



**Economic and Social  
Council**

Distr.  
GENERAL

ECE/TRANS/WP.29/2007/28  
5 April 2007

Original: ENGLISH

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**ECONOMIC COMMISSION FOR EUROPE**

**INLAND TRANSPORT COMMITTEE**

**World Forum for Harmonization of Vehicle Regulations**

One-hundred-and-forty-second session  
Geneva, 26-29 June 2007  
Item 4.2.9. of the provisional agenda

**1958 AGREEMENT**

Consideration of draft amendments to existing Regulations

Proposal for the 02 series of amendments to Regulation No. 96  
(Diesel emissions of agricultural tractors)

Submitted by the Working Party on Pollution and Energy (GRPE)

The text reproduced below was adopted by GRPE at its fifty-third session. It is based on ECE/TRANS/WP.29/GRPE/2006/7/Rev.1, as amended by Annex 4 to the report. It is submitted to WP.29 and AC.1 for consideration (ECE/TRANS/WP.29/GRPE/53, para. 25).

Contents, insert a new Appendix 5 to Annex 4 to read:

"Annex 4 - Appendix 5 - Durability Requirements"

The text of the Regulation,

Insert a new paragraph 1.3., to read:

"1.3. used in machinery intended and suited, to move, or to be moved on the ground, with or without road, having an installed net power higher than 18 kW, but not more than 560 kW, operated under constant speed, including but not limited to:

1.3.1. gas compressors;

1.3.2. irrigation pumps;

1.3.3. generating sets with intermittent load;

1.3.4. turf care, chippers, snow removal equipment, sweepers. "

Insert a new paragraph 2.13., to read:

"2.13. "emission durability period" means the number of hours indicated in Annex 4, Appendix 4, used to determine the deterioration factors."

Paragraph 2.13. (former), renumber as paragraph 2.14.

Paragraph 4.4.3., amend to read:

"4.4.3. an additional symbol consisting in a letter from D to K indicating the emission level (paragraph 5.2.1.) according to which the engine or engine family has been approved."

Paragraph 5.2.1., the table, amend to read (adding stage H to K emission limits):

"

Power Band	Net power (P) (kW)	Carbon monoxide (CO) (g/kWh)	Hydrocarbons (HC) (g/kWh)	Oxides of nitrogen (NO <sub>x</sub> ) (g/kWh)	Particulates (PT) (g/kWh)
E	130 ≤ P ≤ 560	3.5	1.0	6.0	0.2
F	75 ≤ P < 130	5.0	1.0	6.0	0.3
G	37 ≤ P < 75	5.0	1.3	7.0	0.4
D	18 ≤ P < 37	5.5	1.5	8.0	0.8
	Net power (P) (kW)	Carbon monoxide (CO) (g/kWh)	Sum of hydro-carbons and oxides of nitrogen (HC + NO <sub>x</sub> ) (g/kWh)		Particulates (PT) (g/kWh)
H	130 ≤ P ≤ 560	3.5	4.0		0.2
I	75 ≤ P < 130	5.0	4.0		0.3
J	37 ≤ P < 75	5.0	4.7		0.4
K	19 ≤ P < 37	5.5	7.5		0.6

The limit values for power bands H to K shall include deterioration factors calculated in accordance with Annex 4, Appendix 5."

Paragraphs 11.1. to 11.10., amend to read

- "11.1. As from the official date of entry into force of the 02 series of amendments, no Contracting Party applying this Regulation shall refuse to grant ECE approval under this Regulation as amended by the 02 series of amendments.
- 11.2. As from the date of entry into force of the 02 series of amendments, Contracting Parties applying this Regulation may refuse to grant ECE approvals to intermittent speed engines, or engine families, of the power bands H, I, J and K which do not meet the requirements of this Regulation as amended by the 02 series of amendments.
- 11.3. As from the date of entry into force of the 02 series of amendments, Contracting Parties applying this Regulation may refuse the placing on the market of intermittent speed engines, or engine families, included in the power bands H, I, J and K not approved under this Regulation as amended by the series 02 of amendments.
- 11.4. As from 1 January 2010, Contracting Parties applying this Regulation may refuse to grant ECE approvals to constant speed engines, or engine families, of the power bands H, I and

K which do not meet the requirements of this Regulation as amended by the 02 series of amendments.

- 11.5. As from 1 January 2011, Contracting Parties applying this Regulation may refuse to grant ECE approvals to constant speed engines, or engine families, of the power band J which do not meet the requirements of this Regulation as amended by the 02 series of amendments.
- 11.6. As from 1 January 2011, Contracting Parties applying this Regulation may refuse the placing on the market of constant speed engines, or engine families, included in the power bands H, I and K not approved under this Regulation as amended by the series 02 of amendments.
- 11.7. As from 1 January 2012, Contracting Parties applying this Regulation may refuse the placing on the market of constant speed engines, or engine families, included in the power band J not approved under this Regulation as amended by the series 02 of amendments.
- 11.8. By derogation to the provisions stipulated on paragraphs 11.3., 11.6. and 11.7., Contracting Parties applying this Regulation may postpone each date mentioned in the above paragraphs for two years in respect of engines with a production date prior to the said dates.
- 11.9. By derogation to the provisions stipulated in paragraphs 11.3., 11.6. and 11.7., Contracting Parties applying this Regulation may continue to permit the placing on the market of engines approved on the basis of a previous technical standard, provided that the engines are intended as replacement for fitting in vehicles in use, and that it is not technically feasible for the engines in question to satisfy the new requirements of the 02 series of amendments.
- 11.10. As from 1 January 2012, Contracting Parties applying this Regulation may refuse the placing on the market of constant speed engines, or engine families, included in the power band J not approved under this Regulation as amended by the series 02 of amendments."

Paragraph 11.11. (former), should be deleted.

Annex 4,

Paragraph 2.7., amend to read:

- "2.7. The fuel shall be the reference fuel specified in Annex 5 for the respective power band:
  - (a) A.5.1. for power bands D to G
  - (b) A.5.2. for power bands H to K

Optionally, the reference fuel specified in paragraph A.5.1. may be used for power bands H to K.

The cetane number ..."

Paragraph 3.6.1., amend to read:

"3.6.1. For intermittent speed engines, the following 8-mode cycle shall be followed in dynamometer operation on the test engine:"

Insert a new paragraph 3.6.2., to read:

"3.6.2. For constant speed engines, the following 5-mode cycle shall be followed in dynamometer operation on the test engine:

Mode Number	Engine Speed	Percent Load	Weighting Factor
1	Rated	100	0.05
2	Rated	75	0.25
3	Rated	50	0.30
4	Rated	25	0.30
5	Rated	10	0.10

The load figures are percentage values of the torque corresponding to the prime power rating defined as the maximum power available during a variable power sequence, which may be run for an unlimited number of hours per year, between stated maintenance intervals and under the stated ambient conditions, the maintenance being carried out as prescribed by the manufacturer."

Paragraphs 3.6.2. to 3.6.6. (former), renumber as paragraphs 3.6.3. to 3.6.7.

Add a new Appendix 5, to read:

#### "Annex 4 - Appendix 5

### EMISSION DURABILITY REQUIREMENTS

This appendix shall apply to power bands H to K only.

#### 1. Emission durability period and deterioration factors

1.1. Manufacturers shall determine a Deterioration Factor (DF) value for each regulated pollutant for all power band H to K engine families. Such DFs shall be used for type approval and production line testing by either:

- adding the DF to the emission test result, if paragraph 1.2.1. applies, or
- multiplying the emission test result with the DF, if paragraph 1.2.2. applies.

1.1.1. Test to establish DFs shall be conducted as follows:

1.1.1.1. The manufacturer shall conduct durability tests to accumulate engine operating hours according to a test schedule that is selected on the basis of good engineering judgement to be representative of in-use engine operation in respect to characterizing emission performance deterioration. The durability test period should typically represent the equivalent of at least one quarter of the emission durability period (EDP).

Service accumulation operating hours may be acquired through running engines on a dynamometer test bed or from actual in-field machine operation. Accelerated durability tests can be applied whereby the service accumulation test schedule is performed at a higher load factor than typically experienced in the field. The acceleration factor relating the number of engine durability test hours to the equivalent number of EDP hours shall be determined by the engine manufacturer based on good engineering judgement.

During the period of the durability test, no emission sensitive components can be serviced or replaced other than to the routine service schedule recommended by the manufacturer.

The test engine, subsystems, or components to be used to determine exhaust emission DFs for an engine family, or for engine families of equivalent emission control system technology, shall be selected by the engine manufacturer on the basis of good engineering judgement. The criterion is that the test engine should represent the emission deterioration characteristic of the engine families that will apply the resulting DF values for certification approval. Engines of different bore and stroke, different configuration, different air management systems, different fuel systems can be considered as equivalent in respect to emissions deterioration characteristics if there is a reasonable technical basis for such determination.

DF values from another manufacturer can be applied if there is a reasonable basis for considering technology equivalence with respect to emissions deterioration, and evidence that the tests have been carried according to the specified requirements.

Emissions testing will be performed according to the procedures defined in this Regulation for the test engine after initial run-in but before any service accumulation, and at the completion of the durability. Emission tests can also be performed at intervals during the service accumulation test period, and applied in determining the deterioration trend.

1.1.1.2. The service accumulation tests or the emissions tests performed to determine deterioration shall not be witnessed by the approval authority.

1.1.1.3. Determination of DF values from durability tests

An additive DF is defined as the value obtained by subtraction of the emission value, determined at the beginning of the EDP, from the emissions value determined to represent the emission performance at the end of the EDP.

A multiplicative DF is defined as the emission level determined for the end of the EDP divided by the emission value recorded at the beginning of the EDP.

Separate DF values shall be established for each of the pollutants covered by the legislation. In the case of establishing a DF value relative to the NO<sub>x</sub> + HC standard, for an additive DF, this is determined based on the sum of the pollutants notwithstanding that a negative deterioration for one pollutant may not offset deterioration for the other. For a multiplicative NO<sub>x</sub>+HC DF, separate HC and NO<sub>x</sub> DFs shall be determined and applied separately when calculating the deteriorated emission levels from an emissions test result before combining the resultant deteriorated NO<sub>x</sub> and HC values to establish compliance with the standard.

In cases where the testing is not conducted for the full EDP, the emission values at the end of the EDP are determined by extrapolation of the emission deterioration trend established for the test period, to the full EDP.

When emissions test results have been recorded periodically during the service accumulation durability testing, standard statistical processing techniques based on good practice shall be applied to determine the emission levels at the end of the EDP; statistical significance testing can be applied in the determination of the final emissions values.

If the calculation results in a value of less than 1.00 for a multiplicative DF, or less than 0.00 for an additive DF, then the DF shall be 1.0 or 0.00, respectively.

- 1.1.1.4. A manufacturer may, with the approval of the type approval authority, use DF values established from results of durability tests conducted to obtain DF values for certification of on-road HD CI engines according to ECE Regulation No. 49. This will be allowed if there is technological equivalency between the test on-road engine and the non-road engine families applying the DF values for certification. The DF values derived from on-road engine emission durability test results shall be calculated on the basis of EDP values defined in paragraph 2., Table 1.
- 1.1.1.5. In the case where an engine family uses established technology, an analysis based on good engineering practices may be used in lieu of testing to determine a deterioration factor for that engine family subject to approval of the type approval authority.
- 1.2. DF information in approval applications
  - 1.2.1. Additive DFs shall be specified for each pollutant in an engine family certification application for CI engines not using any after-treatment device.
  - 1.2.2. Multiplicative DFs shall be specified for each pollutant in an engine family certification application for CI engines using an after-treatment device.
  - 1.2.3. The manufacturer shall furnish the type-approval agency on request with information to support the DF values. This would typically include emission test results, service

accumulation test schedule, maintenance procedures together with information to support engineering judgements of technological equivalency, if applicable.

2. Emission durability periods for engines of power bands H to K

2.1. Manufacturers shall use the EDP in Table 1 of this paragraph.

Table 1: EDP categories for power bands H to K (hours)

Category (power band)	Useful life (hours) (EDP)
$\leq 37$ kW (constant speed engines)	3,000
$\leq 37$ kW (not constant speed engines)	5,000
$> 37$ kW	8,000

"

Annex 5,

The title, amend to read:

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

Part 1. Agricultural and forestry tractor and non-road mobile machinery reference fuel for  
CI engines type approved to meet limit values of power bands D to G

Note: Key properties ...

...."

After note 12, add the following title and table:

"Part 2. Agricultural and forestry tractor and non-road mobile machinery reference fuel for  
CI engines type approved to meet limit values of power bands H to K



Parameter	Unit	Limits <u>1/</u>		Test Method
		minimum	maximum	
Cetane number <u>2/</u>		52.0	54.0	EN-ISO 5165
Density at 15°C	kg/m <sup>3</sup>	833	837	EN-ISO 3675
Distillation:				
50 per cent point	°C	245	-	EN-ISO 3405
95 per cent point	°C	345	350	EN-ISO 3405
- Final boiling point	°C	-	370	EN-ISO 3405
Flash point	°C	55	-	EN 22719
CFPP	°C	-	-5	EN 116
Viscosity at 40°C	mm <sup>2</sup> /s	2.5	3.5	EN-ISO 3104
Polycyclic aromatic hydrocarbons	per cent m/m	3.0	6.0	IP 391
Sulphur content <u>3/</u>	mg/kg	-	300	ASTM D 5453
Copper corrosion		-	class 1	EN-ISO 2160
Conradson carbon residue (10 per cent DR)	per cent m/m	-	0.2	EN-ISO 10370
Ash content	per cent m/m	-	0.01	EN-ISO 6245
Water content	per cent m/m	-	0.05	EN-ISO 12937
Neutralisation (strong acid) number	mg KOH/g	-	0.02	ASTM D 974
Oxidation stability <u>4/</u>	mg/ml	-	0.025	EN-ISO 12205

1/ The values quoted in the specifications are "true values". In establishment of their limit values the terms of ISO 4259 "Petroleum products – Determination and application of precision data in relation to methods of test" have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility).

Notwithstanding this measure, which is necessary for technical reasons, the manufacturer of fuels should nevertheless aim at a zero value where the stipulated maximum value is 2R and at the mean value in the case of quotations of maximum and minimum limits. Should it be necessary to clarify the questions as to whether a fuel meets the requirements of the specifications, the terms of ISO 4259 should be applied.

2/ The range for the cetane number is not in accordance with the requirements of a minimum range of 4R. However, in the case of a dispute between fuel supplier and fuel user, the terms of ISO 4259 may be used to resolve such disputes provided replicate measurements, of sufficient number to archive the necessary precision, are made in preference to single determinations.

3/ The actual sulphur content of the fuel used for the test shall be reported.

4/ Even though oxidation stability is controlled, it is likely that shelf life will be limited. Advice should be sought from the supplier as to storage conditions and life.

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