INTERNATIONAL STANDARD

ISO 16232-4

First edition
2007-06-01

Road vehicles — Cleanliness of components of fluid circuits —

Part 4:
Method of extraction of contaminants by ultrasonic techniques

Véhicules routiers — Propreté des composants des circuits de fluide —

Partie 4: Méthode d'extraction des contaminants par ultrasons

Reference number
ISO 16232-4:2007(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

This document is a preview generated by EVS

COPYRIGHT PROTECTED DOCUMENT

© ISO 2007

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16232-4 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 5, *Engine test*.

ISO 16232 consists of the following parts, under the general title *Road vehicles — Cleanliness of components of fluid circuits*:

- *Part 1: Vocabulary*
- *Part 2: Method of extraction of contaminants by agitation*
- *Part 3: Method of extraction of contaminants by pressure rinsing*
- *Part 4: Method of extraction of contaminants by ultrasonic techniques*
- *Part 5: Method of extraction of contaminants on functional test bench*
- *Part 6: Particle mass determination by gravimetric analysis*
- *Part 7: Particle sizing and counting by microscopic analysis*
- *Part 8: Particle nature determination by microscopic analysis*
- *Part 9: Particle sizing and counting by automatic light extinction particle counter*
- *Part 10: Expression of results*

Introduction

The presence of particulate contamination in a fluid system is acknowledged to be a major factor governing the life and reliability of that system. The presence of particles residual from the manufacturing and assembly processes will cause a substantial increase in the wear rates of the system during the initial run-up and early life, and may even cause catastrophic failures.

In order to achieve reliable performance of components and systems, control over the amount of particles introduced during the build phase is necessary, and measurement of particulate contaminants is the basis of control.

The ISO 16232 series has been drafted to fulfil the requirements of the automotive industry, since the function and performance of modern automotive fluid components and systems are sensitive to the presence of a single or a few critically sized particles. Consequently, ISO 16232 requires the analysis of the total volume of extraction liquid and of all contaminants collected using an approved extraction method.

The ISO 16232 series has been based on existing ISO International Standards such as those developed by ISO/TC 131/SC6. These International Standards have been extended, modified and new ones have been developed to produce a comprehensive suite of International Standards to measure and report the cleanliness levels of parts and components fitted to automotive fluid circuits.

This part of ISO 16232 defines procedures for the removal and collection of contaminants from components using ultrasonic bath or an ultrasonic probe so that their cleanliness can be evaluated.

The cleanliness level of a component, as determined according to this method, depends to a large extent on the test parameters (e.g. the frequency, the power and duration of the ultrasound and the type of application, bath or sonotrode). It is advisable that all parameters be included in the inspection document and rigorously followed by the test staff.

Road vehicles — Cleanliness of components of fluid circuits —

Part 4:
Method of extraction of contaminants by ultrasonic techniques

1 Scope

This part of ISO 16232 describes the principles of extraction of contaminants from a component either by immersion in an ultrasonic bath or by applying ultrasonic vibrations directly via sonotrodes. It is preferably applied to small and medium sized components of various geometry of which both internal and/or external surfaces have to be examined (e.g. joint seals, gears, etc). It is also applicable to small parts to be analysed in batches.

This method can be used on its own or in association with other methods of extraction described in the ISO 16232 series.

NOTE 1 The suitability of this method for complex geometries – e.g. tiny bores or large cavities with small openings – is decided on a case by case basis.

NOTE 2 Depending on the shape of the components, this method can be used also for batches containing multiple layers of components provided that there is no obstruction to the extraction of contaminants from the surface and their subsequent transfer into the test liquid. Small compact parts of large number are cleaned in a single layer.

Unless otherwise specified, this part of ISO 16232 deals with particulate contamination only. It does not, therefore, cover appearance defects or contamination by liquid or gaseous materials. It covers the amount and the nature of residual particles resulting from manufacturing processes and from the environment.

2 Normative references

The following referenced documents are indispensable for the application 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 16232-1, *Road vehicles — Cleanliness of components of fluid circuits — Part 1: Vocabulary*

ISO 16232-2, *Road vehicles — Cleanliness of components of fluid circuits — Part 2: Method of extraction of contaminants by agitation*

ISO 16232-3, *Road vehicles — Cleanliness of components of fluid circuits — Part 3: Method of extraction of contaminants by pressure rinsing*

ISO 16232-5, *Road vehicles — Cleanliness of components of fluid circuits — Part 5: Method of extraction of contaminants on functional test bench*

ISO 16232-6, *Road vehicles — Cleanliness of components of fluid circuits — Part 6: Particle mass determination by gravimetric analysis*

ISO 16232-7, *Road vehicles — Cleanliness of components of fluid circuits — Part 7: Particle sizing and counting by microscopic analysis*

ISO 16232-8, *Road vehicles — Cleanliness of components of fluid circuits — Part 8: Particle nature determination by microscopic analysis*

ISO 16232-9, *Road vehicles — Cleanliness of components of fluid circuits — Part 9: Particle sizing and counting by automatic light extinction particle counter*

ISO 16232-10:2007, *Road vehicles — Cleanliness of components of fluid circuits — Part 10: Expression of results*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16232-1 apply.

4 Principle

The contaminants are extracted from the surface of the component by ultrasound. The cleaning effect is due to the cavitation, which creates micro-bubbles that implode close to the particles which are then expelled from and transferred to the extraction liquid for subsequent analysis.

NOTE 1 In case of an active component, the particles are extracted from the entire controlled surface of the component by traversing liquid.

NOTE 2 Several operating parameters influence the extraction efficiency, e.g. power density, operating time and medium, the placement and orientation of the component in relation to the ultrasonic source and the material the component is made of.

5 Equipment

5.1 General

The equipment used shall neither alter nor modify the size distribution of the extracted particles.

5.2 Test liquid

The test liquid shall be compatible with all the materials in the component, with the liquid used in the final system and with the test equipment, including seals, membrane filters and clean-up filters. A test liquid of low viscosity ($\leqslant 5\ \mathrm{mm}^2/\mathrm{s}$) and having the capability of removing (or dissolving) oil and grease is recommended. It should be filtered to attain the requirements of 6.3.3.

SAFETY PRECAUTIONS — In case a tested component will be reclaimed for final use, application of incompatible test liquid may cause hazardous damage.

5.3 Test component container

A closed container should be used for the transfer of the component from the place of sampling to the place of particle extraction. This container shall be appropriate to the shape of the component and made of material compatible with the test liquid. Its degree of cleanliness shall comply with the blank requirements specified in 6.3.3.