleted;

(c) entries 5.2 to 5.5 are deleted;

(d) entries 6 to 8.22.4.2 are replaced by the following:

‘6. ESSENTIAL CHARACTERISTICS OF THE ENGINE

6.1.7. Category and sub-category of the engine <sup>(7)</sup>:

6.2.1. Combustion Cycle: four stroke cycle/two stroke cycle/rotary/other (specify) <sup>(4)</sup>: ...

6.2.2. Ignition Type: Compression ignition/spark ignition <sup>(4)</sup>

6.2.3.1. Cylinders’ number: ... and configuration <sup>(26)</sup>:

6.2.8. Fuel

6.2.8.1. Fuel Type <sup>(9)</sup>:

6.2.8.3. List of additional fuels, fuel mixtures or emulsions compatible with use by the engine declared by the manufacturer in accordance with point 1.4 of Annex I to Delegated Regulation (EU) 2017/654 (provide reference to recognised standard or specification): .....

6.3.2.1. Declared rated speed: ... rpm

6.3.2.1.2. Declared rated net power: ... kW

6.3.2.2. Maximum power speed: ... rpm

6.3.2.2.2. Maximum net power: ... kW

6.3.6.4. Engine total swept volume: ... cm<sup>3</sup>;

(5) Appendix 2 is amended as follows:

(a) entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(b) entries 2.5 to 2.5.4.2 are deleted;

(c) entries 5.2 to 5.5 are deleted;

(d) the following entries 6 to 6.3.6.4 are inserted before entry 10:

‘6. ESSENTIAL CHARACTERISTICS OF THE ENGINE

6.1.7. Category and sub-category of the engine <sup>(7)</sup>:

6.2.1. Combustion Cycle: four stroke cycle/two stroke cycle/rotary/other (specify) <sup>(4)</sup>: ...

6.2.2. Ignition Type: Compression ignition/spark ignition <sup>(4)</sup>

6.2.3.1. Cylinders’ number: ... and configuration <sup>(26)</sup>:

6.3.2.1. Declared rated speed: ... rpm

6.3.2.1.2. Declared rated net power: ... kW



6.3.2.2. Maximum power speed: ... rpm

6.3.2.2.2. Maximum net power: ... kW

6.3.6.4. Engine total swept volume: ... cm<sup>3</sup>;

(e) the following entries 11 to 11.4 are added:

'11. DRIVE-TRAIN AND CONTROL <sup>(13)</sup>

11.1. Brief description and schematic drawing of the vehicle drive-train and its control system (transmission ratio change system, clutch control or any other element of drive-train): ...

11.2. Transmission

11.2.1. Brief description and schematic drawing of transmission ratio change system(s) and its control: ...

11.2.2. Diagram and or drawing of the power transmission: ...

11.2.3. Type of power transmission: Gear (including planetary gear sets) / belt / hydrostatic / electric / other <sup>(4)</sup> (if other, specify: ...)

11.2.4. Brief description of the electrical/electronic components (if any): ...

11.2.5. Location relative to the engine: ...

11.2.6. Method of control: ...

11.2.7. Transfer box: with/without <sup>(4)</sup>

11.2.8. Type of transmission ratio change system: Mechanical (gear change) / Double clutch (gear change) / Semi-automatic (gear change) / Automatic (gear change) / Continuously Variable Transmission/ hydrostatic / not applicable / other <sup>(4)</sup> (if other, specify: ...)

11.3. Clutch (if any)

11.3.1 Brief description and schematic drawing of the clutch and its control system:

11.3.2 Maximum torque conversion:

11.4. Gear ratios

Gear	Internal gearbox ratios (ratios of engine to gearbox output shaft revolutions)	Internal transfer box ratios (ratios of engine to transfer box output shaft revolutions)	Final drive ratio(s) (ratio of gearbox output shaft to driven wheel revolutions)	Total gear ratios	Ratio (engine speed/vehicle speed) for manual transmission only
Maximum for CVT (*)					
1					
2					
3					
...					
Minimum for CVT (*)					
Reverse					
1					
...					

(\*) Continuously variable transmission'

(6) Appendix 3 is amended as follows:

(a) entry 2.2 is replaced by the following:

'2.2. Type <sup>(6)</sup>: ...';

- (b) entries 2.5 to 2.5.4.2 are deleted;
- (c) entries 5.2 to 5.5 are deleted;
- (d) entries 6 to 8.22.4.2 are replaced by the following:

‘6.            ESSENTIAL CHARACTERISTICS OF THE ENGINE

6.1.7.        Category and sub-category of the engine (7):

6.2.1.        Combustion Cycle: four stroke cycle/two stroke cycle/rotary/other (specify) (4): ...

6.2.2.        Ignition Type: Compression ignition/spark ignition (4)

6.2.3.1.      Cylinders' number: ... and configuration (26):

6.2.8.        Fuel

6.2.8.1.      Fuel Type (9): ...

6.2.8.3.      List of additional fuels, fuel mixtures or emulsions compatible with use by the engine declared by the manufacturer in accordance with point 1.4 of Annex I to Delegated Regulation (EU) 2017/654 (provide reference to recognised standard or specification): .....

6.3.2.1.      Declared rated speed: ... rpm

6.3.2.1.2.    Declared rated net power: ... kW

6.3.2.2.      Maximum power speed: ... rpm

6.3.2.2.2.    Maximum net power: ... kW

6.3.6.4.      Engine total swept volume: ... cm<sup>3</sup>;

- (7) in Appendix 4, entry 2.2 is replaced by the following:

‘2.2. Type (6): ...’;

- (8) in Appendix 5, entry 2.2 is replaced by the following:

‘2.2. Type (6): ...’;

- (9) in Appendix 6, entry 2.2 is replaced by the following:

‘2.2. Type (6): ...’;

- (10) in Appendix 7, entry 2.2 is replaced by the following:

‘2.2. Type (6): ...’;

- (11) in Appendix 8, entry 2.2 is replaced by the following:

‘2.2. Type (6): ...’;

- (12) in Appendix 9, entry 2.2 is replaced by the following:

‘2.2. Type (6): ...’;

- (13) Appendix 10 is amended as follows:

- (a) the title is replaced by the following:

‘Appendix 10

**Model information document relating to EU type-approval of electro-magnetic compatibility of electrical/electronic sub-assemblies as a component/STU’;**

- (b) entry 2.2 is replaced by the following:

‘2.2. Type (6): ...’;

- (14) in Appendix 11, entry 2.2 is replaced by the following:

‘2.2. Type (6): ...’;

(15) in Appendix 12, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(16) in Appendix 13, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(17) in Appendix 14, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(18) Appendix 15 is amended as follows:

(a) entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(b) entries 5.2 to 5.4 are deleted;

(c) entries 6 to 7.1.1 are replaced by the following:

‘6.            ESSENTIAL CHARACTERISTICS OF THE ENGINE

6.1.7.       Category and sub-category of the engine <sup>(7)</sup>: ...

6.2.1.       Combustion Cycle: four stroke cycle/two stroke cycle/rotary/other (specify) <sup>(4)</sup>: ...

6.2.2.       Ignition Type: Compression ignition/spark ignition <sup>(4)</sup>

6.2.3.1.     Cylinders’ number: ... and configuration <sup>(26)</sup>:

6.3.2.1.     Declared rated speed: ... rpm

6.3.2.1.2.   Declared rated net power: ... kW

6.3.2.2.     Maximum power speed: ... rpm

6.3.2.2.2.   Maximum net power: ... kW

6.3.6.4.     Engine total swept volume: ... cm<sup>3</sup>’;

(d) entries 11.1 to 11.2.3 are replaced by the following:

‘11.1.   Brief description and schematic drawing of the vehicle drive-train and its control system (transmission ratio change system, clutch control or any other element of drive-train): ...

11.2.   Transmission

11.2.1.   Brief description and schematic drawing of transmission ratio change system(s) and its control: ...

11.2.2.   Diagram and or drawing of the power transmission: ...

11.2.3.   Type of power transmission: Gear (including planetary gear sets) / belt / hydrostatic / electric / other <sup>(4)</sup> (if other, specify: ...)’;

(e) entry 11.2.8 is replaced by the following:

‘11.2.8.   Type of transmission ratio change system: Mechanical (gear change) / Double clutch (gear change) / Semi-automatic (gear change) / Automatic (gear change) / Continuously Variable Transmission/hydrostatic / not applicable / other <sup>(4)</sup> (if other, specify: ...)’;

(f) entry 43.2 is replaced by the following:

‘43.2.   Specifications of the vehicle with respect to the control circuits of the pneumatic, hydraulic and/or electric control lines of the braking system(s) and a list of the supported messages and parameters: ...’;

(g) entries 43.5 and 43.5.1 are replaced by the following:

‘43.5.   Braking transmission (on towing vehicle)

43.5.1.   Braking transmission of the service braking system on towing vehicle: mechanical/pneumatic/hydraulic/hydrostatic/without power assistance/power-assisted/fully powered transmission <sup>(4)</sup>’;

(h) entries 43.5.3 and 43.6 are replaced by the following:

‘43.5.3. Locking of left and right braking controls: yes/no <sup>(4)</sup>

43.6. Towed vehicle braking control devices (on towing vehicle);

(i) entries 43.6.2 to 43.6.5 are replaced by the following entries 43.6.2 to 43.7.3.2.1:

‘43.6.2. Description of the connectors, couplings and safety devices (including drawings, sketches and the identification of any electronic parts): .....

43.6.2.1. Pneumatic connection type: Two lines/None <sup>(4)</sup>

43.6.2.1.1. Pneumatic supply pressure (two lines): ... kPa

43.6.2.1.2. Electrical control line: yes/no <sup>(4)</sup>

43.6.2.2. Hydraulic connection type: Single line / Two lines / None <sup>(4)</sup>

43.6.2.2.1. Hydraulic supply pressure: Single line: ... kPa Two lines: ... kPa

43.6.2.2.2. Presence of ISO 7638:2003 connector <sup>(15)</sup>: yes/no <sup>(4)</sup>

43.7. Towed vehicle braking devices (on towed vehicle)

43.7.1. Towed vehicle braking control system technology: Hydraulic / Pneumatic / Electric/ Inertia / None <sup>(4)</sup>

43.7.2. Towed vehicle-brake actuating device: Drum / Disc / Other <sup>(4)</sup>

43.7.2.1. Description and characteristics: .....

43.7.3. Description of the connectors, couplings and safety devices (including drawings, sketches and the identification of any electronic parts): .....

43.7.3.1. Pneumatic connection type: Two lines/None <sup>(4)</sup>

43.7.3.1.1. Electrical control line: yes/no <sup>(4)</sup>

43.7.3.2. Hydraulic connection type: Two lines / None <sup>(4)</sup>

43.7.3.2.1. Presence of ISO 7638:2003 connector <sup>(15)</sup>: yes/no <sup>(4)</sup>;

(19) Appendix 16 is amended as follows:

(a) entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(b) the following entries 6 to 6.3.6.4 are inserted before entry 48:

‘6. ESSENTIAL CHARACTERISTICS OF THE ENGINE

6.1.7. Category and sub-category of the engine <sup>(7)</sup>: ...

6.2.1. Combustion Cycle: four stroke cycle/two stroke cycle/rotary/other (specify) <sup>(4)</sup>: ...

6.2.2. Ignition Type: Compression ignition/spark ignition <sup>(4)</sup>

6.2.3.1. Cylinders’ number: ... and configuration <sup>(26)</sup>:

6.3.2.1. Declared rated speed: ... rpm

6.3.2.1.2. Declared rated net power: ... kW

6.3.2.2. Maximum power speed: ... rpm

6.3.2.2.2. Maximum net power: ... kW

6.3.6.4. Engine total swept volume: ... cm<sup>3</sup>;

(c) the following entries 11 to 11.4 are inserted before entry 48:

‘11. DRIVE-TRAIN AND CONTROL <sup>(13)</sup>

11.1. Brief description and schematic drawing of the vehicle drive-train and its control system (transmission ratio change system, clutch control or any other element of drive-train): ...

11.2. Transmission

11.2.1. Brief description and schematic drawing of transmission ratio change system(s) and its control: ...

11.2.2. Diagram and or drawing of the power transmission: ...

11.2.3. Type of power transmission: Gear (including planetary gear sets) / belt / hydrostatic / electric / other <sup>(4)</sup> (if other, specify: ...)

11.2.4. Brief description of the electrical/electronic components (if any): ...

11.2.5. Location relative to the engine: ...

11.2.6. Method of control: ...

11.2.7. Transfer box: with/without <sup>(4)</sup>

11.2.8. Type of transmission ratio change system: Mechanical (gear change) / Double clutch (gear change) / Semi-automatic (gear change) / Automatic (gear change) / Continuously Variable Transmission/ hydrostatic / not applicable / other <sup>(4)</sup> (if other, specify: ...)

11.3. Clutch (if any)

11.3.1 Brief description and schematic drawing of the clutch and its control system:

11.3.2 Maximum torque conversion:

11.4. Gear ratios

Gear	Internal gearbox ratios (ratios of engine to gearbox output shaft revolutions)	Internal transfer box ratios (ratios of engine to transfer box output shaft revolutions)	Final drive ratio(s) (ratio of gearbox output shaft to driven wheel revolutions)	Total gear ratios	Ratio (engine speed/vehicle speed) for manual transmission only
Maximum for CVT (*)					
1					
2					
3					
...					
Minimum for CVT (*)					
Reverse					
1					
...					

(\*) Continuously variable transmission'

(20) in Appendix 17, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(21) in Appendix 18, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(22) in Appendix 19, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(23) in Appendix 20, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(24) in Appendix 21, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(25) in Appendix 22, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(26) in Appendix 23, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(6)</sup>: ...’;

(27) the explanatory notes relating to the information document are amended as follows:

(a) explanatory notes <sup>(6)</sup> and <sup>(7)</sup> are replaced by the following:

<sup>(6)</sup> For engines, indicate the engine type designation or, in case of engine types within an engine family, the Family Type (FT) in accordance with point 4 of Part B of Annex I to Commission Implementing Regulation (EU) 2017/656.

<sup>(7)</sup> Indicate the category and sub-category of the engine in accordance with Article 4 and Annex I to Regulation (EU) 2016/1628’;

(b) explanatory note <sup>(9)</sup> is replaced by the following:

‘<sup>(9)</sup> Indicate the fuel type by the following codes:

B5: Diesel (non-road gas-oil)

E85: Ethanol

ED95: Ethanol for dedicated compression ignition engines

E10: Petrol

NG: Natural gas/Biomethane

LPG: Liquid Petroleum Gas

O (...): Other (specify)

The Sub Fuel type by the following codes (only for Natural gas/Biomethane):

U: Universal fuel — high calorific fuel (H-gas) and low calorific fuel (L-gas)

RH: Restricted fuel — high calorific fuel (H-gas)

RL: Restricted fuel — low calorific fuel (L-gas)

LNG: Fuel specific

The fuelling arrangement by the following codes:

L: Liquid-fuel only

G: Gaseous-fuel only

D1A: Dual-fuel type 1A

D1B: Dual-fuel type 1B

D2A: Dual-fuel type 2A

D2B: Dual-fuel type 2B

D3B: Dual-fuel type 3B’;

- (c) explanatory note <sup>(26)</sup> is replaced by the following:
- ‘<sup>(26)</sup> Indicate the layout of the cylinders by the following codes:
- LI: in line
  - V: in V
  - O: opposed
  - S: single
  - R: radial
  - O (...): other (specify);
- (d) explanatory notes <sup>(12)</sup>, <sup>(24)</sup>, <sup>(29)</sup>, <sup>(39)</sup>, <sup>(40)</sup> and <sup>(56)</sup> are deleted.
-

## ANNEX II

Annex II to Implementing Regulation (EU) 2015/504 is amended as follows:

- (1) in point 2.1.1, in the template of Addendum 1, the words ‘Additional information on the engine (4):’ and entry 2.5.2 are deleted;
- (2) in the explanatory notes relating to Annex II, explanatory note (4) is replaced by the following:

‘(4) For engines, indicate the engine type designation or, in case of engine types within an engine family, the Family Type (FT) in accordance with point 4 of Part B of Annex I to Commission Implementing Regulation (EU) 2017/656.’.

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## ANNEX III

Appendix 1 of Annex III to Implementing Regulation (EU) 2015/504 is amended as follows:

(1) Model 1 of Section 2 is amended as follows:

(a) under the heading 'General powertrain characteristics' entries 5.2, 5.3 and 5.5 are deleted;

(b) the entries under the heading 'Engine' are amended as follows:

(i) entry 2.2 is replaced by the following:

'2.2. Type <sup>(37)</sup>: ...';

(ii) entry 2.5.2 is deleted;

(iii) entries 6.1 to 7.1.1 are replaced by the following:

'6.1.7. Category and sub-category of the engine <sup>(12)</sup>: ...

6.2.1. Combustion Cycle: four stroke cycle/two stroke cycle/rotary/other (specify) <sup>(1)</sup>: ...

6.2.2. Ignition Type: Compression ignition/spark ignition <sup>(1)</sup>

6.2.3.1. Cylinders' number: ... and configuration <sup>(24)</sup>: ...

6.2.8.1. Fuel Type <sup>(20)</sup>: Fuel type / Sub Fuel type / Fuelling arrangement

6.2.8.3. List of additional fuels compatible with use by the engine <sup>(21)</sup>:

6.3.2.1.2. Declared rated net power: ... kW

6.3.2.2.2. Maximum net power: ... kW

6.3.6.4. Engine total swept volume: ... cm<sup>3</sup>;

(c) entry 11.2.8 under the heading 'Gearbox' is replaced by the following:

'11.2.8. Type of transmission ratio change system: Mechanical (gear change) / Double clutch (gear change) / Semi-automatic (gear change) / Automatic (gear change) / Continuously Variable Transmission/hydrostatic / not applicable / other <sup>(1)</sup> (if other, specify: ...)';

(d) entries under the heading 'Braking' are amended as follows:

(i) entry 43.5.1 is replaced by the following:

'43.5.1. Braking transmission: mechanical/pneumatic/ hydraulic / hydrostatic / without power assistance/power-assisted/fully powered transmission <sup>(1)</sup>;

(ii) entry 43.5.3 is deleted;

(e) in the text under the heading 'Results of the sound level test (external)', the words 'Measured according to Annex III to Commission Delegated Regulation (EU) 2015/96' are replaced by the words 'Measured in accordance with Annex II to Commission Delegated Regulation (EU) 2018/985, as last amended by Commission Delegated Regulation (EU) .../... <sup>(1)</sup> <sup>(28)</sup>;

(f) the text under the heading 'Results of exhaust emission tests (inclusive of Deterioration Factor)' is amended as follows:

(i) the first and second indents are replaced by the following:

— Commission Delegated Regulation (EU) 2018/985, as last amended by Commission Delegated Regulation (EU) .../... <sup>(1)</sup> <sup>(28)</sup>: yes/no <sup>(1)</sup>; or

— Regulation (EU) 2016/1628 of the European Parliament and of the Council, as last amended by (Commission Delegated) <sup>(1)</sup> Regulation (EU) .../... (of the European Parliament and of the Council) <sup>(1)</sup> <sup>(29)</sup>: yes/no <sup>(1)</sup>; or;

(ii) the last indent is deleted;

(iii) the table is replaced by the following

'Emissions	CO (g/kWh)	HC (g/kWh)	NO <sub>x</sub> (g/kWh)	HC + NO <sub>x</sub> (g/kWh)	PM (g/kWh)	PN (#/kWh)	Test Cycle <sup>(1)</sup>
NRSC <sup>(2)</sup> / ESC / WHSC <sup>(1)</sup>							
NR transient test <sup>(3)</sup> / ETC / WHTC <sup>(1)</sup>							
CO <sub>2</sub> result <sup>(4)</sup> :							

*Explanatory notes:*

For engines tested on heavy duty test cycles, indicate the final test results (inclusive of Deterioration Factor) and the CO<sub>2</sub> result of the ESC/WHSC or ETC/WHTC test in accordance with Regulation (EC) 595/2009.

For engines tested on non-road test cycles, indicate the applicable information of the Test Report For Non-Road Engines set out in Appendix 1 to Annex VI to Commission Implementing Regulation (EU) 2017/656, in accordance with the following explanatory notes:

<sup>(1)</sup> For NRSC, note the cycle indicated in point 9.1 (Table 4) of; for transient test note the cycle indicated in point 10.1 (Table 8).

<sup>(2)</sup> Copy the "Final test result with DF" results from Table 6.

<sup>(3)</sup> Copy the "Final test result with DF" results from Table 9 or, as applicable, from Table 10.

<sup>(4)</sup> For an engine type or engine family that is tested on both the NRSC and a non-road transient cycle, indicate the hot cycle CO<sub>2</sub> emissions values from the NRTC noted in point 10.3.4 or the CO<sub>2</sub> emissions values from the LSI-NRTC noted in point 10.4.4. For an engine only tested on an NRSC indicate the CO<sub>2</sub> emissions values given in that cycle from point 9.3.3.;

(g) the heading 'Comments <sup>(32)</sup>' is replaced by the following:

'Comments:;

(2) Model 2 of Section 2 is amended as follows:

(a) the entries under the heading 'Braking' are replaced by the following:

'43.4.6. Electronic braking system: yes/no/optional <sup>(1)</sup>

43.7.1. Towed vehicle braking control system technology: Hydraulic / Pneumatic / Electric / Inertia / None <sup>(1)</sup>

43.7.4. Connections type: two-lines / none <sup>(1)</sup>

43.7.5. Electrical control line: yes/no <sup>(1)</sup>

43.7.6. Presence of ISO 7638:2003 connector <sup>(33p)</sup>: yes/no <sup>(1)</sup>;

(b) the heading 'Comments <sup>(32)</sup>' is replaced by the following:

'Comments:;

(3) the explanatory notes relating to Appendix 1 are amended as follows:

(a) the following explanatory note <sup>(12)</sup> is inserted:

<sup>(12)</sup> Indicate the category and sub-category of the engine in accordance with Article 4 and Annex I to Regulation (EU) 2016/1628;

(b) explanatory notes <sup>(20)</sup> and <sup>(21)</sup> are replaced by the following:

<sup>(20)</sup> Indicate the fuel type by the following codes:

B5: Diesel (non-road gas-oil)

E85: Ethanol

ED95: Ethanol for dedicated compression ignition engines

E10: Petrol

NG: Natural gas/Biomethane

LPG: Liquid Petroleum Gas

O (...): Other (specify)

The Sub Fuel type by the following codes (only for Natural gas/Biomethane):

U: Universal fuel — high calorific fuel (H-gas) and low calorific fuel (L-gas)

RH: Restricted fuel — high calorific fuel (H-gas)

RL: Restricted fuel — low calorific fuel (L-gas)

LNG: Fuel specific

The fuelling arrangement by the following codes:

L: Liquid-fuel only

G: Gaseous-fuel only

D1A: Dual-fuel type 1A

D1B: Dual-fuel type 1B

D2A: Dual-fuel type 2A

D2B: Dual-fuel type 2B

D3B: Dual-fuel type 3B

- (<sup>21</sup>) As declared by the manufacturer in accordance with point 1 of Annex I to Commission Delegated Regulation (EU) 2017/654 (provide reference to recognised standard or specification);

(c) explanatory note (<sup>22</sup>) is deleted;

(d) the following explanatory note (<sup>24</sup>) is inserted:

‘(<sup>24</sup>) Indicate the layout of the cylinders by the following codes:

LI: in line

V: in V

O: opposed

S: single

R: Radial

O (...): Other (specify);

(e) explanatory note (<sup>29</sup>) is replaced by the following:

‘(<sup>29</sup>) Indicate only the latest amendment.’;

(f) explanatory note (<sup>31</sup>) is deleted;

(g) explanatory note (<sup>32</sup>) is deleted;

(h) the following explanatory note (<sup>37</sup>) is inserted:

‘(<sup>37</sup>) Indicate the engine type designation or, in case of engine types within an engine family, the Family Type (FT) in accordance with point 4 of Part B of Annex I to Commission Implementing Regulation (EU) 2017/656.’.

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## ANNEX IV

Annex IV to Implementing Regulation (EU) 2015/504 is amended as follows:

(1) point 4.2.1.7 is replaced by the following:

‘4.2.1.7. For C-category vehicles, in addition, technically permissible maximum mass per set of track trains, and, in the same line, average contact pressure on the ground; this information must be combined with that provided for point 4.2.1.6 and listed in order from front to rear, in the following format: ‘S-1: ... kg P: ... kPa’ ‘S-2: ... kg P: ... kPa’ ‘S-...: ... kg P: ... kPa’. Each entry separated by one or more spaces.’;

(2) the following point 2.1.1.10 is inserted:

‘2.1.1.10. For vehicles fitted with transition engines, as defined in Article 3(32) of Regulation (EU) 2016/1628, the vehicle’s production date in the following format: ‘MM/YYYY’. Alternatively, the vehicle’s production date shall be stated in an additional separate statutory plate stating also the VIN.’;

(3) the following point 5.4 is added:

‘5.4. Specific requirements for marking of engines

Notwithstanding point 5.2, the statutory marking of the engine shall be in accordance with the provisions set out in Annex III to Implementing Regulation (EU) 2017/656, with the following exceptions:

- (a) for engines type-approved in accordance with Regulation (EU) No 167/2013, the EU type-approval number set out in Table 6-1 of Annex VI shall be stated instead of the EU type-approval number set out in Annex V to Implementing Regulation (EU) 2017/656;
- (b) for replacement engines type-approved in accordance with Directive 2000/25/EC of the European Parliament and of the Council (\*), the EC type-approval number set out in Appendix 1 to Chapter C of Annex II to Directive 2003/37/EC of the European Parliament and of the Council (\*\*) shall be stated instead of the EC type-approval number issued in accordance with Directive 97/68/EC of the European Parliament and of the Council (\*\*\*).

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(\*) Directive 2000/25/EC of the European Parliament and of the Council of 22 May 2000 on action to be taken against the emission of gaseous and particulate pollutants by engines intended to power agricultural and forestry tractors and amending Council Directive 74/150/EEC (OJ L 173, 12.7.2000, p. 1).

(\*\*) Directive 2003/37/EC of the European Parliament and of the European Council of 26 May 2003 on the type-approval of agricultural or forestry tractors, their trailers and interchangeable towed machinery, together with their systems, components and separate technical units and repealing Directive 74/150/EEC (OJ L 171, 9.7.2003, p. 1).

(\*\*\*) Directive 97/68/EC of the European Parliament and of the Council of 16 December 1997 on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery (OJ L 59, 27.2.1998, p. 1).’.

## ANNEX V

Annex V to Implementing Regulation (EU) 2015/504 is amended as follows:

- (1) in Appendix 2, in the explanatory notes relating to Appendix 2, explanatory note <sup>(10)</sup> is replaced by the following:

‘<sup>(10)</sup> List only subjects referred to in Annex I to Regulation (EU) No 167/2013 whose approvals have been granted in accordance with Regulation (EU) 2016/1628 or the UNECE regulations referred to in Article 49 of Regulation (EU) No 167/2013 (UNECE approvals), or are based on complete test reports issued on the basis of the OECD standard Codes as an alternative to the test reports drawn up under Regulation (EU) No 167/2013 and the delegated and implementing acts adopted pursuant to that Regulation.’;

- (2) in Appendix 3, in the list of regulatory acts with which the type of vehicle complies, rows 75, 76 and 77 are replaced by the following:

75	EU type-approval of a type of engine or engine family for an agricultural and forestry vehicle type as a component / separate technical unit regarding the pollutants emitted	Commission Delegated Regulation (EU) 2018/985 Annex I		
76	EU type-approval of an agricultural and forestry vehicle type equipped with an engine type or engine family regarding the pollutants emitted	Commission Delegated Regulation (EU) 2018/985 Annex I		
77	External sound emission	Commission Delegated Regulation (EU) 2018/985 Annex III		

- (3) Appendix 4 is amended as follows:

- (a) in Section I, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(11)</sup>: ...’;

- (b) in the explanatory notes relating to Appendix 4, the following explanatory note <sup>(11)</sup> is added:

‘<sup>(11)</sup> Indicate the engine type designation or, in case of engine types within an engine family, the Family Type (FT) in accordance with point 4 of Part B of Annex I to Commission Implementing Regulation (EU) 2017/656.’;

- (4) Appendix 5 is amended as follows:

- (a) in Section I, entry 2.2 is replaced by the following:

‘2.2. Type <sup>(7)</sup>: ...’;

- (b) in the explanatory notes relating to Appendix 5, the following explanatory note <sup>(7)</sup> is added:

‘<sup>(7)</sup> Indicate the engine type designation or, in case of engine types within an engine family, the Family Type (FT) in accordance with point 4 of Part B of Annex I to Commission Implementing Regulation (EU) 2017/656.’.

## ANNEX VI

Annex VI to Implementing Regulation (EU) 2015/504 is amended as follows:

(1) point 2.2.3 is replaced by the following:

‘2.2.3. In the case of a system, component or separate technical unit type-approval, the number of the corresponding Commission Delegated Regulation supplementing Regulation (EU) No 167/2013: ‘2015/208’, ‘2015/68’, ‘1322/2014’, ‘2015/96’ or ‘2018/985’ shall be indicated.’;

(2) in point 4, Table 6-1 is amended as follows:

(a) List I is replaced by the following:

<b>LIST I — Environmental and propulsion unit performance requirements</b>		
System or component/separate technical unit (STU)	Commission Delegated Regulation (EU)	alphanumeric character
System: installation of an engine/engine family	2015/96	A
System: installation of an Stage V engine/engine family	2018/985	A1
System: external sound level	2015/96 or 2018/985	B
Component/STU: engine/engine family	2015/96	C
Component/STU: Stage V engine/engine family	2018/985	C1

(b) the seventh row of List II is replaced by the following:

‘Component/ STU: electro-magnetic compatibility of electrical / electronic sub-assemblies	2015/208	J.
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## ANNEX VII

Appendix 1 to Annex VII to Implementing Regulation (EU) 2015/504 is amended as follows:

- (1) in point 1, the words ‘Measured according to Annex III to Commission Delegated Regulation (EU) 2015/96’ are replaced by the words ‘Measured in accordance with Annex II to Commission Delegated Regulation (EU) 2018/985, as last amended by Commission Delegated Regulation (EU) .../... <sup>(1)</sup> <sup>(3)</sup>’;
- (2) point 2 is amended as follows:
- (a) the first and second indents are replaced by the following:
- Commission Delegated Regulation (EU) 2018/985, as last amended by Commission Delegated Regulation (EU) .../... <sup>(1)</sup> <sup>(3)</sup>: yes/no <sup>(1)</sup>; or
- Regulation (EU) 2016/1628 of the European Parliament and of the Council, as last amended by (Commission Delegated) <sup>(1)</sup> Regulation (EU) .../... (of the European Parliament and of the Council) <sup>(1)</sup> <sup>(4)</sup>: yes/no <sup>(1)</sup>; or’;
- (b) the last indent is deleted;
- (3) points 2.1 and 2.2 are replaced by the following:
- ‘2.1. NRSC <sup>(2)</sup>: ... / ESC / WHSC <sup>(1)</sup> final test results (inclusive of Deterioration Factor) <sup>(6)</sup>:

Variant/Version	...	...	...
CO	... g/kWh	... g/kWh	... g/kWh
HC	... g/kWh	... g/kWh	... g/kWh
NO <sub>x</sub>	... g/kWh	... g/kWh	... g/kWh
HC + NO <sub>x</sub>	... g/kWh	... g/kWh	... g/kWh
PM	... g/kWh	... g/kWh	... g/kWh
PN	... #/kWh	... #/kWh	... #/kWh

2.2. Non-road transient test cycle <sup>(7)</sup>: ... / ETC / WHTC <sup>(1)</sup> final test results (inclusive of Deterioration Factor) <sup>(8)</sup>:

Variant/Version	...	...	...
CO	... g/kWh	... g/kWh	... g/kWh
HC	... g/kWh	... g/kWh	... g/kWh
NO <sub>x</sub>	... g/kWh	... g/kWh	... g/kWh
HC + NO <sub>x</sub>	... g/kWh	... g/kWh	... g/kWh
PM	... g/kWh	... g/kWh	... g/kWh
PN	... #/kWh	... #/kWh	... #/kWh’

- (4) the following point 2.3 is inserted:

‘2.3. CO<sub>2</sub> <sup>(9)</sup>

Variant/Version	...	...	...
CO <sub>2</sub>	...	...	...’

- (5) the explanatory notes relating to Appendix 1 are amended as follows:

- (a) explanatory note <sup>(2)</sup> is replaced by the following:

‘<sup>(2)</sup> For vehicles fitted with engines tested in accordance with a non-road steady-state test cycle, indicate the test cycle in accordance with point 9.1 (Table 4) of the template for the single format of the test report set out in Appendix 1 to Annex VI to Implementing Regulation (EU) 2017/656.’;

(b) explanatory note <sup>(4)</sup> is replaced by the following:

‘<sup>(4)</sup> Indicate only the latest amendment.’;

(c) explanatory note <sup>(6)</sup> is replaced by the following:

‘<sup>(6)</sup> For each engine type fitted on every variant/version, indicate:

- (a) for engines tested in accordance with a non-road steady-state test cycle, copy the “Final test result with DF” results from Table 6 of the template for the single format of the test report set out in Appendix 1 to Annex VI to Implementing Regulation (EU) 2017/656,
- (b) for engines tested on heavy duty test cycles, indicate the final test results (inclusive of Deterioration Factor) of the ESC/WHSC test in accordance with Regulation (EC) No 595/2009.’;

(d) the following explanatory notes <sup>(7)</sup> to <sup>(9)</sup> are added:

‘<sup>(7)</sup> For vehicles fitted with engines tested in accordance with a non-road transient test cycle, indicate the test cycle in accordance with point 10.1 (Table 8) of the template for the single format of the test report set out in Appendix 1 to Annex VI to Implementing Regulation (EU) 2017/656.

‘<sup>(8)</sup> For each engine type fitted on every variant/version, indicate:

- (a) for engines tested in accordance with a non-road transient test cycle, copy the “Final test result with DF” results from Table 9 or, as applicable, from Table 10, of the template for the single format of the test report set out in Appendix 1 to Annex VI to Implementing Regulation (EU) 2017/656,
- (b) for engines tested on heavy duty test cycles, indicate the final test results (inclusive of Deterioration Factor) of the ETC/WHTC test in accordance with Regulation (EC) 595/2009.

‘<sup>(9)</sup> For each engine type fitted on every variant/version, indicate:

- (a) for an engine type or engine family that is tested on both the NRSC and a non-road transient test cycle, copy, as applicable, the following values of the template for the single format of the test report set out in Appendix 1 to Annex VI to Implementing Regulation (EU) 2017/656: the hot cycle CO<sub>2</sub> emissions values from the NRTC noted in point 10.3.4; the CO<sub>2</sub> emissions values from the LSI-NRTC noted in point 10.4.4; or, for an engine only tested on an NRSC, indicate the CO<sub>2</sub> emissions values given in that cycle from point 9.3.3,
  - (b) for engines tested on heavy duty test cycles, indicate the CO<sub>2</sub> result of the ESC/WHSC or ETC/WHTC test in accordance with Regulation (EC) 595/2009.’.
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## ANNEX VIII

Annex VIII to Implementing Regulation (EU) 2015/504 is amended as follows:

(1) point 3.2 is amended as follows:

(a) the first paragraph is replaced by the following:

‘Test reports issued under Directive 2003/37/EC, Regulation (EU) 2016/1628, Regulation (EC) No 595/2009, Directive 2007/46/EC or international regulations referred to in Chapter XIII of Regulation (EU) No 167/2013 and the delegated and implementing acts adopted pursuant to that Regulation shall be accepted for the purposes of type-approval under Regulation (EU) No 167/2013 for the following components and separate technical units under the conditions indicated in Table 8-1:’

(b) in Table 8-1, the first and second rows are replaced by the following:

‘Component/STU: engine/engine family	Test report issued under Directive 2000/25 as last amended by Commission Directive 2014/43/EU; Test report issued under Regulation EU 2016/1628; and Test report issued under Regulation (EC) No 595/2009
Component / STU: electro-magnetic compatibility of electrical / electronic sub-assemblies	Test report issued under Directive 2009/64/EC of the European Parliament and of the Council (*), as far as the testing equipment has been updated in: — Radiated broadband and narrowband electromagnetic emissions from vehicles — Radiated broadband and narrowband electromagnetic emissions from electronic sub-assemblies The measuring equipment and test site shall comply with the requirements of publication No 16-1 series of the International Special Committee on Radio Interference (CISPR): — Radiated broadband and narrowband electromagnetic emissions from vehicles — Antenna calibration may be according to the method described in CISPR publication No 12, Edition 6, Annex C, and Test report issued under UNECE Regulation 10, 04 series of amendments, Corrigendum 1 to the Revision 4, supplement 1 to the 04 series of amendments (OJ L 254, 20.9.2012, p. 1.)

(\*) Directive 2009/64/EC of the European Parliament and of the Council of 13 July 2009 on the suppression of radio interference produced by agricultural or forestry tractors (electromagnetic compatibility) (OJ L 216, 20.8.2009, p. 1).’

(2) the following point 3.5 is added:

‘3.5. Test report for engines

Test reports for engines shall be drafted in accordance with the single format of the test report set out in Annex VI to Implementing Regulation (EU) 2017/656.’

**COMMISSION DELEGATED REGULATION (EU) 2018/987****of 27 April 2018****amending and correcting Delegated Regulation (EU) 2017/655 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to monitoring of gaseous pollutant emissions from in-service internal combustion engines installed in non-road mobile machinery****(Text with EEA relevance)**

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) 2016/1628 of the European Parliament and of the Council of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations (EU) No 1024/2012 and (EU) No 167/2013, and amending and repealing Directive 97/68/EC <sup>(1)</sup>, and in particular Article 19(2) thereof,

Whereas:

- (1) Commission Delegated Regulation (EU) 2017/655 <sup>(2)</sup> lays down, inter alia, the procedures for the monitoring of gaseous pollutant emissions from in-service internal combustion engines installed in non-road mobile machinery.
- (2) Pursuant to Table III-1 of Annex III to Regulation (EU) 2016/1628, the mandatory dates of application for EU type-approval and placing on the market of engines of sub-category NRE-v-5 is one year later than for engines of sub-category NRE-v-6.
- (3) Therefore, to facilitate manufacturers of these NRE-v-5 engines of lower power ranges to comply with the limit dates for submitting test results to the approval authorities set out in Delegated Regulation (EU) 2017/655, the required duration of accumulated service of in-service internal combustion engines installed in non-road mobile machinery and tested in the framework of monitoring of gaseous pollutant emissions should be reduced for that sub-category of engines.
- (4) For the purpose of clarity, it should be stated in Appendix 5 of the Annex to Delegated Regulation (EU) 2017/655 that the reference work and reference CO<sub>2</sub> mass used by the manufacturer in the procedures for the calculation of gaseous pollutant emissions for an engine type, or any engine type within the same engine family, are those specified in the addendum of the EU type-approval certificate of the engine type, or the engine family, in accordance with the template set out in Annex IV to Commission Implementing Regulation (EU) 2017/656 <sup>(3)</sup>.
- (5) To avoid mistakes in the rounding of gaseous pollutant emissions calculations, it should be clarified that the applicable exhaust emissions limit values are set out in Article 18(2) of Regulation (EU) 2016/1628.
- (6) To ensure the internal consistency of the Delegated Regulation (EU) 2017/655 and to align it with Commission Delegated Regulation (EU) 2017/654 <sup>(4)</sup>, certain measurement units should be revised.
- (7) Following the publication of Delegated Regulation (EU) 2017/655, errors of different types, including incorrect assignment of responsibilities and mistakes in certain equations, have been detected and need to be corrected.
- (8) Delegated Regulation (EU) 2017/655 should therefore be amended and corrected accordingly,

<sup>(1)</sup> OJ L 252, 16.9.2016, p. 53.

<sup>(2)</sup> Commission Delegated Regulation (EU) 2017/655 of 19 December 2016 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to monitoring of gaseous pollutant emissions from in-service internal combustion engines installed in non-road mobile machinery (OJ L 102, 13.4.2017, p. 334).

<sup>(3)</sup> Commission Implementing Regulation (EU) 2017/656 of 19 December 2016 laying down the administrative requirements relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council (OJ L 102, 13.4.2017, p. 364).

<sup>(4)</sup> Commission Delegated Regulation (EU) 2017/654 of 19 December 2016 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to technical and general requirements relating to emission limits and type-approval for internal combustion engines for non-road mobile machinery (OJ L 102, 13.4.2017, p. 1).

HAS ADOPTED THIS REGULATION:

*Article 1*

**Amendments to Delegated Regulation (EU) 2017/655**

Delegated Regulation (EU) 2017/655 is amended as follows:

(1) the following Article 3a is inserted:

*‘Article 3a*

**Transitional provisions**

1. Notwithstanding the application of the provisions of this Regulation, as amended by Commission Delegated Regulation (EU) 2018/987 (\*), approval authorities shall, until 31 December 2018, also continue to grant EU type-approvals to engine types or engine families in accordance with this Regulation, in its version applicable on 6 August 2018.;

2. Notwithstanding the application of the provisions of this Regulation, as amended by Delegated Regulation (EU) 2018/987, the Member States shall, until 30 June 2019, also permit the placing on the market of engines based on an engine type approved in accordance with this Regulation, in its version applicable on 6 August 2018.

(\*) Commission Delegated Regulation (EU) 2018/987 of 27 April 2018 amending and correcting Delegated Regulation (EU) 2017/655 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to monitoring of gaseous pollutant emissions from in-service internal combustion engines installed in non-road mobile machinery (OJ L 182, 18.7.2018, p. 40).;

(2) the Annex to Delegated Regulation (EU) 2017/655 is amended in accordance with Annex I to this Regulation.

*Article 2*

**Corrections to Delegated Regulation (EU) 2017/655**

The Annex to Delegated Regulation (EU) 2017/655 is corrected in accordance with Annex II to this Regulation.

*Article 3*

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 27 April 2018.

*For the Commission*

*The President*

Jean-Claude JUNCKER

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## ANNEX I

The Annex to Delegated Regulation (EU) 2017/655 is amended as follows:

(1) points 2.6.1.1 and 2.6.1.2 are replaced by the following:

‘2.6.1.1. Testing 9 engines with an accumulated service of less than *a* % of the EDP, in accordance with Table 1. Test results shall be submitted to the approval authority by 31 December 2022.

2.6.1.2. Testing 9 engines with an accumulated service higher than *b* % of the EDP, in accordance with Table 1. Test reports shall be submitted to the approval authority by 31 December 2024.’;

(2) in point 2.6.1.3, the following Table 1 is added:

‘Table 1

**% of EDP values**

Reference power of selected engine (kW)	<i>a</i>	<i>b</i>
$56 \leq P < 130$	20	55
$130 \leq P \leq 560$	30	70’;

(3) point 2.6.2.1 is replaced by the following:

‘2.6.2.1. The test results of the first nine engines shall be submitted not later than 12 months after the first engine was installed in a non-road mobile machinery and not later than 18 months after starting the production of the approved engine type or engine family.’;

(4) point 3.1.1 is replaced by the following:

‘3.1.1. The non-road mobile machinery’s operator performing the in-service monitoring test may be other than the usual professional one if the manufacturer demonstrates to the approval authority that the designated operator has attained enough skills and training to operate the non-road mobile machine.’;

(5) in Appendix 3, in point 4.1, the table is replaced by the following:

‘Table

**Tolerances**

Slope of the regression line, <i>m</i>	0,9 to 1,1 – Recommended
Coefficient of determination, <i>r</i> <sup>2</sup>	min. 0,90 – Mandatory’;

(6) Appendix 5 is amended as follows:

(a) the following point 2.1.5 is inserted before Figure 1:

‘2.1.5. The reference work and reference CO<sub>2</sub> mass of an engine type, or for all engine types within the same engine family, shall be those specified in points 11.3.1 and 11.3.2 of the addendum to the EU type approval certificate of the engine type or the engine family, as set out in Annex IV to Commission Implementing Regulation (EU) 2017/656 (\*).

(\*) Commission Implementing Regulation (EU) 2017/656 of 19 December 2016 laying down the administrative requirements relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council (OJ L 102, 13.4.2017, p. 364).’;

(b) point 3 is replaced by the following:

**‘3. Rounding of gaseous pollutant emissions calculations**

In accordance with Standard ASTM E 29-06b (Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications), the final test results shall be rounded in one step to the number of places to the right of the decimal point indicated by the applicable exhaust emissions limit values set out in Article 18(2) of Regulation (EU) 2016/1628 plus one additional significant figure.’

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## ANNEX II

The Annex to Delegated Regulation (EU) 2017/655 is corrected as follows:

(1) point 5.1 is replaced by the following:

‘5.1. The ECU shall provide data stream information to the measurement instruments or data logger of the Portable Emissions Measurement System (PEMS) in accordance with the requirements set out in Appendix 7.’;

(2) points 6.1 to 6.4 are replaced by the following:

‘6.1. In-service monitoring tests shall be conducted using PEMS in accordance with Appendix 1.

6.2. Manufacturers shall comply with the test procedure set out in Appendix 2 with regard to the in-service monitoring of engines installed on non-road mobile machinery using a PEMS.

6.3. Manufacturers shall follow the procedures set out in Appendix 3 for the pre-processing of the data resulting of the in-service monitoring of engines installed on non-road mobile machinery using a PEMS.

6.4. Manufacturers shall follow the procedures set out in Appendix 4 for the determination of valid events during an in-service monitoring test of engines installed on non-road mobile machinery using a PEMS.’;

(3) point 8 is replaced by the following:

**‘8. Calculations**

Manufacturers shall follow the procedures set out in Appendix 5 for the gaseous pollutant emissions calculations for the in-service monitoring of engines installed on non-road mobile machinery using a PEMS.’;

(4) in point 10.1, the first sentence is replaced by the following:

‘Manufacturers shall draft a test report of the in-service monitoring of engines installed on non-road mobile machinery using a PEMS for each engine tested.’;

(5) Appendix 5 is corrected as follows:

(a) point 2.2.1 is replaced by the following:

**‘2.2.1. Calculations of the brake specific gaseous pollutant emissions**

The brake-specific gaseous pollutant emissions  $e_{\text{gas}}$  (g/kWh) shall be calculated for each averaging window and each gaseous pollutant in the following way:

$$e_{\text{gas}} = \frac{m_i}{W(t_{2,i}) - W(t_{1,i})}$$

Where:

—  $m_i$  is the mass emission of the gaseous pollutant during the  $i^{\text{th}}$  averaging window, g/averaging window,

—  $W(t_{2,i}) - W(t_{1,i})$  is the engine work during the  $i^{\text{th}}$  averaging window, kWh.’;

(b) point 2.2.3 is replaced by the following:

**‘2.2.3. Calculations of the conformity factors**

The conformity factors shall be calculated for each individual valid averaging window and each individual gaseous pollutant in the following way:

$$CF = \frac{e_{\text{gas}}}{L}$$

Where:

—  $e_{\text{gas}}$  is the brake-specific emission of the gaseous pollutant, g/kWh;

—  $L$  is the applicable limit, g/kWh.’;

- (c) in point 2.3, in the legend for the first equation, the indents relating to  $m_{\text{CO}_2}(t_{j,i})$  and  $m_{\text{CO}_2,ref}$  are replaced by the following:

- $m_{\text{CO}_2}(t_{j,i})$  is the CO<sub>2</sub> mass measured between the test start and time  $t_{j,i}$ , g;
- $m_{\text{CO}_2,ref}$  is the CO<sub>2</sub> mass determined for the NRTC, g;

- (d) in point 2.3.1, in the legend for the equation, the indent relating to  $P_{\text{max}}$  is replaced by the following:

- $P_{\text{max}}$  is the maximum net power, as defined in Article 3(28) of Regulation (EU) 2016/1628, kW;

- (e) point 2.3.2 is replaced by the following:

‘2.3.2. Calculations of the conformity factors

The conformity factors shall be calculated for each individual averaging window and each individual pollutant in the following way:

$$CF = \frac{CF_I}{CF_C}$$

With

$$CF_I = \frac{m_i}{m_{\text{CO}_2}(t_{2,i}) - m_{\text{CO}_2}(t_{1,i})} \text{ (in service ratio) and}$$

$$CF_C = \frac{m_L}{m_{\text{CO}_2,ref}} \text{ (certification ratio)}$$

Where:

- $m_i$  is the mass emission of the gaseous pollutant during the  $i^{\text{th}}$  averaging window, g/averaging window,
- $m_{\text{CO}_2}(t_{2,i}) - m_{\text{CO}_2}(t_{1,i})$  is the CO<sub>2</sub> mass during the  $i^{\text{th}}$  averaging window, g;
- $m_{\text{CO}_2,ref}$  is the engine CO<sub>2</sub> mass determined for the NRTC, g,
- $m_L$  is the mass emission of gaseous pollutant corresponding to the applicable limit on the NRTC, g;

- (6) in Appendix 8, point 2.8 is replaced by the following:

‘2.8. Engine total swept volume [cm<sup>3</sup>].’

**COMMISSION IMPLEMENTING REGULATION (EU) 2018/988****of 27 April 2018****amending and correcting Implementing Regulation (EU) 2017/656 laying down the administrative requirements relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council****(Text with EEA relevance)**

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) 2016/1628 of the European Parliament and of the Council of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations (EU) No 1024/2012 and (EU) No 167/2013 and amending and repealing Directive 97/68/EC <sup>(1)</sup>, and in particular Articles 18(5), 21(3), 23(5), 24(12) and 32(3) thereof,

Whereas:

- (1) Commission Implementing Regulation (EU) 2017/656 <sup>(2)</sup> lays down, inter alia, the templates for certain documents to be drawn up in the context of the EU type-approval of internal combustion engines for non-road mobile machinery. Given a number of errors and omissions, those templates should be amended and corrected and made more comprehensive.
- (2) For the purpose of transparency and completeness, the engine manufacturer should include in the information folder a copy of the demonstration reports of specific tests when applying for an EU type-approval.
- (3) In order to harmonise and facilitate the procedures for the calculation of gaseous pollutant emissions for in-service monitoring of non-road mobile engines in accordance with Commission Delegated Regulation (EU) 2017/655 <sup>(3)</sup>, the reference work and the reference CO<sub>2</sub> mass used for that calculation should be stated in the addendum of the template of the EU type-approval certificate and in the single format of the test report.
- (4) For the purpose of harmonising the terminology used in the entire legislative package relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery and clarifying their meaning, the terms 'cylinder displacement' and 'engine displacement' appearing in Implementing Regulation (EU) 2017/656 should be replaced by the terms 'swept volume per cylinder' and 'engine total swept volume'.
- (5) Finally, following the publication of Implementing Regulation (EU) 2017/656, minor errors of different types have been detected and need to be corrected. In particular, certain changes should be made to provisions containing contradictions or redundant information and certain references and numbering should be corrected.
- (6) In particular, points 10 to 11.2 of the template for the single format of the test report should be corrected in order to correctly reflect the terminology used in Regulation (EU) 2016/1628.
- (7) Implementing Regulation (EU) 2017/656 should therefore be amended and corrected accordingly.
- (8) The measures provided for in this Regulation are in accordance with the opinion of the Technical Committee – Motor Vehicles,

<sup>(1)</sup> OJ L 252, 16.9.2016, p. 53.

<sup>(2)</sup> Commission Implementing Regulation (EU) 2017/656 of 19 December 2016 laying down the administrative requirements relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council (OJ L 102, 13.4.2017, p. 364).

<sup>(3)</sup> Commission Delegated Regulation (EU) 2017/655 of 19 December 2016 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to monitoring of gaseous pollutant emissions from in-service internal combustion engines installed in non-road mobile machinery (OJ L 102, 13.4.2017, p. 334).



HAS ADOPTED THIS REGULATION:

#### *Article 1*

### **Amendments to Implementing Regulation (EU) 2017/656**

Implementing Regulation (EU) 2017/656 is amended as follows:

- (1) the following Article 12a is inserted:

*'Article 12a*

#### **Transitional provisions**

1. Notwithstanding the application of the provisions of this Regulation, as amended by Commission Implementing Regulation (EU) 2018/988 (\*), approval authorities shall, until 31 December 2018, also continue to grant EU type-approvals to engine types or engine families in accordance with this Regulation, in its version applicable on 6 August 2018.

2. Notwithstanding the application of the provisions of this Regulation, as amended by Implementing Regulation (EU) 2018/988, the Member States shall, until 30 June 2019, also permit the placing on the market of engines based on an engine type approved in accordance with this Regulation, in its version applicable on 6 August 2018.

(\*) Commission Implementing Regulation (EU) 2018/988 of 27 April 2018 amending and correcting Implementing Regulation (EU) 2017/656 laying down the administrative requirements relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council (OJ L 182, 18.7.2018, p. 46).';

- (2) Annex I is amended in accordance with Annex I to this Regulation;
- (3) Annex IV is amended in accordance with Annex IV to this Regulation;

#### *Article 2*

### **Corrections to Implementing Regulation (EU) 2017/656**

Implementing Regulation (EU) 2017/656 is corrected as follows:

- (1) Annex I is corrected in accordance with Annex II to this Regulation;
- (2) in Annex II, Appendix 1 and Appendix 2 are corrected in accordance with Annex III to this Regulation;
- (3) in Annex III, Appendix 1, Table 1, the ninth row, in the first column, the words 'Applicable exemption code (EM) or transition code (TM) from column 4 of Table 1 of Appendix 2 to Annex II' are replaced by the words 'Applicable exemption code (EM) or transition code (TR) from column 4 of Table 1 of Appendix 2 to Annex II';
- (4) in Annex IV, the Addendum to the EU type-approval certificate is corrected in accordance with Annex V to this Regulation;
- (5) Annex V is corrected in accordance with Annex VI to this Regulation;
- (6) Annex VI is corrected in accordance with Annex VII to this Regulation;
- (7) Annex IX is corrected in accordance with Annex VIII to this Regulation.

#### *Article 3*

### **Entry into force**

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 27 April 2018.

*For the Commission*

*The President*

Jean-Claude JUNKER

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(ii) the following rows with item numbers 3.10.3 to 3.10.4.1 are inserted:

3.10.3.	Air injection									
3.10.3.1.	Operation principle:			X						
3.10.4.	Other(s)									
3.10.4.1.	Type(s):			X'						

(iii) the following row with item number 3.11.1.3.1 is inserted:

3.11.1.3.1.	Test conditions for measurement:	X	X'							
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(iv) the following rows with item numbers 3.11.7 and 3.11.7.1 are inserted:

3.11.7.	Other device(s) or feature(s)									
3.11.7.1.	Type(s):			X'						

## ANNEX II

Annex I to Implementing Regulation (EU) 2017/656 is corrected as follows:

(1) in Part A, point 1.3 is replaced by the following:

‘1.3. Manufacturer’s statement on the compliance of the engine type or engine family with the exhaust emission limits set out in Annex II to Regulation (EU) 2016/1628 with regard to specified liquid fuels, fuel mixtures or fuel emulsions other than those set out in point 1.2.2 of Annex I to Delegated Regulation (EU) 2017/654;’

(2) Part B is corrected as follows:

(a) point 2.1.3.2 is replaced by the following:

‘2.1.3.2. An (X) in the corresponding column of the table identifies the purpose(s) for which each item is required:

(a) “Test” means information required for the conduct of the emissions test,

(b) “Installation” means information required for the installation in non-road mobile machinery, and

(c) “Homologation” means information required for any inspection to confirm that the engine matches with the characteristics of the specified engine type, and, where applicable, of the specified engine family.

The columns “test”, “installation” and “homologation” are for information only, and may be omitted from the information document submitted to the approval authority;’

(b) in point 4.2, the second paragraph is replaced by the following:

‘The engine family designation shall clearly and unequivocally identify those engines presenting a unique combination of technical features for those items set out in Part B of Appendix 3 applicable to the particular engine family;’

(3) Appendix 3 is corrected as follows:

(a) Part B is corrected as follows:

(i) point 2.5 is replaced by the following:

‘2.5. Range of swept volume per cylinder (cm<sup>3</sup>): .....’;

(ii) point 2.8.3 is replaced by the following:

‘2.8.3. list of additional fuels, fuel mixtures or emulsions suitable for use by the engine, as declared by the manufacturer in accordance with point 1.2.3 of Annex I to Delegated Regulation (EU) 2017/654 (provide reference to recognised standard or specification): .....’;

(b) in Part C, the table is corrected as follows:

(i) the row with item number 3.4.6 is replaced by the following:

‘3.4.6.	Pre-conditioning for RMC NRSC: Steady-state operation/RMC:	X								
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(ii) the rows with item numbers 3.6.4 and 3.6.5 are replaced by the following:

‘3.6.4.	Engine total swept volume (cm <sup>3</sup> ):			X						
3.6.5.	Swept volume per cylinder as % of parent engine:			X						If engine family’

- (iii) the rows with item numbers 3.8.3 and 3.8.3.1 are replaced by the following:

3.8.3.	Charge air cooler: Yes/No	X	X						
3.8.3.1.	Type: air-air/air-water/other (specify)		X						

- (iv) in the row with item number 3.8.3.4, the item number ‘3.8.3.4.’ is replaced by the item number ‘3.8.3.3.’;

- (v) the row with item number 3.10.1.1 is replaced by the following:

‘3.10.1.1.	Characteristics: cooled/uncooled, high pressure/low pressure/other (specify):			X’						
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- (vi) the row with item number 3.1.1.3 is replaced by the following:

‘3.11.1.3.	Minimum temperature at inlet to first after-treatment device (deg. C), if stated:	X	X'							
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- (vii) the row with item number 3.14.2 is replaced by the following:

'3.14.2.	Pressure regulator(s)/vaporiser(s)																			
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## ANNEX III

Annex II to Implementing Regulation (EU) 2017/656 is corrected as follows:

(1) in Appendix 1, in Section 2, point 3 is replaced by the following:

‘3. Exemption Code (EM)/transition code (TR) <sup>(6)</sup>: .....’;

(2) in Appendix 2, Table 1 is corrected as follows:

(i) in the heading of column 4, the words ‘Exemption Code (EM) or transition code (TM) (column 4)’ are replaced by the words ‘Exemption code (EM) or transition code (TR) (column 4)’;

(ii) in the first row, in column 5 (‘Text for supplementary information’), the words ‘ENGINE NOT FOR USE IN EU MACHINERY’ are replaced by the words ‘ENGINE NOT FOR USE IN EU NON-ROAD MOBILE MACHINERY’.

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## ANNEX IV

Annex IV to Implementing Regulation (EU) 2017/656 is amended as follows:

(1) in the Addendum to the EU type-approval certificate, the following points 11.3 to 11.3.2 are added:

‘11.3. In service monitoring reference values <sup>(9)</sup>

11.3.1. Reference work (kWh): .....

11.3.2. Reference CO<sub>2</sub> mass (g): .....’;

(2) in the Explanatory notes to Annex IV, the following explanatory note <sup>(9)</sup> is added:

‘<sup>(9)</sup> Only applicable to engines of sub-categories NRE-v-5 and NRE-v-6 tested on NRTC.’

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## ANNEX V

In Annex IV to Implementing Regulation (EU) 2017/656, the Addendum to the EU type-approval certificate is corrected as follows:

(1) points 2.11.8, 2.11.9 and 2.11.10 are replaced by the following:

‘2.11.8. Other after-treatment devices (specify): .....

2.11.9. Other devices or features that have a strong influence on emissions (specify): .....’;

(2) in point 3.6.4 in the second column ‘Item description’, the words ‘Engine Displacement (cm<sup>3</sup>):’ are replaced by the words ‘Engine total swept volume (cm<sup>3</sup>):’;

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## ANNEX VI

Annex V to Implementing Regulation (EU) 2017/656 is corrected as follows:

- (1) in point 3.1, the introductory wording of the first paragraph is replaced by the following:

‘Example of a EU type-approval number of an NRSh-v-1b engine operating on petrol fuel, issued by the Netherlands, which has been extended three times:’;

- (2) in point 3.2, the introductory wording of the first paragraph is replaced by the following:

‘Example of a EU type-approval number of a NRE-c-3 type 1A dual fuel engine operating on gaseous fuel of type LN2 (a specific liquefied natural gas/liquefied biomethane composition resulting in a  $\lambda$ -shift factor not differing by more than 3 per cent the  $\lambda$ -shift factor of the G20 gas specified in Annex I to Delegated Regulation (EU) 2017/654 and the ethane content of which does not exceed 1,5 per cent), which has not yet been extended, issued by France:’;

- (3) in point 3.3, the introductory wording of the first paragraph is replaced by the following:

‘Example of a EU type-approval number of a RLL-v-1 engine according to the SPE emission limits operating on diesel fuel, issued by Austria, which has been extended 2 times:’.

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## ANNEX VII

Annex VI to Implementing Regulation (EU) 2017/656 is corrected as follows:

(1) point 2.6 is replaced by the following:

‘2.6. The test report may be delivered on paper or in an electronic format agreed between the manufacturer, technical service and approval authority.’;

(2) Appendix 1 is corrected as follows:

(i) points 10 to 11.2 are replaced by the following:

‘10. **Information concerning the conduct of the transient test (if applicable)**

10.1. Cycle (mark cycle with X) to be stated in Table 8:

Table 8

**Transient test cycle**

NRTC	
LSI-NRTC	

10.2. Transient test deterioration factors:

10.2.1. Deterioration Factor (DF): calculated/fixed

10.2.2. DF values and the emissions results to be stated in Table 9 or Table 10

10.3. NRTC emission results:

Table 9

**DF values and the emissions results for NRTC**

DF mult/add	CO	HC	NO <sub>x</sub>	HC+NO <sub>x</sub>	PM	PN
Emissions	CO (g/kWh)	HC (g/kWh)	NO <sub>x</sub> (g/kWh)	HC+NO <sub>x</sub> (g/kWh)	PM (g/kWh)	PN (#/kWh)
Cold start						
Hot start test result with/without regeneration						
Weighted test result						
$k_{ru}/k_{rd}$ mult/add						
Weighted test result with IRAFs						
<b>Final test result with DF</b>						

10.3.1. Hot cycle CO<sub>2</sub> (g/kWh):

10.3.2. Cycle average NH<sub>3</sub> (ppm):

10.3.3. Cycle work for hot start test (kWh):

10.3.4. Cycle CO<sub>2</sub> for hot start test (g):

## 10.4. LSI-NRTC emission results

Table 10

**DF values and the emissions results for LSI- NRTC**

DF mult/add	CO	HC	NO <sub>x</sub>	HC+NO <sub>x</sub>	PM	PN
Emissions	CO (g/kWh)	HC (g/kWh)	NO <sub>x</sub> (g/kWh)	HC+NO <sub>x</sub> (g/kWh)	PM (g/kWh)	PN (#/kWh)
test result with/without regeneration						
$k_{ru}/k_{rd}$ mult/add						
Test result with IRAFs						
<b>Final test result with DF</b>						

10.4.1. Cycle CO<sub>2</sub> (g/kWh):10.4.2. Cycle average NH<sub>3</sub> (ppm):

10.4.3. Cycle work (kWh):

10.4.4. Cycle CO<sub>2</sub> (g):

10.5. Sampling system used for the transient test:

10.5.1. Gaseous emissions:

10.5.2. PM:

10.5.3. Particle number:

**11. Final emissions results**

11.1. Cycle emissions results to be stated in Table 11.

Table 11

**Final emissions results**

Emissions	CO (g/kWh)	HC (g/kWh)	NO <sub>x</sub> (g/kWh)	HC+NO <sub>x</sub> (g/kWh)	PM (g/kWh)	PN (#/kWh)	Test Cycle (°)
NRSC final result with DF (²).							
Final transient test result with DF (³)							

11.2. CO<sub>2</sub> result (⁴):

11.3. In service monitoring reference values (⁵)

11.3.1. Reference work (kWh) (⁶):

11.3.2. Reference CO<sub>2</sub> mass (g) (⁷):

(ii) the explanatory notes to Appendix 1 are replaced by the following:

*'Explanatory notes to Appendix 1:*

*(Footnote markers, footnotes and explanatory notes not to be stated on the test report)*

- <sup>(1)</sup> For NRSC indicate the cycle noted in point 9.1 (Table 4); for transient test indicate cycle noted in point 10.1 (Table 8).
  - <sup>(2)</sup> Copy the "Final test result with DF" results from Table 6.
  - <sup>(3)</sup> Copy "Final test result with DF" results from Table 9 or 10, as applicable.
  - <sup>(4)</sup> For an engine type or engine family that is tested on both the NRSC and a transient cycle, indicate the hot cycle CO<sub>2</sub> emissions values from the NRTC noted in point 10.3.4 or the CO<sub>2</sub> emissions values from the LSI-NRTC noted in point 10.4.4. For an engine only tested on an NRSC indicate the CO<sub>2</sub> emissions values given in that cycle noted in point 9.3.3.
  - <sup>(5)</sup> Only applicable to engines of sub-categories NRE-v-5 and NRE-v-6 tested on NRTC.
  - <sup>(6)</sup> Indicate the cycle work for hot start test value from the NRTC noted in point 10.3.3.
  - <sup>(7)</sup> Indicate the cycle CO<sub>2</sub> for hot start test value from the NRTC noted in point 10.3.4.1.
-

## ANNEX VIII

Points 2.4.4 to 2.4.4.3 of Annex IX to Implementing Regulation (EU) 2017/656 are replaced by the following:

‘2.4.4. Swept volume per cylinder

2.4.4.1. Engine with a swept volume per cylinder  $\geq 750 \text{ cm}^3$

In order for engines with a swept volume per cylinder of  $\geq 750 \text{ cm}^3$  to be considered to belong to the same engine family, the spread of their swept volume per cylinder shall not exceed 15 per cent of the largest swept volume per cylinder within the engine family.

2.4.4.2. Engine with a swept volume per cylinder  $< 750 \text{ cm}^3$

In order for engines with an individual cylinder swept volume of  $< 750 \text{ cm}^3$  to be considered to belong to the same engine family, the spread of their swept volume per cylinder shall not exceed 30 per cent of the largest swept volume per cylinder within the engine family.

2.4.4.3. Engine with greater spread in swept volume per cylinder

Notwithstanding points 2.4.4.1 and 2.4.4.2, engines with a swept volume per cylinder that exceeds the spread defined in paragraphs 2.4.4.1 and 2.4.4.2 may be considered to belong to the same engine family subject to the approval of the approval authority. The approval shall be based on technical elements (calculations, simulations, experimental results etc.) showing that exceeding the spread does not have a significant influence on the exhaust emissions.’

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**COMMISSION DELEGATED REGULATION (EU) 2018/989****of 18 May 2018****amending and correcting Delegated Regulation (EU) 2017/654 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to technical and general requirements relating to emission limits and type-approval for internal combustion engines for non-road mobile machinery****(Text with EEA relevance)**

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) 2016/1628 of the European Parliament and of the Council of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations (EU) No 1024/2012 and (EU) No 167/2013, and amending and repealing Directive 97/68/EC <sup>(1)</sup>, and in particular Article 25(4)(a-d), Article 26(6), Article 42(4)(b) and Article 43(5) thereof,

Whereas:

- (1) In order to enable the use of certain fuels legally marketed in some Member States without imposing an additional burden on manufacturers, the permitted content of fatty-acid methyl ester ('FAME') should be 8,0 % v/v instead of 7,0 % v/v.
- (2) In order to ensure consistency with Article 7(2) of Commission Implementing Regulation (EU) 2017/656 <sup>(2)</sup>, where an existing RLL test report is submitted to obtain a Stage V type approval in accordance with that Article, it should be permitted to use the same version of 'F' test type cycle for the purposes of checking the conformity of production of engines type-approved on that cycle.
- (3) In order to improve the testing procedures for engines without an after-treatment system, specific requirements for determining deterioration factors should be established for engines without an after-treatment system.
- (4) In order to consider all possible emission control strategies, the technical requirements relating to emission control strategies should include the base emission control strategy and not only the auxiliary emission control strategy.
- (5) Emission control strategies' requirements were originally laid down for engines subject to a transient cycle. However, those requirements are not suitable for engines only subject to the NRSC which are not tested on a transient cycle. Existing engine transient emission control strategies should therefore be adapted to those engines by distinguishing between the conditions on the emission test (steady-state only) and any other operating conditions (transient).
- (6) In order to take into account the regeneration of an after-treatment system during the demonstration based on random point selection in accordance with point 3 of Annex V to Commission Delegated Regulation (EU) 2017/654 <sup>(3)</sup> and to clarify that an engine after-treatment system may regenerate before the emission test cycle is run, the test requirements referred to in point 4 of Annex V of Delegated Regulation (EU) 2017/654 should be modified accordingly with new specific provisions on regeneration.
- (7) In addition, to reduce the likelihood of regeneration during the test, the minimum sample time when the discrete-mode NRSC is used for the demonstration based on random point selection in accordance with point 3 of Annex V to Delegated Regulation (EU) 2017/654 should be reduced to 3 minutes per point.

<sup>(1)</sup> OJ L 252, 16.9.2016, p. 53.

<sup>(2)</sup> Commission Implementing Regulation (EU) 2017/656 of 19 December 2016 laying down the administrative requirements relating to emission limits and type-approval of internal combustion engines for non-road mobile machinery in accordance with Regulation (EU) 2016/1628 of the European Parliament and of the Council (OJ L 102, 13.4.2017, p. 364).

<sup>(3)</sup> Commission Delegated Regulation (EU) 2017/654 of 19 December 2016 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to technical and general requirements relating to emission limits and type-approval for internal combustion engines for non-road mobile machinery (OJ L 102, 13.4.2017, p. 1).

- (8) For the purpose of comprehensiveness, the manufacturer should include in the information folder as set out in Part A of Annex I to Implementing Regulation (EU) 2017/656 demonstration reports documenting the demonstrations conducted pursuant to specific technical requirements and procedures set out in Delegated Regulation (EU) 2017/654.
- (9) The reference to the provisions of Regulation (EU) 2016/1628 requiring that deterioration factors are taken into account in the emission laboratory test results set out in Article 4 of Delegated Regulation (EU) 2017/654 is incorrect and should be corrected.
- (10) To ensure consistency of Regulation (EU) 2016/1628 and all Delegated and Implementing Regulations adopted pursuant to that Regulation, some requirements applicable to engine-after-treatment system families should also be applicable to engine families, or groups of engine families.
- (11) Certain changes should be made to provisions containing contradictions or redundant information and certain references should be corrected.
- (12) Following the publication of Delegated Regulation (EU) 2017/654, further errors of different types, such as terminology and numbering, have been detected and need to be corrected.
- (13) Delegated Regulation (EU) 2017/654 should therefore be amended and corrected accordingly,

HAS ADOPTED THIS REGULATION:

#### *Article 1*

### **Amendments to Delegated Regulation (EU) 2017/654**

Delegated Regulation (EU) 2017/654 is amended as follows:

- (1) the following Article 20a is inserted:

*'Article 20a*

#### **Transitional provisions**

1. Notwithstanding the application of the provisions of this Regulation, as amended by Commission Delegated Regulation (EU) 2018/989, approval authorities shall, until 31 December 2018, also continue to grant EU type-approvals to engine types or engine families in accordance with this Regulation, in its version applicable on 6 August 2018.

2. Notwithstanding the application of the provisions of this Regulation, as amended by Commission Delegated Regulation (EU) 2018/989, the Member States shall, until 30 June 2019, also permit the placing on the market of engines based on an engine type approved in accordance with this Regulation, in its version applicable on 6 August 2018.;

- (2) Annex I is amended in accordance with Annex I to this Regulation;
- (3) Annex II is amended in accordance with Annex II to this Regulation;
- (4) Annex III is amended in accordance with Annex III to this Regulation;
- (5) Annex IV is amended in accordance with Annex IV to this Regulation;
- (6) Annex V is amended in accordance with Annex V to this Regulation;
- (7) Annex VI is amended in accordance with Annex VI to this Regulation;
- (8) Annex VII is amended in accordance with Annex VII to this Regulation;
- (9) Annex VIII is amended in accordance with Annex VIII to this Regulation;
- (10) Annex IX is amended in accordance with Annex IX to this Regulation;
- (11) Annex XIII is amended in accordance with Annex X to this Regulation;
- (12) Annex XV is amended in accordance with Annex XI to this Regulation.



*Article 2***Corrections to Delegated Regulation (EU) 2017/654**

Delegated Regulation (EU) 2017/654 is corrected as follows:

- (1) Article 4 is replaced by the following:

‘Article 4

**Methodology for adapting the emission laboratory test results to include the deterioration factors**

The emission laboratory test results shall be adapted to include the deterioration factors, comprising those related with the measurement of the particle number (PN) and with gaseous-fuelled engines, referred to in Article 25(1)(c) of Regulation (EU) 2016/1628, in accordance with the methodology laid down in Annex III to this Regulation.’;

- (2) Annex I is corrected in accordance with Annex XII to this Regulation;

- (3) in Annex II, point 3.3.2 is replaced by the following:

‘3.3.2. The initial assessment and verification of product conformity arrangements may also be carried out in cooperation with the approval authority of another Member State, or the appointed body designated for this purpose by the approval authority.’;

- (4) Annex III is corrected in accordance with Annex XIII to this Regulation;
- (5) Annex IV is corrected in accordance with Annex XIV to this Regulation;
- (6) Annex V is corrected in accordance with Annex XV to this Regulation;
- (7) Annex VI is corrected in accordance with Annex XVI to this Regulation;
- (8) Annex VII is corrected in accordance with Annex XVII to this Regulation;
- (9) Annex VIII is corrected in accordance with Annex XVIII to this Regulation.

*Article 3***Entry into force**

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 18 May 2018.

*For the Commission*  
*The President*  
Jean-Claude JUNCKER

## ANNEX I

Annex I to Delegated Regulation (EU) 2017/654 is amended as follows:

(1) point 1.2.2 is replaced by the following:

‘1.2.2. In the absence of either a standard from the European Committee for Standardization (“CEN standard”) for non-road gas-oil or a table of fuel properties for non-road gas-oil in Directive 98/70/EC of the European Parliament and of the Council (\*), the diesel (non-road gas-oil) reference fuel in Annex IX shall represent market non-road gas-oils with a sulphur content not greater than 10 mg/kg, cetane number not less than 45 and a fatty-acid methyl ester (“FAME”) content not greater than 8,0 % v/v. Except where otherwise permitted in accordance with points 1.2.2.1, 1.2.3 and 1.2.4, the manufacturer shall make a corresponding declaration to the end-users in accordance with the requirements in Annex XV that operation of the engine on non-road gas-oil is limited to those fuels with a sulphur content not greater than 10 mg/kg (20 mg/kg at point of final distribution) cetane number not less than 45 and a FAME content not greater than 8,0 % v/v. The manufacturer may optionally specify other parameters (e.g. for lubricity).

(\*) Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC (OJ L 350, 28.12.1998, p. 58).’;

(2) point 1.2.2.1 is amended as follows:

(a) the first paragraph is replaced by the following:

‘The engine manufacturer shall not indicate at any time that an engine type or engine family may be operated within the Union on market fuels other than those that comply with the requirements in this point unless the manufacturer additionally complies with the requirement in point 1.2.3’;

(b) point (c) is replaced by the following:

‘(c) In the case of diesel (non-road gas-oil), Directive 98/70/EC and also both a cetane number not less than 45 and FAME not greater than 8,0 % v/v.’;

(3) point 2.4.1.4 is deleted.

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## ANNEX II

Annex II to Delegated Regulation (EU) 2017/654 is amended as follows:

(1) the following point 6.2.3.1 is inserted:

‘6.2.3.1. Notwithstanding point 6.2.3, in the case of engines of category RLL where an existing test report is used for type-approval in accordance with Article 7(2) of Implementing Regulation (EU) 2017/656, the per cent load and power and the weighting factor for the mode number of the test cycle type F for the purpose of this Annex may be the same as that used for the type-approval test.’;

(2) in point 6.2.4, the words ‘, as determined in accordance with Annex III’ are replaced by the words ‘that were determined in accordance with Annex III’;

(3) in point 6.4, the third sentence is replaced by the following:

‘For engines fuelled with natural gas/biomethane (NG) or liquefied petroleum gas (LPG), including dual-fuel engines, the tests shall be performed with at least two of the reference fuels for each gaseous-fuelled engine, except in the case of a gaseous-fuelled engine with a fuel-specific type-approval where only one reference fuel is required, as described in Appendix 1 to Annex I.’.

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## ANNEX III

Annex III to Delegated Regulation (EU) 2017/654 is amended as follows:

(1) points 3.1.3 and 3.1.4 are replaced by the following:

‘3.1.3. The test engine shall represent the emission deterioration characteristics of the engine families that will apply the resulting deterioration factors for type approval. The engine manufacturer shall select one engine representing the engine family, group of engine families or engine-after-treatment system family, as determined in accordance with point 3.1.2, for testing over the service accumulation schedule referred to in point 3.2.2, which shall be reported to the approval authority before any testing commences.

3.1.4. If the approval authority decides that the worst case emissions of the engine family, group of engine families or engine-after-treatment system family can be better characterised by another test engine, the test engine to be used shall be selected jointly by the approval authority and the engine manufacturer.’;

(2) point 3.2.1 is replaced by the following:

‘3.2.1. General

Deterioration factors applicable to an engine family, group of engine families or an engine-after-treatment system family shall be developed from the selected engines based on a service accumulation schedule that includes periodic testing for gaseous and particulate emissions over each test cycle applicable to the engine category, as given in Annex IV to Regulation (EU) 2016/1628. In the case of non-road transient test cycles for engines of category NRE (“NRTC”), only the results of the hot-start run of the NRTC (“hot-start NRTC”) shall be used.’;

(3) in point 3.2.5.2, the last paragraph is replaced by the following:

‘Where emission values are used for engine families in the same group of engine families or engine-after-treatment family but with different emission durability periods, then the emission values at the emission durability period end point shall be recalculated for each emission durability period by extrapolation or interpolation of the regression equation as determined in point 3.2.5.1.’;

(4) in point 3.2.6.1, the last paragraph is deleted;

(5) the following point 3.2.6.1.1 is inserted:

‘3.2.6.1.1. Notwithstanding point 3.2.6.1, for PN, either an additive DF of 0,0 or a multiplicative DF of 1,0 may be used, in conjunction with the results of previous DF testing that did not establish a value for PN if both of the following conditions are fulfilled:

(a) the previous DF test was conducted on engine technology that would have qualified for inclusion in the same engine after-treatment system family, as set out in point 3.1.2, as the engine family to which it is intended to apply the DFs; and,

(b) the test results were used in a previous type-approval granted before the applicable EU type-approval date given in Annex III to Regulation (EU) 2016/1628.’.

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## ANNEX IV

Annex IV to Delegated Regulation (EU) 2017/654 is amended as follows:

(1) the following points 2.2.3.1 and 2.2.4 are inserted:

‘2.2.3.1. Notwithstanding point 2.2.3, in the case of engine (sub-)categories that are not subject to non-road transient test cycles for EU type-approval purposes, the base emission control strategy may identify when transient operating conditions occur and apply the corresponding emission control strategy. In this case, this emission control strategy shall be included in the overview of the base emission control strategy required by point 1.4 of Annex I to Implementing Regulation (EU) 2017/656 and in the confidential information on emission control strategy set out in Appendix 2 to that Annex.

2.2.4. The manufacturer shall demonstrate to the technical service at the time of the EU type-approval test that the operation of the base emission control strategy complies with the provisions of this section on the basis of the documentation referred to in point 2.6.’;

(2) in point 2.6, the paragraph under the heading is deleted;

(3) the following points 2.6.1 and 2.6.2 are inserted:

‘2.6.1. The manufacturer shall comply with the documentation requirements laid down in point 1.4 of Part A of Annex I to Implementing Regulation (EU) 2017/656 and Appendix 2 to that Annex.

2.6.2. The manufacturer shall ensure that all documents used for this purpose are marked with an identification number and date of issue. The manufacturer shall notify to the approval authority whenever the particulars recorded are changed. In this case, it shall issue, either a updated version of the documents concerned where the relevant pages are marked clearly showing the date of revision and the nature of the amendment, or alternatively, a new consolidated version accompanied by an index containing a detailed description and date of each amendment.’;

(4) Appendix 1 is amended as follows:

(a) point 2.2.1 is replaced by the following:

‘2.2.1. Monitoring for reagent level in the storage tank shall be conducted under all conditions where measurement is technically feasible (for instance, under all conditions when a liquid reagent is not frozen).’;

(b) the following points 2.2.2 and 2.2.3 are inserted:

‘2.2.2. Reagent freeze protection shall apply at ambient temperatures at or below 266 K (– 7 °C).

2.2.3. All elements of the NO<sub>x</sub> control diagnostic system other than those listed in points 2.2.1 and 2.2.2 shall, at a minimum, be operational at the applicable control conditions set out in point 2.4 of this Annex for each engine category. The diagnostic system shall remain operational outside of this range where technically possible.’;

(c) the following point 2.3.2.2.4 is inserted:

‘2.3.2.2.4. Evaluation of the design criteria may be performed in a cold chamber test cell using an entire non-road mobile machinery or parts representative of those to be installed on a non-road mobile machinery or based on field tests.’;

(d) point 2.3.2.3 is replaced by the following:

‘2.3.2.3. Activation of the operator warning and inducement system for a non-heated system’;

(e) the following points 2.3.2.3.1 and 2.3.2.3.2 are inserted:

‘2.3.2.3.1. The operator warning system described in points 4 to 4.9 shall be activated if no reagent dosing occurs at an ambient temperature ≤ 266 K (– 7 °C).

2.3.2.3.2. The severe inducement system as referred to in point 5.4 shall be activated if no reagent dosing occurs within a maximum of 70 minutes after engine start at an ambient temperature ≤ 266 K (– 7 °C).’;

(f) points 2.3.3, 2.3.3.1 and 2.3.3.2 are deleted;

(g) in point 5.2.1.1, the following point (ea) is inserted:

‘(ea) A description of the connection for, and method to read, the records referred to in point (e) shall be included in the information folder set out in Part A of Annex I to Implementing Regulation (EU) 2017/656;’;

(h) point 9.5 is replaced by the following:

‘9.5. As an alternative to the monitoring requirements set out in point 9.2, the manufacturer may monitor for failures using a NO<sub>x</sub> sensor located in the exhaust system. In this case,

(a) the NO<sub>x</sub> value at which the NCM shall be detected shall not exceed the lower of either the applicable NO<sub>x</sub> limit multiplied by 2,25 or the applicable NO<sub>x</sub> limit plus 1,5 g/kWh. For engine sub-categories with a combined HC and NO<sub>x</sub> limit, the applicable NO<sub>x</sub> limit value for the purpose of this point shall be the combined limit value for HC and NO<sub>x</sub> reduced by 0,19 g/kWh.

(b) a single warning may be used, including, where messages are used, the statement “high NO<sub>x</sub> – root cause unknown”,

(c) in point 9.4.1 the maximum number of engine operating hours between the activation of the operator warning system and the activation of the low-level inducement system shall be reduced to 10,

(d) in point 9.4.2 the maximum number of engine operating hours between the activation of the operator warning system and the activation of the severe inducement system shall be reduced to 20.’;

(i) points 10.3.1 to 10.3.3.1 are replaced by the following:

‘10.3.1. The compliance of the warning system activation shall be demonstrated by performing two tests: lack of reagent, and one failure category identified in sections 7, 8 or 9.

10.3.2. Selection of the failure to be tested among those referred to in sections 7, 8 or 9.

10.3.2.1. The approval authority shall select one failure category. In the case that a failure is selected from points 7 or 9, the additional requirements set out in points 10.3.2.2 or 10.3.2.3 shall apply, respectively.

10.3.2.2. For the purpose of demonstrating the activation of the warning system in case of a wrong reagent quality, a reagent shall be selected with a dilution of the active ingredient at least as dilute as that communicated by the manufacturer in accordance with the requirements set out in points 7 to 7.3.3.

10.3.2.3. For the purpose of demonstrating the activation of the warning system in case of failures that may be attributed to tampering, and are defined in section 9 the selection shall be performed in accordance with the following requirements:

10.3.2.3.1. The manufacturer shall provide the approval authority with a list of such potential failures.

10.3.2.3.2. The failure to be considered in the test shall be selected by the approval authority from the list referred to in point 10.3.2.3.1.

10.3.3. Demonstration

10.3.3.1. For the purpose of this demonstration, a separate test shall be performed for the lack of reagent and the failure selected in accordance with points 10.3.2 to 10.3.2.3.2.’;

(j) the following points 10.5 and 10.5.1 are inserted:

‘10.5. Documentation of the demonstration

10.5.1. A demonstration report shall document the demonstration of the NCD system. The report shall:

(a) identify the failures examined;

(b) describe the demonstration performed including the applicable test cycle;

(c) confirm that the applicable warnings and inducements were activated as required by this regulation; and

(d) be included in the information folder as set out in Part A of Annex I of Implementing Regulation (EU) 2017/656.’;

(k) points 11.4.1.1 and 11.4.1.1.1 are replaced by the following:

‘11.4.1.1. To comply with the requirements of this Appendix, the system shall contain counters to record the number of hours during which the engine has been operated while the system has detected any of the following NCM:

- (a) an incorrect reagent quality;
- (b) an interruption of reagent dosing activity;
- (c) an impeded EGR valve;
- (d) a failure of the NCD system.

11.4.1.1.1. The manufacturer may use one or more counters for grouping the NCMs indicated in point 11.4.1.1.’;

(l) the following points 13.4 and 13.4.1 are added:

‘13.4. Documentation of the demonstration

13.4.1. A demonstration report shall document the demonstration of the minimum acceptable reagent concentration. The report shall:

- (a) identify the failures examined;
- (b) describe the demonstration performed including the applicable test cycle;
- (c) confirm that the pollutant emissions arising from this demonstration did not exceed the NO<sub>x</sub> threshold specified in point 7.1.1;
- (d) be included in the information folder as set out in Part A of Annex I to Implementing Regulation (EU) 2017/656.’;

(5) Appendix 2 is amended as follows:

(a) points 2 to 4.5 are replaced by the following:

‘2. General requirements

The requirements of Appendix 1 apply to engines in scope of this Appendix, except as set out in points 3 and 4 of this Appendix.

3. Exceptions to the requirements of Appendix 1

In order to account for safety concerns the operator inducement system set out in points 5 and 11.3 of Appendix 1 shall not apply to engines under the scope of this Appendix. The requirement to store data in an on-board computer log set out in point 4 of this Appendix shall apply wherever the inducement would have been activated in accordance with points 2.3.2.3.2, 6.3, 7.3, 8.4 and 9.4 of Appendix 1.

4. Requirement for storing incidents of engine operation with inadequate reagent injection or reagent quality

4.1. The on-board computer log must record in non-volatile computer memory or counters the total number and duration of all incidents of engine operation with inadequate reagent injection or reagent quality in a manner to ensure that the information cannot be intentionally deleted.

4.1.1. It shall be possible for national inspection authorities to read these records with a scan tool.

4.1.2. A description of the connection for, and method to read, these records shall be included in the information folder as set out in Part A of Annex I of Implementing Regulation (EU) 2017/656.

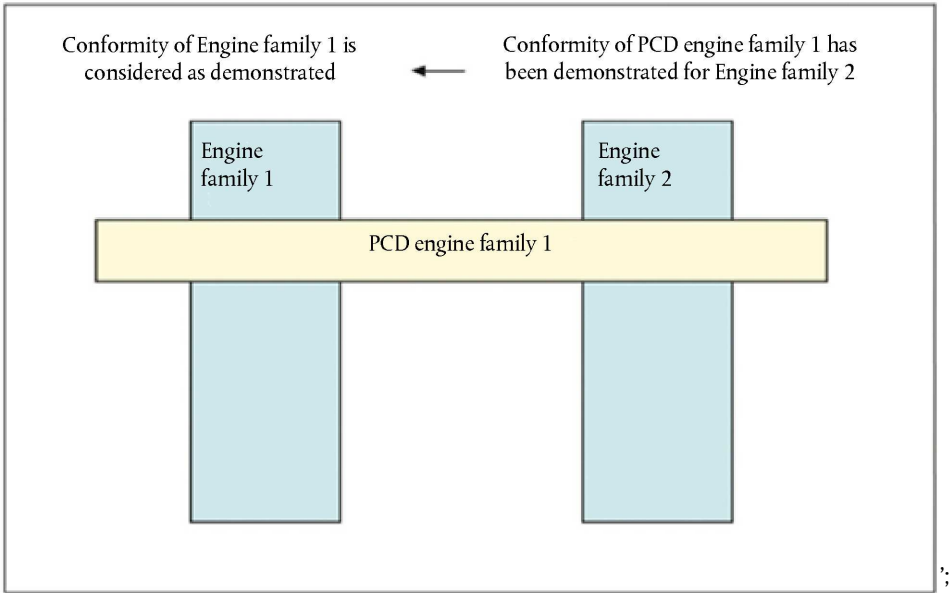
4.2. The duration of an incident of inadequate reagent level recorded in the on-board computer log as specified in point 4.1, in place of an inducement in accordance with point 6.3 of Appendix 1, shall commence when the reagent tank becomes empty, that is, when the dosing system is unable to draw further reagent from the tank, or at any level below 2,5 % of its nominally full capacity at the discretion of the manufacturer.

4.3. The duration of an incident recorded in the on-board computer log as specified in point 4.1, in place of the inducement specified in points 6.3, 7.3, 8.4 and 9.4 of Appendix 1, shall commence when the respective counter reaches the value for severe inducement in Table 4.4 of Appendix 1.

- 4.4. The duration of an incident recorded in the on-board computer log as specified in point 4.1, in place of the inducement specified in point 2.3.2.3.2 of Appendix 1, shall commence when inducement would have commenced.
- 4.5. The duration of an incident recorded in the on-board computer log as specified in point 4.1 shall end when the incident has been remedied.;
- (b) the following point 4.6 is inserted:
  - ‘4.6. When conducting a demonstration pursuant to section 10.4 of Appendix 1, the demonstration shall be conducted in accordance with the requirements applicable to demonstration of the severe inducement system, but the demonstration of severe inducement system shall be replaced by a demonstration of the storage of an incident of engine operation with inadequate reagent injection or reagent quality.’;
- (6) Appendix 4 is amended as follows:
  - (a) point 2.2.1 is replaced by the following:
    - ‘2.2.1. The PCD system shall, at a minimum, be operational at the applicable control conditions set out in point 2.4 of Annex IV for each engine category. The diagnostic system shall remain operational outside of this range where technically possible.’;
  - (b) point 3.1 is replaced by the following:
    - ‘3.1. The OEM shall provide to all end-users of new non-road mobile machinery written instructions about the emission control system and its correct operation as required in Annex XV.’;
  - (c) the following point 5.4 is inserted:
    - ‘5.4. A description of the connection for, and method to read, these records shall be included in the information folder as set out in Part A of Annex I of Implementing Regulation (EU) 2017/656.’;
  - (d) point 9.2.1 is replaced by the following:
    - ‘9.2.1. In the case where engines of an engine family belong to a PCD engine family that has already been EU type-approved, in accordance with point 2.3.6 (Figure 4.8), the compliance of that engine family is deemed to be demonstrated without further testing, provided the manufacturer demonstrates to the authority that the monitoring systems necessary for complying with the requirements of this Appendix are similar within the considered engine and PCD engine families.

Figure 4.8

Previously demonstrated conformity of a PCD engine family





(e) in point 9.3.3.6.2, point (a) is replaced by the following:

‘(a) the requested test-cycle results in a monitor that will run in real world operation conditions; and’;

(f) the following points 9.3.6 and 9.3.6.1 are added:

‘9.3.6. Documentation of the demonstration

9.3.6.1. A demonstration report shall document the demonstration of the PCD system. The report shall:

- (a) identify the failures examined;
  - (b) describe the demonstration performed including the applicable test cycle;
  - (c) confirm that the applicable warnings were activated as required by this regulation;
  - (d) be included in the information folder as set out in Part A of Annex I to Implementing Regulation (EU) 2017/656.’.
-

ANNEX V

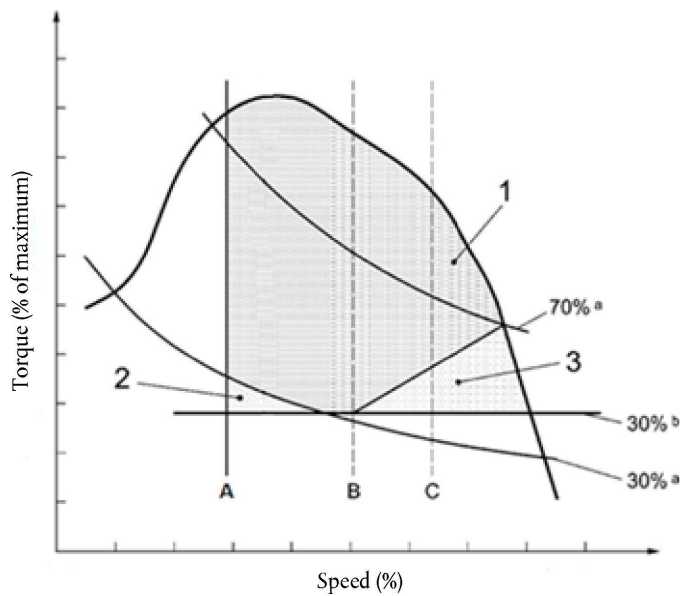
Annex V to Delegated Regulation (EU) 2017/654 is amended as follows:

(1) point 2.1.2 is amended as follows:

(a) Figure 5.2 is replaced by the following:

Figure 5.2

Control area for variable-speed engines of category NRE with maximum net power < 19 kW and variable-speed engines of category IWA with maximum net power < 300 kW, speed C < 2 400 rpm



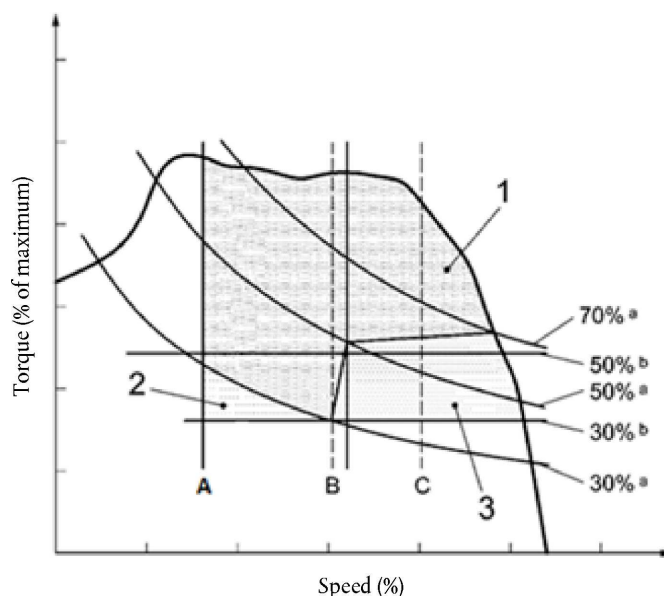
Key

- |                                   |                                     |
|-----------------------------------|-------------------------------------|
| 1 Engine Control Area             | 2 All Emissions Carve-Out           |
| 3 PM Carve-Out                    | <sup>a</sup> % of maximum net power |
| <sup>b</sup> % of maximum torque; |                                     |

(b) Figure 5.3 is replaced by the following:

‘Figure 5.3

**Control area for variable-speed engines of category NRE with maximum net power < 19 kW and variable-speed engines of category IWA with maximum net power < 300 kW, speed  $C \geq 2\,400$  rpm**



#### Key

- |   |   |
|---|---|
| 1 Engine Control Area                   | 2 All Emissions Carve-Out                 |
| 3 PM Carve-Out                          | <sup>a</sup> Percent of maximum net power |
| <sup>b</sup> Percent of maximum torque; |   |

(2) the following point 3.1 is inserted:

‘3.1. For the purpose of the random selections required in point 3, acknowledged statistical methods of randomization shall be used.’;

(3) point 4 is amended as follows:

(a) the introductory wording is replaced by the following

‘The test shall be carried out immediately after the applicable NRSC as follows.’;

(b) point (a) is replaced by the following:

‘(a) the test of the randomly selected torque and speed points shall either be carried out immediately after the discrete-mode NRSC test sequence described in points (a) to (e) of point 7.8.1.2 of Annex VI but before the post test procedures (f) or after the ramped modal non-road steady-state test cycle (“RMC”) test sequence described in points (a) to (d) of point 7.8.2.3 of Annex VI but before the post test procedures (e) as relevant.’;

(c) points (e) and (f) are replaced by the following:

‘(e) for gaseous and PN, if applicable, summation calculations,  $N_{mode}$  in equations (7-64) or (7-131) and (7-178) shall be set to 1 and a weighting factor of 1 shall be used;

(f) for PM calculations the multiple filter method shall be used; for summation calculations,  $N_{mode}$  in equations (7-67) or (7-134) shall be set to 1 and a weighting factor of 1 shall be used.’;

(4) the following point 5 is added:

‘5. Regeneration

In the case that a regeneration event occurs during or immediately preceding the procedure set out in point 4, upon completion of that procedure the test may be voided at the request of the manufacturer, irrespective of the cause of the regeneration. In this case the test shall be repeated. The same torque and speed points shall be used although the running order may be changed. It shall not be deemed necessary to repeat any torque and speed points for which a pass result has already been obtained. The following procedure shall be used for repeating the test:

- (a) The engine shall be operated in a manner to ensure that the regeneration event has completed and, where applicable, the soot load in the particulate after-treatment system has been re-established;
  - (b) The engine warm-up procedure shall be performed in accordance with point 7.8.1.1 of Annex VI;
  - (c) The test procedure specified in point 4 shall be repeated commencing at the stage referred to in point 4(b).’.
-

## ANNEX VI

Annex VI to Delegated Regulation (EU) 2017/654 is amended as follows:

- (1) point 1 is replaced by the following:

**‘1. Introduction**

This Annex describes the method of determining emissions of gaseous and particulate pollutants from the engine to be tested and the specifications related to the measurement equipment. As from section 6, the numbering of this Annex is consistent with the numbering of the Global technical regulation No 11 (\*) (GTR No 11) and UNECE Regulation No 96.04 series of amendments (\*\*), Annex 4B. However, some points of the GTR No 11 are not needed in this Annex, or are modified in accordance with the technical progress.

- (\*) Global technical regulation No 11 on Engine Emissions from agricultural and forestry tractors and from non-road mobile machinery under the Global Registry created on 18 November 2004, pursuant to Article 6 of the Agreement concerning the establishing of global technical regulations for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles.
- (\*\*) Regulation No 96 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of compression ignition (C.I.) engines to be installed in agricultural and forestry tractors and in non-road mobile machinery with regard to the emissions of pollutants by the engine.’;

- (2) in point 5.1, the second, third and fourth paragraphs are replaced by the following:

‘The measured values of gaseous and particulate pollutants and of CO<sub>2</sub> exhausted by the engine refer to the brake-specific emissions in grams per kilowatt-hour (g/kWh), or number per kilowatt-hour (#/kWh) for PN.

The gaseous and particulate pollutants that shall be measured are those for which limit values are applicable to the engine sub-category being tested as set out in Annex II to Regulation (EU) 2016/1628. The results, inclusive of:

- (a) the crankcase emissions determined in accordance with section 6.10, if relevant,
  - (b) the adjustment factors for infrequent regeneration of the after-treatment system determined in accordance with section 6.6, if relevant, and
  - (c) as the final step of the calculation, the deterioration factor determined in accordance with Annex III,
- shall not exceed the applicable limit values.

The CO<sub>2</sub> shall be measured and reported for all engine sub-categories as required by Article 43(4) of Regulation (EU) 2016/1628.’;

- (3) point 5.2.5.1.1 is replaced by the following:

**‘5.2.5.1.1. Calculation of MTS**

In order to calculate the MTS the transient mapping procedure shall be performed in accordance with point 7.4. The MTS is then determined from the mapped values of engine speed versus power. MTS shall be calculated by means of one of the following options:

- (a) Calculation based upon low speed and high speed values

$$MTS = n_{lo} + 0,95 \cdot (n_{hi} - n_{lo}) \quad (6-1)$$

where:

$n_{hi}$  is the high speed as defined in Article 1(12),

$n_{lo}$  is the low speed as defined in Article 1(13).

- (b) Calculation based upon the longest vector method

$$MTS = n_i \quad (6-2)$$

where:

$n_i$  is the average of the lowest and highest speeds at which  $(n_{normi}^2 + P_{normi}^2)$  is equal to 98 % of the maximum value of  $(n_{normi}^2 + P_{normi}^2)$

If there is only one speed at which the value of  $(n_{\text{normi}}^2 + P_{\text{normi}}^2)$  is equal to 98 % of the maximum value of  $(n_{\text{normi}}^2 + P_{\text{normi}}^2)$ :

$$\text{MTS} = n_i \quad (6-3)$$

where:

$n_i$  is the speed at which the maximum value of  $(n_{\text{normi}}^2 + P_{\text{normi}}^2)$  occurs.

where:

$n$  is the engine speed

$i$  is an indexing variable that represents one recorded value of an engine map

$n_{\text{normi}}$  is an engine speed normalized by dividing it by  $n_{\text{pmax}}$

$P_{\text{normi}}$  is an engine power normalized by dividing it by  $P_{\text{max}}$

$n_{\text{pmax}}$  is the average of the lowest and highest speeds at which power is equal to 98 % of  $P_{\text{max}}$ .

Linear interpolation shall be used between the mapped values to determine:

(i) the speeds where power is equal to 98 % of  $P_{\text{max}}$ . If there is only one speed at which power is equal to 98 % of  $P_{\text{max}}$ ,  $n_{\text{pmax}}$  shall be the speed at which  $P_{\text{max}}$  occurs;

(ii) the speeds where  $(n_{\text{normi}}^2 + P_{\text{normi}}^2)$  is equal to 98 % of the maximum value of  $(n_{\text{normi}}^2 + P_{\text{normi}}^2)$ ;

(4) point 5.2.5.2 is amended as follows:

(a) the first paragraph is replaced by the following:

‘The rated speed is defined in Article 3(29) of Regulation (EU) 2016/1628. Rated speed for variable-speed engines subject to an emission test other than those tested on a constant-speed NRSC defined in Article 1(31) of this Regulation shall be determined from the applicable mapping procedure set out in point 7.6 of this Annex. Rated speed for variable-speed engines tested on a constant-speed NRSC shall be declared by the manufacturer according to the characteristics of the engine. Rated speed for constant-speed engines shall be declared by the manufacturer according to the characteristics of the governor. Where an engine type equipped with alternative speeds as permitted by Article 3(21) of Regulation (EU) 2016/1628 is subject to an emission test, each alternative speed shall be declared and tested.’;

(b) the third paragraph is replaced by the following:

‘For engines of category NRSh the 100 % test speed shall be within  $\pm 350$  rpm of the rated speed declared by the manufacturer.’;

(5) point 5.2.5.3 is amended as follows:

(a) the introductory wording of the first paragraph is replaced by the following:

‘Where required, the maximum torque speed determined from the maximum torque curve established by the applicable engine mapping procedure in point 7.6.1 or 7.6.2 shall be one of the following’;

(b) in the last paragraph, the words ‘engines of category NRS or NRSh’ are replaced by the words ‘engines of category NRS’;

(6) in point 6.2, the first paragraph is replaced by the following:

‘A charge-air cooling system with a total intake-air capacity that represents production engines’ in-use installation shall be used. Any laboratory charge-air cooling system shall be designed to minimize accumulation of condensate. Any accumulated condensate shall be drained and all drains shall be completely closed before emission testing. The drains shall be kept closed during the emission test. Coolant conditions shall be maintained as follows:

(a) a coolant temperature of at least 293 K (20 °C) shall be maintained at the inlet to the charge-air cooler throughout testing;

- (b) at the rated speed and full load, the coolant flow rate shall be set to achieve an air temperature within  $\pm 5$  K ( $\pm 5$  °C) of the value designed by the manufacturer after the charge-air cooler's outlet. The air- outlet temperature shall be measured at the location specified by the manufacturer. This coolant flow rate set point shall be used throughout testing;
- (c) if the engine manufacturer specifies pressure-drop limits across the charge-air cooling system, it shall be ensured that the pressure drop across the charge-air cooling system at engine conditions specified by the manufacturer is within the manufacturer's specified limit(s). The pressure drop shall be measured at the manufacturer's specified locations;';

(7) point 6.3.4 is replaced by the following:

**'6.3.4. Determination of auxiliary power**

Where applicable as per point 6.3.2 and 6.3.3, the values of auxiliary power and the measurement/calculation method for determining auxiliary power shall be submitted by the engine manufacturer for the whole operating area of the applicable test cycles, and approved by the approval authority;';

(8) point 6.6.2.3 is amended as follows:

- (a) the last sentence of the first paragraph is replaced by the following:

'The exact procedure to determine this frequency shall be agreed by the approval authority based upon good engineering judgement.';

- (b) the title of Figure 6.1 is replaced by the following:

'Figure 6.1

**Scheme of infrequent regeneration with  $n$  number of measurements and  $n_r$  number of measurements during regeneration';**

- (c) equation (6-9) and the legend thereof are replaced by the following:

$$\bar{e}_w = \frac{n \cdot \bar{e} + n_r \cdot \bar{e}_r}{n + n_r} \quad (6-9)$$

Where:

$n$  is the number of tests in which regeneration does not occur,

$n_r$  is the number of tests in which regeneration occurs (minimum one test),

$\bar{e}$  is the average specific emission from a test in which the regeneration does not occur [g/kWh or #/kWh]

$\bar{e}_r$  is the average specific emission from a test in which the regeneration occurs [g/kWh or #/kWh];

- (d) equations (6-10) and (6-11) are replaced by the following:

$$k_{ru,m} = \frac{\bar{e}_w}{\bar{e}} \quad (\text{upward adjustment factor}) \quad (6-10)$$

$$k_{rd,m} = \frac{\bar{e}_w}{\bar{e}_r} \quad (\text{downward adjustment factor}) \quad (6-11)';$$

- (a) equations (6-12) and (6-13) are replaced by the following:

$$k_{ru,a} = \bar{e}_w - \bar{e} \quad (\text{upward adjustment factor}) \quad (6-12)$$

$$k_{rd,a} = \bar{e}_w - \bar{e}_r \quad (\text{downward adjustment factor}) \quad (6-13)';$$

(9) in point 6.6.2.4, in the third paragraph, point (b) is replaced by the following:

- (b) Upon request by the manufacturer, the approval authority may account for regeneration events differently than pursuant to point (a). However, this option only applies to events that occur extremely infrequently, and which cannot be practically addressed using the adjustment factors described in point 6.6.2.3.';

(10) point 7.3.1.1 is amended as follows:

- (a) the heading is replaced by the following:

'7.3.1.1. General requirements for preconditioning the sampling system and the engine';

(b) the following paragraph is added:

‘Engines fitted with an after-treatment system may be operated prior to cycle-specific preconditioning set out in points 7.3.1.1.1 to 7.3.1.1.4, so that the after-treatment system is regenerated and, where applicable, the soot load in the particulate after-treatment system is re-established.’;

(11) point 7.3.1.1.5 is deleted;

(12) points 7.3.1.2 to 7.3.1.5 are replaced by the following:

‘7.3.1.2. Engine cool-down (NRTC)

A natural or forced cool-down procedure may be applied. For forced cool-down, good engineering judgment shall be used to set up systems to send cooling air across the engine, to send cool oil through the engine lubrication system, to remove heat from the coolant through the engine cooling system, and to remove heat from an exhaust after-treatment system. In the case of a forced after-treatment cool down, cooling air shall not be applied until the exhaust after-treatment system has cooled below its catalytic activation temperature. Any cooling procedure that results in unrepresentative emissions is not permitted.

7.3.1.3. Verification of HC contamination

If there is any presumption of an essential HC contamination of the exhaust gas measuring system, the contamination with HC may be checked with zero gas and the hang-up may then be corrected. If the amount of contamination of the measuring system and the background HC system has to be checked, it shall be conducted within 8 hours of starting each test-cycle. The values shall be recorded for later correction. Before this check, the leak check has to be performed and the FID analyzer has to be calibrated.

7.3.1.4. Preparation of measurement equipment for sampling

The following steps shall be taken before emission sampling begins:

- (a) Leak checks shall be performed within 8 hours prior to emission sampling in accordance with point 8.1.8.7;
- (b) For batch sampling, clean storage media shall be connected, such as evacuated bags or tare-weighted filters;
- (c) All measurement instruments shall be started in accordance with the instrument manufacturer's instructions and good engineering judgment;
- (d) Dilution systems, sample pumps, cooling fans, and the data-collection system shall be started;
- (e) The sample flow rates shall be adjusted to desired levels, using bypass flow, if desired;
- (f) Heat exchangers in the sampling system shall be pre-heated or pre-cooled to within their operating temperature ranges for a test;
- (g) Heated or cooled components such as sample lines, filters, chillers, and pumps shall be allowed to stabilize at their operating temperatures;
- (h) Exhaust gas dilution system flow shall be switched on at least 10 minutes before a test sequence;
- (i) Calibration of gas analyzers and zeroing of continuous analyzers shall be carried out in accordance with the procedure of point 7.3.1.5;
- (j) Any electronic integrating devices shall be zeroed or re-zeroed, before the start of any test interval.

7.3.1.5. Calibration of gas analyzers

Appropriate gas analyzer ranges shall be selected. Emission analyzers with automatic or manual range switching are allowed. During a test using transient (NRTC or LSI-NRTC) test cycles or RMC and during a sampling period of a gaseous emission at the end of each mode for discrete-mode NRSC testing, the range of the emission analyzers shall not be switched. Also the gains of an analyzer's analogue operational amplifier(s) shall not be switched during a test cycle.



All continuous analyzers shall be zeroed and spanned using internationally-traceable gases that meet the specifications of point 9.5.1. FID analyzers shall be spanned on a carbon number basis of one (C<sub>1</sub>).;

(13) the following point 7.3.1.6 is inserted:

‘7.3.1.6. PM filter preconditioning and tare weighing

The procedures for PM filter preconditioning and tare weighing shall be performed in accordance with point 8.2.3.’;

(14) point 7.4 is replaced by the following:

‘7.4. Test cycles

The EU type-approval test shall be conducted using the appropriate NRSC and, where applicable, NRTC or LSI-NRTC, specified in Article 18 of Regulation (EU) 2016/1628 and Annex IV thereto. The technical specifications and characteristics of the NRSC, NRTC and LSI-NRTC are laid down in Annex XVII of this Regulation and the method for determination of the torque, power and speed settings for these test cycles set out in section 5.2.’;

(15) point 7.5 is amended as follows:

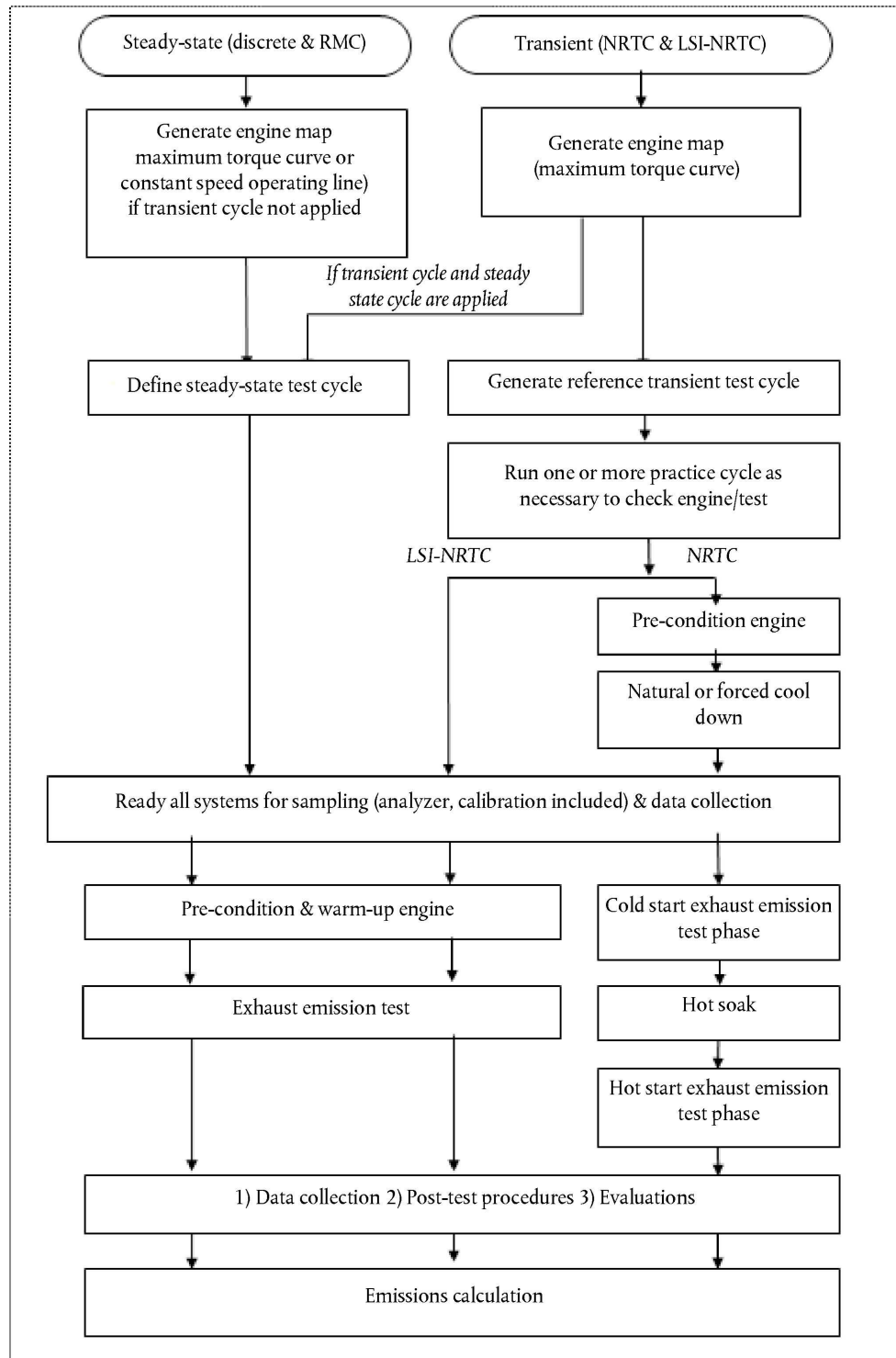
(a) in the first paragraph, point (h) is replaced by the following:

‘(h) PM filter(s) shall be pre-conditioned, weighed (empty weight), loaded, re-conditioned, again weighed (loaded weight) and then samples shall be evaluated in accordance with the pre-test (point 7.3.1.6) and post-test (point 7.3.2.2) procedures’;

(b) Figure 6.4 is replaced by the following:

‘Figure 6.4

**Test sequence**



(16) in point 7.5.1.2, points (a) and (b) are replaced by the following:

- ‘(a) If the engine stalls anywhere during the cold start run of the NRTC, the entire test shall be voided;
- (b) If the engine stalls anywhere during the hot-start run of the NRTC, only this run shall be voided. The engine shall be soaked in accordance with point 7.8.3, and the hot-start run repeated. In this case, the cold-start run does not need to be repeated;’

(17) point 7.8.1.2 is amended as follows:

(a) point (b) is replaced by the following:

‘(b) Each mode has a mode length of at least 10 minutes. In each mode the engine shall be stabilised for at least 5 minutes. Gaseous emissions, and, where applicable, PN, shall be sampled for 1 to 3 minutes at the end of each mode and PM emissions shall be sampled in accordance with point (c).

Notwithstanding the previous paragraph, when either testing spark ignition engines using cycles G1, G2 or G3 or when conducting measurements in accordance with Annex V of this Regulation each mode has a mode length of at least 3 minutes. In this case gaseous emissions, and, where applicable, PN, shall be sampled for at least the last 2 minutes of each mode and PM emissions shall be sampled in accordance with point (c). The mode length and sampling time may be extended to improve accuracy.

The mode length shall be recorded and reported.’;

(b) in point (c), the first paragraph is replaced by the following:

‘For PM emissions, the PM sampling may be done either with the single filter method or with the multiple filter method. Since the results of the methods may differ slightly, the method used shall be declared with the results.’;

(18) in point 7.8.2.4, the last sentence of the first paragraph is replaced by the following:

‘When conducting testing of engines of reference power greater than 560 kW the regression line tolerances of Table 6.2 and the point deletion of Table 6.3 may be used.’;

(19) in point 7.8.3.5, Table 6.3 is replaced by the following:

‘Table 6.3

**Permitted point deletions from regression analysis**

Event	Conditions ( $n$ = engine speed, $T$ = torque)	Permitted point deletions
Minimum operator demand (idle point)	$n_{\text{ref}} = n_{\text{idle}}$ and $T_{\text{ref}} = 0 \%$ and $T_{\text{act}} > (T_{\text{ref}} - 0,02 T_{\text{maxmappedtorque}})$ and $T_{\text{act}} < (T_{\text{ref}} + 0,02 T_{\text{maxmappedtorque}})$	speed and power
Minimum operator demand	$n_{\text{act}} \leq 1,02 n_{\text{ref}}$ and $T_{\text{act}} > T_{\text{ref}}$ or $n_{\text{act}} > n_{\text{ref}}$ and $T_{\text{act}} \leq T_{\text{ref}}$ or $n_{\text{act}} > 1,02 n_{\text{ref}}$ and $T_{\text{ref}} < T_{\text{act}} \leq (T_{\text{ref}} + 0,02 T_{\text{maxmappedtorque}})$	power and either torque or speed
Maximum operator demand	$n_{\text{act}} < n_{\text{ref}}$ and $T_{\text{act}} \geq T_{\text{ref}}$ or $n_{\text{act}} \geq 0,98 n_{\text{ref}}$ and $T_{\text{act}} < T_{\text{ref}}$ or $n_{\text{act}} < 0,98 n_{\text{ref}}$ and $T_{\text{ref}} > T_{\text{act}} \geq (T_{\text{ref}} - 0,02 T_{\text{maxmappedtorque}})$	power and either torque or speed

Where:

$n_{\text{ref}}$  is the reference speed (see section 7.7.2.),

$n_{\text{idle}}$  is the idle speed,

$n_{\text{act}}$  is the actual (measured) speed,

$T_{\text{ref}}$  is the reference torque (see section 7.7.2.),

$T_{\text{act}}$  is the actual (measured) torque,

$T_{\text{maxmappedtorque}}$  is the highest value of torque on the full-load torque curve mapped in accordance with section 7.6.’;

(20) in point 8.1.2, Table 6.4 is amended as follows:

(a) the row referring to point 8.1.11.4 is replaced by the following:

'8.1.11.4.: Sample dryer NO <sub>2</sub> penetration (chiller)	Upon initial installation and after major maintenance.;
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(b) the row referring to point 8.1.12.1 is replaced by the following:

'8.1.12.: Sample dryer verification	For thermal chillers: upon installation and after major maintenance. For osmotic membranes: upon installation, within 35 days of testing and after major maintenance.;
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(21) point 8.1.7 is replaced by the following:

'8.1.7. Measurement of engine parameters and ambient conditions

Internal quality procedures traceable to recognised national or international standards shall be applied. Otherwise the following procedures apply.;

(22) in point 8.1.8.4.1(f), the first paragraph is replaced by the following:

'CFV or SSV may alternatively be removed from its permanent position for calibration as long as the following requirements are met when installed in the CVS.:'

(23) in point 8.1.8.5.1(a), point (iv) is replaced by the following:

'(iv) The hydrocarbon contamination verification in the sample system shall be performed as described in point 7.3.1.3.:'

(24) in point 8.1.8.5.4, the first and second sentence below the heading are replaced by the following:

'Vacuum side leak check verification of the HC sampling system may be performed in accordance with point (g). If this procedure is used, the HC contamination procedure set out in point 7.3.1.3 may be used.:'

(25) point 8.1.8.5.8 is deleted;

(26) point 8.1.9.1.2 is replaced by the following:

'8.1.9.1.2. Measurement principles

H<sub>2</sub>O can interfere with an NDIR analyzer's response to CO<sub>2</sub>. If the NDIR analyzer uses compensation algorithms that utilize measurements of other gases to meet this interference verification, these other measurements shall be conducted simultaneously to test the compensation algorithms during the analyzer interference verification.;

(27) in point 8.1.9.1.4, point (b) is replaced by the following:

'(b) A humidified test gas shall be created by bubbling zero air that meets the specifications set out in point 9.5.1 through distilled water in a sealed vessel. If the sample is not passed through a dryer, control the vessel temperature to generate an H<sub>2</sub>O content in the test gas at least as high as the maximum expected during testing. If the sample is passed through a dryer during testing, control the vessel temperature to generate an H<sub>2</sub>O content in the test gas at least as high as the maximum expected at the outlet of the dryer, in accordance with point 9.3.2.3.1.1.:'

(28) point 8.1.9.2.4(b) is replaced by the following:

'(b) A humidified CO<sub>2</sub> test gas shall be created by bubbling a CO<sub>2</sub> span gas through distilled water in a sealed vessel. If the sample is not passed through a dryer, the vessel temperature shall be controlled to generate an H<sub>2</sub>O content in the test gas at least as high as the maximum expected during testing. If the sample is passed through a dryer during testing, the vessel temperature shall be controlled to generate an H<sub>2</sub>O content in the test gas at least as high as the maximum expected at the outlet of the dryer, in accordance with point 9.3.2.3.1.1. A CO<sub>2</sub> span gas concentration shall be used at least as high as the maximum expected during testing.:'

(29) point 8.1.10.1.3 is amended as follows:

(a) in point (b), the last sentence is replaced by the following:

‘With the FID fuel and airflow rates set at the manufacturer’s recommendations, a span gas shall be introduced to the analyzer;’

(b) point (c) is amended as follows:

(i) point (i) is replaced by the following:

‘(i) The response at a given FID fuel flow shall be determined from the difference between the span gas response and the zero gas response;’

(ii) in point (ii), the last sentence is replaced by the following:

‘The span and zero response at these FID fuel flows shall be recorded;’

(30) in point 8.1.10.2.4(a), the second sentence is deleted;

(31) point 8.1.11.1.5 is amended as follows:

(a) point (e) is replaced by the following:

‘(e) The NO span gas shall be humidified by bubbling it through distilled water in a sealed vessel. If the humidified NO span gas sample does not pass through a sample dryer for this verification test, the vessel temperature shall be controlled to generate an H<sub>2</sub>O content in the span gas approximately equal to the maximum mole fraction of H<sub>2</sub>O expected during emission testing. If the humidified NO span gas sample does not pass through a sample dryer, the quench verification calculations in point 8.1.11.2.3 scale the measured H<sub>2</sub>O quench to the highest mole fraction of H<sub>2</sub>O expected during emission testing. If the humidified NO span gas sample passes through a dryer for this verification test, the vessel temperature shall be controlled to generate an H<sub>2</sub>O content in the span gas at least as high as the maximum expected at the outlet of the dryer in accordance with point 9.3.2.3.1.1. In this case, the quench verification calculations set out in point 8.1.11.2.3 do not scale the measured H<sub>2</sub>O quench;’

(b) the last sentence of point (f) is replaced by the following: ‘Note that the sample dryer shall meet the sample dryer verification check in point 8.1.12;’

(32) in point 8.1.11.3.4(g), the introductory wording is replaced by the following:

‘This difference shall be multiplied by the ratio of the expected mean HC concentration to the HC concentration measured during the verification. The analyzer meets the interference verification of this point if this result is within  $\pm 2\%$  of the NO<sub>x</sub> concentration expected at the emission limit value, as set out in equation (6-25);’

(33) in point 8.1.11.4.2, the words ‘cooling bath’ are replaced by the words ‘sample dryer’.

(34) point 8.1.12 is replaced by the following:

#### ‘8.1.12. Sample dryer verification

If a humidity sensor for continuous monitoring of dew point at the sample dryer outlet is used this check does not apply, as long as it is ensured that the dryer outlet humidity is below the minimum values used for quench, interference, and compensation checks.

If a sample dryer is used as allowed in point 9.3.2.3.1 to remove water from the sample gas, the performance shall be verified upon installation, after major maintenance, for thermal chillers. For osmotic membrane dryers, the performance shall be verified upon installation, after major maintenance, and within 35 days of testing.

Water can inhibit an analyzer’s ability to properly measure the exhaust component of interest and thus is sometimes removed before the sample gas reaches the analyzer. For example water can negatively interfere with a CLD’s NO<sub>x</sub> response through collisional quenching and can positively interfere with an NDIR analyzer by causing a response similar to CO.

The sample dryer shall meet the specifications as determined in point 9.3.2.3.1 for dew point,  $T_{\text{dew}}$ , and absolute pressure,  $p_{\text{total}}$ , downstream of the osmotic-membrane dryer or thermal chiller.

The following sample dryer verification procedure method shall be used to determine sample dryer performance, or good engineering judgment shall be used to develop a different protocol:

- (i) polytetrafluoroethylene ("PTFE") or stainless steel tubing shall be used to make necessary connections;
- (ii)  $N_2$  or purified air shall be humidified by bubbling it through distilled water in a sealed vessel that humidifies the gas to the highest sample dew point that is estimated during emission sampling;
- (iii) The humidified gas shall be introduced upstream of the sample dryer;
- (iv) The humidified gas temperature downstream of the vessel shall be maintained at least 5 K (5 °C) above its dew point;
- (v) The humidified gas dew point,  $T_{\text{dew}}$ , and pressure,  $p_{\text{total}}$ , shall be measured as close as possible to the inlet of the sample dryer to verify that the dew point is the highest that was estimated during emission sampling;
- (vi) The humidified gas dew point,  $T_{\text{dew}}$ , and pressure,  $p_{\text{total}}$ , shall be measured as close as possible to the outlet of the sample dryer;
- (vii) The sample dryer meets the verification if the result of point (d)(vi) of this section is less than the dew point corresponding to the sample dryer specifications as determined in point 9.3.2.3.1 plus 2 K (2 °C) or if the mol fraction from (d)(vi) is less than the corresponding sample dryer specifications plus 0,002 mol/mol or 0,2 volume %. Note for this verification, sample dew point is expressed in absolute temperature, Kelvin.;

(35) points 8.1.12.1 to 8.1.12.2.5 are deleted;

(36) the following points 8.1.13 to 8.1.13.2.5 are inserted:

#### ‘8.1.13. PM measurements

##### 8.1.13.1. PM balance verifications and weighing process verification

###### 8.1.13.1.1. Scope and frequency

This section describes three verifications.

- (a) Independent verification of PM balance performance within 370 days prior to weighing any filter;
- (b) Zero and span of the balance within 12 h prior to weighing any filter;
- (c) Verification that the mass determination of reference filters before and after a filter weighing session be less than a specified tolerance.

###### 8.1.13.1.2. Independent verification

The balance manufacturer (or a representative approved by the balance manufacturer) shall verify the balance performance within 370 days of testing in accordance with internal audit procedures.

###### 8.1.13.1.3. Zeroing and spanning

Balance performance shall be verified by zeroing and spanning it with at least one calibration weight, and any weights that are used shall meet the specifications in point 9.5.2 to perform that verification. A manual or automated procedure shall be used:

- (a) A manual procedure requires that the balance shall be used in which the balance shall be zeroed and spanned with at least one calibration weight. If normally mean values are obtained by repeating the weighing process to improve the accuracy and precision of PM measurements, the same process shall be used to verify balance performance;
- (b) An automated procedure is carried out with internal calibration weights that are used automatically to verify balance performance. These internal calibration weights shall meet the specifications in point 9.5.2 to perform that verification.

#### 8.1.13.1.4. Reference sample weighing

All mass readings during a weighing session shall be verified by weighing reference PM sample media (e.g. filters) before and after a weighing session. A weighing session may be as short as desired, but no longer than 80 hours, and may include both pre- and post-test mass readings. Successive mass determinations of each reference PM sample media shall return the same value within  $\pm 10 \mu\text{g}$  or  $\pm 10 \%$  of the expected total PM mass, whichever is higher. Should successive PM sample filter weighing events fail that criterion, all individual test filter mass readings occurring between the successive reference filter mass determinations shall be invalidated. These filters may be re-weighed in another weighing session. Should a post-test filter be invalidated then the test interval is void. That verification shall be performed as follows:

- (a) At least two samples of unused PM sample media shall be kept in the PM-stabilization environment. These shall be used as references. Unused filters of the same material and size shall be selected for use as references;
- (b) References shall be stabilized in the PM stabilization environment. References shall be considered stabilized if they have been in the PM-stabilization environment for a minimum of 30 min, and the PM-stabilization environment has been within the specifications of point 9.3.4.4 for at least the preceding 60 min;
- (c) The balance shall be exercised several times with a reference sample without recording the values;
- (d) The balance shall be zeroed and spanned. A test mass shall be placed on the balance (e.g. calibration weight) and then removed ensuring that the balance returns to an acceptable zero reading within the normal stabilization time;
- (e) Each of the reference media (e.g. filters) shall be weighed and their masses recorded. If normally mean values are obtained by repeating the weighing process to improve the accuracy and precision of reference media (e.g. filters) masses, the same process shall be used to measure mean values of sample media (e.g. filters) masses;
- (f) The balance environment dew point, ambient temperature, and atmospheric pressure shall be recorded;
- (g) The recorded ambient conditions shall be used to correct results for buoyancy as described in point 8.1.13.2. The buoyancy-corrected mass of each of the references shall be recorded;
- (h) Each of the reference media's (e.g. filter's) buoyancy-corrected reference mass shall be subtracted from its previously measured and recorded buoyancy-corrected mass;
- (i) If any of the reference filters' observed mass changes by more than that allowed under this section, all PM mass determinations made since the last successful reference media (e.g. filter) mass validation shall be invalidated. Reference PM filters may be discarded if only one of the filters mass has changed by more than the allowable amount and a special cause for that filter's mass change can be positively identified which would not have affected other in-process filters. Thus the validation can be considered a success. In that case, the contaminated reference media shall not be included when determining compliance with paragraph (j) of this point, but the affected reference filter shall be discarded and replaced;
- (j) If any of the reference masses change by more than that allowed under point 8.1.13.1.4, all PM results that were determined between the two times that the reference masses were determined shall be invalidated. If reference PM sample media is discarded in accordance with point (i), at least one reference mass difference that meets the criteria set out in point 8.1.13.1.4 shall be available. Otherwise, all PM results that were determined between the two times that the reference media (e.g. filters) masses were determined shall be invalidated.

#### 8.1.13.2. PM sample filter buoyancy correction

##### 8.1.13.2.1. General

PM sample filter shall be corrected for their buoyancy in air. The buoyancy correction depends on the sample media density, the density of air, and the density of the calibration weight used to calibrate the balance. The buoyancy correction does not account for the buoyancy of the PM itself, because the mass of PM typically accounts for only (0,01 to 0,10) % of the total weight. A correction to this small fraction of mass would be at the most 0,010 %. The buoyancy-corrected values are the tare masses of

the PM samples. These buoyancy-corrected values of the pre-test filter weighing are subsequently subtracted from the buoyancy-corrected values of the post-test weighing of the corresponding filter to determine the mass of PM emitted during the test.

#### 8.1.13.2.2. PM sample filter density

Different PM sample filter have different densities. The known density of the sample media shall be used, or one of the densities for some common sampling media shall be used, as follows:

- (a) For PTFE-coated borosilicate glass, a sample media density of 2 300 kg/m<sup>3</sup> shall be used;
- (b) For PTFE membrane (film) media with an integral support ring of polymethylpentene that accounts for 95 % of the media mass, a sample media density of 920 kg/m<sup>3</sup> shall be used;
- (c) For PTFE membrane (film) media with an integral support ring of PTFE, a sample media density of 2 144 kg/m<sup>3</sup> shall be used.

#### 8.1.13.2.3. Air density

Because a PM balance environment shall be tightly controlled to an ambient temperature of 295 ± 1 K (22 ± 1 °C) and a dew point of 282,5 ± 1 K (9,5 ± 1 °C), air density is primarily function of atmospheric pressure. Therefore a buoyancy correction is specified that is only a function of atmospheric pressure.

#### 8.1.13.2.4. Calibration weight density

The stated density of the material of the metal calibration weight shall be used.

#### 8.1.13.2.5. Correction calculation

The PM sample filter shall be corrected for buoyancy by means of equation (6-27):

$$m_{\text{cor}} = m_{\text{uncor}} \cdot \left( \frac{1 - \frac{\rho_{\text{air}}}{\rho_{\text{weight}}}}{1 - \frac{\rho_{\text{air}}}{\rho_{\text{media}}}} \right) \quad (6-27)$$

Where:

- $m_{\text{cor}}$  is the PM sample filter mass corrected for buoyancy
  - $m_{\text{uncor}}$  is the PM sample filter mass uncorrected for buoyancy
  - $\rho_{\text{air}}$  is the density of air in balance environment
  - $\rho_{\text{weight}}$  is the density of calibration weight used to span balance
  - $\rho_{\text{media}}$  is the density of PM sample filter
- with

$$\rho_{\text{air}} = \frac{p_{\text{abs}} \cdot M_{\text{mix}}}{R \cdot T_{\text{amb}}} \quad (6-28)$$

Where:

- $p_{\text{abs}}$  is the absolute pressure in balance environment
- $M_{\text{mix}}$  is the molar mass of air in balance environment
- $R$  is the molar gas constant.
- $T_{\text{amb}}$  is the absolute ambient temperature of balance environment';

(37) in point 9.3.2.1.1, the first sentence is replaced by the following:

'When used in accordance with point 9.3.1.1.1, the internal volume of the mixing chamber shall not be less than ten times the individual cylinder swept volume of the engine under test.';



(38) in point 9.3.2.2, point (b) is replaced by the following:

‘(b) For THC transfer lines a wall temperature tolerance throughout the entire line of  $(464 \pm 11)$  K [ $(191 \pm 11)$  °C] shall be maintained. If sampled from raw exhaust gas, an unheated, insulated transfer line may be connected directly to a probe. The length and insulation of the transfer line shall be designed to cool the highest expected raw exhaust gas temperature to no lower than 191 °C, as measured at the transfer line outlet. For dilute sampling a transition zone between the probe and transfer line of up to 0,92 m in length is allowed to transition the wall temperature to  $(464 \pm 11)$  K [ $(191 \pm 11)$  °C].’;

(39) in point 9.3.2.3.1.1, the last paragraph is replaced by the following:

‘For the highest expected water vapour concentration  $H_m$ , the water removal technique shall maintain humidity at  $\leq 5$  g water/kg dry air (or about 0,8 volume %  $H_2O$ ), which is 100 % relative humidity at 277,1 K (3,9 °C) and 101,3 kPa. This humidity specification is equivalent to about 25 % relative humidity at 298 K (25 °C) and 101,3 kPa. This may be demonstrated by either:

- (a) measuring the temperature at the outlet of the sample dryer; or
- (b) measuring humidity at a point just upstream of the CLD; or
- (c) performing the verification procedure in point 8.1.12.’;

(40) in point 9.3.3.4.3, the second sentence is replaced by the following:

‘Sample temperature shall be controlled to a  $320 \pm 5$  K ( $47 \pm 5$  °C) tolerance, as measured anywhere within 200 mm upstream or 200 mm downstream of the PM filter media.’;

(41) in point 9.3.4.4, in point (b), the last sentence is replaced by the following:

‘This value shall be used to calculate the PM sample filter buoyancy correction in point 8.1.13.2.’;

(42) in point 9.4.1.2, the last sentence is replaced by the following:

‘Where more than one instrument for a particular measurement is specified, one of them will be identified by the approval authority upon application as the reference for showing that an alternative procedure is equivalent to the specified procedure.’;

(43) in point 9.4.1.3, the first sentence is replaced by the following:

‘Data from multiple instruments to calculate test results for a single test may be used for all measurement instruments described in this point, with prior approval of the approval authority.’;

(44) in point 9.4.5.3.2, the first sentence is replaced by the following:

‘For the purpose of controlling of a partial flow dilution system to extract a proportional raw exhaust gas sample, a flow meter response time faster than indicated in Table 6.8 is required.’;

(45) in point 9.4.6, the last sentence is replaced by the following:

‘The NDIR-based system shall meet the calibration and verifications set out in point 8.1.9.1 or 8.1.9.2, as applicable.’;

(46) in point 9.4.12, the paragraph below the heading is replaced by the following:

‘A FTIR (Fourier transform infrared) analyser, NDUV or laser infrared analyser may be used in accordance with Appendix 4.’;

(47) point 9.5.1.1(a) is amended as follows,

(a) point (i) is replaced by the following:

‘(i) 2 % contamination, measured relative to the mean concentration expected at the emission limit value. For example, if a CO concentration of 100,0  $\mu\text{mol/mol}$  is expected, then it would be allowed to use a zero gas with CO contamination less than or equal to 2 000  $\mu\text{mol/mol}$ .’;

(b) in point (iii), in Table 6.9, the third row is replaced by the following:

‘CO <sub>2</sub>	$\leq 10 \mu\text{mol/mol}$	$\leq 10 \mu\text{mol/mol}$ ’;
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(48) in point 9.5.1.1(c), point (i) is replaced by the following:

‘(i) CH<sub>4</sub>, balance purified synthetic air and/or N<sub>2</sub> (as applicable);’

(49) in point 9.5.1.2, point (b) is replaced by the following:

‘(b) Calibration gases may be relabelled and used after their expiration date if it is approved in advance by approval authority.’;

(50) in point 9.5.1.3, the second paragraph below the heading is deleted;

(51) Appendix 1 is amended as follows:

(a) in point 1.3.4, the first sentence is replaced by the following:

‘For particle number measurement, exhaust gas mass flow rate, determined according to any of the methods described in points 2.1.6.1 to 2.1.6.4 of Annex VII, is used for controlling the partial flow dilution system to take a sample proportional to the exhaust gas mass flow rate.’;

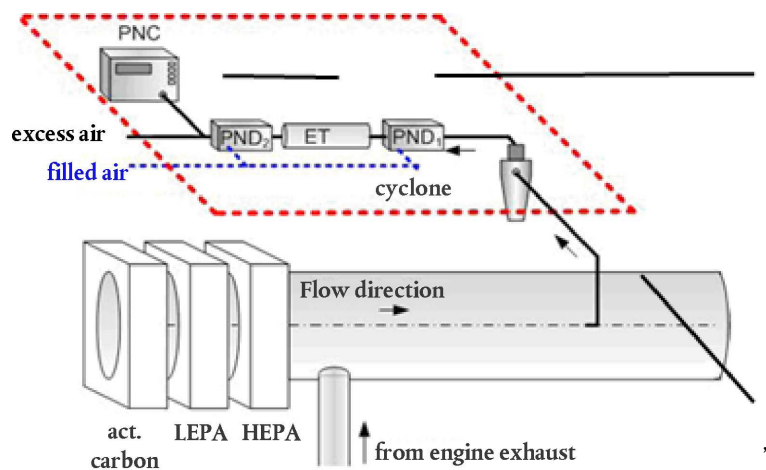
(b) in point 2.1.3.3.3, the first sentence is replaced by the following:

‘Control heated stages to constant nominal operating temperatures, within the range specified in point 2.1.3.3.2, to a tolerance of  $\pm 10$  K ( $\pm 10$  °C).’;

(c) in point 2.1.4, figure 6.10 is replaced by the following

‘Figure 6.10

**Schematic of recommended particle sampling system – Full flow sampling**



(52) in Appendix 3, in point 3, in the second paragraph, the first sentence is replaced by the following:

‘The torque broadcast by the ECU shall be accepted without correction if, at each point where measurements were taken, the factor calculated from dividing the torque value from the dynamometer by the torque value from the ECU is not less than 0,93 (i.e. a maximum difference of 7 %).’;

(53) Appendix 4 is amended as follows:

(a) in point 4.2.7, the last sentence is replaced by the following:

‘The expiration date of the calibration gases shall be recorded.’;

(b) in point 4.2.8, point (j) is replaced by the following:

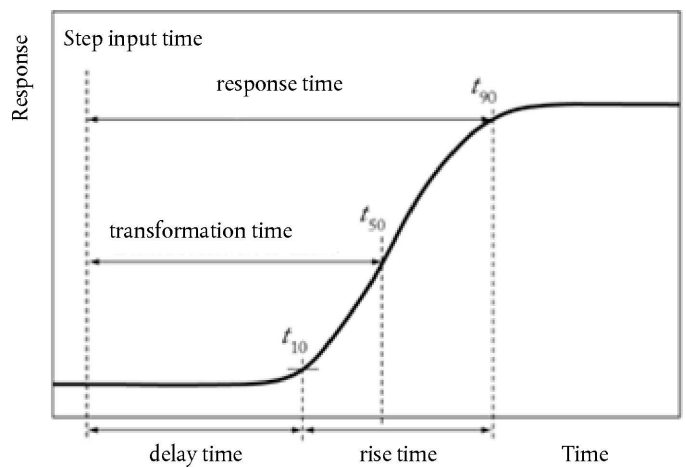
‘(j) Analyser shall have combined interference within  $\pm 2$  % of the applicable mean value of ammonia (NH<sub>3</sub>) specified in point 3.4 of Annex IV.’;

(54) Appendix 5 is amended as follows:

(a) in point 2.4, figure 6-11 is replaced by the following:

Figure 6-11

**Illustration of system responses**



(b) the following point 2.5 is added:

‘2.5. Step input time is the time at which there is a change in the parameter being measured.’.

## ANNEX VII

Annex VII to Delegated Regulation (EU) 2017/654 is amended as follows:

- (1) point 2.1 is replaced by the following:

‘2.1. Measurement of gaseous emissions in raw exhaust gas’;

- (2) in point 2.1.1, equation (7-1) is replaced by the following:

$$q_{\text{gas},i} = k_h \cdot k \cdot u_{\text{gas}} \cdot q_{\text{mew},i} \cdot c_{\text{gas},i} \cdot 3\,600 \quad (7-1);$$

- (3) in point 2.1.3, equation (7-4) is replaced by the following:

$$k_{w,a} = \frac{\left(1 - \frac{1,2442 \cdot H_a + 111,19 \cdot w_H}{773,4 + 1,2442 \cdot H_a + \frac{q_{\text{mf},i}}{q_{\text{mad},i}} \cdot k_f \cdot 1\,000} \cdot \frac{q_{\text{mf},i}}{q_{\text{mad},i}}\right)}{\left(1 - \frac{p_r}{p_b}\right)} \quad (7-4);$$

- (4) in point 2.1.5.2., equation (7-13) is replaced by the following:

$$M_{e,i} = \frac{1 + \frac{q_{\text{mf},i}}{q_{\text{maw},i}}}{\frac{q_{\text{mf},i}}{q_{\text{maw},i}} \cdot \frac{\frac{a}{4} + \frac{\varepsilon}{2} + \frac{\delta}{2}}{12,011 + 1,00794 \cdot a + 15,9994 \cdot \varepsilon + 14,0067 \cdot \delta + 32,065 \cdot \gamma} + \frac{H_a \cdot 10^{-3}}{2 \times 1,00794 + 15,9994 + \frac{1}{M_a}} \cdot \frac{1}{1 + H_a \cdot 10^{-3}}} \quad (7-13);$$

- (5) in point 2.1.6.4, in the legend of equation (7-21), the row corresponding to the term ‘ $w_c$ ’ is replaced by the following:

‘ $w_c$  = carbon content of fuel [% mass] (see equation (7-82) of point 3.3.3.1 or table 7.3);’

- (6) in point 2.2.3, in the legend of equation (7-34), the rows corresponding to the terms ‘ $M_{\text{da},w}$ ’ and ‘ $M_{r,w}$ ’ are replaced by the following:

‘ $M_{\text{da},w}$  = molar mass of dilution air [g/mol] (see equation (7-144) of point 3.9.3)

$M_{r,w}$  = molar mass of raw exhaust gas [g/mol] (see Appendix 2 point (5));’

- (7) point 2.3.1 is replaced by the following:

‘2.3.1. Transient (NRTC and LSI-NRTC) test cycles and RMC

The particulate mass shall be calculated after buoyancy correction of the particulate sample mass in accordance with point 8.1.1 3.2.5 of Annex VI.’;

- (8) in point 2.3.1.1.2, equation (7-46) is replaced by the following:

$$q_{\text{medf},i} = q_{\text{mew},i} \cdot r_{d,i} \quad (7-46);$$

- (9) point 2.4.1.1 is amended as follows:

- (a) in the legend of equation (7-59), the following row is added:

‘ $\Delta t_i$  = the measurement interval [s];’

- (b) in the legend of equation (7-60), the row corresponding to the term ‘ $T_{i,AUX}$ ’ is replaced by the following:

‘ $T_{i,AUX}$  = corresponding value of torque required to drive auxiliaries determined in accordance with equation (6-18) of Annex VI.’;

- (10) in point 2.4.1.2, the legend of equation (7-64) is amended as follows:

- (a) the row corresponding to the term ‘ $P_i$ ’ is replaced by the following:

‘ $P_i$  = engine power for the mode  $i$  [kW] calculated by adding to the measured power  $P_{\text{meas}}$  [kW] the power required to drive auxiliaries  $P_{\text{AUX}}$  [kW] determined in accordance with equation (6-8) of Annex VI ( $P_i = P_{\text{meas}} + P_{\text{AUX}}$ ).’;

(b) the following row is added:

'N<sub>mode</sub> = number of modes in applicable discrete-mode NRSC';

(11) point 2.4.2.2 is amended as follows:

(a) equation (7-66) is replaced by the following:

$$e_{PM} = \frac{q_{mPM}}{\sum_{i=1}^{N_{mode}} (P_i \cdot WF_i)} \quad (7-66);$$

(b) the legend of equation (7-66) is amended as follows:

(i) the row corresponding to the term 'P<sub>i</sub>' is replaced by the following:

'P<sub>i</sub> = engine power for the mode i [kW] calculated by adding to the measured power P<sub>meas</sub> [kW] the power required to drive auxiliaries P<sub>AUX</sub> [kW] determined in accordance with equation (6-8) of Annex VI (P<sub>i</sub> = P<sub>meas</sub> + P<sub>AUX</sub>).';

(ii) the following row is added:

'N<sub>mode</sub> = number of modes in applicable discrete-mode NRSC';

(c) equation (7-67) is replaced by the following:

$$e_{PM} = \frac{\sum_{i=1}^{N_{mode}} (q_{mPMi} \cdot WF_i)}{\sum_{i=1}^{N_{mode}} (P_i \cdot WF_i)} \quad (7-67);$$

(d) the legend of equation (7-67) is amended as follows:

(i) the row corresponding to the term 'P<sub>i</sub>' is replaced by the following:

'P<sub>i</sub> = engine power for the mode i [kW] calculated by adding to the measured power P<sub>meas</sub> [kW] the power required to drive auxiliaries P<sub>AUX</sub> [kW] determined in accordance with equation (6-8) of Annex VI (P<sub>i</sub> = P<sub>meas</sub> + P<sub>AUX</sub>).';

(ii) the following row is added:

'N<sub>mode</sub> = number of modes in applicable discrete-mode NRSC';

(12) in point 3.3.4, the first paragraph is replaced by the following:

'For HC measurement, x<sub>THC[THC-FID]</sub> shall be calculated by using the initial THC contamination concentration x<sub>THC[THC-FID]init</sub> from point 7.3.1.3 of Annex VI by means of equation (7-83).';

(13) in point 3.3.5, the last sentence is replaced by the following:

'A certain flow-weighted mean concentration of an emission at the emission limit value might be already expected based on previous testing with similar engines or testing with similar equipment and instruments.';

(14) point 3.5 is replaced by the following.

'3.5. Measurement of gaseous emissions in raw exhaust gas';

(15) in point 3.5.3, in point (c), equation (7-113) is replaced by the following:

$$\dot{n}_{exh} = \frac{\dot{m}_{fuel} \cdot W_C \cdot (1 + X_{H_2Oexhdry})}{M_c \cdot X_{Combndry}} \quad (7-113);$$

(16) point 3.6.1 is replaced by the following

'3.6.1. Emission mass calculation and background correction

The calculation of gaseous emissions mass m<sub>gas</sub> [g/test] as a function of molar emissions flow rates shall be calculated as follows:

(a) Continuous sampling, varying flow rate, shall be calculated by means of equation (7-106):

$$m_{gas} = \frac{1}{f} \cdot M_{gas} \cdot \sum_{i=1}^N \dot{n}_{exhi} \cdot X_{gasi} \quad [\text{see equation (7-106)}]$$

Where:

- $M_{\text{gas}}$  = generic emission molar mass [g/mol]  
 $\dot{n}_{\text{exhi}}$  = instantaneous exhaust gas molar flow rate on a wet basis [mol/s]  
 $x_{\text{gasi}}$  = instantaneous generic gas molar concentration on a wet basis [mol/mol]  
 $f$  = data sampling rate [Hz]  
 $N$  = number of measurements [-]

(b) Continuous sampling, constant flow rate, shall be calculated by means of equation (7-107):

$$m_{\text{gas}} = M_{\text{gas}} \cdot \dot{n}_{\text{exh}} \cdot \bar{x}_{\text{gas}} \cdot \Delta t \quad [\text{see equation (7-107)}]$$

Where:

- $M_{\text{gas}}$  = generic emission molar mass [g/mol]  
 $\dot{n}_{\text{exh}}$  = exhaust gas molar flow rate on a wet basis [mol/s]  
 $\bar{x}_{\text{gas}}$  = mean gaseous emission molar fraction on a wet basis [mol/mol]  
 $\Delta t$  = time duration of test interval

(c) Batch sampling, regardless the flow rate is varying or constant, shall be calculated by means of equation (7-108):

$$m_{\text{gas}} = \frac{1}{f} \cdot M_{\text{gas}} \cdot \bar{x}_{\text{gas}} \sum_{i=1}^N \dot{n}_{\text{exhi}} \quad [\text{see equation (7-108)}]$$

Where:

- $M_{\text{gas}}$  = generic emission molar mass [g/mol]  
 $\dot{n}_{\text{exhi}}$  = instantaneous exhaust gas molar flow rate on a wet basis [mol/s]  
 $\bar{x}_{\text{gas}}$  = mean gaseous emission molar fraction on a wet basis [mol/mol]  
 $f$  = data sampling rate [Hz]  
 $N$  = number of measurements [-]

(d) In case of diluted exhaust gas calculated values for mass of the pollutants shall be corrected by subtracting the mass of background emissions, due to dilution air:

- (i) Firstly, the molar flow rate of dilution air  $n_{\text{airdil}}$  [mol/s] shall be determined over the test interval. This may be a measured quantity or a quantity calculated from the diluted exhaust gas flow and the flow-weighted mean fraction of dilution air in diluted exhaust gas,  $\bar{x}_{\text{dil/exh}}$ ;
- (ii) The total flow of dilution air  $n_{\text{airdil}}$  [mol] shall be multiplied by the mean concentration of background emission. This may be a time-weighted mean or a flow-weighted mean (e.g., a proportionally sampled background). The product of  $n_{\text{airdil}}$  and the mean concentration of a background emission is the total amount of a background emission;
- (iii) If the result is a molar quantity, it shall be converted to a mass of the background emission  $m_{\text{bkgnd}}$  [g] by multiplying it by emission molar mass,  $M_{\text{gas}}$  [g/mol];
- (iv) Total background mass shall be subtracted from total mass to correct for background emissions;
- (v) The total flow of dilution air may be determined by a direct flow measurement. In this case, the total mass of background shall be calculated, using the dilution air flow,  $n_{\text{airdil}}$ . The background mass shall be subtracted from the total mass. The result shall be used in brake-specific emission calculations;

- (vi) The total flow of dilution air may be determined from the total flow of diluted exhaust gas and a chemical balance of the fuel, intake air, and exhaust gas as described in point 3.4. In this case, the total mass of background shall be calculated, using the total flow of diluted exhaust gas,  $n_{dexh}$ . Then this result shall be multiplied by the flow-weighted mean fraction of dilution air in diluted exhaust gas,  $\bar{x}_{dil/exh}$ .

Considering the two cases (v) and (vi), equations (7-115) and (7-116) shall be used:

$$m_{bkgnd} = M_{gas} \cdot x_{gasdil} \cdot n_{airdil} \quad \text{or} \quad m_{bkgnd} = M_{gas} \cdot \bar{x}_{dil/exh} \cdot \bar{x}_{bkgnd} \cdot n_{dexh} \quad (7-115)$$

$$m_{gascor} = m_{gas} - m_{bkgnd} \quad (7-116)$$

where:

- $m_{gas}$  = total mass of the gaseous emission [g]
- $m_{bkgnd}$  = total background masses [g]
- $m_{gascor}$  = mass of gas corrected for background emissions [g]
- $M_{gas}$  = molecular mass of generic gaseous emission [g/mol]
- $x_{gasdil}$  = gaseous emission concentration in dilution air [mol/mol]
- $n_{airdil}$  = dilution air molar flow [mol]
- $\bar{x}_{dil/exh}$  = flow-weighted mean fraction of dilution air in diluted exhaust gas [mol/mol]
- $\bar{x}_{bkgnd}$  = gas fraction of background [mol/mol]
- $n_{dexh}$  = total flow of diluted exhaust gas [mol];

(17) in point 3.6.3, point (b) is amended as follows:

- (a) in point (i), the introductory wording is replaced by the following:

‘PDP molar flow rate. Based upon the speed at which the Positive Displacement Pump (PDP) operates for a test interval, the corresponding slope  $a_1$ , and intercept,  $a_0$  [-], as calculated with the calibration procedure set out in point 3.9.2, shall be used to calculate molar flow rate  $\dot{n}$  [mol/s] by means of equation (7-117):’;

- (b) in point (ii), the introductory wording is replaced by the following:

‘SSV molar flow rate. Based on the  $C_d$  versus  $R_e^\#$  equation determined in accordance with point 3.9.4, the Sub-Sonic Venturi (SSV) molar flow rate during an emission test  $\dot{n}$  [mol/s] shall be calculated by means of equation (7-119):’;

- (c) in point (iii), the introductory wording is replaced by the following:

‘CFV molar flow rate. To calculate the molar flow rate through one venturi or one combination of venturis, its respective mean  $C_d$  and other constants, determined in accordance with point 3.9.5, shall be used. The calculation of its molar flow rate  $\dot{n}$  [mol/s] during an emission test shall be calculated by means of equation (7-120):’;

(18) point 3.8.1.1 is amended as follows:

- (a) equation (7-126) is replaced by the following:

$$W_{act} = \sum_{i=1}^N P_i \cdot \Delta t_i = \frac{1}{f} \cdot \frac{1}{3\,600} \cdot \frac{1}{10^3} \cdot \frac{2 \cdot \pi}{60} \cdot \sum_{i=1}^N (n_i \cdot T_i) \quad (7-126);$$

- (b) in the legend of equation (7-126), the following row is added:

‘ $\Delta t_i$  = the measurement interval [s];’;

- (c) the legend of equation (7-127) is replaced by the following:

‘Where:

$T_{i,meas}$  is the measured value of instantaneous engine torque

$T_{i,AUX}$  is the corresponding value of torque required to drive auxiliaries determined in accordance with point 7.7.2.3(b) of Annex VI.’;

(19) in point 3.8.1.2, the legend of equation (7-131) is amended as follows:

(a) the row corresponding to the term ' $P_i$ ' is replaced by the following:

' $P_i$  = engine power for the mode  $i$  [kW] calculated by adding to the measured power  $P_{meas}$  [kW] the power required to drive auxiliaries  $P_{AUX}$  [kW] determined in accordance with equation (6-8) of Annex VI ( $P_i = P_{meas} + P_{AUX}$ ).';

(b) the following row is added:

' $N_{mode}$  = number of modes in applicable discrete-mode NRSC';

(20) point 3.8.2.2.1 is amended as follows:

(a) equation (7-133) is replaced by the following:

$$e_{PM} = \frac{\dot{m}_{PM}}{\sum_{i=1}^{N_{mode}} (P_i \cdot WF_i)} \quad (7-133);$$

(b) the legend of equation (7-133) is amended as follows:

(i) the row corresponding to the term ' $P_i$ ' is replaced by the following:

' $P_i$  = engine power for the mode  $i$  [kW] calculated by adding to the measured power  $P_{meas}$  [kW] the power required to drive auxiliaries  $P_{AUX}$  [kW] determined in accordance with equation (6-8) of Annex VI ( $P_i = P_{meas} + P_{AUX}$ ).';

(ii) the following row is added:

' $N_{mode}$  = number of modes in applicable discrete-mode NRSC';

(21) point 3.8.2.2.2 is amended as follows:

(a) equation (7-134) is replaced by the following:

$$e_{PM} = \frac{\sum_{i=1}^{N_{mode}} (\dot{m}_{PMi} \cdot WF_i)}{\sum_{i=1}^{N_{mode}} (P_i \cdot WF_i)} \quad (7-134);$$

(b) the legend of equation (7-134) is amended as follows:

(i) the row corresponding to the term ' $P_i$ ' is replaced by the following:

' $P_i$  = engine power for the mode  $i$  [kW] calculated by adding to the measured power  $P_{meas}$  [kW] the power required to drive auxiliaries  $P_{AUX}$  [kW] determined in accordance with equation (6-8) of Annex VI ( $P_i = P_{meas} + P_{AUX}$ ).';

(ii) the following row is added:

' $N_{mode}$  = number of modes in applicable discrete-mode NRSC';

(22) in point 3.9.3, in point (a), equation (7-140) is replaced by the following:

$$C_d = \dot{n}_{ref} \cdot \frac{\sqrt{Z \cdot M_{mix} \cdot R \cdot T_{in}}}{C_f \cdot A_t \cdot p_{in}} \quad (7-140);$$



(23) in Appendix 3, in point 5, the following Table 7.9 and Table 7.10 are added:

‘Table 7-9

**Critical F values,  $F_{\text{crit}90}$ , versus  $N - 1$  and  $N_{\text{ref} - 1}$  at 90 per cent confidence**

$N - 1$	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	1000+
$N_{\text{ref} - 1}$																			
1	39,86	49,50	53,59	55,83	57,24	58,20	58,90	59,43	59,85	60,19	60,70	61,22	61,74	62,00	62,26	62,52	62,79	63,06	63,32
2	8,526	9,000	9,162	9,243	9,293	9,326	9,349	9,367	9,381	9,392	9,408	9,425	9,441	9,450	9,458	9,466	9,475	9,483	9,491
3	5,538	5,462	5,391	5,343	5,309	5,285	5,266	5,252	5,240	5,230	5,216	5,200	5,184	5,176	5,168	5,160	5,151	5,143	5,134
4	4,545	4,325	4,191	4,107	4,051	4,010	3,979	3,955	3,936	3,920	3,896	3,870	3,844	3,831	3,817	3,804	3,790	3,775	3,761
5	4,060	3,780	3,619	3,520	3,453	3,405	3,368	3,339	3,316	3,297	3,268	3,238	3,207	3,191	3,174	3,157	3,140	3,123	3,105
6	3,776	3,463	3,289	3,181	3,108	3,055	3,014	2,983	2,958	2,937	2,905	2,871	2,836	2,818	2,800	2,781	2,762	2,742	2,722
7	3,589	3,257	3,074	2,961	2,883	2,827	2,785	2,752	2,725	2,703	2,668	2,632	2,595	2,575	2,555	2,535	2,514	2,493	2,471
8	3,458	3,113	2,924	2,806	2,726	2,668	2,624	2,589	2,561	2,538	2,502	2,464	2,425	2,404	2,383	2,361	2,339	2,316	2,293
9	3,360	3,006	2,813	2,693	2,611	2,551	2,505	2,469	2,440	2,416	2,379	2,340	2,298	2,277	2,255	2,232	2,208	2,184	2,159
10	3,285	2,924	2,728	2,605	2,522	2,461	2,414	2,377	2,347	2,323	2,284	2,244	2,201	2,178	2,155	2,132	2,107	2,082	2,055
11	3,225	2,860	2,660	2,536	2,451	2,389	2,342	2,304	2,274	2,248	2,209	2,167	2,123	2,100	2,076	2,052	2,026	2,000	1,972
12	3,177	2,807	2,606	2,480	2,394	2,331	2,283	2,245	2,214	2,188	2,147	2,105	2,060	2,036	2,011	1,986	1,960	1,932	1,904
13	3,136	2,763	2,560	2,434	2,347	2,283	2,234	2,195	2,164	2,138	2,097	2,053	2,007	1,983	1,958	1,931	1,904	1,876	1,846
14	3,102	2,726	2,522	2,395	2,307	2,243	2,193	2,154	2,122	2,095	2,054	2,010	1,962	1,938	1,912	1,885	1,857	1,828	1,797
15	3,073	2,695	2,490	2,361	2,273	2,208	2,158	2,119	2,086	2,059	2,017	1,972	1,924	1,899	1,873	1,845	1,817	1,787	1,755
16	3,048	2,668	2,462	2,333	2,244	2,178	2,128	2,088	2,055	2,028	1,985	1,940	1,891	1,866	1,839	1,811	1,782	1,751	1,718
17	3,026	2,645	2,437	2,308	2,218	2,152	2,102	2,061	2,028	2,001	1,958	1,912	1,862	1,836	1,809	1,781	1,751	1,719	1,686
18	3,007	2,624	2,416	2,286	2,196	2,130	2,079	2,038	2,005	1,977	1,933	1,887	1,837	1,810	1,783	1,754	1,723	1,691	1,657
19	2,990	2,606	2,397	2,266	2,176	2,109	2,058	2,017	1,984	1,956	1,912	1,865	1,814	1,787	1,759	1,730	1,699	1,666	1,631
20	2,975	2,589	2,380	2,249	2,158	2,091	2,040	1,999	1,965	1,937	1,892	1,845	1,794	1,767	1,738	1,708	1,677	1,643	1,607
21	2,961	2,575	2,365	2,233	2,142	2,075	2,023	1,982	1,948	1,920	1,875	1,827	1,776	1,748	1,719	1,689	1,657	1,623	1,586
20	2,949	2,561	2,351	2,219	2,128	2,061	2,008	1,967	1,933	1,904	1,859	1,811	1,759	1,731	1,702	1,671	1,639	1,604	1,567

N – 1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	1000+
23	2,937	2,549	2,339	2,207	2,115	2,047	1,995	1,953	1,919	1,890	1,845	1,796	1,744	1,716	1,686	1,655	1,622	1,587	1,549
24	2,927	2,538	2,327	2,195	2,103	2,035	1,983	1,941	1,906	1,877	1,832	1,783	1,730	1,702	1,672	1,641	1,607	1,571	1,533
25	2,918	2,528	2,317	2,184	2,092	2,024	1,971	1,929	1,895	1,866	1,820	1,771	1,718	1,689	1,659	1,627	1,593	1,557	1,518
26	2,909	2,519	2,307	2,174	2,082	2,014	1,961	1,919	1,884	1,855	1,809	1,760	1,706	1,677	1,647	1,615	1,581	1,544	1,504
27	2,901	2,511	2,299	2,165	2,073	2,005	1,952	1,909	1,874	1,845	1,799	1,749	1,695	1,666	1,636	1,603	1,569	1,531	1,491
28	2,894	2,503	2,291	2,157	2,064	1,996	1,943	1,900	1,865	1,836	1,790	1,740	1,685	1,656	1,625	1,593	1,558	1,520	1,478
29	2,887	2,495	2,283	2,149	2,057	1,988	1,935	1,892	1,857	1,827	1,781	1,731	1,676	1,647	1,616	1,583	1,547	1,509	1,467
30	2,881	2,489	2,276	2,142	2,049	1,980	1,927	1,884	1,849	1,819	1,773	1,722	1,667	1,638	1,606	1,573	1,538	1,499	1,456
40	2,835	2,440	2,226	2,091	1,997	1,927	1,873	1,829	1,793	1,763	1,715	1,662	1,605	1,574	1,541	1,506	1,467	1,425	1,377
60	2,791	2,393	2,177	2,041	1,946	1,875	1,819	1,775	1,738	1,707	1,657	1,603	1,543	1,511	1,476	1,437	1,395	1,348	1,291
120	2,748	2,347	2,130	1,992	1,896	1,824	1,767	1,722	1,684	1,652	1,601	1,545	1,482	1,447	1,409	1,368	1,320	1,265	1,193
1000+	2,706	2,303	2,084	1,945	1,847	1,774	1,717	1,670	1,632	1,599	1,546	1,487	1,421	1,383	1,342	1,295	1,240	1,169	1,000

Table 7-10

**Critical F values,  $F_{\text{crit}95}$ , versus N – 1 and  $N_{\text{ref}} - 1$  at 95 per cent confidence**

N – 1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	1000+
$N_{\text{ref}} - 1$																			
1	161,4	199,5	215,7	224,5	230,1	233,9	236,7	238,8	240,5	241,8	243,9	245,9	248,0	249,0	250,1	251,1	252,2	253,2	254,3
2	18,51	19,00	19,16	19,24	19,29	19,33	19,35	19,37	19,38	19,39	19,41	19,42	19,44	19,45	19,46	19,47	19,47	19,48	19,49
3	10,12	9,552	9,277	9,117	9,014	8,941	8,887	8,845	8,812	8,786	8,745	8,703	8,660	8,639	8,617	8,594	8,572	8,549	8,526
4	7,709	6,944	6,591	6,388	6,256	6,163	6,094	6,041	5,999	5,964	5,912	5,858	5,803	5,774	5,746	5,717	5,688	5,658	5,628
5	6,608	5,786	5,410	5,192	5,050	4,950	4,876	4,818	4,773	4,735	4,678	4,619	4,558	4,527	4,496	4,464	4,431	4,399	4,365
6	5,987	5,143	4,757	4,534	4,387	4,284	4,207	4,147	4,099	4,060	4,000	3,938	3,874	3,842	3,808	3,774	3,740	3,705	3,669
7	5,591	4,737	4,347	4,120	3,972	3,866	3,787	3,726	3,677	3,637	3,575	3,511	3,445	3,411	3,376	3,340	3,304	3,267	3,230
8	5,318	4,459	4,066	3,838	3,688	3,581	3,501	3,438	3,388	3,347	3,284	3,218	3,150	3,115	3,079	3,043	3,005	2,967	2,928
9	5,117	4,257	3,863	3,633	3,482	3,374	3,293	3,230	3,179	3,137	3,073	3,006	2,937	2,901	2,864	2,826	2,787	2,748	2,707
10	4,965	4,103	3,708	3,478	3,326	3,217	3,136	3,072	3,020	2,978	2,913	2,845	2,774	2,737	2,700	2,661	2,621	2,580	2,538

N – 1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	1000+
11	4,844	3,982	3,587	3,357	3,204	3,095	3,012	2,948	2,896	2,854	2,788	2,719	2,646	2,609	2,571	2,531	2,490	2,448	2,405
12	4,747	3,885	3,490	3,259	3,106	2,996	2,913	2,849	2,796	2,753	2,687	2,617	2,544	2,506	2,466	2,426	2,384	2,341	2,296
13	4,667	3,806	3,411	3,179	3,025	2,915	2,832	2,767	2,714	2,671	2,604	2,533	2,459	2,420	2,380	2,339	2,297	2,252	2,206
14	4,600	3,739	3,344	3,112	2,958	2,848	2,764	2,699	2,646	2,602	2,534	2,463	2,388	2,349	2,308	2,266	2,223	2,178	2,131
15	4,543	3,682	3,287	3,056	2,901	2,791	2,707	2,641	2,588	2,544	2,475	2,403	2,328	2,288	2,247	2,204	2,160	2,114	2,066
16	4,494	3,634	3,239	3,007	2,852	2,741	2,657	2,591	2,538	2,494	2,425	2,352	2,276	2,235	2,194	2,151	2,106	2,059	2,010
17	4,451	3,592	3,197	2,965	2,810	2,699	2,614	2,548	2,494	2,450	2,381	2,308	2,230	2,190	2,148	2,104	2,058	2,011	1,960
18	4,414	3,555	3,160	2,928	2,773	2,661	2,577	2,510	2,456	2,412	2,342	2,269	2,191	2,150	2,107	2,063	2,017	1,968	1,917
19	4,381	3,522	3,127	2,895	2,740	2,628	2,544	2,477	2,423	2,378	2,308	2,234	2,156	2,114	2,071	2,026	1,980	1,930	1,878
20	4,351	3,493	3,098	2,866	2,711	2,599	2,514	2,447	2,393	2,348	2,278	2,203	2,124	2,083	2,039	1,994	1,946	1,896	1,843
21	4,325	3,467	3,073	2,840	2,685	2,573	2,488	2,421	2,366	2,321	2,250	2,176	2,096	2,054	2,010	1,965	1,917	1,866	1,812
22	4,301	3,443	3,049	2,817	2,661	2,549	2,464	2,397	2,342	2,297	2,226	2,151	2,071	2,028	1,984	1,938	1,889	1,838	1,783
23	4,279	3,422	3,028	2,796	2,640	2,528	2,442	2,375	2,320	2,275	2,204	2,128	2,048	2,005	1,961	1,914	1,865	1,813	1,757
24	4,260	3,403	3,009	2,776	2,621	2,508	2,423	2,355	2,300	2,255	2,183	2,108	2,027	1,984	1,939	1,892	1,842	1,790	1,733
25	4,242	3,385	2,991	2,759	2,603	2,490	2,405	2,337	2,282	2,237	2,165	2,089	2,008	1,964	1,919	1,872	1,822	1,768	1,711
26	4,225	3,369	2,975	2,743	2,587	2,474	2,388	2,321	2,266	2,220	2,148	2,072	1,990	1,946	1,901	1,853	1,803	1,749	1,691
27	4,210	3,354	2,960	2,728	2,572	2,459	2,373	2,305	2,250	2,204	2,132	2,056	1,974	1,930	1,884	1,836	1,785	1,731	1,672
28	4,196	3,340	2,947	2,714	2,558	2,445	2,359	2,291	2,236	2,190	2,118	2,041	1,959	1,915	1,869	1,820	1,769	1,714	1,654
29	4,183	3,328	2,934	2,701	2,545	2,432	2,346	2,278	2,223	2,177	2,105	2,028	1,945	1,901	1,854	1,806	1,754	1,698	1,638
30	4,171	3,316	2,922	2,690	2,534	2,421	2,334	2,266	2,211	2,165	2,092	2,015	1,932	1,887	1,841	1,792	1,740	1,684	1,622
40	4,085	3,232	2,839	2,606	2,450	2,336	2,249	2,180	2,124	2,077	2,004	1,925	1,839	1,793	1,744	1,693	1,637	1,577	1,509
60	4,001	3,150	2,758	2,525	2,368	2,254	2,167	2,097	2,040	1,993	1,917	1,836	1,748	1,700	1,649	1,594	1,534	1,467	1,389
120	3,920	3,072	2,680	2,447	2,290	2,175	2,087	2,016	1,959	1,911	1,834	1,751	1,659	1,608	1,554	1,495	1,429	1,352	1,254
1000+	3,842	2,996	2,605	2,372	2,214	2,099	2,010	1,938	1,880	1,831	1,752	1,666	1,571	1,517	1,459	1,394	1,318	1,221	1,000'

(24) Appendix 5 is amended as follows:

- (a) in point 2.2, in the legend of equation (7-178), the row corresponding to the term ' $P_i$ ' is replaced by the following:

$P_i$  = engine power for the mode  $i$  [kW] calculated by adding to the measured power  $P_{meas}$  [kW] the power required to drive auxiliaries  $P_{AUX}$  [kW] determined in accordance with equation (6-8) of Annex VI ( $P_i = P_{meas} + P_{AUX}$ );

- (b) in point 2.3, the first sentence is replaced by the following:

'The final NRSC and weighted average NRTC test results shall be rounded in one step to three significant figures in accordance with ASTM E 29-06B.'

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## ANNEX VIII

Annex VIII to Delegated Regulation (EU) 2017/654 is amended as follows:

(1) in point 4.2.2.2, in the last paragraph, the following sentence is added:

‘A description of the connection for, and method to read, those records shall be included in the information folder as set out in Part A of Annex I of Implementing Regulation (EU) 2017/656.’;

(2) in point 4.5.1, point (b) is replaced by the following:

‘(b) In case of a Type 2 engine, the resulting difference between the highest and the lowest maximum  $GER_{cycle}$  within the family shall never exceed the range set out in point 2.4.15 of Annex IX to Implementing Regulation (EU) 2017/656, except as permitted by point 3.1.’;

(3) point 6.4.1 is replaced by the following:

‘6.4.1. The manufacturer shall present the approval authority with evidence showing that the  $GER_{cycle}$  span of all members of the dual-fuel engine family remains within the range set out in point 2.4.15 of Annex IX to Implementing Regulation (EU) 2017/656, or in the case of engines with an operator-adjustable  $GER_{cycle}$  satisfy the requirements of point 6.5 (for example, through algorithms, functional analyses, calculations, simulations, results of previous tests, etc.)’;

(4) the following point 6.8 is inserted:

‘6.8. Documentation of the demonstration

A demonstration report shall document the demonstration conducted pursuant to points 6.1 to 6.7.1 The report shall:

(a) describe the demonstration performed, including the applicable test cycle;

(b) be included in the information folder as set out in Part A of Annex I of Implementing Regulation (EU) 2017/656.’;

(5) Appendix 2 is amended as follows:

(a) in point 7.1.3.2.1, the introductory wording of the first paragraph is replaced by the following:

‘In the case that the exact equations are applied to calculate instantaneous values of  $u_{gas}$  in accordance with paragraph 7.1.3.2(a) then, when calculating the mass per test of a gaseous emission for transient (NRTC and LSI-NRTC) test cycles and RMC,  $u_{gas}$  shall be included in the summation in equation (7-2) of point 2.1.2 of Annex VII by means of equation (8-1)’;

(b) in point 7.1.3.3, the second paragraph is replaced by the following:

‘The requirements of point 8.2.1.2 of Annex VI shall apply for controlling the dilution ratio. In particular, if the combined transformation time of the exhaust gas flow measurement and the partial flow system exceeds 0,3 s, look-ahead control based on a pre-recorded test run shall be used. In this case, the combined rise time shall be  $\leq 1$  s and the combined delay time  $\leq 10$  s. Except in the case that the exhaust gas mass flow is measured directly the determination of exhaust gas mass flow shall use values of  $\alpha$ ,  $\gamma$ ,  $\delta$  and  $\epsilon$  determined in accordance with point 7.1.5.3.’;

(c) in point 7.1.3.4, in the paragraph under the heading, the first sentence is replaced by the following:

‘The flow meter referred to in points 9.4.5.3 and 9.4.5.4 of Annex VI shall not be sensitive to the changes in exhaust gas composition and density.’;

(d) in point 7.1.4.1, the heading is replaced by the following:

‘7.1.4.1 Determination of the background corrected concentrations’;

(e) point 7.1.5.2 is replaced by the following:

‘7.1.5.2. Calculation of the fuel mixture components

Equations (8-2) to (8-7) shall be used to calculate the elemental composition of the fuel mixture:

$$q_{mf} = q_{mf1} + q_{mf2} \quad (8-2)$$

$$w_H = \frac{w_{H1} \times q_{mf1} + w_{H2} \times q_{mf2}}{q_{mf1} + q_{mf2}} \quad (8-3)$$

$$w_C = \frac{w_{C1} \times q_{mf1} + w_{C2} \times q_{mf2}}{q_{mf1} + q_{mf2}} \quad (8-4)$$

$$w_S = \frac{w_{S1} \times q_{mf1} + w_{S2} \times q_{mf2}}{q_{mf1} + q_{mf2}} \quad (8-5)$$

$$w_N = \frac{w_{N1} \times q_{mf1} + w_{N2} \times q_{mf2}}{q_{mf1} + q_{mf2}} \quad (8-6)$$

$$w_O = \frac{w_{O1} \times q_{mf1} + w_{O2} \times q_{mf2}}{q_{mf1} + q_{mf2}} \quad (8-7)$$

where:

$q_{mf1}$  is the fuel mass flow rate of fuel 1 [kg/s]

$q_{mf2}$  is the fuel mass flow rate of fuel 2 [kg/s]

$w_H$  is the hydrogen content of fuel [% mass]

$w_C$  is the carbon content of fuel [% mass]

$w_S$  is the sulphur content of fuel [% mass]

$w_N$  is the nitrogen content of fuel [% mass]

$w_O$  is the oxygen content of fuel [% mass]';

(f) the following point 7.1.5.3 is inserted:

'7.1.5.3. Calculation of the molar ratios of H, C, S, N and O related to C for the fuel mixture

The calculation of the atomic ratios (especially the H/C-ratio  $\alpha$ ) is given in Annex VII by means of equations (8-8) to (8-11):

$$\alpha = 11,9164 \cdot \frac{w_H}{w_C} \quad (8-8)$$

$$\gamma = 0,37464 \cdot \frac{w_S}{w_C} \quad (8-9)$$

$$\delta = 0,85752 \cdot \frac{w_N}{w_C} \quad (8-10)$$

$$\varepsilon = 0,75072 \cdot \frac{w_O}{w_C} \quad (8-11)$$

where:

$w_H$  is the hydrogen content of fuel, mass fraction [g/g] or [% mass]

$w_C$  is the carbon content of fuel, mass fraction [g/g] or [% mass]

$w_S$  is the sulphur content of fuel, mass fraction [g/g] or [% mass]

$w_N$  is the nitrogen content of fuel, mass fraction [g/g] or [% mass]

$w_O$  is the oxygen content of fuel, mass fraction [g/g] or [% mass]

$\alpha$  is the molar hydrogen ratio (H/C)

$\gamma$  is the molar sulphur ratio (S/C)

$\delta$  is the molar nitrogen ratio (N/C)

$\varepsilon$  is the molar oxygen ratio (O/C)

referring to a fuel  $CH\alpha O\varepsilon N\delta S\gamma$ .

(g) in point 7.2.3, in the first paragraph, the last sentence is replaced by the following:

‘The instantaneous molar component ratios shall be input in the equations (7-88), (7-90), and (7-91) of Annex VII for the continuous chemical balance.’;

(h) in point 7.2.3.1, the introductory wording of equation (8-16) is replaced by the following:

‘In cases where exhaust gas mass flow rate is calculated based on the mixed fuel rate then  $w_c$  in equation (7-113) of Annex VII shall be calculated by means of equation (8-16):’.

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## ANNEX IX

In point 2 of Appendix 2 of Annex IX to Delegated Regulation (EU) 2017/654, the introductory wording before equation (9-5) is replaced by the following:

‘The value of  $S_\lambda$  may be determined from the ratio of the ratio of the stoichiometric composition of oxygen and methane to the ratio of the stoichiometric composition of oxygen and the fuel blend supplied to the engine, as set out in equation (9-5):’.

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## ANNEX X

In Annex XIII to Delegated Regulation (EU) 2017/654, point 1 is amended as follows:

(1) in point (1), the introductory wording is replaced by the following:

‘(1) EU type-approvals granted on the basis of Regulation (EC) No 595/2009 of the European Parliament and of the Council (\*) and its implementing measures, where a technical service confirms that the engine type meets:

(\*) Regulation (EC) No 595/2009 of the European Parliament and of the Council of 18 June 2009 on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI) and on access to vehicle repair and maintenance information and amending Regulation (EC) No 715/2007 and Directive 2007/46/EC and repealing Directives 80/1269/EEC, 2005/55/EC and 2005/78/EC (OJ L 188, 18.7.2009, p. 1.);

(2) in point (2), the introductory wording is replaced by the following:

‘(2) type-approvals in conformity with UNECE Regulation No 49.06 series of amendments (\*\*), where a technical service confirms that the engine type meets:

(\*\*) Regulation No 49 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the measures to be taken against the emission of gaseous and particulate pollutants from compression-ignition engines and positive ignition engines for use in vehicles (OJ L 171, 24.6.2013, p. 1’.

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## ANNEX XI

In point 3(15) of Annex XV to Delegated Regulation (EU) 2017/654, point (a) is replaced by the following:

- ‘(a) where the engine is to be operated within the Union on diesel or non-road gas-oil, a statement indicating that a fuel with sulphur content not greater than 10 mg/kg (20 mg/kg at point of final distribution) cetane number not less than 45 and a FAME content not greater than 8 % v/v shall be used.’
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## ANNEX XII

Annex I to Delegated Regulation (EU) 2017/654 is corrected as follows:

(1) point 2.4.1 is replaced by the following:

‘2.4.1. Engines fuelled with CNG and designed for operation on either the range of H-gases or on the range of L-gases’;

(2) points 2.5.2 and 2.5.2.1 are replaced by the following:

‘2.5.2. Fuel-specific dual-fuel engine fuelled with Liquefied Natural Gas (LNG)

2.5.2.1. For a dual-fuel engine family where the engines are calibrated for a specific LNG gas composition resulting in a  $\lambda$ -shift factor not differing by more than 3 % from the  $\lambda$ -shift factor of the  $G_{20}$  fuel specified in Annex IX, and the ethane content of which does not exceed 1,5 %, the parent engine shall only be tested on the  $G_{20}$  reference gas fuel, or on the equivalent fuel created using an admixture of pipeline gas with other gases, as specified in Appendix 1 of Annex IX.’

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## ANNEX XIII

Annex III to Delegated Regulation (EU) 2017/654 is corrected as follows:

(1) point 3.1.2 is replaced by the following:

‘3.1.2. Engines from different engine families may be further combined into families based on the type of exhaust after-treatment system utilised or where no after-treatment is used, based upon the similarity of the technical characteristics of the emission control system. Engines of different bore and stroke, different configuration, different air management systems or different fuel systems may be considered equivalent in respect to emissions deterioration characteristics if the manufacturer provides data to the approval authority that there is a reasonable technical basis for such determination. In order to place engine families having similar technical specifications and installation for the exhaust after-treatment systems into the same engine after-treatment system family, the manufacturer shall provide data to the approval authority that demonstrates that the emissions reduction performance of such engines is similar.’;

(2) in point 3.4.1.3, the second sentence is replaced by the following:

‘The approval authority shall not refuse to approve maintenance requirements that are reasonable and technically necessary, including but not limited to those identified in point 3.4.1.4.’.

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## ANNEX XIV

Annex IV to Delegated Regulation (EU) 2017/654 is corrected as follows:

(1) point 2.3.1 is replaced by the following:

‘2.3.1. An auxiliary emission control strategy may be activated by an engine or a non-road mobile machinery, provided that the auxiliary emission control strategy’;

(2) Appendix 1 is corrected as follows:

(a) point 2.3.1 is replaced by the following:

‘2.3.1. It is permitted to use a heated or a non-heated reagent tank and dosing system. A heated system shall meet the requirements of points 2.3.2.2 to 2.3.2.2.4. A non-heated system shall meet the requirements of point 2.3.2.3.’;

(b) point 2.3.2.2 is replaced by the following:

‘2.3.2.2. Design criteria for a heated system

A heated system shall be so designed that it meets the performance requirements set out in points 2.3.2 to 2.3.2.2.4 when tested using the procedure defined.’;

(c) point 3.1 is replaced by the following:

‘3.1. The OEM shall provide to all end-users of new non-road mobile machinery written instructions about the emission control system and its correct operation in accordance with Annex XV.’;

(d) point 7.1.1.1 is replaced by the following:

‘7.1.1.1. The value of  $CD_{min}$  specified by the manufacturer shall be used during the demonstration set out in section 13 and recorded in Part C of the information document specified in Annex I to Implementing Regulation (EU) 2017/656.’;

(e) points 9 to 9.2.3.2 are replaced by the following:

‘9. Other failures that may be attributed to tampering

9.1. In addition to the level of reagent in the reagent tank, the reagent quality, and the interruption of dosing, the following failures shall be monitored because they may be attributed to tampering:

(a) failures of the NO<sub>x</sub> Control Diagnostic (NCD) system as described in point 9.2.1;

(b) failures of the exhaust gas recirculation (EGR) valve as described in point 9.2.2.

9.2. Monitoring requirements and counters

9.2.1. NCD system

9.2.1.1. The NO<sub>x</sub> Control Diagnostic (NCD) system shall be monitored for electrical failures and for removal or deactivation of any sensor that prevents it from diagnosing any other failures set out in sections 6 to 8 (component monitoring).

A non-exhaustive list of sensors that affect the diagnostic capability are those directly measuring NO<sub>x</sub> concentration, urea quality sensors, ambient sensors and sensors used for monitoring reagent dosing activity, reagent level, or reagent consumption.

9.2.1.2. A counter shall be attributed to each of the monitoring failures. The NCD system counters shall count the number of engine operating hours when the DTC associated to a malfunction of the NCD system is confirmed to be active. Different NCD system failures may be grouped into a single counter.

9.2.1.2.1. The manufacturer may group the NCD system failure together with one or more of the systems listed in sections 7, 8 and point 9.2.2 into a single counter.

9.2.1.3. Details of the NCD system counter(s) activation and deactivation criteria and mechanisms are described in section 11.

- 9.2.2. Impeded EGR valve
- 9.2.2.1. The exhaust gas recirculation (EGR) system shall be monitored for an impeded EGR valve.
- 9.2.2.2. A counter shall be attributed to an impeded EGR valve. The EGR valve counter shall count the number of engine operating hours when the DTC associated to an impeded EGR valve is confirmed to be active.
- 9.2.2.2.1. The manufacturer may group the impeded EGR valve failure together with one or more of the systems listed in sections 7, 8 and point 9.2.1 into a single counter.
- 9.2.2.3. Details of the EGR valve counter activation and deactivation criteria and mechanisms are described in section 11.;
- (f) point 10.2.1. is replaced by the following:
- ‘10.2.1. The demonstration that the monitoring systems for other members of the NCD engine family are similar may be performed by presenting to the approval authorities such elements as algorithms, functional analyses, etc.’;
- (g) point 10.2.3. is replaced by the following:
- ‘10.2.3. In the case where engines of an engine family belong to an NCD engine family that has already been EU type-approved, as referred to in point 10.2.1 (Figure 4.3), the compliance of that engine family is deemed to be demonstrated without further testing, provided the manufacturer demonstrates to the authority that the monitoring systems necessary for complying with the requirements of this Appendix are similar within the considered engine and NCD engine families.

Table 4.1

**Illustration of the content of the demonstration process in accordance with the provisions in points 10.3 and 10.4**

Mechanism	demonstration elements
Warning system activation specified in point 10.3	— 2 activation tests (incl. lack of reagent) — Supplementary demonstration elements, as appropriate
Low-level inducement activation specified in point 10.4.	— 2 activation tests (incl. lack of reagent) — Supplementary demonstration elements, as appropriate — 1 torque reduction test
Severe inducement activation specified in point 10.4	— 2 activation tests (incl. lack of reagent) — Supplementary demonstration elements, as appropriate’;

- (h) point 10.3.3.5.2 is replaced by the following:
- ‘10.3.3.5.2. The demonstration of the warning system activation is deemed to be accomplished if, at the end of each demonstration test performed in accordance with point 10.3.3, the warning system has been properly activated and the DTC for the selected failure has got the “confirmed and active” status.’;
- (i) points 10.4.2 and 10.4.3 are replaced by the following:
- ‘10.4.2. The test sequence shall demonstrate the activation of the inducement system in case of the failure selected by the approval authority from the list as referred to in point 10.3.2.1 for the test of the warning system.
- 10.4.3. For the purpose of this demonstration,
- (a) the manufacturer shall, in agreement with the approval authority, be permitted to accelerate the test by simulating the achievement of a certain number of operating hours,
- (b) the achievement of the torque reduction required for low-level inducement may be demonstrated at the same time as the general engine performance approval process performed in accordance with this Regulation. A separate torque measurement during the inducement system demonstration is not required in this case,

- (c) the low-level inducement, if applicable, shall be demonstrated in accordance with the requirements of point 10.4.5,
    - (d) the severe inducement shall be demonstrated in accordance with the requirements of point 10.4.6.;
  - (j) point 13.3 is replaced by the following:
    - '13.3. The pollutant emissions resulting from this test shall not exceed the NO<sub>x</sub> threshold specified in point 7.1.1.;
- (3) Appendix 4 is corrected as follows:
- (a) point 2.3.2.3 is replaced by the following:
    - '2.3.2.3. In cases where more than the period of running time indicated in Table 4.5 is required for the monitors to accurately detect and confirm a PCM (e.g. monitors using statistical models or with respect to fluid consumption on the non-road mobile machinery), the approval authority may permit a longer period for monitoring provided the manufacturer justifies the need for the longer period (for example by technical rationale, experimental results, in-house experience, etc.).';
  - (b) point 6.1 is replaced by the following:
    - '6.1. The PCD system shall detect the complete removal of the particulate after-treatment system inclusive of the removal of any sensors used to monitor, activate, de-activate or modulate its operation.'
-

## ANNEX XV

Point 1 of Annex V to Delegated Regulation (EU) 2017/654 is corrected as follows:

- (1) the second and third paragraphs are replaced by the following:

‘This Annex sets out the technical requirements relating to the area associated with the relevant NRSC, within which the amount by which the emissions shall be permitted to exceed the emission limits set out in Annex II to Regulation (EU) 2016/1628 is controlled.

When an engine is tested in the manner set out in test requirements of section 4 the emission of gaseous and particulate pollutants sampled at any randomly selected point within the applicable control area set out in section 2 shall not exceed the applicable emission limit values in Annex II to Regulation (EU) 2016/1628 multiplied by a factor of 2,0.’;

- (2) the last paragraph is replaced by the following:

‘The installation instructions provided by the manufacturer to the OEM in accordance with Annex XIV shall identify the upper and lower boundaries of the applicable control area and shall include a statement to clarify that the OEM shall not install the engine in such a way that it constrains the engine to operate permanently at only combinations of speed and torque outside of the control area for the torque curve corresponding to the approved engine type or engine family.’;

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## ANNEX XVI

Annex VI to Delegated Regulation (EU) 2017/654 is corrected as follows:

- (1) in point 5.2.5.6, the second paragraph is replaced by the following:

‘Where the governor installed on the engine is used the 100 % speed shall be the engine governed speed as defined in Article 1(24).’;

- (2) point 6.3.1 is replaced by the following:

‘6.3.1. Basis for emission measurement

The basis of specific emissions measurement is uncorrected net power as defined in Article 3(25) of Regulation (EU) 2016/1628.’;

- (3) in point 6.3.3, the last sentence of the second paragraph is replaced by the following:

‘The power absorbed by auxiliaries shall be used to adjust the set values and to calculate the work produced by the engine over the test cycle in accordance with point 7.7.1.3 or point 7.7.2.3(b).’;

- (4) in point 7.4.2.1, the two paragraphs below Figure 6.3 are replaced by the following:

- (a) point (a) is replaced by the following:

‘(a) the cold start run shall commence after either the engine and exhaust after-treatment systems have cooled down to room temperature after natural engine cool down, or after forced cool down, and the engine, coolant and oil temperatures, exhaust after-treatment systems and all engine control devices are stabilized between 293 K and 303 K (20 °C and 30 °C). The measurement of the emissions for this run shall be started with the start of the cold engine.’;

- (b) point (c) is replaced by the following:

‘(c) the hot-start run shall commence immediately after the soak period with the cranking of the engine. The gaseous analyzers shall be switched on at least 10 seconds before the end of the soak period to avoid switching signal peaks. The measurement of emissions for this run shall be started in parallel with the cranking of the engine.

Brake specific emissions expressed in (g/kWh), or number per kilowatt-hour (#/kWh) for PN, shall be determined by using the procedures set out in this section for both the cold start run and hot-start run of the test cycle. Composite weighted emissions shall be computed by weighting the cold-start run results by 10 % and the hot-start run results by 90 % as detailed in Annex VII.’;

- (5) in point 7.6, the words ‘as defined in Article 2(12)’ are replaced by the words ‘as defined in Article 1(12)’;

- (6) in point 7.6.3.1, in point (b), the fourth and fifth sentences are replaced by the following:

‘The power recorded shall not exceed the rated power as defined in Article 3(27) of Regulation (EU) 2016/1628 by more than 12,5 %. If this value is exceeded the manufacturer shall revise the declared rated power.’;

- (7) in point 7.7.2.3 in the legend of equation (6-16), the second row is replaced by the following:

‘*max.torque* is the maximum torque for the respective test speed taken from the engine mapping performed in accordance with point 7.6.2 adjusted where necessary in accordance with point 7.7.2.3(b).’;

- (8) in point 8.2.3.5, the last sentence is replaced by the following:

‘However, if a PM mass of 400 µg or more is expected, then the sample media shall be stabilised for at least 60 min.’;

- (9) in point 9.2.1(c), point (i) is replaced by the following:

‘(i) For removing background PM, the diluent shall be filtered with high-efficiency particulate air (HEPA) filters that have an initial minimum collection efficiency specification of 99,97 % (see Article 1(19) for procedures related to HEPA-filtration efficiencies).’;

(10) in point 9.2.2(g), the last paragraph is replaced by the following:

‘For PM sampling, the already proportional flow coming from CVS goes through secondary dilution (one or more) to achieve the requested overall dilution ratio as shown in Figure 6.7 and set out in point 9.2.3.2;’

(11) in point 9.2.3.1, in the first paragraph, the last sentence is replaced by the following:

‘These need to satisfy other criteria such as in points 8.1.8.6 (periodic calibration) and 8.2.1.2 (validation) for varying dilution PFD, and point 8.1.4.5 as well as Table 6.5 (linearity verification) and point 8.1.8.5.7 (verification) for constant dilution PFD.’;

(12) in point 9.2.3.3, the last paragraph is replaced by the following:

‘The system may be used also for a previously diluted exhaust gas where, via a constant dilution-ratio, an already proportional flow is diluted (see Figure 6.7). This is the way of performing secondary dilution from a CVS tunnel to achieve the necessary overall dilution ratio for PM sampling.’;

(13) in Appendix 4, in point 3.4.1, the last sentence is replaced by the following:

‘The difference between the pre-test and post-test results shall be less than 2 % of full scale.’.

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## ANNEX XVII

Annex VII to Delegated Regulation (EU) 2017/654 is corrected as follows:

(1) point 2.4.1.1 is corrected as follows:

(a) equation (7-59) is replaced by the following:

$$W_{act} = \sum_{i=1}^N P_i \cdot \Delta t_i = \frac{1}{f} \cdot \frac{1}{3\,600} \cdot \frac{1}{10^3} \cdot \frac{2 \cdot \pi}{60} \cdot \sum_{i=1}^N (n_i \cdot T_i) \quad (7-59)';$$

(2) point 3.9.5 is replaced by the following:

‘3.9.5. CFV calibration

Some CFV flow meters consist of a single venturi and some consist of multiple venturis, where different combinations of venturis are used to meter different flow rates. For CFV flow meters that consist of multiple venturis, either calibration of each venturi independently to determine a separate discharge coefficient,  $C_d$ , for each venturi, or calibration of each combination of venturis as one venturi may be performed. In the case where a combination of venturis is calibrated, the sum of the active venturi throat areas is used as  $A_v$ , the square root of the sum of the squares of the active venturi throat diameters as  $d_v$ , and the ratio of the venturi throat to inlet diameters is the ratio of the square root of the sum of the active venturi throat diameters ( $d_v$ ) to the diameter of the common entrance to all of the venturis ( $D$ ). To determine the  $C_d$  for a single venturi or a single combination of venturis, the following steps shall be performed:

- (a) With the data collected at each calibration set point an individual  $C_d$  for each point shall be calculated using equation (7-140);
- (b) The mean and standard deviation of all the  $C_d$  values shall be calculated in accordance with equations (7-155) and (7-156);
- (c) If the standard deviation of all the  $C_d$  values is less than or equal to 0,3 % of the mean  $C_d$ , then the mean  $C_d$  shall be used in equation (7-120), and the CFV shall be used only down to the lowest  $r$  measured during calibration;

$$r = 1 - (\Delta p/p_m) \quad (7-148)$$

- (d) If the standard deviation of all the  $C_d$  values exceeds 0,3 % of the mean  $C_d$ , the  $C_d$  values corresponding to the data point collected at the lowest  $r$  measured during calibration shall be omitted;
- (e) If the number of remaining data points is less than seven, corrective action shall be taken by checking calibration data or repeating the calibration process. If the calibration process is repeated, checking for leaks, applying tighter tolerances to measurements and allowing more time for flows to stabilize, is recommended;
- (f) If the number of remaining  $C_d$  values is seven or greater, the mean and standard deviation of the remaining  $C_d$  values shall be recalculated;
- (g) If the standard deviation of the remaining  $C_d$  values is less than or equal to 0,3 % of the mean of the remaining  $C_d$ , that mean  $C_d$  shall be used in equation (7-120) and the CFV values only down to the lowest  $r$  associated with the remaining  $C_d$  shall be used;
- (h) If the standard deviation of the remaining  $C_d$  still exceeds 0,3 % of the mean of the remaining  $C_d$  values, the steps set out in points (d) to (g) shall be repeated.’;

(3) in Appendix 6, equation (7-180) is replaced by the following:

$$c_{NH3} = (0,1 \times c_{NH3,cold}) + (0,9 \times c_{NH3,hot}) \quad (7-180)'.$$

## ANNEX XVIII

Annex VIII to Delegated Regulation (EU) 2017/654 is corrected as follows:

- (1) in point 4.6, the words ‘as required by’ are deleted;
- (2) in Appendix 2, in point 4., in the third paragraph below the heading, the last sentence is replaced by the following:  
‘This shall be compensated via one of the methods described in point 7’.

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