
**Functional pigments and extenders for
special application —**

**Part 3:
Fumed silica for silicone rubber
application**

*Pigments et matières de charges fonctionnels pour applications
spéciales —*

Partie 3: Silice fumée pour caoutchouc silicone



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Published in Switzerland

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Foreword

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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 voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 256, *Pigments, dyestuffs and extenders*.

A list of all parts in the ISO 18473 series can be found on the ISO website.

Introduction

Fumed silica (pyrogenic silicon dioxide) is one kind of pure amorphous white inorganic powder which has high specific surface area, nano-scale primary particle size resulting in a “stable/none destroyable” aggregated structure, and a relatively high (among silica products) concentration of surface silanol groups. The properties of fumed silica can be chemically modified by reaction with these silanol groups. Commercial available fumed silica can be divided into two groups: hydrophilic fumed silica and hydrophobic fumed silica. Because of the above-mentioned features, it is widely used as an important ingredient in many industries such as the rubber, paint and plastics industries. The major application for fumed silica is the silicone rubber industry.

Silicone rubbers exhibit excellent properties, such as flexibility at low temperature, good weather resistance, electric insulation, media resistance, physiological inertia, low surface tension and surface energy, which permit them to fulfil important needs in the market. However, these unique properties cannot be demonstrated effectively without reinforcing filler due to the low strength ($< 0,4$ MPa) of cured polydimethylsiloxane (PDMS) which is the main component of silicones; therefore, silicone rubber usually contains reinforcing filler besides additive and curing agent. Fumed silica as one of the functional fillers, which is used widely in room temperature vulcanized silicone rubber (RTV), high temperature vulcanized silicone rubber (HTV) or high consistency vulcanized silicone rubber (HCR) and liquid silicone rubber (LSR), plays an important role in the strength, rheological and transparency properties of the silicone polymer. The testing methods for the dispersed fumed silica aggregate size and the silanol density, which both have obvious effects on the above properties of silicone rubber, are still being developed.

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Functional pigments and extenders for special application —

Part 3: Fumed silica for silicone rubber application

1 Scope

This document specifies requirements and corresponding methods of test for fumed silica in powder form for silicone rubber application. This document is applicable to untreated and surface treated fumed silica.

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 787-2, *General methods of test for pigments and extenders — Part 2: Determination of matter volatile at 105 °C*

ISO 787-9, *General methods of test for pigments and extenders — Part 9: Determination of pH value of an aqueous suspension*

ISO 787-11, *General methods of test for pigments and extenders — Part 11: Determination of tamped volume and apparent density after tamping*

ISO 787-18, *General methods of test for pigments and extenders — Part 18: Determination of residue on sieve — Mechanical flushing procedure*

ISO 3262-1, *Extenders for paints — Specifications and methods of test — Part 1: Introduction and general test methods*

ISO 3262-20:2000, *Extenders for paints — Specifications and methods of test — Part 20: Fumed silica*

ISO 9277, *Determination of the specific surface area of solids by gas adsorption — BET method*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

ISO 18451-1, *Pigments, dyestuffs and extenders — Terminology — Part 1: General terms*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18451-1 and the following apply.

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

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

3.1

fumed silica

amorphous silica produced from silicon halides by high-temperature flame hydrolysis

Note 1 to entry: It can be also subjected to further surface treatment.

4 Classification and designation

4.1 Classification

Fumed silica is classified as hydrophilic and hydrophobic, according to whether it can be dispersed in water or not.

4.2 Designation

Fumed silica can normally be designated according to its specific surface area determined by the Brunauer, Emmett and Teller (BET) method.

NOTE It is usually designated with the value of specific surface area (m^2/g), such as 150, 200, 300 and 380.

5 Requirements and test methods

5.1 Appearance

Fumed silica appears as a white and loose powder.

5.2 Technical requirements

The essential requirements for hydrophilic and for hydrophobic fumed silica are specified in [Table 1](#) and [Table 2](#), respectively.

Table 1 — Essential requirements for hydrophilic fumed silica

Characteristic	Unit	Requirement	Test method
Specific surface area (BET)	m^2/g	Designated value $\pm 10\%$ tolerance ^a	ISO 9277
pH value ^b	—	$\geq 3,8$	ISO 787-9
Loss on drying (105 °C)	% (mass fraction)	$\leq 2,0$	ISO 787-2
Residue on 45 μm sieve	mg/kg	≤ 150	ISO 787-18
Fe content ^c	mg/kg	$\leq 11,0$	ISO 3262-20:2000, Clause 7
Al content ^c	mg/kg	$\leq 13,0$	ISO 3262-20:2000, Clause 7
Ti content ^c	mg/kg	$\leq 6,0$	ISO 3262-20:2000, Clause 7
Carbon content	% (mass fraction)	$\leq 0,2$	ISO 3262-20:2000, Clause 8
Loss on ignition	% (mass fraction)	$\leq 2,5$	ISO 3262-1

^a Subject to agreement between the interested parties, when the designated specific surface area is less than 135 m^2/g or greater than 300 m^2/g .

^b Test is based on 4 % (mass fraction) aqueous suspension.

^c Calculated as the content of each element, expressed in micrograms per kilogram.

Table 2 — Essential requirements for hydrophobic fumed silica

Characteristic	Unit	Requirement	Test method
Specific surface area (BET)	m ² /g	Designated value $\pm$ 10 % tolerance ^a	ISO 9277
pH value^b	—	$\geq 3,8$	ISO 787-9
Loss on drying (105 °C)	% (mass fraction)	$\leq 1,0$	ISO 787-2
Fe content^c	mg/kg	$\leq 11,0$	ISO 3262-20:2000, Clause 7
Al content^c	mg/kg	$\leq 13,0$	ISO 3262-20:2000, Clause 7
Ti content^c	mg/kg	$\leq 6,0$	ISO 3262-20:2000, Clause 7
Carbon content	% (mass fraction)	$\geq 0,3$	ISO 3262-20:2000, Clause 8

^a Subject to agreement between the interested parties, when the designated specific surface area is less than 135 m²/g or greater than 300 m²/g.

^b Test is based on 4 % (mass fraction) 1 + 1 methanol water suspension or ethanol water suspension. The solvent used is noted in test report.

^c Calculated as the content of each element, expressed in micrograms per kilogram.

5.3 Conditional requirements

Tamped density is a conditional requirement and shall be subjected to agreement between the interested parties.

The test method of tamped density follows ISO 787-11, the result should be reported in g/l.

6 Sampling

Take a representative sample of the product to be tested, as described in ISO 15528.

7 Marking and labelling

The outer packing information shall be clearly marked in a visible location including, but not limited to, the following:

- manufacturer name, brand and address;
- product name;
- type;
- net weight;
- batch number or production date;
- a “keep away from rain” mark.

8 Test report

The test report shall include at least the following information:

- all information necessary to completely identify the product tested;
- a reference to this document, i.e. ISO 18473-3:2018;
- the method used, the result(s) of the test, including a reference to the clause which explains how the results were calculated, and whether or not the product complies with the relevant specification limits;