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Gasoline engines with direct injection — Cleanliness assessment of fuel injection equipment

Moteurs à essence — Evaluation de propreté pour équipement d'injection de combustible

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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 of 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 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 second edition cancels and replaces the first edition (ISO 19724:2016), of which it constitutes a minor revision. The main changes compared to the previous edition are as follows:

— The reporting of the inspection results (Clause 6) changed from FIECC (Fuel Injection Equipment Cleanliness Code, as in ISO 12345:2013) to CCC (Component Cleanliness Code, as in ISO 16232);

— The references to different parts of the ISO 16232 series have been modified to the newest edition: ISO 16232:2018.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Modern fuel injection systems contain many closely controlled clearances and rely on the fuel-flowing characteristics of small orifices. Thus, they require the close control of sources of contamination in order to maintain the operational performance demanded of them throughout their design life. To this end, such systems are designed with integral fuel-filtration equipment, which reduces the amount of potentially damaging debris that could enter the system from external sources.

However, contamination of the fuel injection system can also occur internally, from system use or wear, from equipment servicing, or as a result of the original supplier's manufacturing and assembly processes. The focus of this document is on the latter source of contamination and is thus concerned with the assessment of the cleanliness of the fuel injection equipment as originally supplied to the engine manufacturer.

Fuel injection systems comprise a number of components. These are the low-pressure elements (fuel tank, pipework, filters, lift pump, etc.), a high-pressure fuel pump, a high-pressure pipe, a fuel rail with a high pressure sensor and fuel injectors.

During the preparation of this document, the importance of care in the handling and measurement of contamination samples was clearly recognized. Moreover, the low levels of contaminant with fuel injection equipment make this a particularly difficult task. For this document to be used meaningfully as an indicator of component cleanliness and a driver towards higher quality standards, extreme attention to detail is required of the user. Verification requirements for the test equipment used are therefore emphasized. Helpful standards for appropriate conditions and handling are given in the bibliography.

It is not always clear what level of cleanliness is sufficient for rated performance and life time on a cost-effective basis. The actual quantitative levels can only be set in relation to other parameters, agreed between the manufacturer, supplier and user. This document provides a set of procedures for evaluating the cleanliness of fuel injection equipment and a framework for a common measurement and reporting.

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Gasoline engines with direct injection — Cleanliness assessment of fuel injection equipment

WARNING — Application of this document may involve the use of hazardous materials, operations and equipment. This document does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicable regulatory limitations prior to use.

1 Scope

This document specifies cleanliness assessment procedures for evaluating the amount of debris present on the clean side of the constituent parts of high-pressure gasoline direct fuel injection systems. The presence of such debris could lead to a reduction in the system's operational performance.

While other International Standards (e.g. ISO 16232) relate to the cleanliness of different types of components used in road vehicle fluid circuits, this document focuses on the special procedures applied for the components of gasoline direct fuel injection systems.

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 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 14644-1, *Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness by particle concentration*

ISO 16232:2018, *Road vehicles — Cleanliness of components and systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16232 apply.

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

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

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

4 Procedures

4.1 General

All tests shall be carried out in a clean laboratory environment. Failure to achieve a satisfactory blank test level of contamination could indicate unsuitable control of test conditions. Clean room conditions according to ISO 14644-1, class 8, are recommended as a minimum for these procedures.

The appropriate method to determine the required amount of fluid is by use of an extraction curve (declining test), as described in ISO 16232:2018, 6.2.3.1 and B.1. In order to avoid each laboratory finding a different amount of fluid to be required, a guideline for the volume is given here for each component.

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