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Diesel engines — Fuel filters — Method for evaluating fuel/water separation efficiency

Moteurs diesel — Filtres à carburant — Méthode d'évaluation de l'efficacité de séparation carburant-eau

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 34, *Vehicle propulsion, powertrain, and powertrain fluids*.

This document cancels and replaces the first edition ISO/TS 16332:2006 which has been technically revised. The main changes compared to the previous edition are as follows:

— test fuel definition;

— change of IFT measurement standard and interface age;

— droplet size distribution;

— test duration;

— additional preconditioning cycle; and

— validation of test procedure by conduction of two round robin tests (see Annex G).

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Introduction

Modern fuel injection systems, installed in passenger cars, as well as in heavy duty or off-road applications, require high and stable separation efficiencies for all insoluble contaminants in the fuel to ensure a prolonged life. Beside solid contamination, undissolved water, in finely or coarsely emulsified form, can also reduce the lifetime of injection systems. Suitable fuel/water separators, having a high level water separation efficiency, are an absolute necessity for system longevity.

Factors found to affect the separation efficiency of undissolved water in the field are mainly due to the fuel quality, which can differ widely in different regions of the world and which can also differ when biogenic components are added to the fuel. Additionally the separation efficiency is strongly influenced by fuel composition.

Separation efficiency tests can be applied mainly for two purposes:

— To evaluate the field performance of a fuel/water separator

  To evaluate the performance of a fuel/water separator close to field conditions, the usage of commercially, untreated fuel as test fluid is necessary.

— To compare fuel/water separators under repeatable test conditions

  For a fuel/water separator comparison in the laboratory, fuel conditioning is necessary to achieve constant and repeatable test conditions. Water separation efficiency results obtained with treated fuel can be significantly different from those with commercially available, untreated fuel.

Tests performed with new fuel/water separators can lead to considerably higher water separation efficiencies.

NOTE Ageing of the fuel/water separator due to operational conditions can strongly affect the water separation function of a fuel/water separator. To test a fuel/water separator in an “end of life” state, it can be aged in advance. It is proposed to do this by a standardized ageing procedure, to get comparable “end of life” states. However, it is not a part of this document nor any other ISO standard. This procedure may be explored in future.

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Diesel engines — Fuel filters — Method for evaluating fuel/water separation efficiency

1 Scope

This document specifies a fuel/water separator comparison test under defined and simplified laboratory conditions.

This test is intended for pressure side fuel/water separators as well as for suction side fuel/water separators. Pressure side fuel/water separators are tested with fine droplets and suction side filters are tested with coarse droplets using the same test rig layout.

The rated flow (in litres per hour) is intended for the range between 50 l/h and 1 500 l/h. By agreement between customer and fuel/water separator manufacturer, and with some modifications, the procedures can be used for fuel/water separators with higher or lower flow rates.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1219-1, *Fluid power systems and components — Graphical symbols and circuit diagrams — Part 1: Graphical symbols for conventional use and data-processing applications*

ISO 9101, *Surface active agents — Determination of interfacial tension — Drop volume method*

ISO 6889, *Surface active agents — Determination of interfacial tension by drawing up liquid films*

ISO 12937, *Petroleum products — Determination of water — Coulometric Karl Fischer titration method*

ISO 13320, *Particle size analysis — Laser diffraction methods*

ASTM D4176–04 (2009), *Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
interfacial tension
IFT
work which is required to increase the interface of the liquid by one surface area unit

Note 1 to entry: In case of additivated liquids, the IFT-value has a significant time dependency. Therefore the default value for the interface age within ISO 16332-usage is defined at 10 s.

Note 2 to entry: The conditions and parameters for determination of IFT by the drop volume method according to ISO 9101 are defined in Annex C.

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Note 3 to entry: Interfacial tension is equivalent to the specific interfacial energy and is expressed in Millinewtons per meter (mN/m). Alternative methods to determine the IFT (at 10 s) can be used, as long as the comparability to ISO 9101 is ensured.

3.2
droplet size distribution
DSD
percentage of the droplet population in different size ranges

Note 1 to entry: For further information, see B.3.

3.3
water concentration at the saturation level of dissolved water
c_S
concentration of water in water saturated test fuel with the IFT adjusted by Monoolein

Note 1 to entry: The determination of c_S is defined in Annex E.

3.4
base water concentration
c_B
concentration of water in the test fuel, determined after the preconditioning cycle

Note 1 to entry: See 8.4.3 or 9.1.3.

Note 2 to entry: In case one of the $c_{T,down,i}$-values [determined in 9.1.4 c) and d)] is lower than c_B (determined in 9.1.3) take the lowest value as c_B.

3.5
undissolved water concentration
c_U
concentration of free water, that is concentration above base water concentration

3.6
total water concentration
c_T
summation of base water concentration and undissolved water concentration

Note 1 to entry: $c_T = c_U + c_B$.

3.7
sample index
i
integer from 1 to n, where n equals the number of samples

3.8
instantaneous water separation efficiency
η_i
water separation efficiency, at test time t_i

3.9
average water separation efficiency
η_{av}
average water separation efficiency, calculated based on the average downstream water concentration

Note 1 to entry: Calculation according to 9.2 e).

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3.10
calibration flow rate
Q_C
fuel flow rate, which is adjusted for calibration purpose of the emulsifying device

Note 1 to entry: The calibration procedure is defined in B.4.

3.11
sampling point index
< up> reference to the upstream sampling point

3.12
sampling point index
< down> reference to the downstream sampling point

4 Symbols

Graphical symbols used in this document for fluid power system components are in accordance with ISO 1219-1.

5 Test equipment

5.1 Test fluids

5.1.1 Test fuels

For the validation and for each filter test one of the following three kinds of fuels can be used as test fuel.

— F1 Unmodified service station fuel

— F2 Standard test fuels: Fuels, treated according to Annex A

Test fuel F2.1: High IFT test fuel

— IFT (10 s): 22 ± 2 mN/m, according to ISO 9101, parameterized according to Annex C

  Alternatively IFT (60 s): 20 ± 2 mN/m, according to ISO 9101 or ISO 6889.

— Separability (ASTM D 1401): To be reported

Test fuel F2.2: Low IFT test fuel

— IFT (10 s): 13 ± 2 mN/m, according to ISO 9101

  Alternatively IFT (60 s): 11 ± 2 mN/m, according to ISO 9101 or ISO 6889.

To describe the test fuel used, the following parameters shall be determined:

— IFT(10 s) and IFT(60 s);

— separability (ASTM D 1401);

— water saturation level according to Annex E;

— bio diesel content (optional);

— density (optional);

— kinematic viscosity (optional);

— CFPP (optional).

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