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Effect of conductivity on multi-pass testing as per ISO 4548-12:2017

~~CD/DTR~~ stage

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Foreword

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This document was prepared by Technical Committee ISO/TC 70, *Internal combustion engines* Subcommittee SC 7, *Tests for lubricating oil filters*.

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.

Introduction

~~ISO 4548-12 (2000 and 2017 editions) states that oil~~ (MIL-PRF-5606, AIR 3520 and other suitable fluids) conductivity is ~~required~~ to be set to “at least 1 000 pS/m” prior to conducting a lubricating oil filter ~~per ISO 4548-12 (2000 and 2017 editions),~~ with a recommended level of “1 500 pS/m ~~+/- +/-~~ 500 pS/m.” Prior to the revision of ISO 4548-12:2000 (started in 2016), fluid conductivity had received ~~more~~~~increasing~~ attention. Some labs reported issues with maintaining fluid conductivity during these tests and discussed the ~~affects~~~~effects~~ conductivity can have on filter capacity results. Testing showed the fluid conductivity can decrease during a test, which corresponded to an increase in filter capacity. A ~~Task Force~~~~task force~~ was established within ISO/TC70/SC7/WG2 to investigate this issue. Findings from this work ~~is~~~~are~~ summarized in this document. The root cause of the fluid conductivity problem was not discovered and most labs did not report any issues with maintaining conductivity during ISO 4548-12 testing.

Experiments were conducted by one ~~(1)~~ laboratory, oil was examined by two ~~(2)~~ laboratories, and survey results were sent from nine ~~(9)~~ laboratories. Three ~~(3)~~ sets of experiments were conducted including testing with flat sheet samples and commercially available filters to examine the effect of fluid conductivity change. Fresh and aged oil were examined to see if any components of the fluid were depleted during normal use.

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Effect of conductivity on multi-pass testing as per ISO 4548-12:2017

1 Scope

This document outlines the importance of conductivity in multi-pass filter testing per ISO 4548-12. This information also applies to filters tested per other multi-pass filter test standards, such as ISO 16889 and ISO 19438. ~~The filters~~Filters tested ~~per~~according to each method ~~may~~can experience similar changes in performance during the fluid conductivity changes outlined within this document.

The objectives of this ~~Technical Report~~document are to clarify the following issues:

- Examine how conductivity affects filter capacity test results when filters are tested per ISO 4548-12:2017.
- Compare findings to ISO 4548-12:2017 operating parameters.

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 4548-1, *Methods of test for full-flow lubricating oil filters for internal combustion engines — Part 1: Differential pressure/flow characteristics*

~~ISO 4548-12:2017, Methods of test for full flow lubricating oil filters for internal combustion engines — Part 12: Filtration efficiency using particle counting and contaminant retention capacity~~

4.3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4548-1 apply.

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

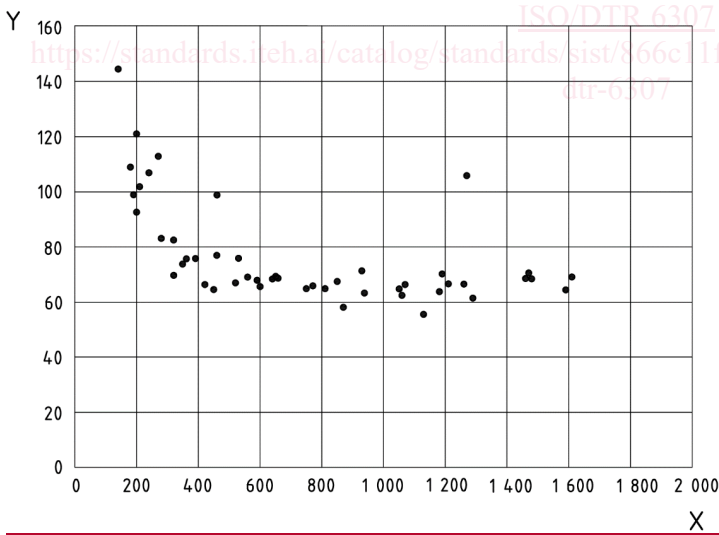
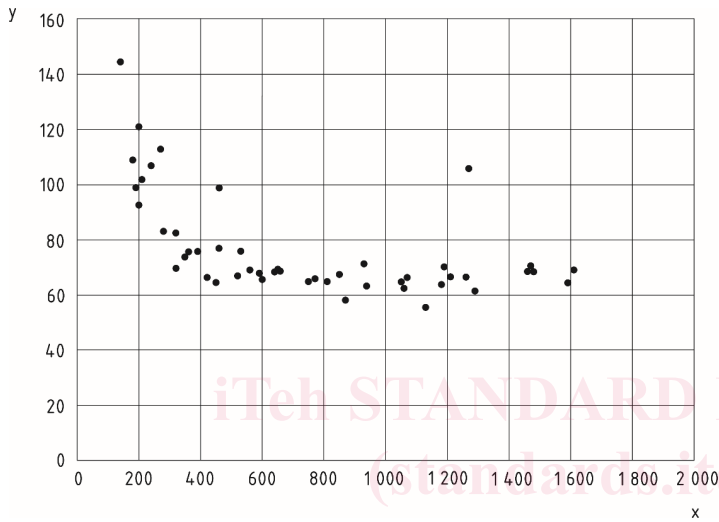
- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

5.4 Reference filter testing

This issue was first reported after a lab used “reference filters” to monitor the consistency of their multi-pass test system. These are typical production spin-on filters, but specifically manufactured to limit filter-to-filter variation. These reference filters are constructed with synthetic media and a media area of ~~3039~~3 039 cm². These filters are typically used as hydraulic/transmission oil filters on heavy-duty diesel engines for off-road equipment.

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From 2012 to 2015, this lab gathered data from periodic testing of these reference filters per ISO 16889:2008 (Figure 1). Initial and final conductivity were logged during this testing. Test technicians noticed final conductivity would significantly drop during some tests, corresponding with a higher than expected capacity. Specific parameters of this testing are shown below.



Key

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y — Retained Capacity (g)
 x — Final Conductivity (pS/m)
 X final conductivity (pS/m)
 Y retained capacity (g)
 Flow Rate: 75 lpm
 BUGL: 10 mg/l of A3 dust per ISO 12103-1:2016
 Terminal dP: 345 kPa
 Expected capacity: 60 – 70 g
 Expected performance: $\beta_{200} = 14 \mu\text{m}(c) / \beta_{1,000} = 19 \mu\text{m}(c)$

Figure 1 — Reference filter capacity versus final conductivity

Flow Rate: 75 lpm

BUGL: 10 mg/l of A3 dust per ISO 12103-1:2016

Terminal dP: 345 kPa

Expected capacity: 60 – 70 g

Expected performance: $\beta_{200} = 14 \mu\text{m}(c) / \beta_{1,000} = 19 \mu\text{m}(c)$

When a reference filter test results were outside of the expected results (tolerance), the fluid in the test system would be changed. This fixed the issue and allowed the reference filter to test within expected results. Reference filter testing has continued at this lab, but in 2015 more attention was paid to fluid change-outs of the test system. Reference filters were tested in old oil (used for some time and ready to be changed) and new oil, at different levels of initial conductivity (results shown in Figure 2). Figure 2 also shows the results from testing reference filters throughout 2015 as “Historical Data.” This is normal lab practice for monitoring the status of the test system and fluid.

The 2016 Study conducted with old and new oil was done at initial conductivity levels of 1 000 pS/m, 1 500 pS/m, and 2 000 pS/m. The reference filter capacity results were significantly higher than historical results when tested with the old fluid, signifying the need for the fluid to be changed. This old fluid was left in the test system for the 2016 study. The new fluid was a fresh batch of oil, removed from the drum, added to the test system, and additized with conductivity improving fluid to establish the initial conductivity level(s).