

# Diesel engines — Cleanliness assessment of fuel injection equipment

ICS 43.060.40

National foreword

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The UK participation in its preparation was entrusted to Technical Committee MCE/22, Engines for road vehicles, which has the responsibility to:

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- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

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Summary of pages

This document comprises a front cover, an inside front cover, the ISO title page, pages ii to v, a blank page, pages 1 to 23 and a back cover.

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## **Diesel engines — Cleanliness assessment of fuel injection equipment**

*Moteurs diesels — Évaluation de la propreté de l'équipement d'injection*



Reference number  
ISO 12345:2002(E)



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 12345 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 7, *Injection equipment and filters for use on road vehicles*.

Annex B forms a normative part of this International Standard. Annexes A and C are for information only.

## 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 International Standard 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. Traditional systems contain low-pressure elements (fuel tank, pipe-work, filters, lift pump, etc.), a fuel injection pump, high-pressure pipes and fuel injectors, located within the engine cylinder head.

During the preparation of this International Standard, the importance of care in the handling and measurement of contamination samples was clearly recognized. Moreover, the low levels of contaminant experienced with fuel injection equipment makes this a particularly difficult task. For this International Standard 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, in detail.

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

Work on cleanliness assessment continues within ISO/TC 22/SC 7 and among other groups of experts, and could result in an amendment of this International Standard in the near future. Items under consideration are

- cleanliness procedures specifically applicable to common rail systems, and
- improvement of the reporting scheme of the cleanliness level.



# Diesel engines — Cleanliness assessment of fuel injection equipment

## 1 Scope

This International Standard specifies cleanliness assessment procedures for evaluating the amount of debris found within the constituent parts of a fuel injection system for diesel engines that could lead to a reduction in the system's operational effectiveness. It is mainly concerned with new equipment not yet fitted to a diesel engine, and is therefore aimed primarily at engine and fuel injection equipment manufacturers.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3722:1976, *Hydraulic fluid power — Fluid sample containers — Qualifying and controlling cleaning methods*

ISO 4006:1991, *Measurement of fluid flow in closed conduits — Vocabulary and symbols*

ISO 4008-1, *Road vehicles — Fuel injection pump testing — Part 1: Dynamic conditions*

ISO 4020:2001, *Road vehicles — Fuel filters for diesel engines — Test methods*

ISO 4405:1991, *Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the gravimetric method*

ISO 4407:2002, *Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the counting method using an optical microscope*

ISO 4113, *Road vehicles — Calibration fluid for diesel injection equipment*

ISO 4788:1980, *Laboratory glassware — Graduated measuring cylinders*

ISO 7440-1, *Road vehicles — Fuel injection equipment testing — Part 1: Calibrating nozzle and holder assemblies*

ISO 7876-1, *Fuel injection equipment — Vocabulary — Part 1: Fuel injection pumps*

ISO 7876-2, *Fuel injection equipment — Vocabulary — Part 2: Fuel injectors*

ISO 7876-3, *Fuel injection equipment — Vocabulary — Part 3: Unit injectors*

ISO 7876-4, *Fuel injection equipment — Vocabulary — Part 4: High-pressure pipes and end-connections*

ISO 7967-7:1998, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 7: Governing systems*

ISO 8535-1, *Compression-ignition engines — Steel tubes for high-pressure fuel injection pipes — Part 1: Requirements for seamless cold-drawn single-wall tubes*

ISO 8535-2, *Compression-ignition engines — Steel tubes for high-pressure fuel injection pipes — Part 2: Requirements for composite tubes*

ISO 8984-1, *Diesel engines — Testing of fuel injectors — Part 1: Hand-lever-operated testing and setting apparatus*

ISO 11171:1999, *Hydraulic fluid power — Calibration of automatic particle counters for liquids*

ISO 11500:1997, *Hydraulic fluid power — Determination of particulate contamination by automatic counting using the light extinction principle*

ISO 11943:1999, *Hydraulic fluid power — On-line automatic particle-counting systems for liquids — Methods of calibration and validation*

ISO 18413:—<sup>1)</sup>, *Hydraulic fluid power — Cleanliness of parts and components — Inspection document and principles related to contaminant collection, analysis and data reporting*

SAE J1549:1988, *Diesel fuel injection pump — Validation of calibrating nozzle holder assemblies*

### **3 Terms and definitions**

For the purposes of this International Standard, the terms and definitions given in ISO 4006, ISO 7876-1 to ISO 7876-4, ISO 7967-7 and the following apply.

#### **3.1**

##### **fuel injection equipment cleanliness code**

##### **FIECC**

three-figure code representing the distribution of particles by size found during cleanliness testing of fuel-injection equipment

#### **3.2**

##### **average cleanliness level**

##### **ACL**

average level for cleanliness measured in gravimetric or particle count terms over at least five consecutive readings

#### **3.3**

##### **required cleanliness level**

##### **RCL**

required level for cleanliness of components or products under test, measured in terms of gravimetric or particle count

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1) To be published.