The European Association of Internal
Combustion Engine Manufacturers

EUROMOT

EUROMOT POSITION

28 March 2013

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EUROMOT Position to the Draft ISC PEMS Test Protocol

1. GENERAL COMMENT

Euromot welcomes the draft proposal for an in-service conformity (ISC) procedure for variable speed engines of categories Q and R (56 to 560 kW) of Directive 97/68/EC. Euromot members have actively supported the pilot programme and contributed test data and practical observations on the potential future application of ISC to the non-road sector. Euromot welcomes the fact that JRC have recognised the need to modify the baseline EU on-highway test protocol in order to be applicable to non-road engines.

Euromot members have studied the resulting detailed test protocol proposed by JRC and uploaded to CIRCABC on 2013-02-25 [1] and comments on specific items are provided in section 2 of this document. Euromot members are fully supportive of the development of the in-service test methodology, but Euromot is unable to complete the evaluation of this test protocol without first receiving the anticipated draft report from the pilot programme, which has yet to be provided. Based upon slide 45 of the presentation made by JRC on 2013-01-23 [2], it was understood by Euromot that this report would contain:

- Evaluation of new proposals by JRC/participants and consolidated reporting by JRC based on the data available
- Use of the consolidated reporting for decision making
- Comparison EU / US data evaluation methods

[1] https://circabc.europa.eu/sd/d/9e89d58f-97c5-415c-868f-9115e2d4886c/Draft_ISC_Proc_%20NRMM-PEMS.docx
[2] https://circabc.europa.eu/sd/d/8bd8f782-6372-4d4e-8ecb-7c787b8471d3/JRC_PEMS_NRMM_January2013.pdf

President: Georg Diderich

General Manager: Dr Peter Scherm

ENGINE IN SOCIETY

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Most importantly, whilst Euromot continues to support this activity, it notes that there is a current lack of any proposal from DG Enterprise in respect to concluding the open policy items within the draft protocol, nor any proposal as to how and when in-service conformity would be implemented. As this information is critical in order to be able to assess the impact of introducing ISC, Euromot believes it is essential for DG Enterprise to provide further information in this regard before completing the consultation, impact assessment and draft legal act for amending or replacing 97/68/EC.

Euromot would welcome the opportunity for a further dialogue to resolve the specific items identified below.

2. SPECIFIC ITEMS

Please refer to the identified section of the draft annex and its associated appendices for the following items, which are listed in chronological order.

Section 2.1. (working versus operating conditions)

Euromot notes that the draft annex makes reference to 'normal operating conditions' and 'working and non-working events' at various points. In section 2.1 the third phrase 'normal working conditions' is also used. In order to avoid confusion Euromot recommends avoiding this third phrase. There are other typographic issues with this paragraph. A possible simplified wording for section 2.1 is as follows:

'The conformity of in-service engines of an engine family shall be demonstrated by testing a number of machines in which engines from the family are installed. Each in-service conformity test shall be representative of operating an engine from the family, installed in a machine, under normal operating conditions, with the usual professional operator of the machine. When the machine is operated by an operator other than the usual professional operator of the particular machine, this alternative operator shall be skilled and trained to operate a machine of the type to be tested.'

Section 2.4. (ECU and communication interface)

Section 2.4 regards an engine without an ECU communication interface as non-compliant. Euromot notes that this appears to imply that a family of mechanically controlled engines (without an ECU or communication interface) would automatically be considered non-compliant. Consequently, either mechanically controlled engines must be excluded from ISC testing (for example as per the exclusion to section 8. of Annex I to 97/68/EC given in section 8.1 of that Annex), or a revision to the test requirements will be necessary, in order to avoid a presumption of non-compliance.

Section 2.4 additionally identifies an engine with a non-standard data protocol as non-compliant. Euromot notes that whilst manufacturers will most likely be using one of a number

of published data protocols, as of today there is no defined single standard data protocol for non-road engines. An alternative ending to the section could be:

'…with missing data or a data protocol that does not enable clear identification and validation of the necessary signals, shall be considered as non compliant.'

Manufacturers are already finalising and obtaining type approvals for their stage IV engines. Consequently it would be unacceptable for a specific single standard data protocol to be retrospectively required for stage IV engines.

Section 3.1.3. (approval of selected engine and machine configuration)

Euromot notes that the last sentence states that *'The basis for selection shall be developed to guide type approval authorities and manufacturers.'* Whilst not entirely clear, Euromot understands this to mean that some form of guidance document will be developed. Euromot welcomes the opportunity to work with Commission and other stakeholders in order to develop such guidance.

Section 4.4.2 (Directive 2009/30/EC)

Euromot believes that this reference should read 98/70/EC not 2009/30/EC as directive 2009/30/EC was an amendment to the base directive 98/70/EC.

Section 4.5 (working and non-working activity)

In order to ensure consistent use of the terms 'working and non-working activity' two minor typographical changes are proposed:

- It is suggested to remove the word *'work'* from the first paragraph of section 4.5 (*'…or by operating the machine in its usual ~~work~~ activity'*).
- It is suggested to delete the word 'work' from the first sub-bullet of section 4.5 (*'comprise loaded ~~work~~ activities that the majority of the in-service population of the selected machine type could reasonably be expected to perform, and'*).
- It is suggested to replace the words *'work activity'* in third sub-bullet of section 4.5 with the words *'working activity'.* ('*comprise sufficient loaded working activity…'*)

Section 5.1.2. (verification of torque signal at full load)

Euromot notes that verification of the torque signal is highly challenging on a non-road machine under normal operating conditions. In particular, as highlighted in a number of pilot programme meetings, reaching the full load curve in order to verify the torque signal is not likely to be feasible on many non-road machines. This is because it is either physically not possible to reach the full load curve (due to constraints from machine transmission system or

other operational characteristics), or to do so would require such extreme loading of the machine that this would pose a risk to the machine or its operator.

If the method for verification of the torque signal requires that the engine be operated at full load when installed in the machine during the ISC test then most likely many machines cannot be tested using the procedure for in-service conformity set out in the draft annex.

Consequently Euromot believes that agreeing an alternative approach for the verification of conformity of such ECU data streams is essential prior to introduction of the requirement to conduct in-service conformity. As suggested by JRC in the presentation of 2013-01-23 [3], a potential alternative approach could be the 'Demonstration of ALL signals "correctness" at type approval'.

Euromot rejects the mandatory use of the CO2 mass based method when full load operation in the machine is not feasible, but insists that further discussion takes place with JRC, DG Enterprise and stakeholders to agree a solution to ensure that the intended work-based window methodology that has been evaluated during the two-year pilot programme can be used.

Section 6.2 (reporting of results using the CO2 mass based method)

Euromot notes that the conformity factors shall be calculated and presented for the CO2 mass based method in addition to the work-based method. Euromot welcomes the fact that the pass/fail decision shall only be made on the basis of the work-based method, but questions why it is still necessary to calculate and report results according to the CO2 mass based method, as this appears to be a duplicate (redundant) technique.

Euromot notes that engine type approval data only provides the data to calculate the CO2 based certification ratio (Appendix 1 section 4.3.2.) for the parent engine of the engine family, whilst the engine subjected to the ISC test could be a different engine within the family for which the parent certification ratio would not be representative, and consequently would yield a misleading result.

Furthermore, importantly, Euromot notes that the use of the CO2 mass based method for testing non-road engines has also not been evaluated during the two-year pilot programme.

For the above reasons Euromot proposes to delete the CO2 mass based method from the draft Annex.

Table 2 (maximum allowed conformity factors)

The draft procedure currently specifies a conformity factor of 2.00 for in-service conformity emission testing. Euromot fully supports this factor of 2.00 as it is consistent with the factor specified in sections 4.1.2.7. and 8.6 of Annex I of 97/68/EC (as amended by 2012/46/EU), which applies to stage IV engines of categories Q & R at the time of type approval.

[3] https://circabc.europa.eu/sd/d/8bd8f782-6372-4d4e-8ecb-7c787b8471d3/JRC_PEMS_NRMM_January2013.pdf

Euromot notes that in the draft text provided by JRC the conformity factor is still highlighted for further discussion outside the PEMS pilot programme. Euromot believes that this factor should remain unchanged at a value of 2.00 for stage IV engines, for the reasons cited in this section.

Section 8.4 (Determination of a satisfactory or non-satisfactory test during confirmatory testing)

Euromot notes that the criteria for a 'non-satisfactory' confirmatory test is different to the fail criteria for the determination of the in-service conformity of an engine family. The action arising from a non-satisfactory confirmatory test is also unclear. Euromot believes that a confirmatory test should not be considered non-satisfactory unless a 'fail' decision has been reached according to the criteria set out in section 3.1.

Section 9 (Plan of remedial measures)

Euromot notes the absence of any such plan in the draft test procedure and believes it is essential for DG Enterprise to provide further information in this regard before completing the consultation, impact assessment and draft legal act for amending or replacing 97/68/EC.

Appendix 1, section 2.2. (test parameters)

Table 1 should be updated to indicate the ambient temperature source as *'ECU or sensor'* to be consistent with the notation used elsewhere in the table and with section 2.4.4. of this appendix.

Appendix 1, section 2.4.4. (Ambient temperature)

Euromot notes that the two proposed options are either to measure the ambient temperature before and after the test at a reasonable distance from the machine, or to use ECU signal for intake air temperature to measure the temperature experienced by the engine.

Euromot notes that it is not possible for the engine to know the temperature 'at a reasonable distance from the machine'. Furthermore it is not clear how the two measurements would be used to determine whether the test is valid (presumably both measurements shall be within the ambient temperature range specified in section 4.2 but this is not specified).

Euromot recommends using the temperature experienced by the engine to determine ambient temperature and supports the use of the ECU signal for this purpose. Euromot believes that the use of an ambient temperature probe adjacent to the engine air intake should equally be a permitted alternative to determine the air temperature experienced by the engine.

It is suggested to refer to the engine signal as the engine ECU signal, rather than the CAN signal to be consistent with other text in the draft Annex and in table 1.

Appendix 1, section 2.4.5. (Connection with the engine ECU)

As already noted in this document, whilst manufacturers will most likely be using one of a number of published data protocols, as of today there is no defined single standard data protocol for non-road engines. An alternative wording for the section could be:

'A data logger shall be used to record the engine parameters listed in Table 1. This data logger shall make use of the engine or machine communication interface which permits the off-board transmission of the necessary ECU data.'

Appendix 1, section 2.6.6. (Identification of valid data points for emissions calculation)

Euromot welcomes and fully supports the methodology proposed by JRC. Euromot observes that the values contained in the associated appendix 5 appear reasonable, but notes that at this time it has not received any report containing the analysis of the data supplied by engine manufacturers to JRC, nor have manufacturers had sufficient time to individually evaluate test data using the proposed values. Consequently, Euromot supports these values at this time, but will continue to evaluate this issue as more data becomes available.

Appendix 1 section 2.7.5 (drift correction)

Euromot notes that there is a requirement to apply a drift correction, or to void the test, if the difference between pre-test and post-test results is equal to or greater than 2 per cent. Furthermore, when a drift correction is applied, in order for the test not to be void 'The difference between the uncorrected and the corrected brake-specific emission values shall be within ± 6 per cent of the uncorrected brake-specific emission values.'

When the measured brake specific values are high these per cent values appear reasonable. However, in the case that the measured brake specific emission values are low and approaching the lower limit of measurement capability of the emission analyser, whilst the engine should easily pass the in-service conformity test it becomes extremely difficult to comply with the above per cent values.

Consequently, in order to ensure that test data is not unnecessarily voided, Euromot believes these requirements should be re-examined.

Appendix 1, section 3.2.1. (Analysers and EFM data)

Euromot notes that the consistency check required by this section has not been evaluated during the non-road pilot programme. A preliminary examination by one engine manufacturer has revealed that it may not be possible to comply with the regression requirements of this section when testing a non-road machine conducting repetitive transient activity with high rates of change. This is believed to be due to the different response characteristics (and hence instantaneous time alignment) of the EFM, gas analyzers and fuel flow rate, which can result in outliers in the regression plot.

Euromot believes that further evaluation of this item will be required before the proposed test procedure is finalised.

Appendix 1, section 3.2.2. (ECU torque data)

As already highlighted in this document this requirement is impractical. In addition, the cross reference (*'section 5 of Annex II'*) appears to be incorrect.

Appendix 1, section 4.1 (cross reference to section 2.6.5.)

Euromot believes that the cross-reference to section 2.6.5. is incorrect and should read 2.6.6.

Treatment of infrequent regeneration events during an in-service conformity test

Euromot notes that there is no instruction in the draft test procedure as to what action to take if an infrequent regeneration event occurs during an in-service conformity test. Euromot believes that it would be inappropriate to use test data obtained during an infrequent regeneration event without applying an adjustment factor to the emissions as determined during the engine type approval process. Recognising the difficulty in applying an adjustment factor to an in-service conformity test, Euromot recommends that the data associated with a regeneration event be excluded from the analysis.

Treatment of crankcase emissions during an in-service conformity test

Euromot notes that the draft test procedure does not specify whether crankcase emissions must be included in the in-service conformity test measurement. At type approval, for engines that vent crankcase gases to atmosphere, the crankcase emissions must be included in the measurement. Whilst it is possible to measure crankcase emissions from an engine installed in a test cell, by installing additional laboratory piping systems from the engine to exhaust gas analysers, measuring crankcase emissions from an engine installed in a machine would be very difficult. Considering the minimal contribution that crankcase gases make to the overall emission result, Euromot recommend that crankcase gases are not required to be included when conducting an in-service conformity test.

Engine malfunction during an in-service conformity test

Euromot notes that an engine that is not in conformity with the type-approved configuration, has been improperly maintained, or is showing signs of abuse that could impact the emissions results, should not be chosen for testing. However, the draft text does not provide instruction in respect to an engine malfunction occurring during an in-service conformity test.

Euromot believes that in the case that a malfunction occurs during an in-service conformity test and that the machine operator is clearly notified by an on-board monitoring system that a malfunction has occurred (via a malfunction lamp, text message or other indicator), the test

should be void. Any malfunction should be corrected before conducting any further in-service conformity test on the engine.

Machine-based restrictions on ISC testing using PEMS

In the presentation of 2013-01-23 [4] JRC proposed that the possibility to extract the engine from the machine to conduct ISC testing should remain for small machines. This was proposed on the basis that it may not be possible to install the PEMS on the machine in a manner that would permit safe operation. Euromot recommends that this option to extract the engine be retained for any case (irrespective of size) where safe installation and operation is not possible and no alternative machine is available. Such testing should be required to comply with the type approval requirements for the engine family.

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For more information please contact:

European Association of Internal Combustion
Engine Manufacturers – EUROMOT
Dr Peter Scherm, +49 69 6603-1354, peter.scherm@euromot.eu
EU Transparency Register ID number: 6284937371-73

[4] https://circabc.europa.eu/sd/d/8bd8f782-6372-4d4e-8ecb-7c787b8471d3/JRC_PEMS_NRMM_January2013.pdf

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