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(ISO 10397 : 1993)

Measuring method for airborne fibrous particles — Part 4: Stationary source emissions — Determination of asbestos plant emissions — Method of fibre count measurement

ICS 13.040.40

Descriptors : air, quality, exhaust gases, asbestos, determination of content, particle size measurement, coarse-grain material, flues

Reference number : JIS K 3850-4 : 2000 (E)

Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of International Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law.

JIS K 3850 series consist of the following four parts with the title of *Measuring method for airborne fibrous particles*.

Part 1: *Optical microscopy method and scanning electron microscopy method*

Part 2: *Direct-transfer transmission electron microscopy method*

Part 3: *Indirect-transfer transmission electron microscopy method*

Part 4: *Stationary source emissions — Determination of asbestos plant emissions — Method by fibre count measurement*

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Measuring method for airborne fibrous particles — Part 4: Stationary source emissions — Determination of asbestos plant emissions — Method by fibre count measurement

Introduction This Japanese Industrial Standard has been prepared based on the first edition of ISO 10397 *Stationary source emissions—Determination of asbestos plant emissions—Method by fibre count measurement* published in 1993 without modifying the technical contents. Annex F (informative) refers safety precautions.

The portions with sidelines or underlines with dots are the matters not stated in the original International Standard.

1 Scope This Standard specifies a method, using a fibre count technique, for the assessment of fibre concentrations in flowing gas streams in ducts, chimneys or flues from industrial processes using asbestos.

This method may be used to determine fibre concentrations from a wide range of processes where it is known that “regulated” fibres are present in emissions. No attempt is made to identify asbestos fibre types separately from other fibres.

NOTES 1 If fibre identification is required, reference should be made to ISO 10312 (JIS K 3850-2).

2 This method may be used to check that dust collection equipment, used to trap or prevent asbestos fibres escaping into the atmosphere, is working properly and effectively.

The range of application of the method for concentrations of fibres in ducts is about 0.05 fibres/cm³ to 10 fibres/cm³ although this range may vary according to the sampled volume which in turn will depend on duct velocities and the sampling apparatus used.

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid, and standards and amendments published thereafter are not applicable. The normative references without the indication of the year of coming into effect apply limiting only to the most recent edition (including amendments).

JIS K 3850-1 *Measuring method for airborne fibrous particles—Part 1 : Optical microscopy method and scanning electron microscopy method*

ISO 3966 : 1977 *Measurement of fluid flow in closed conduits—Velocity area method using Pitot static tubes*

ISO 8672 : 1993 *Air quality—Determination of the number concentration of airborne inorganic fibres by phase contrast optical microscopy—Membrane filter method*

ISO 9096 : 1992 *Stationary source emissions—Determination of concentration and mass flow rate of particulate material in gas-carrying ducts—Manual gravimetric method*

ISO 10312 : 1995 *Ambient air—Determination of asbestos fibres—Direct transfer transmission electron microscopy method*

3 Definitions For the purposes of this Standard, the following definitions apply.

3.1 aspect ratio Ratio of the length of the fibres to their diameter.

3.2 access port A hole in the duct, provided with a flanged or threaded socket, through which the sampling probe is inserted along the sampling line.

3.3 cumulative sampling The collection of a single composite sample obtained by sampling for the required period at each sampling point in turn.

3.4 duct A chimney stack or ducting at the outlet of dust collecting equipment carrying asbestos-fibre laden gases.

3.5 fibre concentration The number of “regulated” fibres per normal cubic centimetre of gas.

3.6 fibre count technique A method for counting the number of “regulated” fibres present on a membrane filter and the calculation of fibre concentrations (JIS K 3850-1).

3.7 isokinetic sampling Sampling at a rate such that the velocity and direction of the gas entering the sampling nozzle is the same as that of the gas in the duct just prior to the sampling point.

3.8 pump A fan, vacuum pump or other apparatus used for extracting a sample of gas from ducts or chimneys.

3.9 “regulated” fibres Fibres that meet the following criteria :

length $\geq 5 \mu\text{m}$,

diameter $\leq 3 \mu\text{m}$,

minimum aspect ratio 3 : 1.

3.10 hydraulic diameter D_1 : The equivalent diameter of a rectangular duct given by the formula

$$D_1 = \frac{4 \times \text{Area of the sampling plane}}{\text{Perimeter of the sampling plane}}$$

4 Symbols with their corresponding units and subscripts See table 1 for symbols and their corresponding units and table 2 for subscripts.

Table 1 Symbols and their corresponding units

symbol	Meaning	Unit
A_F	Effective filtering area of the membrane filter	mm ²
C	The concentration of fibres in the stack	fibres/cm ³
D_G	Diameter of the Walton-Beckett graticule	μm
D_F	Diameter of the exposed area of filter	mm
d	Diameter of the filter nozzle	mm
f	Fibres (see 3.1)	
K	Calibration factor for Pitot-static tube	
k	Simplified calibration factor for Pitot-static tube	
N	Total number of fibres counted	
n	Number of graticule areas examined	
P	Absolute pressure	Pa
δ_p	Differential pressure (Pitot-static readings)	Pa
R	Sampling rate	m ³ /min
T	Absolute temperature	K
t	Temperature of the duct gases	°C
v	Gas velocity at a sampling point	m/s
V	Volume of sampled gas	m ³
ρ	Density of duct gas	kg/m ³
Θ	Duration of sampling	s

Table 2 Subscripts

Subscript	Meaning
S	Standard conditions of 1.013 bar and 0°C
F	Filter
G	Graticule
I	Integrating meter
T	Total

5 Principle The apparatus is inserted into a moving gas stream and a known volume is withdrawn isokinetically. The sampled gas is passed through a filter medium which removes particulate matter (including fibres) from the gas stream. The filter is treated to make it transparent when viewed under a microscope, and the number of fibres are counted, in a precise number of fields viewed using a phase-contrast optical microscope.

Knowing the volume of gas sampled, the cross-sectional area of the filter, the number of “regulated” fibres counted, and the cross-sectional area of each field, the concentration of fibres in the moving gas stream can then be calculated.

6 Summary of method The method specifies the apparatus and the way in which it is to be used to take a sample, in order that the concentration of fibres emitted in a gas stream from an asbestos process can be determined by measurement and calculation. This enables an assessment to be made of the effectiveness of the measures being taken to prevent pollution.

The sampling train shown schematically in figure 1, consists of the following :

— probe with nozzle and fibre collector ;

- flow regulation equipment ;
- volume measurement apparatus ;
- pump.

The analytical equipment consists of :

- a phase contrast microscope ;
- filter “clearing” equipment ;
- flow and temperature measurement apparatus.

This is a sensitive method which requires small samples and relatively short sampling times, which enables several samples to be taken, thus improving the precision of the method. In practice, a preliminary sample and two definitive samples will normally be taken.

Initially, before sampling can begin, it will be necessary to take note of all plant operating parameters and dimensions at the sampling plane. Then, the flow rate and temperature of the gases in the duct are measured and the atmospheric pressure is noted.

Once these preliminaries have been dealt with, the sampling train is assembled, selecting the appropriate nozzle to ensure that isokinetic sampling can be carried out.

The sampling probe is inserted in sequence into the access holes in the duct and a sample is withdrawn isokinetically from the four points at the centre of four equal areas. The sample volume is then recorded. The sample, which is collected on a membrane filter, is transported to a laboratory where it is treated to enable the counting of the fibres under a phase-contrast microscope.

From the recorded data, the concentration of fibres in the duct can be calculated.

7 Apparatus

7.1 General Use a sampling train for sampling regulated fibres as shown in figure 1. The apparatus to be used is listed in table 3. The items of apparatus provided shall be constructed of materials (e.g. stainless steel) capable of withstanding the conditions under which they will be used, shall be portable or transportable, and shall be capable of sampling isokinetically (see 12.3) at a steady rate.

NOTES 1 Access ports on the duct will be needed to enable sampling to take place.

2 A well established and accepted laboratory to undertake analytical work will be required. The laboratory should be part of a quality control system.

7.2 List of apparatus A full list of apparatus is given in table 3. The numbers assigned to the first seven of apparatus refer to those shown in figure 1, which shows a typical sampling train. All the apparatus used for sampling and analysis shall comply with the requirements given in table 3.

7.3 Sampling probe (including nozzle and fibre collector) The probe tube shall be attached to the sample nozzle and filter holder and be long enough to enable these to be inserted into the duct through an access port, at the sampling point. It shall be provided with a mechanism for sealing the access port in such a way that entrance of ambient air or escape of duct gases are kept to a minimum.

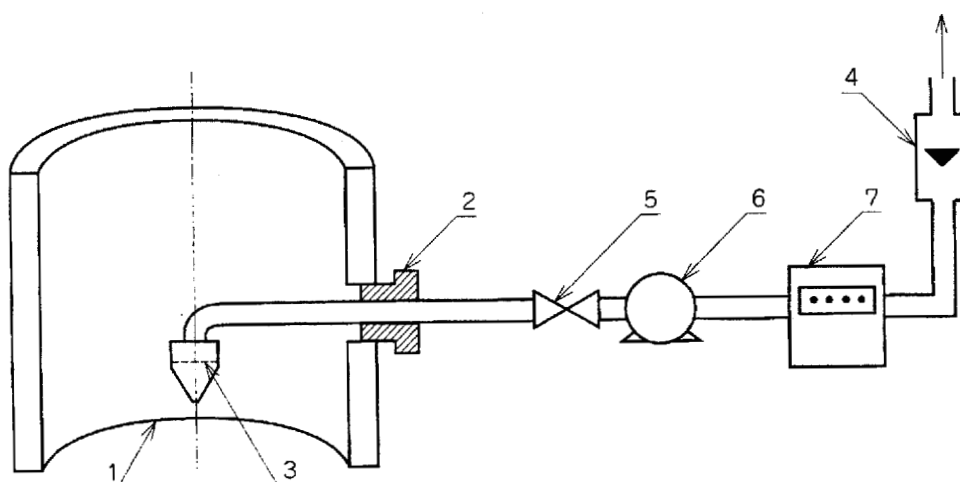
NOTE This sealing mechanism can also act as a support and a means for securing the probe in the correct sampling positions. A typical design is shown in figure 2.

The sample nozzle (see figure 3) shall be sharp edged in principle, but short enough to minimize the possibility of fibre deposition. Also, it shall be robust enough to prevent damage during general use.

NOTE The designs shown in figure 3 have been evaluated to ensure even distribution of fibres over the membrane filter.

Table 3 Sampling and analytical apparatus

Number (see figure 1)	Apparatus	Design	Requirements
1	Sample nozzle and filter holder	See figure 3	See 7.3 and figure 3
2	Probe tube and support	Rigid and tubular to support filter holder and sample nozzle and to seal duct	See 7.3 and figure 2
3	Fibre collector	Membrane filter (mixed esters)	Efficiency of >98 % for 3 μ m size particles
4	Flowmeter for sampling	Orifice plate, variable flow orifice	Volumetric flow rate accurate to within ± 2 %
5	Regulator for sampling	Control valve or equivalent method for adjusting flow	Capable of maintaining isokinetic sampling (see 12.3)
6	Pump	Vacuum pump or fan, or equivalent with smooth flow characteristics	Suitable for isokinetic sampling and shall be gas-tight when an integrating gasmeter is employed
7	Device for measuring sample volume	Integrating dry gasmeter or equivalent (see annex B)	Gas volume measured with an accuracy of ± 2 %
8	Device for measuring temperature (in duct)	Thermocouple or equivalent	Accurate to ± 1 % of absolute temperature
9	Device for measuring flow	Pitot-static tube (see annex B) connected to a device for measuring differential pressure	Complying with ISO 3966
10	Sample containers	Sealable	Large enough to contain filter holder
11	Optical microscope	Phase contrast	Complying with ISO 8672
12	Filter clearing apparatus	Acetone/triacetin (see figure 4)	Complying with ISO 8672
13	Timing device	Stopwatch	To read to the nearest 1 s
14	Device for measuring duct dimensions	Calibrated rod, reliable drawings or equivalent (see clause 8)	Internal dimension of duct measured to ± 1 %
15	Device for measuring atmospheric pressure	Barometer or equivalent	Accurate to ± 1 %



NOTE The numbers in this figure correspond to items of apparatus listed in table 3.

Figure 1 Typical sampling train

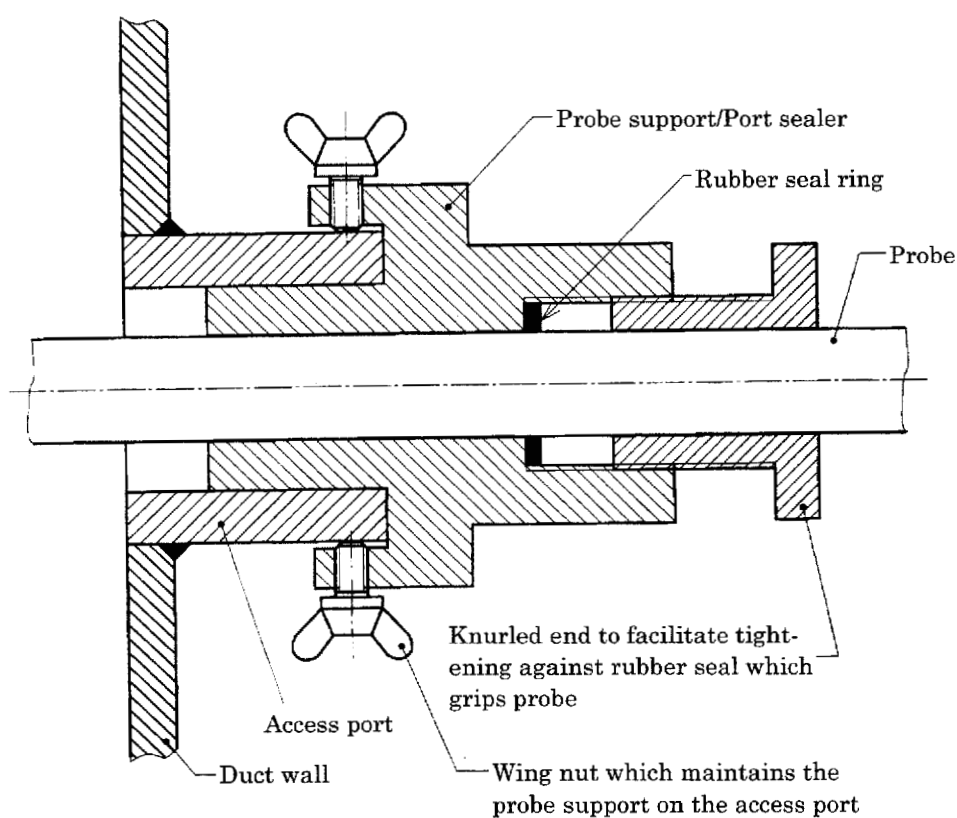


Figure 2 Typical access port with probe support/port sealer

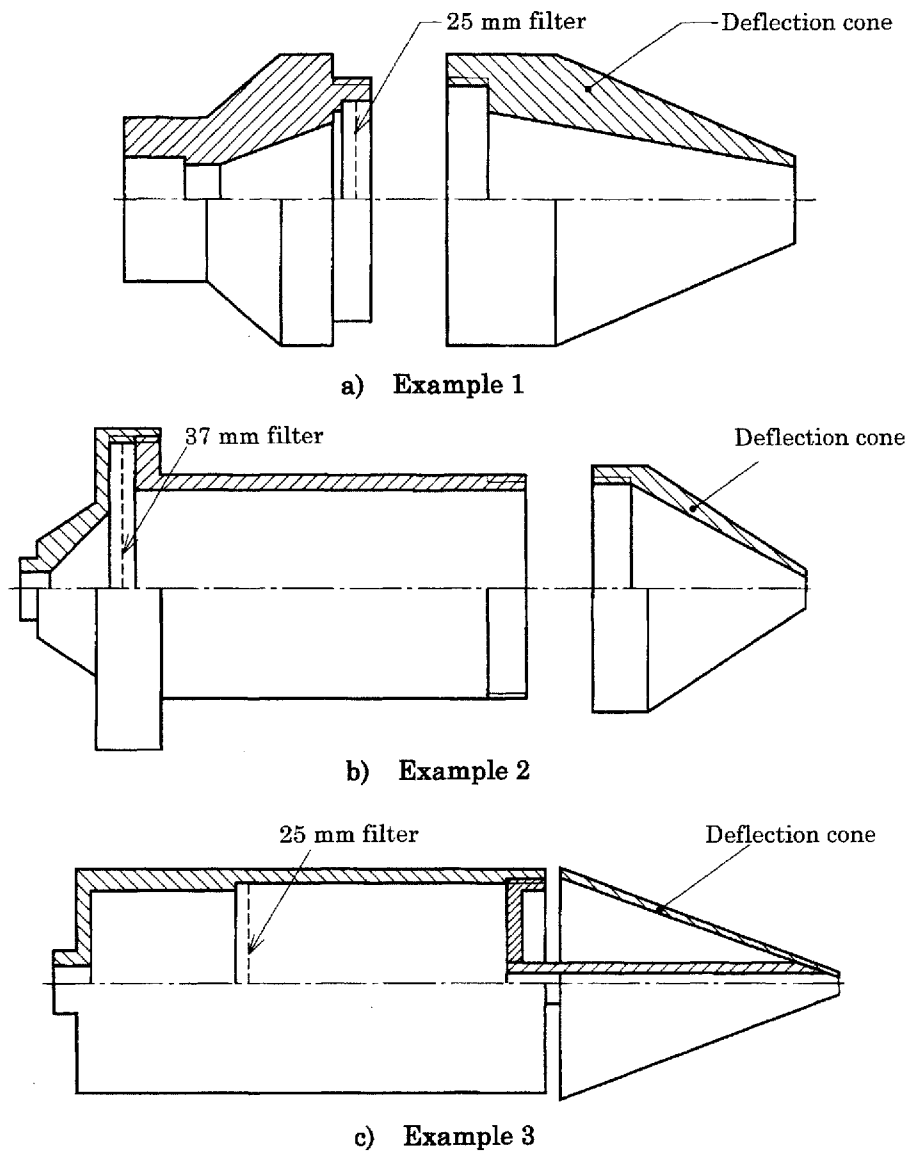


Figure 3 Typical sample nozzle and filter holder designs