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Item [X] of the provisional agenda
Retrofit Emission Control devices (REC)

Draft new Regulation on uniform requirements for retrofit emission control devices to heavy duty vehicles equipped with engines type approved according to Regulation No. 49 and NRMM and tractors with engines type approved according to Regulation No. 96.

Submitted by the expert from [_____]

The text reproduced below was prepared by the expert from [_____] as a result of the discussion of the informal group on retrofit emission control devices (REC) regarding a proposal for a new Regulation on REC.

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Remarks are highlighted in green.

[Values], [dates], [provisions] and [parameter] not fixed yet are indicated in [square brackets], indicated in [red] and [highlighted in yellow].

I. Proposal

Draft new Regulation on uniform requirements for retrofit emission control devices to heavy duty vehicles equipped with engines type approved according to Regulation No. 49 and NRMM and tractors with engines type approved according to Regulation No. 96.

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1. Scope

1.1 This Regulation applies to vehicles of categories M > 3.5t and N [1] and their C.I. engines according to Regulation No. 49 and

1.2 applies to C.I. engines according to Regulation No. 96:

used in category T vehicles [1/] having an installed net power higher than 18 kW but not more than 560 kW,

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 variable speed.

2. Definitions

2.1. *"Adjustment factors"* means additive (upward adjustment factor and downward adjustment factor) or multiplicative factors to be considered during the periodic (infrequent) regeneration.

2.2. *"Particulate reduction REC"* means a particulate reduction system that has a gravimetric particulate reduction / particle number reduction efficiency, determined according to number 9 and meeting the reduction levels indicated under number 3.

Class X only dealing with PM reduction without consideration of NO_2 emissions deleted

2.4. *"Class A* retrofit emission control device (REC)" means a retrofit emission control device with respect to particulate matter emissions only which does not significantly [which level to be allowed?] increase the direct NO_2 emissions.

2.5. *"Class B* retrofit emission control device (REC)" means a retrofit emission control device with respect to NOx emissions emissions only.

2.6. *"Class C* retrofit emission control device (REC)" means a retrofit emission control device with respect to particulate matter emissions and NOx emissions and thus NO_2 emissions.

2.7. *"Reduction level"* means a certain reduction efficiency in % to be met by the retrofit emission control device (REC) according to number 3.

2.8. *"Combined deNOx- particulate filter"* means an exhaust aftertreatment system designed to concurrently reduce emissions of oxides of nitrogen (NO_x) and particulate pollutants (PT);

2.9. *"Continuous regeneration"* means the regeneration process of a treatment system that occurs either permanently or at least once per applicable test cycle.

[1]/ As defined in Annex 7 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), (document TRANS/WP.29/78/Rev.1/Amend.2, as last amended by Amend.4).

2.10. *"deNOx system"* means an exhaust after-treatment system designed to reduce emissions of oxides of nitrogen (NO_x) (e.g. passive and active lean NO_x catalysts, NO_x adsorbers and selective catalytic reduction (SCR) systems).

2.11. *"Emission control monitoring system"* means the system that ensures correct operation of the NOx control measures implemented in the engine system according to the requirements of paragraph [---]

2.12. *"ESC test"* means a test cycle consisting of 13 steady state modes to be applied in accordance with paragraph [---] of Regulation No. 49.

2.13. *"ETC test"* means a test cycle consisting of 1800 second-by-second transient modes to be applied in accordance with paragraph [---] of Regulation No.49.

2.14. *"Reduction efficiency"* means the efficiency based on the ratio between the mass emissions measured down- and upstream of an after-treatment reduction system.

2.15. *"Gaseous pollutants"* means carbon monoxide, hydrocarbons (assuming a ratio of $CH_{1.85}$ for diesel, $CH_{2.525}$ for LPG and $CH_{2.93}$ for NG (NMHC) and an assumed molecule $CH_3O_{0.5}$ for ethanol-fuelled diesel engines), methane (assuming a ratio of CH_4 for NG) and oxides of nitrogen, the last-named being expressed in nitrogen dioxide (NO_2) equivalent;

2.16. *"Load condition"* means constant particulate load condition of the particulate reduction system under specific driving conditions without external regeneration measures.

[2.17. *"Nitrogen dioxide (NO_2)"* to be discussed]

2.18 *"NOx-reduction system"* means a deNOx system that has mass emission reduction efficiency, determined according to number 5 or number 6, according to the classification levels indicated under [---] of.

2.19. *"NRSC cycle"* refer to NRMM-GTR

2.20. *"NRTC cycle"* refer to NRMM-GTR

2.21. *"Particulate reduction system"* means an exhaust gas after-treatment for reducing particulate emissions by mechanical and / or aerodynamic separation and by diffusion and / or inertial separation. Engine-specific modifications to structural components, electronic elements and electronic components are not considered part of the particulate reduction systems. [If, however, additional measures with respect to emission-relevant components and / or system components such as modifying the exhaust gas recirculation (EGR) control for further proper functioning are necessary for retrofitting with the PARTICULATE REDUCTION SYSTEM, these measures must be approved by the engine manufacturer.]

2.22. *"Particulate matter (PM "* means any material collected on a specified filter medium after diluting C.I. engine exhaust gas with clean filtered air so that the temperature does not exceed 325K (52 °C);

[2.23. "Particulate number (PN)" to be discussed]

2.24. *"Particulate reduction system family"* means a family of particulate reduction systems that are technically identical with respect to functioning according to the harmonisation criteria for system families in number [---].

2.25. *"Periodic regeneration"* means the regeneration process of an emission control device that occurs periodically in less than 100 hours of normal engine operation. During cycles where regeneration occurs, emission standards can be exceeded.

2.26. *"Reagent"* means any medium that is stored on-board the vehicle in a tank and provided to the exhaust after-treatment system (if required) upon request of the emission control system.

2.27. *"Retrofit emission control device (REC)"* means any particulate reduction system, NOx-reduction system or combinations of both used for retrofit purposes

WHSC / WHTC to be added.

3. Reduction levels

3.1. In order to receive certification for an REC, the reduction levels indicated in table 3.1 need to be achieved: Those levels are to be applied to the engine raw emissions of the test engine defined under [---].

Table 3.1:
Reduction levels

	Reduction efficiency (%)	
	NOx	PM / PN
Reduction Level 1	33	50 [66] / 30
Reduction Level 2	66	80
Reduction Level 3	80	90 [95]
Reduction Level 4	95	95

Reduction level with 10% for NOx and 30 % for PM deleted

3.2 For the purpose of this regulation the reduction level for NOx shall be applicable to NOx-reduction systems only and the PM reduction level to particulate reduction systems only. For combined systems any combination of the reduction levels shown in table 3.1 is applicable.

3.3 A Class A to Class D REC can be approved to any reduction level applicable as indicated in table 3.2.

3.4 Contracting parties may introduce additional requirements to the REC such as meeting a certain limit value defined in Regulation No. 49 or Regulation No. 96.

Table 3.2:
REC Classes / Reduction level

	Reduction level applicable	
	NOx	PM / PN
Class A	-	1 / 2 / 3 / 4
Class B	1 / 2 / 3 / 4	-
Class C	1 / 2 / 3 / 4	1 / 2 / 3 / 4

3.5 In any case the REC shall be capable of achieving the next higher emission level with respect to the limits of Regulation No. 49 and No. 96 and the intended REC classification as indicated in table 3.3 and table 3.4.

Table 3.3:
REC Matrix for Regulation No. 49

Base	Component	Reduction level				Class A	Class B	Class C
Euro III	NOx	1	2	3	4	Euro III	Euro IV	Euro IV
	PM	1	2	3	4	Euro IV	Euro III	Euro IV
Euro IV	NOx	1	2	3	4	Euro IV	Euro V	Euro V
	PM	1	2	3	4	Euro V / EEV	Euro IV	Euro V / EEV
Euro V / EEV	NOx	1	2	3	4	Euro V	Euro VI	Euro VI
	PM	1	2	3	4	Euro VI	Euro V / EEV	Euro VI

Table 3.4:
REC Matrix for Regulation No. 96

Base	Component	Reduction level				Class A	Class B	Class C
Stage II	NOx	1	2	3	4	Stage II	Stage III A	Stage III A
	PM	1	2	3	4	Stage III A	Stage II	Stage III A
Stage III A	NOx	1	2	3	4	Stage III A	Stage III B	Stage III B
	PM	1	2	3	4	Stage III B	Stage III A	Stage III B
Stage III B	NOx	1	2	3	4	Stage III B	Stage IV	Stage IV
	PM	1	2	3	4	Stage IV	Stage III B	Stage IV

4. Requirements for retrofit emission control devices

4.1 The applicant shall provide proof of the tests described in numbers [---] and confirm that the functional capability of the system is guaranteed during normal operation in

a) Vehicles of category M1> 3.5 t and N over a mileage of [200,000] km or a service life of up to [6] years, depending on which criterion is first reached,

b) Non road mobile machinery over [4000] operating hours or a service life of up to [6] years, depending on which criterion is first reached.

The particulate reduction systems shall not be fitted with devices that render these systems inoperative; otherwise the requirements of number [---] apply.

4.2 The applicant shall conduct a 1000 hours durability test on an engine / REC combination, either as field test in a typical vehicle / machine application or on an engine test cell. The engine for the durability run may be a different one than the test engine. After the durability test, the REC will be demounted, if applicable, and be installed with the test engine on the same test bench as used for the baseline and control testing. The final emissions reduction result will be based on the control testing with the aged REC.
to be completed

5. Compliance criteria for particulate reduction REC

5.1 The particulate reduction system shall not deviate with respect to the following features:

a) Type of retention and functioning of reduction material (metal, ceramic).
b) Reduction design of filter material (sheets/plates, braid, wound, cell/material/non-woven density, porosity, pore diameter, number of pockets/blades/balls, surface roughness, diameter of wire/balls/fibre).
c) [Minimum] thickness of the coating of the particulate reduction system or upstream catalysers (g/ft3)
d) Canning/packaging (storage/retention of carrier)
e) Volume ± 30%
f) Type of regeneration (periodic or continuous)
g) Regeneration strategy (catalytic, thermal, electrothermal regeneration)
h) Method of applying additives /dosing system (if used)
i) Type of additive (if used)
j) Introduction conditions (max. + 0.5 m introduction difference between the turbocharger outlet (turbine) and the inlet of the particulate reduction system)
k) With or without upstream oxidation catalyser

5.2 Further use of the existing oxidation catalyser(s):

Oxidation catalysers installed upstream of the reduction system in a separate canning can continue to be used in individual cases after retrofitting, provided these are shown to be:

a) not more than 5 years old,
b) have been installed in the vehicle for not longer than [200,000 km / 4000 hrs] (proof of mileage / operating hours by means of service log and odometer) and
c) have no visible defects or
d) the manufacturer of the particulate reduction system verifies, as part of the operating permit required under number [---] that the relevant required limits can also be complied with without the standard production oxidation catalyser(s) (the operating permit must contain proof)

If none of the aforementioned proofs are shown, the oxidation catalysers must be replaced by new catalysers before retrofitting with the particulate reduction system.

To test the particulate reduction REC on the engine test cell, the REC must be fitted so that it has a distance of at least 2 m from the outlet of the turbocharger (turbine) to the REC inlet. If the applicant can show that a distance shorter than the maximum distance is used within his subsequent application areas, the length of the pipe can be correspondingly reduced. Insulation or similar means are permissible only if they are also used during the subsequent operation of the vehicle.

6. Compliance criteria for NO_x reduction REC

7. Active devices

7.1 If devices are present in or fitted to the particulate reduction REC system that under certain condition mean that certain limits cannot be complied with by the system according to number [---], the applicant shall then demonstrate

a) the conditions under which such devices are activated/deactivated,
b) that they are used only for the protection of the particulate reduction REC or the engine or for the regeneration of the particulate reduction REC and are not permanently activated,
c) that after an activation the device is deactivated not later than after two test cycles specified for the REC according to number [---], in such a way that the original condition is restored. Verification must be shown in an endurance run that includes at least 5 activations / deactivations,
e) that the specified endurance criteria are complied with and
f) that the driver is informed of the activation of such a device.

8. Fuel

8.1 The measurements for testing the particulate reduction systems are taken using the reference fuel applicable to the reduction level according to number 3 intended to be reached by the REC after being installed and the corresponding version of Regulation No. 49 and Regulation No. 96

8.2 The maximum specific fuel consumption during the applicable test cycle shall be not more than 4% greater in the retrofitted condition than the specific consumption in the non-retrofitted condition.

The measurements for determining the fuel consumption are carried out in parallel with the measurements according to number [---] for continuously regenerating systems or according to number [---] for periodically regenerating systems.

9. Choice test engine

The engine chosen for testing should originate from a family of engines corresponding to the subsequent application range of the REC. The regulated components of the chosen test engine shall be below the applicable base emission limit.

The test engine for the selected application area shall meet the following criteria.

- 100% to [60%] power of the parent engine in the particular family according to Regulation No. 49
- smallest used filter volume (V_{FI}) corresponding to subsequent application range for the selected test engine. Space velocity better to be used e.g. for overlapping power ranges! Catalytic surface area / max. Power => CARB

In all cases, the applicable test cycles are to be used for the exhaust gas verification measurements. The gaseous emissions and particulate (PM / PN) emissions are to be measured during at least every fifth test cycle during the measurements for verification of the regeneration characteristic.

For REC intended to be used on engines according to Regulation No. 96 testing on one test engine per each power category (if applicable) is mandatory.

The selected test engine must comply in series production condition and in retrofitted condition with the values of the original homologated limit value stage for all limited emissions. The modification on the test engine must comply with the subsequent series condition of the modification applied for. Vehicles with on-board diagnosis shall not be limited with respect to their monitoring function after the retrofit system has been installed. The electronic engine control unit (e.g. for injection, air-mass meter, exhaust gas reduction) shall not be altered by the retrofitting.

For the purpose of this regulation the REC testing is conducted showing the capability of a REC to reduce PM / PN and / or NOx emissions from one emission stage to the subsequent emission stage.

10. Test of a particulate reduction REC

10.1 For assessment of the particulate reduction system, an endurance run of at least [100] ETC / WHTC test cycles or [50] NRTC cycles must be carried out to prove the functional capability. The endurance run is used to verify the functional capability and stability of the system and also its efficiency. The gaseous emissions and the particulate mass / particulate number must be measured in at least each fifth test cycle. The testing of the particulate reduction system is carried out for families with regard to the particular application range, i.e. one system test takes place for each application area.

Furthermore, the endurance run is used to verify whether it is a continuous or periodically regenerating particulate reduction system.

If the applicant can prove that a particulate reduction system tested for vehicles of Category M < 3.5 t or Category N, is designed for use in the same manner on C.I. engines for use in non road mobile machinery and the family of test engines according to 4.2 is representative for such applications and meets the compliance criteria of 7.1.2, the application range can be extended to C.I. engines for use in non-road mobile machinery. A reverse extension is not possible.

10.2 The verification of a continuously operating regeneration process is considered to be proofed if a suitable assessment variable on the particulate reduction REC can be regarded as constant over a time period of at least 25 applicable test cycles. The particulate emission and the exhaust gas backpressure can be regarded as suitable assessment variables.

These variables are considered constant within the meaning of this regulation where there is a coefficient of variance of less than 15% over 25 test cycles. The exhaust gas backpressure is measured continuously and the particulate emissions are measured during at least every fifth test cycle.

The coefficient of variance (CoV) is calculated as follows.

$$\text{Variance} = \frac{\text{Standard deviation X (n)}}{\text{Average value X (n)}}$$

with:

$$\text{Standard deviation} = \sqrt{\frac{\text{n } \Sigma x^2 - (\Sigma x)^2}{n^2}}$$

and:

$$\text{Average value} = (x_1 + x_2 + ... + x_n) / \text{n}$$

where:

n = number of measured values

x = respective single measured value

10.3 If an REC manufacturer intends to apply for an REC that can reduce PM / PN and / or NOx emissions over two subsequent emission stage additional verification becomes necessary.

This additional verification is then performed according to number 10.2 and 10.7. on a test engine selected according to 9.3 based on the emission level to be retrofitted.

It is sufficient to perform the additional testing only one engine family member representative for the application range. For that reason it is possible to transfer the emission class extension to other engine families respectively there application ranges.

The REC to be drawn upon for the examination for proof in a lower emission class must derive from the application range of the basic REC. If this is not the case, and the system is not identical, then the full test for a new type in accordance with this regulation is necessary.

If the scope of application is widened, the applicant must additionally certify in the letter of application, the REC is also designed and suitable for higher raw emission burdens when used on lower emission level engines.

10.4 Test of the regeneration characteristic for particulate reduction REC for Reduction level 2 and 2.

Particulate systems according to reduction level 1 and reduction level 2 are subjected to further testing for the verification of the regeneration characteristic.

This test is carried out by loading the system until a constant exhaust gas backpressure is reached or over a time period of a maximum of 100 h. The exhaust gas backpressure is considered constant if not earlier than after 50 h the exhaust gas backpressure is within a range of 4 mbar within a period of 30 min. The test points of the loading cycle are to be selected so that the maximum exhaust gas temperature of 180 ^{0}C at the inlet of the particulate reduction system is not exceeded. The loading is preferably carried out by running up to a constant speed of between 50% and 75% of the rated speed of the test engine.

After the particulate REC loading has been reached, or after a maximum of 100 h, regeneration is activated. This can, for example, be activated by running to higher load mode step. After completion of the regeneration, exhaust gas measurements are to be taken in at least three ESC test cycles and / or three ETC (WHSC / WHTC) test cycles or three NRSC and / or NRTC cycles. The measured exhaust gas values shall not deviate from the measured exhaust gas values before the REC loading by more than 15% for the gaseous emissions or more than 20% for the emissions of the particulate mass / particulate number.

The manufacturer shall verify that the maximum temperatures occurring during the regeneration process are uncritical to the REC.

As an alternative to the loading procedure described above, the manufacturer can provide a particulate reduction REC already loaded to the limit for the regeneration test.

10.5 Test of the opacity of the smoke in the ELR test cycle.

The opacity of the smoke is to be tested in accordance with the specifications of Regulation No. 49 for engines to be used in vehicles of category M>3.5 t and N.

10.6 Assessment criteria for continuously regenerating particulate reduction systems

The REC system test of the particulate reduction REC is considered satisfactory if the reduction level criteria defined under number 3 are met.

10.6.1 Limited pollutants

The limited pollutants (CO, HC, PM and NO_x) in the initial condition and in the retrofitted condition shall comply with the limit values of the original homologated pollutant class. The NO_2 / NOx ratio for the initial condition and retrofitted condition is to be recorded and shown in the test report.

The determination of the NO_2 - and NOx- mass emissions is to be determined by simultaneous measurement according to [---]. UBA NO2 measurement procedure to be added.

10.7 Assessment criteria for periodically regenerating particulate reduction systems

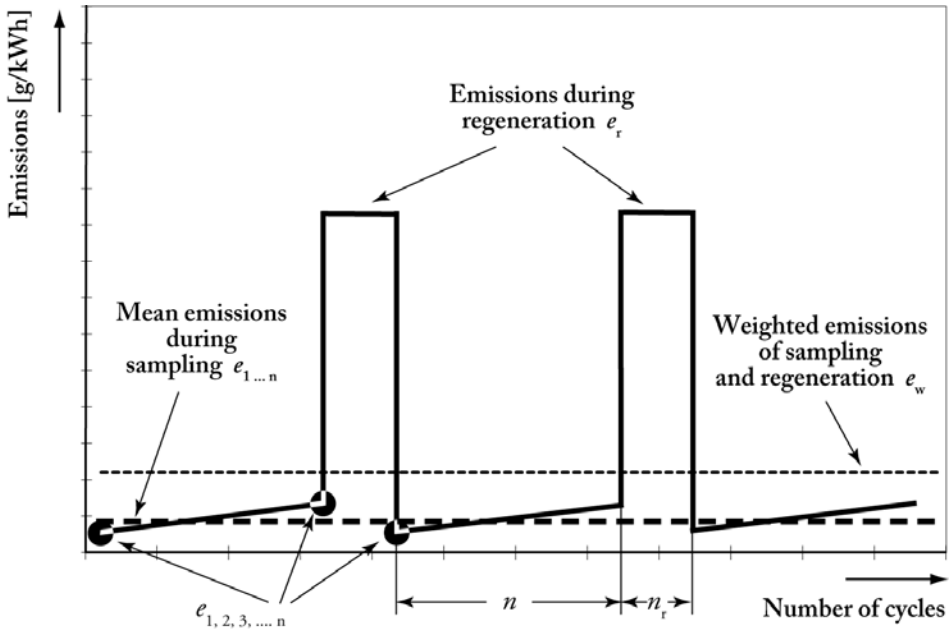
This provision only applies for REC which are regenerated on a periodic basis. The emissions shall be measured on at least three ESC / ETC or WHSC / WHTC or NRSC / NRTC hot start tests, one during and two outside a regeneration event on a stabilized REC system. The regeneration process shall occur at least once during the test cycle. If regeneration takes longer than one test cycle, consecutive test cycles shall be run until regeneration is completed. .

The REC manufacturer shall declare the normal parameter conditions under which the regeneration process occurs (soot load, temperature, exhaust back-pressure, etc.). The manufacturer shall also provide the frequency of the regeneration event in terms of fraction of tests during which the regeneration occurs (*F*). The exact procedure to determine this fraction shall be agreed by the type approval authority based upon good engineering judgement. For a regeneration test, the manufacturer shall provide a particulate reduction REC system that has been loaded. As an option, the manufacturer may run consecutive test cycle until the particulate reduction REC is loaded. Emissions measurement is not required on all tests.

Average emissions between regeneration phases shall be determined from the arithmetic mean of several approximately equidistant tests. As a minimum, at least one test cycle as close as possible prior to a regeneration test and one test cycle immediately after a regeneration test shall be conducted.

During the regeneration test, all the data needed to detect regeneration shall be recorded (CO or NO_x emissions, temperature before and after the REC, exhaust back pressure, etc.). During the regeneration process, the applicable emission limits may be exceeded. The test procedure is schematically shown in **figure 9.1**.

Figure 9.1:
Scheme of periodic regeneration



The system test of a periodically regenerating particulate reduction REC is considered passed if the following criteria are met.

The particulate emissions PT (g/kWh) for periodically regenerating systems are determined as follows.

$$PT = PT_r \times F + (1-F) \times PT_{wor}$$

Where:

F = frequency of the regeneration event in terms of fraction of tests during which the regeneration occurs [-]

PT_{wor} = average specific emission from a test in which the regeneration does not occur [g/kWh]

PT_r = average specific emission from a test in which the regeneration occurs [g/kWh]

At the choice of the manufacturer and based on upon good engineering analysis, the regeneration adjustment factor kr, expressing the average emission rate, may be calculated either multiplicative or additive as follows:

$k_r = PT / PT_{wor}$ (multiplicative adjustment factor)

or

$k_{Ur} = PT - PT_{wor}$ (upward adjustment factor)

or

$k_{Dr} = PT - PT_r$ (downward adjustment factor)

If more than two measurements between the regeneration phases are used to determine the emissions, these further measurements must be taken at equal intervals and an arithmetical average taken.

10.7.1 Limited pollutants

The limited pollutants (CO, HC, PM and NO_x) in the initial condition and in the retrofitted condition shall comply with the limit values of the original homologated pollutant class. The NO_2 / NOx ratio for the initial condition and retrofitted condition is to be recorded and shown in the test report.

The determination of the NO_2 - and NOx- mass emissions is to be determined by simultaneous measurement according to [---].UBA NO2 measurement procedure to be added.

10.7.2 Weighted gaseous emissions

The emission of gaseous components Mgas (g/kWh) for periodically regenerating systems is determined as follows.

$$Mgas = Mgas_{r} \times F + (1-F) \times Mgas_{wor}$$

where:

F = frequency of the regeneration event in terms of fraction of tests during which the regeneration occurs [-]

$Mgas_{wor}$ = average specific emission from a test in which the regeneration does not occur [g/kWh]

Mgs_{r} = average specific emission from a test in which the regeneration occurs [g/kWh]

At the choice of the manufacturer and based on upon good engineering analysis, the regeneration adjustment factor kr, expressing the average emission rate, may be calculated either multiplicative or additive as follows:

$k_{r} = Mgas / Mgas_{wor}$ (multiplicative adjustment factor)

or

$k_{Ur} = Mgas - Mgas_{wor}$ (upward adjustment factor)

or

$k_{Dr} = Mgas - Mgas_{r}$ (downward adjustment factor)

10.7.3 Smoke opacity

The opacity of the smoke is to be tested in accordance with the specifications of Regulation No. 49 for engines to be used in vehicles of category M>3.5 t and N. The smoke opacity shall not exceed 0.8 m^{-1} both in the initial condition and in the retrofitted condition.

11. Family criteria for particulate reduction REC

Families can be formed from particulate reduction REC of different sizes / volumes provided the following compliance criteria are met.

For the specification of the application range of a particulate reduction REC of the same construction with different volumes for various engines and vehicle / machinery types, the family shall not differ with respect to the features according to No. 5.

The application range of a particulate reduction REC family includes an engine family of an engine manufacturer covered by the respective test engine according to Regulation No. 49 for vehicles of category M>3.5t and N.

If the applicant can show that other engine families of that manufacturer or other engine families of other manufacturers of the applicant range covered by the test engine are identical with respect to the family formation criteria, the application area can be extended to these engine families.

The family formation criteria for the extension of the application range are

a) [± 15%] of the displacement of a single cylinder
b) the method of aspiration (turbo engine / normally-aspirated engine)
c) with / without EGR.
d) constant speed / various speed engine.

To be extended for SCR

12. Operating behaviour

No impairment of the operating behaviour and no additional danger to vehicle / machinery safety shall arise due to the installation of the particulate reduction system.

Consider machinery directive

13. Noise

The applicant shall prove that the retrofitting of a particulate reduction system will not lead to deterioration in the noise characteristic. Noise measurement can be omitted for particulate reduction systems fitted in addition to the series production silencer system. [If testing is done it must comply with applicable international standards.]

14. Use of additives

In the case of a particulate reduction REC supported by an additive testing of the non-regulated components according to Annex I becomes necessary.

Add SNR provisions in Annex I / [max. allowable values to be defined].

15. Electromagnetic compatibility

If electronic components or control units are used, they shall comply with the applicable requirements.

16. Installation of a REC

Retrofitting with a REC has to be performed according to the installation provisions of the REC manufacturer. Any further instruction (e.g. given by the vehicle / machinery manufacturer) needs to be considered. The user / operator of the vehicle / machinery retrofitted is responsible for proper installation.

The REC manufacturer has to provide proper installation guidelines.

The vehicle / machinery to be retrofitted must be in a technically serviceable condition. Defects that could impair the achievement of the emission reduction verified or adversely affect the endurance are to be rectified as necessary before the retrofitting.