
Compressed air —

Part 2:

Test methods for oil aerosol content

Air comprimé —

*Partie 2: Méthodes d'essai pour la détermination de la teneur en
aérosols d'huile*

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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 8573-2 was prepared by Technical Committee ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 4, *Quality of compressed air*.

This second edition cancels and replaces the first edition (ISO 8573-2:1996), which has been technically revised.

ISO 8573 consists of the following parts, under the general title *Compressed air*:

- *Part 1: Contaminants and purity classes*
- *Part 2: Test methods for oil aerosol content*
- *Part 3: Test methods for measurement of humidity*
- *Part 4: Test methods for solid particle content*
- *Part 5: Test methods for oil vapour and organic solvent content*
- *Part 6: Test methods for gaseous contaminant content*
- *Part 7: Test method for viable microbiological contaminant content*
- *Part 8: Test methods for solid particle content by mass concentration*
- *Part 9: Test methods for liquid water content*

Compressed air —

Part 2: Test methods for oil aerosol content

1 Scope

This part of ISO 8573 specifies test methods for the sampling and quantitative analysis of oil aerosols and liquid oil that can typically be present in compressed air. Test methods for oil vapour are excluded from this part of ISO 8573 as they are covered by ISO 8573-5.

Two different methods are described, method A and method B. Method B is subdivided into two parts to clearly distinguish between procedures for obtaining the quantity of oil for analysis.

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 8573-1, *Compressed air — Part 1: Contaminants and purity classes*

ISO 8573-5, *Compressed air — Part 5: Test methods for oil vapour and organic solvent content*

ISO 12500-1, *Filters for compressed air — Test method — Part 1: Oil aerosols*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8573-1 and the following apply.

3.1

oil

mixture of hydrocarbons composed of six or more carbon atoms, i.e., C₆₊

3.2

oil aerosol

mixture of liquid oil suspended in a gaseous medium having negligible fall velocity/settling velocity

3.3

wall flow

that proportion of liquid contamination no longer suspended within the air flow of the pipe

4 Units

General use of SI units (Système international d'unités; see ISO 1000) as given throughout this International Standard is recommended. However, in agreement with accepted practice in the pneumatic field, some non-preferred SI units, accepted by ISO, are also used.

$$1 \text{ bar} = 100\,000 \text{ Pa}$$

NOTE Bar(e) is used to indicate effective pressure above atmospheric.

$$1 \text{ l (litre)} = 0,001 \text{ m}^3$$

5 Reference conditions

Reference conditions for oil aerosol content volume statements are as follows:

air temperature	20 °C
absolute air pressure	100 kPa [1 bar (a)]
relative water vapour pressure	0

6 Guide for selection of test method

The test methods may be used at any point in the compressed air system. The choice between methods A and B depends upon the actual level of oil contamination present in the compressed air system, as shown in Table 1. Where wall flow is present, then method A shall be used.

ISO 8573-2:2007
 Table 1 — Guide for the selection of test method
<http://standards.iteh.ai/catalog/standards/sist/17-95b4-ed7a2ab6773e/iso-8573-2-2007>

Parameter	Method A Full flow	Method B1 Full flow	Method B2 Partial flow
Contamination range	1 mg/m ³ to 40 mg/m ³	0,001 mg/m ³ to 10 mg/m ³	0,001 mg/m ³ to 10 mg/m ³
Max. velocity in filter	See 7.1.2.10	1 m/s	1 m/s
Sensitivity	0,25 mg/m ³	0,001 mg/m ³	0,001 mg/m ³
Accuracy	± 10 % of actual value	± 10 % of actual value	± 10 % of actual value
Max. temperature	100 °C	40 °C	40 °C
Testing time (typical)	50 h to 200 h	2 min to 10 h	2 min to 10 h
Filter construction	Coalescing line filter	Three-layer membrane	Three-layer membrane

7 General description of test equipment and method

7.1 Method A

7.1.1 General

This test method is suitable for full flow and samples all of the air flow that is passed through two high-efficiency coalescing filters in series and measures oil in both aerosol and wall-flow forms. It is unsuitable for performing measurements in systems where steady-state flow, temperature and pressure cannot be maintained.

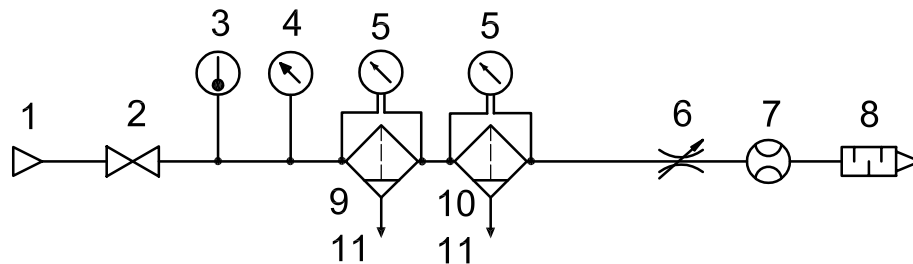
This test method may be used at any point in a compressed-air system where heavy contamination levels of oil are believed to exist.

The test equipment shall be in good working order. Bends and elbows are not permitted. All valves shall be closed and the test equipment checked for leaks by pressurizing, by opening the shut-off valve (key item 2 in Figure 1).

7.1.2 Test equipment

7.1.2.1 General description

The typical arrangement of equipment used in Method A is shown in Figure 1. The test equipment should not influence the collection sample.



Key

- | | | | |
|---|-------------------------------|----|------------------------|
| 1 | compressed air sampling point | 7 | flow sensing/measuring |
| 2 | full-flow ball valve | 8 | silencer |
| 3 | temperature sensing/measuring | 9 | sampling filter |
| 4 | pressure sensing/measuring | 10 | back-up filter |
| 5 | differential pressure gauge | 11 | liquid collection |
| 6 | multi-turn flow control valve | | |

ISO 8573-2:2007
 Figure 1 — Typical arrangement for method A
<https://standards.iteh.ai/catalog/standards/sis/8573-2-2007/iso-8573-2-2007>
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7.1.2.2 Compressed air sampling point (Figure 1, key item 1)

The compressed-air sampling point is a test point at a nominated site in the compressed-air system under investigation.

7.1.2.3 Shut-off valve (Figure 1, key item 2)

This is an optional item for convenient connection to the test point.

7.1.2.4 Temperature sensing/measuring (Figure 1, key item 3)

A temperature sensing/indicating device is used to indicate the compressed air sampling point temperature at the time of the test.

7.1.2.5 Pressure sensing/measuring (Figure 1, key item 4)

A pressure-sensing/indicating device is used to confirm that the coalescing filters are operating within manufacturer's specifications.

7.1.2.6 Differential pressure gauge (Figure 1, key item 5)

These gauges determine the pressure drop across the sample and back-up filters.

7.1.2.7 Flow control valve (Figure 1, key item 6)

In order to adjust the flow accurately, a valve with fine adjustment is required.

7.1.2.8 Flow sensing/measuring (Figure 1, key item 7)

A suitable flow meter with an accuracy of $\pm 5\%$ of the actual value is used to determine the air sample volume, which shall be referred to reference conditions; see Figure 1, key item 7.

7.1.2.9 Silencer (Figure 1, key item 8)

This is to limit the noise during the test and assist in meeting any local noise-reduction requirements.

7.1.2.10 Sampling filter (Figure 1, key item 9)

The sampling filter is a high-efficiency, coalescing filter capable of removing the oil whose concentration is being measured from the upstream concentration and of reducing the downstream concentration to $0,01 \text{ mg/m}^3$ or less as determined by ISO 12500-1.

Flow rate through the sampling filter shall not exceed the manufacturers' recommendation for the test pressure.

The measurements are only valid once the filter has reached steady state conditions.

7.1.2.11 Back-up filter (Figure 1, key item 10)

This filter is identical to the sampling filter and, in the event of malfunction of the sampling filter, collects any oil, that passes through it.

7.1.2.12 Liquid collection (Figure 1, key item 11)

The liquid collected in the sampling or back-up filters (items 9 and 10, respectively), is discharged to a suitable measuring device, graduated in millilitres.

Necessary precautions when discharging the liquid include care in controlling the liquid flow and any subsequent rapid escape of compressed air that can cause the collected oil to foam. In addition, if air bubbles appear in the collected liquid, then allow time for settling before taking a reading. The mass of the oil can be directly measured in milligrams by weighing.

7.2 Method B

The method is subdivided into procedures B1 and B2. Method B2 uses the same test equipment employed in method B1; with the addition of a sampling probe to allow partial-flow sampling under isokinetic conditions from the main pipe flow if the velocity constraints of method B1 are exceeded. Accuracy and limitations are as stated in method B1.

7.2.1 Method B1 — Full-flow sampling

Method B1 deals with the sampling and analysis of oil aerosols at constant flow rate. Within the constraints detailed above, this method permits the quantification of oil aerosols present in a compressed air system, provided wall-flow contamination is not present.

All of the air flow is diverted through the test equipment via suitable in-line valves, which have been previously checked to ensure they do not contribute to the level of oil contamination already present. As this method concerns the measurement of relatively low concentrations of oil in air, particular attention shall be paid to the cleanliness of the test equipment and other precautions shall be taken, e.g. valve purging and stabilization to constant test conditions. Good analytical techniques help improve the confidence level of the measurements.

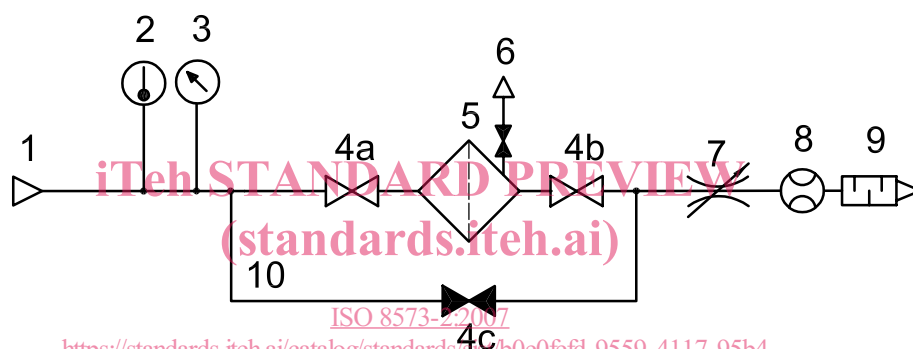
The optimum duration of a test measurement may be determined after an initial test to determine the approximate oil concentration present. When carrying out full-flow tests, it is possible to route the air back into the compressed air system, preventing loss of the product. Conversely, it is also possible to vent the flow to the atmosphere. Flow measurement is required to determine the volume of air used during the test, whichever method is adopted. As the test apparatus is portable, different test locations may be chosen provided the stated parameters are not exceeded and suitable valving for insertion of the test equipment into the circuit exists. Obvious precautions to prevent shock depressurization, which can damage the test filter membrane, or ingress of atmospheric contamination are necessary.

The sampling and analysing equipment used as described give an accuracy of better than $\pm 10\%$ over the range from $0,001 \text{ mg/m}^3$ to approximately 10 mg/m^3 oil content with a minimum sampling time calculated to collect sufficient oil to meet the requirements of the oil mass-per-volume of solvent as stated in 11.2.1. The upper limit for the air velocity (at operating pressure) in front of the test membrane is 1 m/s . The test is performed under full-flow conditions.

At very low oil concentration the recommended sampling time is increased to 1 h or more.

7.2.1.1 Test equipment

A general arrangement of typical test equipment is shown in Figure 2.



Key

1	compressed-air sampling point	6	membrane holder depressurising valve
2	temperature sensing/measuring	7	multi-turn flow control valve
3	pressure sensing/measuring	8	flow sensing/measuring
4a to 4c	full-flow ball valves	9	silencer
5	membrane holder	10	bypass pipe

Figure 2 — Typical arrangement for method B1

7.2.1.1.1 Membrane

In order to obtain good measuring accuracy, a high-efficiency micro-fibreglass membrane should be used. Where the membrane utilizes a binder, this shall not affect the results of the analysis. To achieve the accuracy specified for this method, three layers of membrane in series and in intimate contact shall be used and the membrane shall meet the requirements given in Table 2.

Table 2 — High-efficiency micro-fibreglass membrane

Parameter	Specification
Surface mass, g/m^2	80 to 100
Particle penetration, %	$< 0,000 5$

7.2.1.1.2 Membrane support

In order to prevent the collection membrane from bursting, it shall be supported by a robust, inert material that is sufficiently strong to withstand the differential pressures of the membranes in use during the test. The pressure-drop losses from the support should be minimized to allow the test compressed air flow to pass with a minimum of resistance; see Figure B.3.

7.2.1.1.3 Pipes and valves

It is important that the pipe inner diameter from the connection point in the compressed air system to the membrane holder be constant and crevice free to minimize system loss.

The shut-off valves (key items 4a to 4c in Figure 2) should be full-flow ball type and the hole in the ball should have approximately the same diameter as the pipe.

The bypass pipe may consist of a flexible tube and although full-flow ball valve (key items 4a to 4c in Figure 2) is indicated, this may be of any convenient type.

7.2.1.1.4 Membrane holder

Any readily available membrane holder that accepts circular membranes may be used, taking note of 7.2.1.1.5. A general diagram of a typical membrane holder and description are given in Figure B.4.

7.2.1.1.5 Construction materials

Aluminium and its alloys shall not be used for any component that can come into contact with the solvents.

7.2.2 Method B2 — Partial-flow sampling

7.2.2.1 General

It is necessary to know both main pipe flow and sample flows to define the test conditions.

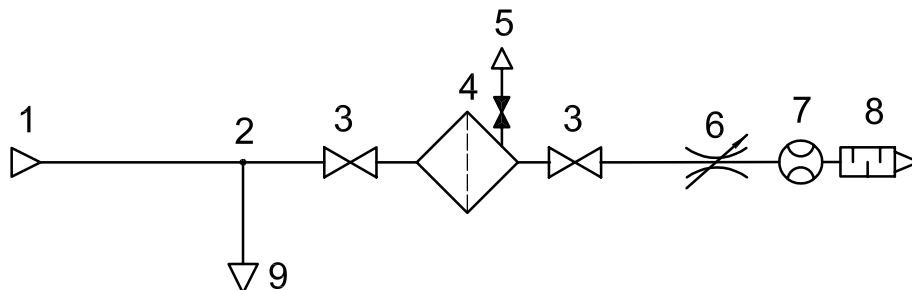
This method employs a sampling probe, which is inserted into any section of the compressed air system using suitable connections and valves and allows a sample of air to be taken from the main pipe flow under identical velocity conditions. The probe may be inserted to an approximately central position across the main pipe diameter and it is recommended that a number of preliminary tests be made.

The pressure seals used in the probe/holder connectors shall not release any hydrocarbon into solution when immersed in the analysing solvent. It is impractical to return the sample flow to the main pipe flow downstream from the membrane holder, and it is usual to vent this flow to atmosphere.

A typical probe design is shown in Figure B.3.

7.2.2.2 Test equipment

A general arrangement of typical test equipment is shown in Figure 3.



Key

1 compressed air supply (upstream)	4 membrane holder	7 flow sensing/measuring
2 isokinetic probe insertion point	5 membrane holder depressurising valve	8 silencer
3 full-flow ball valve	6 multi-turn flow control valve	9 compressed air supply (downstream)

Figure 3 — Typical arrangement for method B2

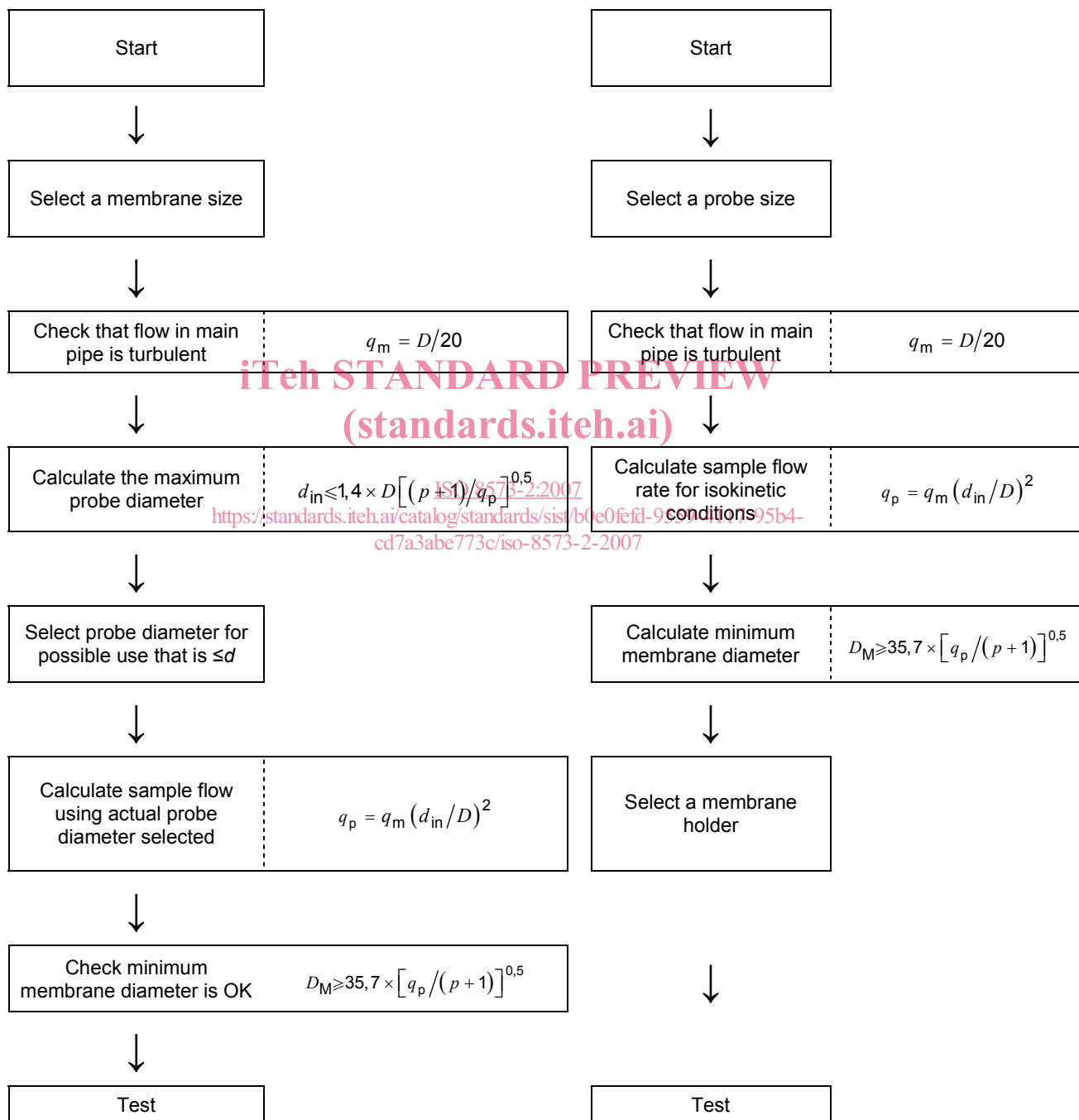
7.2.2.3 Compressed air flow-rates

The air velocities within the main pipeline and within the probe shall be identical throughout the sampling period. This is accomplished through adjustment of the flow controllers to provide appropriate readings on the flow meters.

Verification of identical pipe and probe velocities can be evaluated by the following procedures.

If membrane size is known

If probe size is known



where

q_m is the flow in main pipe, expressed in litres per second (at reference conditions)

q_p is the flow in probe, expressed in litres per second (at reference conditions)

d_{in} is the internal diameter of probe, expressed in millimetres

D is the internal diameter of pipe, expressed in millimetres

D_M is the membrane diameter, expressed in millimetres

p is the system pressure, expressed in pascals [bar(e)]

8 Test procedure — Method A

8.1 General

8.2 Measuring procedure

8.2.1 Start-up

All valves should be in the closed position at the beginning of the test.

Open shut-off valve (key item 2, Figure 1) fully to pressurize the test equipment. Adjust flow using flow control valve (key item 6, Figure 1) to required flow conditions shown on the flow sensing/measuring device (key item 7, Figure 1).

Close valves to liquid collection (key items 11, Figure 1).

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8.2.2 Stabilizing sampling filter

The sampling filter element (key item 9, Figure 1) operates in a saturated condition and time shall be allowed for this condition to be reached.

Measurement shall be taken only when the differential pressure of the sampling filter reaches the stable part of the graph (Figure 4) and oil is visible in the filter bowl of the sampling filter (key item 9, Figure 1).