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Impact of changes in ISO fluid power particle counting — Contamination control and filter test standards

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National foreword

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TECHNICAL REPORT

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Impact of changes in ISO fluid power particle counting — Contamination control and filter test standards

Conséquences des changements survenus dans les normes ISO relatives au comptage des particules — Contrôle de la contamination et essais de filtres

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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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 131, *Fluid power systems*, Subcommittee SC 6, *Contamination control*.

This second edition cancels and replaces the first edition (ISO/TR 16386:1999) which has been technically revised.

Introduction

This Technical Report has been prepared as an information document to give users an understanding into the background and implications of a number of new and revised contamination control standards, namely ISO 11171, ISO 11943, ISO 16889 and ISO 4406.

The adoption of four revised and updated contamination control standards, ISO 11171, ISO 11943, ISO 16889, and ISO 4406:1999, has produced significant changes in terms of how solid contamination levels and filter performance are reported.

With ISO 11171, the method of calibrating automatic particle counters (APCs) using AC Fine Test Dust (ACFTD) used since the early 1970s has been replaced by a new method traceable to the USA's National Institute of Standards and Technology. As a result, contaminant particle sizes previously referred to as 2 µm, 5 µm, 10 µm, and 15 µm became 4 µm(c), 6 µm(c), 10 µm(c), and 14 µm(c), respectively where (c) refers to particle sizing and counting done with an APC calibrated in accordance with ISO 11171.

ISO 11943 is a new standard for calibrating online particle counting systems that are primarily used to evaluate filter performance. With the ISO 16889 filter multi-pass test, which replaces the original ISO 4572 method, ISO Medium Test Dust (ISO MTD) replaces ACFTD as the test dust and the new ISO 11171 traceable particle counter calibration method is used. In ISO 4406:1999, the new calibration method is used, and a new 4 µm(c) size class has been added to the solid contamination code for particle counts made with an automatic particle counter.

These improvements in particle counting and filter testing have a significant impact on contamination control activities. However, it is important to note that there has been no change in the actual contamination levels or in the performance of filters, or their effectiveness in protecting the reliability of components. This Technical Report discusses what the changes are, why they were made, how they impact contamination levels and filter ratings, and how they benefit the industry.

TECHNICAL REPORT ISO/TR 16386:2014(E)

Impact of changes in ISO fluid power particle counting — Contamination control and filter test standards

1 Scope

This Technical Report discusses the impact of changes in International Standards for particle counting, contamination control, and filter testing.

Liquid automatic particle counters (APCs) are used in monitoring contamination levels in hydraulic fluids, to establish component and assembly cleanliness level specifications, and in determining filter efficiencies and particle size ratings. As a result of the replacement of ISO 4402 with ISO 11171 (APC calibration), the replacement of ISO 4572 with ISO 16889 (multi-pass filter test), and the publication of ISO 11943 (online particle counter calibration), the quality and reliability of particle count and filter test data have improved, increasing their usefulness to industry. However, the resultant redefinition of particle sizes and the use of a new test dust affect how contamination levels and filter performance are reported and interpreted.

NOTE The first editions of ISO 11171, ISO 16889 and ISO 11943 were published in 1999; all three of these International Standards either have been, or are in the process of being, revised.

2 Historical background

2.1 What is ACFTD?

ACFTD was a test dust that was originally produced in batches by the AC Spark Plug Division of General Motors Corporation. ACFTD was manufactured by collecting dust from a certain location in Arizona (USA), then ball milling and classifying it into a consistent particle size distribution, including particle sizes from roughly 0 µm to 100 µm. The manufacturer supplied the average volumetric particle size distribution of each batch of ACFTD as determined by either the roller analyser of laser diffraction technique. In 1992, the production of ACFTD ceased.

Because of its relatively consistent particle size distribution, ACFTD had been used to calibrate APCs in ISO 4402 and to evaluate filter performance in ISO 4572 for hydraulic and other applications. With its irregular shape and silicon dust nature, ACFTD was believed to be representative of contaminants found in typical hydraulic systems. In ISO 4402, a particle size distribution for ACFTD is given which is based on optical microscopy work done in the late 1960s. At that time, there was no statistical analysis of batch-to-batch variations in ACFTD. Later, it was discovered that differences exist between the published particle size distribution and actual particle size distributions of subsequent batches of ACFTD. These differences are a significant source of variability in particle count results.

2.2 Calibrating particle counters using ACFTD

Although often taken for granted, particle counting is the mainstay of contamination control programs. APCs are used to monitor contamination levels in the hydraulic fluid of operating equipment, to establish component and assembly cleanliness level specifications, and to provide a basis for determining filtration ratios (beta ratios), efficiencies, and particle size ratings of hydraulic filters.

Calibration consists of establishing the relationship between APC's threshold voltage setting and particle size. This was done by comparing observed particle contamination levels at known threshold settings to the published ACFTD particle size distribution. Because of this, calibration accuracy depends on the accuracy of the published particle size distribution.

In the absence of a more controlled contaminant, ACFTD had been used for APC calibration for hydraulic and other applications. The ACFTD particle size distribution used for calibration in ISO 4402 is based