INTERNATIONAL STANDARD

ISO 12103-1

Second edition
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Road vehicles — Test contaminants for filter evaluation —

Part 1: Arizona test dust

Véhicules routiers — Poussière pour l'essai des filtres —

Partie 1: Poussière d'essai d'Arizona

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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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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

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The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 34, *Propulsion, powertrain and powertrain fluids*.

ISO 12103-1:2016

This second edition cancels and replaces the first edition (ISO 12103-1:1997), which has been technically revised.

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ISO 12103 consists of the following parts, under the general title *Road vehicles — Test contaminants for filter evaluation*:

— *Part 1: Arizona test dust*

— *Part 2: Aluminium oxide test dust*

The following parts are under preparation:

— *Part 3: Soot aerosol*

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Introduction

This part of 12103 specifies four grades of test dusts made from Arizona desert sand composed of naturally occurring compounds which motor vehicles are commonly subjected to. These test dusts are used to determine performance of filtration systems. Due to the abrasive characteristics of these materials, they have also been used in wear studies involving bearings, internal combustion engines and fuel injection systems, seals, fan blades, windshield wipers, etc.

This part of ISO 12103 specifies particle size distribution of four grades of test dust by volume percent as opposed to number characterization.

Dusts complying with volume distribution specified in this part of ISO 12103 are not appropriate for calibration of particle counters. For this purpose, refer to ISO 11171.

This is an Arizona Test Dust standard, not other region document. Other dusts and documents can be brought forward to the committee to be developed into a standard.

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Road vehicles — Test contaminants for filter evaluation —

Part 1: Arizona test dust

1 Scope

This part of ISO 12103 defines particle size distribution and chemical content limits involving four grades of test dust made from Arizona desert sand.

2 Test dust description

ISO test dusts according to this part of ISO 12103 are manufactured from Arizona desert sand. Arizona desert sand is a naturally occurring contaminant consisting primarily of silicon dioxide with smaller amounts of other compounds. It is collected from the Salt River area of Arizona desert and sized to specific particle size.

Arizona desert sand has also been referred to as Arizona road dust, Arizona test dust, Arizona silica, AC fine or coarse test dust, and SAE fine or coarse test dust.

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Bulk density of ISO test dusts made from Arizona sand varies with particle size (see Table 1).

Table 1 — Bulk density

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Category	Approximate bulk density, kg/m^3
ISO ultrafine	500
ISO fine	900
ISO medium	1 025
ISO coarse	1 200

3 Test dust designation

Arizona test dusts are available in four standard grades designated as follows:

— ISO 12103-1, A.1 ultrafine test dust;

— ISO 12103-1, A.2 fine test dust;

— ISO 12103-1, A.3 medium test dust;

— ISO 12103-1, A.4 coarse test dust.

4 Particle size distribution

Particle size distribution is determined using a light scattering particle size analyser, as referenced in ISO 13320.

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Table 2 specifies cumulative volume particle size limits for ISO test dusts made from Arizona desert sand, when determined using a Microtrac S3500™[1)] particle size analyser.

When the different type analyser is employed by a test laboratory, the laboratory should generate suitable correlation data between the analyser by which these powders are supplied to conform [Microtrac[1)] analyser] and by the analyser adopted by the test laboratory.

Table 2 — Particle size distributions (volume % less than)

Size, µm	A1 ultrafine	A2 fine	A3 medium	A4 coarse
352,00	—	—	—	100,0
248,90	—	—	100,0	99,0 – 100,0
176,00	—	100,0	99,0 – 100,0	97,2 – 98,2
124,50	—	99,0 – 100,0	97,2 – 98,6	93,0 – 94,0
88,00	—	97,9 – 98,9	94,7 – 96,0	85,0 – 86,5
44,00	—	89,5 – 91,5	82,0 – 83,5	58,0 – 60,0
22,00	100,0	73,5 – 76,0	62,5 – 64,5	36,0 – 38,5
11,00	95,5 – 97,5	57,0 – 59,5	42,3 – 43,6	21,0 – 23,0
5,50	65,0 – 69,0	39,5 – 42,5	22,1 – 23,2	11,5 – 12,5
2,75	23,0 – 27,0	21,3 – 23,3	10,3 – 11,1	5,5 – 6,3
1,38	7,0 – 10,0	8,0 – 9,5	3,8 – 4,4	1,8 – 2,1
0,97	3,0 – 5,0	4,5 – 5,5	2,0 – 2,4	0,74 – 0,83

NOTE Data shown per Table 2 was determined using the particle size analysis instrument indicated in normative Annex A. Use of any other particle size analysis equipment will obtain different results.

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5 Chemical composition

5.1 Typical chemical content of ISO specified Arizona test dusts

See Table 3.

Table 3 — Chemical content

Element	Percentage of mass
Silicon	69,0 – 77,0
Aluminium	8,0 – 14,0
Iron	4,0 – 7,0
Potassium	2,0 – 5,0
Calcium	2,5 – 5,5
Sodium	1,0 – 4,0
Magnesium	1,0 – 2,0
Titanium	0,0 – 1,0

5.2 Chemical analysis methodology — X-ray fluorescence analysis (XRF)

Chemical analysis is performed using an X-ray fluorescence analyser per ASTM C114-15.

1) Microtrac and Microtrac S3500 are trademarks. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.

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Annex A
(normative)

Analysis equipment and operating procedure

A.1 Particle size analyser

A.1.1 General

Particle size data of ISO specified Arizona test dusts as shown in Table 2, were determined using a Microtrac Model S3500™ light scattering type analyser. Use of any other particle size analysis equipment will obtain different results. Other particle size analysis instruments may be acceptable for analysis of test dust products specified in ISO 12103-1, if suitability and correlation is determined between the Microtrac S3500™ and the other analyser. Use of particle size analysis instruments other than the Microtrac S3500™ will require a modified particle size analysis procedure.

The Microtrac Model S3500™ employs use of three light scattering lasers that are combined to produce the resulting particle size distribution data. A tri-laser system uses precise angular measurement of scattered light through a full 180° angular range with three lasers and two detector arrays. Analysis of scattered light to determine particle size employs a Mie based unified angular scattering theory with a dynamic range of 0,02 microns to 2 800 microns (see Table A.1).

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Normally, it is not acceptable to publish a manufacturer's name or equipment identification. However, due to the close tolerance of the specified particle size limits and variation between instruments by multiple manufacturers, one particle size analysis instrument was defined for this specification.

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Particle size distribution specified limits shown in Table 2 were derived from sample analysis of PTI manufactured test dust produced prior to May 1994 using three separate Microtrac Model S3500™ light scattering analysers.

Table A.1 — Microtrac Model S3500™ specifications

Item	Specification
Measuring range	0,02 micron to 2 800 micron
Basic range	Wet 0,7 micron to 1 000 micron
High range	Wet 2,75 micron to 2 800 micron
Standard range	Wet 0,24 micron to 1 400 micron
Special range	Wet 0,086 micron to 1 400 micron
Extended range	Wet 0,021 micron to 2 000 micron
Enhanced range	Wet 0,021 micron to 2 800 micron
Precision	Spherical Glass Beads D50 = 642 micron, Precision as CV = 0,7 % Spherical Glass Beads D50 = 56 micron, Precision as CV = 1,0 % Spherical Latex Beads D50 = 0,4 micron, Precision as CV = 0,6 %
Lasers	Wavelength 780 nm

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Table A.1 *(continued)*

Power	3 mW nominal
Detection system	Two fixed photo-electric detectors with logarithmically spaced segments placed at correct angles for optimal scattered light detection. 0,02° to 163 ° using 151 detector segments.
Data handling	Volume, Number and Area distributions as well as percentile and other summary data. Data are stored in ODBC format in encrypted Microsoft Access Databases to ensure compatibility with external statistical software applications. Data integrity may be ensured using FDA 21 CFR Part 11 compliant security features including password protection, electronic signatures and assignable permissions.

A.1.2 Microtrac S3500™ particle size analysis procedure

A.1.2.1 Sample preparation

Typical sample preparation is as follows.

a) It is important to ensure the sample taken is representative of the lot of test dust to be tested and mixed well before placing into a clean 20 ml to 50 ml sample vial.

b) Obtain a clean vial and add the required representative sample quantity based on Table A.2.

Table A.2 — Microtrac S3500™ Sample Weights

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ISO grade	Sample amount in mg
ISO ultrafine	14-16
ISO fine	29-31
ISO medium	39-41
ISO coarse	54-56

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c) Add one drop of dispersant to the vial. It is very important that dispersant used does not create bubbles.

d) Add approximately 10 ml distilled water to the vial and mix by gently moving the vial in a circular motion. Avoid creating bubbles.

e) Place sample vial and contents in an external low power ultrasonic bath, having a water depth of 2 cm, for 30 s. The ultrasonic bath should be in the range of 50 W to 100 W, 50 kHz to 80 kHz. Do not use the Microtrac internal ultrasonic as it may cause bubbles.

A.1.2.2 Analyser software sample set-up

Analyser software sample set-up is done as follows.

a) Open the Microtrac FLEX software program.

b) Click “Measure” on the main program window and select S3500/S3000.

c) Click “File” and select “Open Measurement Database”, select appropriate database for the material being analysed.

d) Click “SOP” (Standard Operating Procedure) icon on the measure toolbar. Click Options button to setup appropriate measurement setup parameters. Set measurement parameters per the followings:

1) Timing tab is set as follows:

— Set Zero time = 30 s;

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— Run time = 30 s;

— Number of runs = 3.

2) Identifier tab is used to enter general information if desired.

3) Analysis tab is set using the following tabs:

i) Particle information tab:

I) Select Refractive Index of 1,51 and save with the appropriate particle name.

II) Particle characteristics box:

— Set transparency; Transparent;

— Set Shape; Irregular.

ii) Fluid information tab:

— Select fluid; water;

— Select refractive index; 1,333.

iii) Analysis options tab:

— Select S3000 from Analysis Mode drop down list;

— Select Enabled Standard from Filter drop down list.

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iv) Sample loading tab is used to enter user defined loading index limits for each grade per Table A.2.

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Table A.3 — Microtrac S3500™ loading index limits

ISO grade	Loading index limits
ISO ultrafine	0,89 – 0,90
ISO fine	0,86 – 0,87
ISO medium	0,86 – 0,87
ISO coarse	0,87 – 0,88

v) Perspective tab is set as follows:

— Select Geom 4 Root from Progression drop down list;

— Select Volume from the Distribution drop down list.

vi) SDC tab is set as follows:

I) SDC options; Set the following parameters:

— Number of Rinses = 3;

— Number of Deaerate Cycles = 3;

— Flow = 55.

II) Click OK button when all parameters have been entered.

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