

## **NOTES ON THE 7<sup>TH</sup> RETROFIT EMISSIONS CONTROL DEVICES (REC) INFORMAL GROUP MEETING 20 – 21 September 2011, DG-JRC, Ispra, Italy**

20 September 2011; 10.00 – 17.30

### **1. Welcome and introduction**

Henk Baarbé welcomed meeting participants. Aloïs Krasenbrink also welcomed participants to the JRC and introduced the transport unit which, from 1/09/2011, is part of the Institute for Energy and Transport.

Meeting participants introduced themselves (Doc. REC-07-04).

### **2. Approval of the draft meeting agenda (Doc. REC-07-01)**

It was requested that any non-road issues, particle number, and the NO<sub>x</sub> part of the draft regulation be addressed on the first day. The chairman said that he would aim to go through the annexes on the first day as these had not yet been fully reviewed by the sub-group. With these comments the agenda was approved.

### **3. Approval of draft minutes of 6<sup>th</sup> REC meeting, Geneva, 6 June 2011 (Doc. REC-06-04)**

The minutes of the 6<sup>th</sup> REC meeting were approved without change.

### **4. REC Chairman's report**

#### **a) Report back from GRPE-62 meeting – guidance from GRPE**

The chairman reported on the guidance received from the GRPE chairman concerning the structure of the Regulation, which had resulted in the format of the current draft.

#### **b) Report from 2 editorial meetings held on 13 July and 11 August 2011 in Brussels**

The chairman reported that the two meetings had resulted in some restructuring and tidying-up of the document. It had been circulated both as a 'clean copy with comments' and a 'tracked changes' version.

#### **c) Questions and comments from REC meeting participants**

In response to a request for an explanation of the current scope, the chairman explained that the draft regulation has been framed so as to cover HD and NRMM. The scope of the relevant EU and UNECE Regulations is currently somewhat different (particularly for NRMM), but the scope of the draft Regulation has been framed so as to cover both, with a view to the eventual alignment of the relevant UNECE Regulations with the EU ones. The requirements are organised in terms of systems having to meet PM and/or NO<sub>x</sub> emissions limits equivalent to Euro/UNECE stages, with additional minimum efficiency requirements. Contracting Parties will have to accept all systems approved under the Regulation, but can use taxation and/or incentives to stimulate only specific performance levels.

### **5. Discussion of draft REC Regulation**

#### **a) Quick review of marked-up version of the draft REC (Doc. REC-07-02)**

There were no comments on the marked-up version of the document and participants agreed to continue work on the clear version.

## **b) Detailed consideration of the new draft REC Regulation (Doc. REC-07-03)**

### Title & general

It was suggested that as there are requirements for HC and NO<sub>2</sub> in the draft, they should also be mentioned in the purpose. These were not included as it was considered that they are additional provisions, rather than the aim of the Regulation, which is control of PM and NOx.

The document should refer to PM and NOx in a consistent order.

It was noted that the Annex on PM number is missing. The secretary noted that references to PN had been removed from the main tables as agreed, but any Annex on PM number requirements is still to be added.

### Section 1: Scope

The chairman noted that the title and scope had been modified slightly so as to simplify the description and remove specific references to ECE HD & NRMM Regulations. It was noted that the EU Tractors Directive and Regulation 96 refer to agricultural *and forestry* tractors. It was agreed that the editorial group would align the title with the scope of the ECE Regulations.

Following discussion on whether the final sentence of section 1 (purpose) is necessary it was agreed to leave it in pending further discussion in the editorial group.

### Section 2: Scope

The question of how to handle previously-verified devices (e.g. VERT or national approvals) was discussed in some detail. It was concluded that it had to be up to contracting parties how to handle any existing certifications; the Regulation could not say that existing certifications of any other scheme must automatically be considered equivalent. Nevertheless, it is not the intent to require duplication of existing testing. It was felt that if a manufacturer already has German (Anlage XXVII) and VERT approvals for PM reduction systems, then he might have the test results needed to meet the proposed ECE requirements, but depending on final decision of UNECE on the Regulation. For NOx, national developments are at an earlier stage and it is to be hoped that the Regulation will provide a common template that contracting parties can use.

The issue of PM number test requirements and limit values was then discussed. The chairman noted that it is inherent that retrofits providing upgrades to Euro VI levels will include PM number requirements and Schulte commented that there will be a separate Annex on PM number for retrofitting to Euro VI. It is not intended to include PN for NRMM where there is no existing limit, although it was noted that NRMM Stage V is expected to include such a requirement. D'Urbano noted that Switzerland already has an efficiency requirement based on PM number and considered that it is essential that the Regulation includes such a requirement. Switzerland is ready to provide a draft additional annex if required.

The chairman concluded that to make the Regulation acceptable to all contracting parties it is necessary to include a PM number requirement. He suggested that this could be incorporated into the secondary emissions requirements and should for the moment be restricted to filters with a 90% efficiency (Reduction Level 2). Switzerland (D'Urbano) will prepare a draft proposal covering both HD and NRMM and circulate for comments. Systems that provide PM upgrades to Euro VI would automatically incorporate a PM number requirement.

It was commented that the wording of sections 2.2 to 2.4 needs to be revised to make clear that the power range refers to the engine rather than the application (to take account of machinery/vehicles with 2 engines).

### Section 3: Definitions

The wording of 3.17 needs to be tidied up as the current wording would result in figures of >100%. Also the wording of 3.18 needs to be tidied up as NOx includes NO<sub>2</sub>.

Participants will send any further comments by e-mail.

It was agreed that the definitions should be in alphabetical order.

#### Sections 4: Applications for Approval and Section 5: Markings.

Following discussion of whether the marking/label should be affixed to the vehicle/machine rather than to the REC it was agreed to retain the requirement that the REC itself be labelled as that ensures that there will be a label on the vehicle (with the REC fitted) whereas labelling only the vehicle might allow the REC to be removed.

#### Sections 6: Approval and Section 7: General Requirements

It was suggested that sample access via the filler should be sufficient because in some cases it may be difficult to provide access to special sample points of the urea tank. However, some systems do not permit sampling via the filler, so it was agreed to retain the requirement.

#### Section 8: Performance requirements.

It was proposed and agreed that the section should show the emissions levels first, as these are agreed as being the main requirement, with the efficiencies as the second part.

The provisional figures in Table 8.1 were examined. The PM levels come essentially from current Anlage XXVII etc. Regulations and so appear to be acceptable to all. The NO<sub>x</sub> levels are more open to debate. It was suggested that other national requirements (e.g. greenhouse gas controls) might result in different efficiencies for the same system and the proposed 70% figure is what could be expected to be achieved in real-world driving. Others suggested this might imply that a higher efficiency is required in the legislative cycles. It was agreed that discussion of the NO<sub>x</sub> levels should wait until that Annex has been reviewed.

The inclusion of a PM number requirement in Table 8.1 (with reference to the relevant Annex for appropriate test and calculation requirements) was discussed. As part of this discussion it was eventually decided that the whole table should not be in this position but should only be in the relevant Annexes. It was therefore agreed that there should be an additional paragraph in section 8 to show that there is a PM number requirement with a reference to an Annex on PM number (as paragraph 8.5), written in the same way as that for NO<sub>2</sub> (to be section 8.6).

The allowable NO<sub>2</sub> as a proportion of NO<sub>x</sub> for Type II RECs was discussed. During discussion on whether the appropriate level should be [20%] or [30%], it transpired that there were two different interpretations of the proposed allowance for an increase in NO<sub>2</sub>. Some participants had understood that this would allow the NO<sub>2</sub> of an engine with (for example) 10 g/kWh NO<sub>2</sub> to increase by [20%] to [12%]. Others had understood it to be a 20 percentage point increase (i.e. engine-out 10% NO<sub>2</sub> (as percentage of NO<sub>x</sub>) could increase to 30% of NO<sub>x</sub> after the REC. The latter interpretation was stated to be that used in the US, London and VERT, but was not acceptable to Germany as it could result in an unacceptably high percentage of NO<sub>2</sub> in their view. The Commission's view on the issue is for DG Environment but Martinez said that the EC might find it difficult to accept any increase in NO<sub>2</sub>. Following further discussion on the level of the permissible NO<sub>2</sub> increase for these Type II RECs, it was decided that there were not enough Contracting Parties present to reach a conclusion and the discussion was deferred for further consideration.

It was suggested that a tolerance is required on the 'no NO<sub>2</sub> increase' requirement for Type I RECs (section 8.4.1) to allow for measurement inaccuracies/variability of the base engine. This will be considered in the small working group.

#### Section 9: Application Range

This section is designed to allow REC testing to be conducted on one engine but then to allow extension of the REC approval to a range of similar engines. It was agreed that, subject to review, the word 'family' could be deleted.

#### Section 10: Modifications to engine baseline emissions

It was agreed that the requirement for no modification of the original NO<sub>x</sub> system would require re-certification of the engine if the whole system were to be replaced. The existing text already makes it clear that this could only be done with the agreement of the OEM.

### Section 11: Specifications concerning the emissions of pollutants

It was agreed that the title could be changed to 'measurement of emissions'

### Section 12: Durability Requirements

A reference to section 12 should be added to Paragraph 7.2.

The durability mileage/time should clarify that this is with normal engine and system maintenance. It also needs to be made clear that normal maintenance of the engine and REC must be conducted during the durability run.

The durability has to be conducted on a 'typical' vehicle. Text will be added to show that this should be agreed between the manufacturer and the Type Approval body.

### Section 13: Particulate reduction REC family

A distinction between Type I and Type II is to be included in the family approach.

It was proposed that 'active volume' used in 13.1 f) needs to be defined. It was suggested that this refers to the whole substrate volume but the definition needs to be reviewed by the drafting group. The question was raised as to whether there should be separate tolerances on catalyst and filter.

It was proposed that the requirement in 13.1 k) for a maximum 0.5 m change in distance from turbo outlet to REC inlet should be deleted. Schulte clarified that this refers to change in distance from the parent of the family (which is min. 2 m). It was agreed to state that this requirement is not applicable to active systems or to reword so as to remove the length requirement for active systems (to be considered by the editorial group).

### Section 14: NOx reduction family

Under a) the reference should be to section 9, not 11. Following discussion it was agreed that section 14.2 could be removed entirely as it is covered by section 9 and that the variation in displacement should be 20% rather than 15%.

The requirement 14.3 b) on the ratio of active surface area to nominal exposed surface area was discussed, including the feasibility of measuring such a parameter. It was agreed that suppliers and OEMs would consider suitable wording and a suitable parameter(s). The issue of in-use compliance was also discussed in this respect.

The heading of section 14.4 was deleted as it did not relate to the content. The chairman proposed that the section should also define the shape and length of the mixing tube.

It was suggested to use criteria from Euro VI as an initial basis for the family criteria.

21 September 2011; 10.00 – 16.00

## **6. Continued consideration of new draft REC Regulation (Doc. REC-07-03)**

It was agreed to leave the remainder of section 14 until the editorial group had chance to review it.

### Section 16: Fuel

In a discussion on the need for a maximum 4% fuel consumption change on fitment of a REC, it was agreed that the test would not address any additional fuel used by active regeneration and so the back-pressure increase, which is already controlled, will be the main factor addressed by this requirement and that is already controlled. Nevertheless it was eventually agreed to include a figure of [4%] for both PM and NOx RECs.

### Section 17: Choice of the test engines and REC combination

It was agreed that the test combination should be the largest engine and smallest REC. Wording will be added to section b) to clarify this. It was also agreed to accept the nominal power output range of the test engine (paragraph a) as 100 to 60% of the maximum power of the parent engine.

### Section 18: Operating behaviour

It was suggested that safety should be included in the heading and this was agreed, although the existing text was initially considered to be sufficient to cover the safety requirements. Reference to the Machinery Directive should not be included as this is an EU Directive, not a UNECE Regulation. In further discussion Meretei said that he would prepare additional wording and send it to the group for consideration. It was also noted that at a previous meeting, Giorgio Billi had promised to supply some additional text and he would be contacted for a proposal. It was suggested that the wording should refer to applicable legislation in the contracting party, but the wording will have to be very generic as the locality of Type Approval may not be the same as the locality of operation.

### Section 19: Noise

It was agreed to title the section "External Noise Emissions". It was also agreed that noise testing must comply with applicable international standards as there are not ECE noise Regulations for all categories of vehicle.

### Section 20: Use of additives

The title was changed to 'Use of Additives and/or Reagents'. It was agreed that the information supplied to the operator must define the reagent to be used. This will be included in section 21.6

### Section 21: Installation of a REC [proposed changes are shown in red: ~~deletion~~, addition]

Section 21.1 on provision of installation instructions was modified: "...(~~provided, for instance,~~ by the vehicle or machine manufacturer), ~~authorities and other parties~~..."

The final sentence of 21.1 cannot be included in UNECE legislation: ~~The user or operator of the vehicle or machine that has been retrofitted is responsible for proper installation.~~

Section 21.2 on installation guidelines was modified as follows: "The REC manufacturer must provide ~~proper~~ installation guidelines. The vehicle or machine to be retrofitted must be in a [~~properly maintained and~~ ~~serviceable~~] condition. Defects that could prevent achievement of the emission reduction level for which the REC is approved, or could adversely affect its endurance are to be rectified as necessary before the retrofitting.

To separate out REC manufacturers and operators responsibilities in 21.2 and 21.3, it was agreed to combine the first sentence of 21.2 with 21.3 (as 21.3) and leave the remainder of 21.2 in place.

The wording of 21.4 was changed to cover both reagents and additives.

Section 21.6 was also modified so as to cover both reagents and additives, and text was added to ensure that the instructions specify the type and quality of consumable reagents or additives used.

### Section 22: Conformity of production

The chairman commented that other Regulations contain more detail on Conformity of Production tests to be conducted. It was agreed that the editorial group will examine whether any additional text is required.

### Section 23: Modification and extension of approval of a REC

It was clarified that notification of changes only applies to items mentioned in the information document or technical report. The editorial committee will agree appropriate text.

Section 24: Penalties for non-conformity of production; Section 25: Production definitely discontinued; and Section 26: Names and addresses of technical services conducting approval tests and of Administrative departments

The text is standard wording taken from Reg. 115

### Annex 1: Information Document

**Schulte** proposed including the content of the information documents from Anlage XXVII. He will make a proposal on this for the next meeting.

#### Annex 2: Communication (i.e. Approval document)

There were no comments on this Annex.

#### Annex 3: Arrangement of the REC Type Approval mark

The chairman commented that this should specify additional information (Type 1, level etc.). The editorial group will examine how this additional information should be presented.

#### Annex 4: Application Range:

This is part of the approval documentation and is important because it defines the applications that are relevant for a particular REC. If it is required to add applications this is done by communication with the Type Approval authority. It is an example only. Following discussion on the large number of NRMM that might need to be listed, it was agreed to limit the information to engine- (rather than vehicle-related) information, at least for NRMM. It was also agreed that the column for a report on additional noise emissions is not necessary. The drafting group will provide a revised document that also extends to cover PM and NOx RECs.

#### Annex 5: Requirements for Level 1 Particulate Reduction REC,

#### Annex 6: Requirements for Level 2 Particulate reduction REC,

#### Annex 7: Requirements for Level 1 NOx reduction REC and

#### Annex 8: Requirements for Level 2 NOx reduction REC

It was agreed that the tables from section 8 will be included in the Annexes.

It was noted that the approval test cycle will be the one appropriate to the target level (i.e. ETC/ESC for an application to meet Euro IV/V; WHTC/WHSC of one to meet Euro VI. It needs to be checked that this is clear in Annex 9. Annex 12 shows the test sequence where the engine is tested on the engine's original tests cycles to determine that it meets its original requirement and is then tested on the target cycle to determine baseline without the REC, and reduction efficiency (%) and emissions performance with the REC, followed by tests relative to regeneration. The draft NOx procedures may need to be amended to properly reflect this.

There will be a separate Annex for Euro VI (to be new Annex 9?).

#### Annex 9: Test of a particulate reduction REC

Schulte reviewed the contents of the Annex, which is based on Anlage XXVII. It includes additional requirements (in para. 5.3) where a system aims to improve emissions by 2 levels and requirements for determination of the regeneration type, frequency of regeneration, and related adjustment factors ( $K_i$ ). Appropriate parts of the UBA procedure for NO<sub>2</sub> measurement are included. Engine baseline NO<sub>2</sub> and levels, taken from the UBA procedure were included as Table 1.1. to ensure representativeness of the test engine, but it was agreed that this table could be deleted as there is insufficient data for a range of engines to give a reliable basis for the table.

It was clarified that if one engine is to be tested with several different RECs, the engine baseline would not need to be subjected to repeated tests without the REC.

Schulte will check the standard deviation calculation in paragraph 5.2.

It was queried whether continuously regenerating systems but with glow-plug activated 'back-up' regeneration occurring in less than 1000 hours would be considered as continuously regenerating. Schulte responded that the definition of continuously regenerating would be in line with that for original equipment and so these would be considered as periodically regenerating.

It was noted that the NO<sub>2</sub> tests requires a different 'worst case' (high Pt load) from the main PM reduction test (lowest PM loading). Manufacturers have to specify both minimum and maximum loading for any given family. Galey commented if a manufacturer wished to use, for instance, a shorter substrate with a higher Pt loading (thus giving the same Pt content) within the same family, then this would require the highest loading to be used with the largest substrate, which would not be a production intent. It was agreed that the intent is to ensure that the largest substrate is tested with the largest number of grams of active material. The precise wording will be reviewed.

The approach of using only the urban part of the ETC for the NO<sub>2</sub> test was discussed. The chairman suggested that the urban part of the WHTC would be more appropriate as it includes less severe operating conditions. Some queried the use of only part of a cycle, but both the UK and Germany felt that is essential to use this to examine real-world performance. It was agreed that it needs to be checked whether the 'urban' part of these cycles is properly defined in existing Regulations. It was agreed that the editorial group will examine the wording of this section.

Davies explained the approach used for the test cycles (paragraph 6), noting that the descriptions need to be revised to reflect the definition of the test sequence agreed earlier. The draft text also provides guidance on how to cover engines that are not approved to ECE requirements. Following discussion it was agreed to remove the provisions for constant-speed engines used in hybrid on-road applications (paragraph 6.4). Equivalent paragraphs to 6.4 should therefore also disappear from Annex 10 (paragraph 9.4). The editorial group will work on how to clarify paragraphs 6.1, 6.2. and 6.3 a). the necessity for 6.3 b) was questioned on the basis that it could give negative filtration efficiency. The wording in paragraph 6.5 also needs to be addressed by the editorial group and that in paragraph 6.6 was felt to be confusing - use of the same wording for different baseline tests should be avoided. The editorial group will tidy up this section.

#### Annex 10: Test of a NO<sub>x</sub> reduction REC

Particulate reduction in paragraph 1 should read NO<sub>x</sub> reduction.

iv) should read regulated (not non-regulated) emissions.

It was agreed that the editorial group will work on Annex 10 along same lines as Annex 9.

It was confirmed that there is no need to measure PM from NO<sub>x</sub> reduction systems during the endurance test and this was deleted from paragraph 3.

#### Annex 11: Tests of a PM and NO<sub>x</sub> reduction REC and Annex 12: Test sequence for particulate reduction REC

Not discussed.

#### Annex 13: Measurement of secondary emissions

This section has been taken from the Swiss regulation and is also a principle of US regulations. There was a substantial discussion on the need for and content of this section and the test burden on suppliers, particularly in view of the fact that no limit values could be specified. It was also noted that such emissions could they be present in exhaust gas (without REC) anyway and any requirement would therefore have to look for increases. The list of compounds was discussed also in terms of additional pollutants being considered in the work on WLTP.

The chairman will suggest to GRPE that the REC Regulation abstains from including secondary emissions requirements until there is a clearer idea of what will appear in WLTP. Something could then be inserted at a later date. Annex 13 was then deleted. *[Note: since the meeting it has been requested that this issue be further considered in the small working group.]*

### **7. Outcome and results of the REC-07 meeting**

Not reviewed further.

### **8. Next REC meeting**

The next editorial meeting will be in 3 or 4 weeks, probably at the DfT in London, UK.

The next full meeting is expected to be in the 2<sup>nd</sup> half November, possibly in The Hague.

### **9. Any other business**

There was no other business.