
**Fine ceramics (advanced ceramics,
advanced technical ceramics) —
Test method for air-purification
performance of semiconducting
photocatalytic materials —**

**Part 5:
Removal of methyl mercaptan**

(standards.iteh.ai)

*Céramiques techniques — Méthodes d'essai relatives à la performance
des matériaux photocatalytiques semi-conducteurs pour la
purification de l'air —*

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Partie 5: Élimination du mercaptan méthylique



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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.

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 22197-5 was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

ISO 22197 consists of the following parts, under the general title *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for air-purification performance of semiconducting photocatalytic materials*:

- Part 1: Removal of nitric oxide
- Part 2: Removal of acetaldehyde
- Part 3: Removal of toluene
- Part 4: Removal of formaldehyde
- Part 5: Removal of methyl mercaptan

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for air-purification performance of semiconducting photocatalytic materials —

Part 5: Removal of methyl mercaptan

1 Scope

This part of ISO 22197 specifies a test method for the determination of the air-purification performance of materials that contain a photocatalyst or have photocatalytic films on the surface, usually made from semiconducting metal oxides, such as titanium dioxide or other ceramic materials, by continuous exposure of a test piece to the model air pollutant under illumination with ultraviolet light (UV-A). This part of ISO 22197 is intended for use with different kinds of materials, such as construction materials in flat sheet, board or plate shape, that are the basic forms of materials for various applications. This part of ISO 22197 also applies to structured filter materials including honeycomb-form, woven and non-woven fabrics, and to plastic or paper materials if they contain ceramic microcrystals and composites. This part of ISO 22197 does not apply to powder or granular photocatalytic materials.

This test method is usually applicable to photocatalytic materials produced for air purification. This method is not suitable for the determination of other performance attributes of photocatalytic materials, i.e. decomposition of water contaminants, self-cleaning, antifogging and antibacterial actions. It concerns the removal of methyl mercaptan.

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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 2718:1974, *Standard layout for a method of chemical analysis by gas chromatography*

ISO 4677-1:1985, *Atmospheres for conditioning and testing — Determination of relative humidity — Part 1: Aspirated psychrometer method*

ISO 4892-3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

ISO 6145-7:2001, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 7: Thermal mass-flow controllers*

ISO 10677:2011, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Ultraviolet light source for testing semiconducting photocatalytic materials*

ISO/IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories*

ISO 22197-1:2007, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for air-purification performance of semiconducting photocatalytic materials — Part 1: Removal of nitric oxide*

ISO 80000-1:2009, *Quantities and units — Part 1: General*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1
photocatalyst**
substance that performs one or more functions based on oxidation and reduction reactions under photoirradiation, including decomposition and removal of air and water contaminants, deodorization, and antibacterial, self-cleaning and antifogging actions

**3.2
photocatalytic materials**
materials in which or on which the photocatalyst is added by coating, impregnation, mixing, etc

Note 1 to entry: Such photocatalytic materials are intended primarily for use as building and road construction materials to obtain the above-mentioned functions.

**3.3
zero-calibration gas**
air that does not contain pollutants (i.e. in which common pollutants are below 0,01 µl/l)

Note 1 to entry: The zero-calibration gas is prepared from indoor air, using a laboratory air-purification system, or supplied as a synthetic air in a gas cylinder

**3.4
standard gas**
diluted gases of known concentrations supplied in cylinders and certified by an accredited laboratory

**3.5
test gas**
mixture of air and pollutant(s) of known concentration prepared from a standard gas or a zero-calibration gas, to be used for the performance test of a photocatalytic material

Note 1 to entry: The flow rate, concentration, etc. are expressed at the standard state (0 °C, 101,3 kPa) and dry gas basis (exclusion of water vapour).

**3.6
dark condition**
test condition with no light illumination by the light source for testing and room lightings

Note 1 to entry: Usually the test gas is supplied for comparison with the illuminated reaction.

4 Symbols

For the purposes of this document, the following symbols apply.

- f air-flow rate of test gas converted into that at the standard state (l/min, 0 °C, 101,3 kPa, dry gas basis)
- ϕ_M the volume fraction of methyl mercaptan at the reactor exit (µl/l)
- ϕ_{M0} the supply volume fraction of methyl mercaptan (µl/l)
- n_M the removal quantity, by test piece, of methyl mercaptan (µmol)
- R_M the removal percentage, by test piece, of methyl mercaptan (%)

5 Principle

This part of ISO 22197 concerns the development, comparison, quality assurance, characterization, reliability, and design data generation of photocatalytic materials. The method described is intended to obtain the air-purification performance of photocatalytic materials by exposing a test piece to model polluted air under irradiation by ultraviolet (UV-A) light. Methyl mercaptan (methanethiol, CH_3SH) is chosen as a typical malodorous substance. The test piece, placed in a flow-type photoreactor, is activated by UV irradiation, and adsorbs and oxidizes gas-phase methyl mercaptan. The air-purification performance is determined from the amount of the net removal of methyl mercaptan (μmol). The simple adsorption and desorption of CH_3SH by the test piece (not due to photocatalysis) is evaluated by tests in the dark. However, this standard cannot be applied to the test piece which does not give a stable concentration of methyl mercaptan in the designated time of test. The photocatalytic activity may depend on physical and chemical properties of pollutants mainly due to the adsorption process involved. For complete evaluation of air purification performance of photocatalytic materials, it is recommended to combine one or more suitable test methods as provided in other parts of ISO 22197.

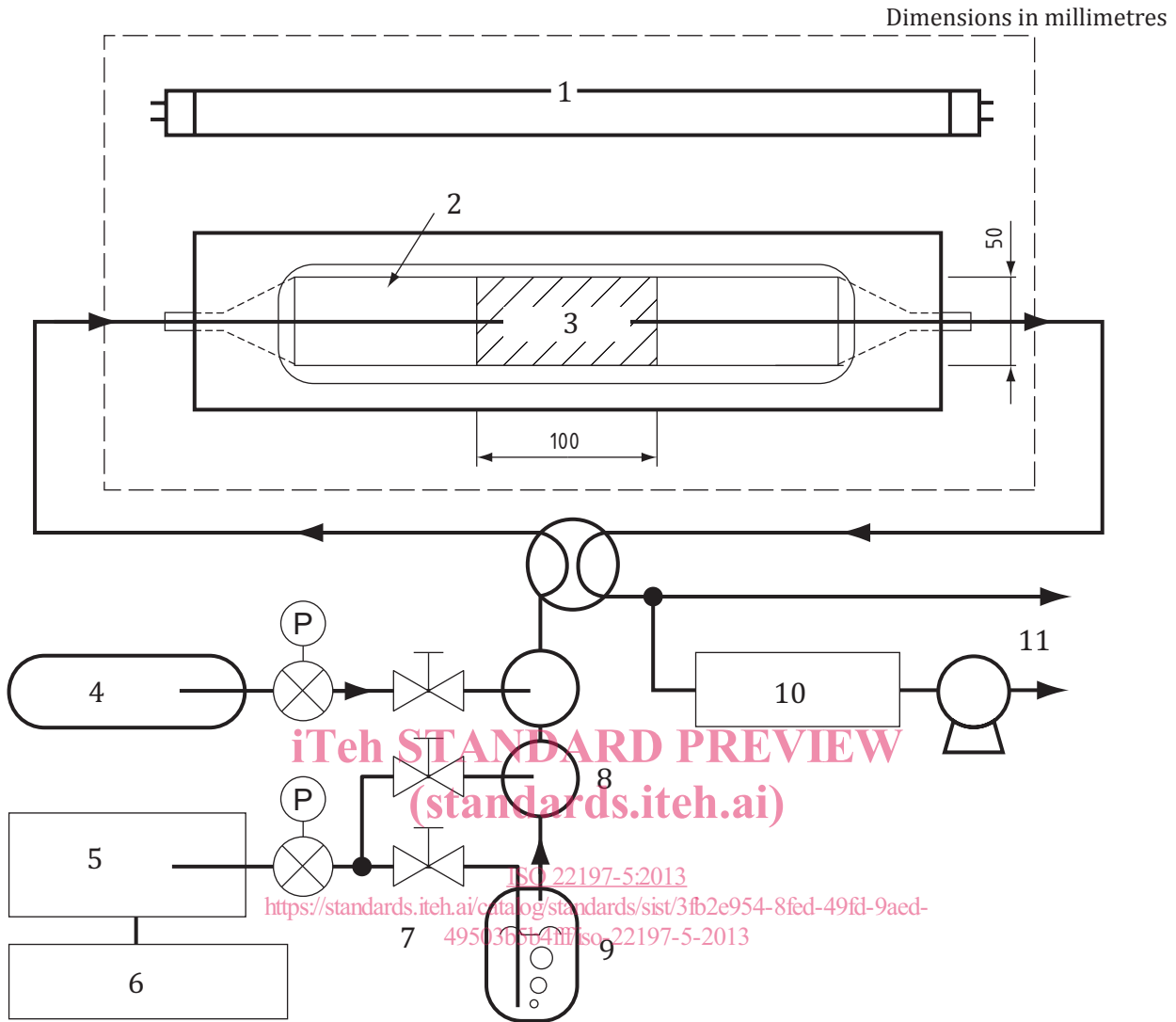
6 Apparatus

6.1 Test equipment

The test equipment enables a photocatalytic material to be examined for its pollutant-removal capability by supplying the test gas continuously, while providing photoirradiation to activate the photocatalyst. It is the same as that used in the test method for the removal of nitric oxide (ISO 22197-1) and consists of a test gas supply, a photoreactor, a light source, and pollutant-measurement equipment. Since low concentrations of pollutants are to be tested, the system shall be constructed with materials of low adsorption and resistant to ultraviolet (UV) radiation, for example, acrylic resin, stainless steel, glass and fluorocarbon polymers. An example of a test system is shown in [Figure 1](#).

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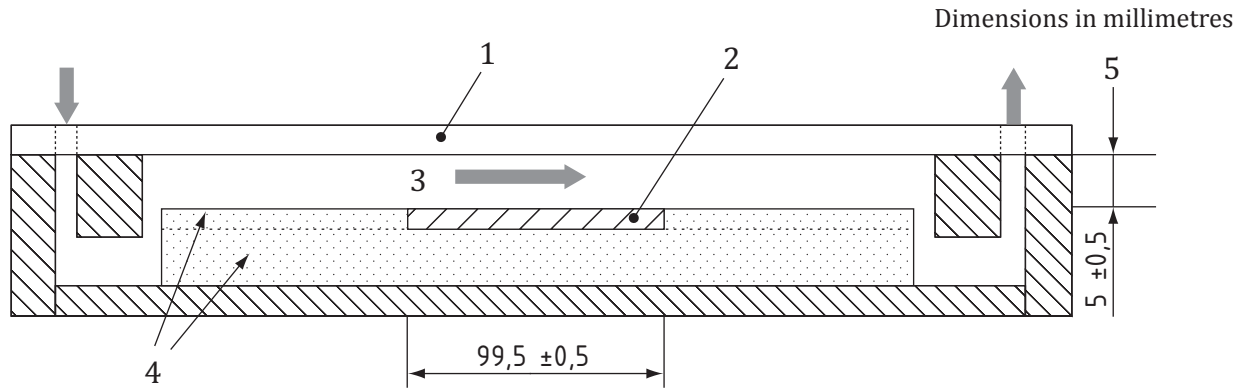
- | | |
|----------------------------|------------------------|
| 1 light source | 7 mass-flow controller |
| 2 optical window | 8 gas mixers |
| 3 test piece | 9 humidifier |
| 4 standard gas (pollutant) | 10 analyser |
| 5 air-purification system | 11 vent |
| 6 compressor | |

Figure 1 — Schematic diagram of the test equipment

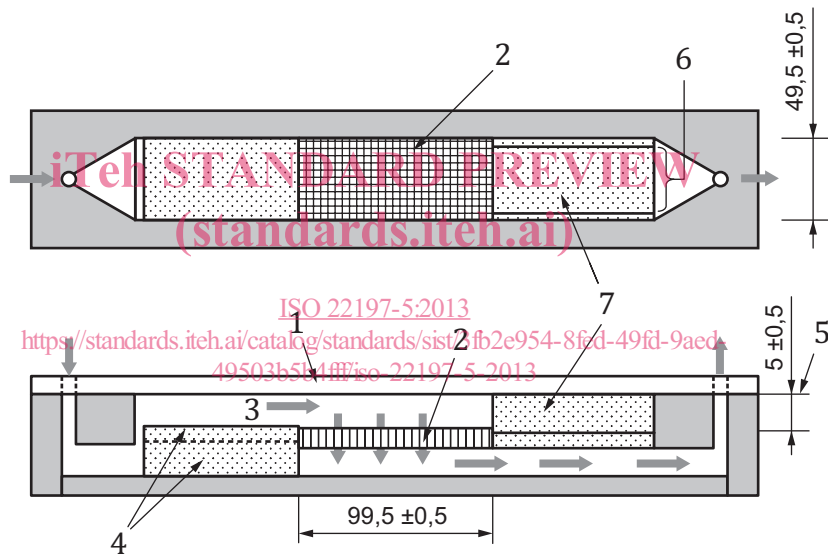
6.2 Test gas supply

The test gas supply provides air polluted with model contaminant at a predetermined concentration, temperature and humidity, and supplies it continuously to the photoreactor. It consists of flow regulators, a humidifier, gas mixers, etc. The flow rate of each gas should be within 5 % of the designated value, which is easily attained by using thermal mass-flow controllers with knowledge of temperature and gas type at calibration in accordance with ISO 6145-7. The expression of gas flow rate in this part of ISO 22197 is that converted to the standard state (0 °C, 101,3 kPa and dry gas basis). Typical capacities of flow controller for pollutant gas, dry air and wet air are 50 ml/min, 1000 ml/min and 1000 ml/min,

respectively. The standard methyl mercaptan gas in a cylinder, normally balanced with nitrogen, shall have a volume fraction of 100 µl/l to 1000 µl/l.



a) For flat test pieces



b) For filter-type test pieces

Key

- 1 window
- 2 test piece
- 3 test gas
- 4 height-adjusting plate
- 5 air layer thickness
- 6 flow channel
- 7 test piece holder

Figure 2 — Cross-sectional view of photoreactor