BRITISH STANDARD

BS ISO
8573-8:2004

Compressed air —

Part 8: Test methods for solid particle content by mass concentration

ICS 71.100.20

BSI
British Standards

National foreword

This British Standard reproduces verbatim ISO 8573-8:2004 and implements it as the UK national standard.

The UK participation in its preparation was entrusted to Technical Committee MCE/8, Compressors, pneumatic tools, pneumatic machines and vacuum technology, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the ISO title page, pages ii to iv, pages 1 to 8, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 17 June 2004

ISBN 0 580 43960 7

INTERNATIONAL STANDARD

ISO 8573-8

First edition
2004-02-01

Compressed air —

Part 8: Test methods for solid particle content by mass concentration

Air comprimé —

Partie 8: Méthodes d'essai pour la détermination de la teneur en particules solides par concentration massique

Reference number
ISO 8573-8:2004(E)

Contents

Page

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 8573-8 was prepared by Technical Committee ISO/TC 118, *Compressors, pneumatic tools and pneumatic machines*, Subcommittee SC 4, *Quality of compressed air*.

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

— *Part 1: Contaminants and purity classes*

— *Part 2: Test methods for aerosol oil 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 methods for viable microbiological contaminant content*

— *Part 8: Test methods for solid particle content by mass concentration*

— *Part 9: Test methods for liquid water content*

Part 2 is under revision.

Compressed air —

Part 8:
Test methods for solid particle content by mass concentration

1 Scope

This part of ISO 8573 specifies test methods for determining the solid particle mass concentration in compressed air, expressed as the mass of solid particles with maximum particle size limits. The limitations of the methods are also given. One of a series of standards aimed at harmonizing air contamination measurements, it identifies sampling techniques and also gives requirements for evaluation, uncertainty considerations and reporting for the air purity parameter solid particles by mass concentration. The test methods are suitable for determining purity classes in accordance with ISO 8573-1. (Particle content based on counting particles is dealt with in ISO 8573-4.)

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 1219-1, *Fluid power systems and components — Graphic symbols and circuit diagrams — Part 1: Graphic symbols*

ISO 3857-1, *Compressors, pneumatic tools and machines — Vocabulary — Part 1: General*

ISO 5598, *Fluid power systems and components — Vocabulary*

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

ISO 8573-2, *Compressed air — Part 2: Test methods for aerosol oil content*

ISO 8573-4, *Compressed air — Part 4: Test methods for solid particle content*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3857-1, ISO 5598, ISO 8573-1 and ISO 8573-4 apply.

4 Units and symbols

For the purposes of this part of ISO 8573, the following, including non-SI-preferred, units are used:

— 1 bar = 100 000 Pa;

— 1 l (litre) = 0,001 m^3;

— bar(a), used for expressing absolute pressure;

— bar(e), used for expressing effective pressure.

For the graphic symbols used in Figure 1, see ISO 1219-1.

5 Selection of methods

The gravimetric method to be used is suitable for mass concentration measurement, however, where water and oil is present in the compressed air, it shall be reduced to a minimum.

A suitable method for solid particle diameter measurement may be selected from those given in Table 1.

Table 1 — Solid particle diameter measurement methods

Type of method	Maximum solid particle diameter d µm	Liquid water and oil contaminant mg/m^3
Microscope method	$d \geqslant 0{,}5$	$\leqslant 20$
Particle sizer method	$0{,}1 \leqslant d \leqslant 40$	Not admitted

6 Sampling techniques

The sampling shall be made at or near the actual pressure and at a constant flow rate.

The choice of sampling method will depend upon the actual level of contamination and the compressed air flow in the compressed air system. For sampling methods, see ISO 8573-2 and ISO 8573-4.

For partial flow sampling, it should be noted that, where large particle sizes are involved, the effects of gravity could introduce sampling errors.

Compressed air samples may be routed back into the main pipe or vent to the atmosphere after measurement. The value of air sample parameters (pressure, temperature, air velocity, etc.) shall be within the ranges specified by the test equipment manufacturer. Method B1 uses full flow sampling from the main pipe flow by means of a Y-piece.

7 Measurement methods

7.1 General

The test equipment and instruments shall be in good working order. Consideration shall be given to the calibration requirements of the measurement equipment used as given in the applicable instructions.

The indicated methods may be used at any point in a compressed air system using portable instruments where conditions of measurement are satisfied and available connectors and shut-off valves exist for connection to the compressed air system.

In order to guarantee the required accuracy of determination of solid particle content by the gravimetric method, the total content of water and oil aerosols in the compressed air sampling shall be less than 20 mg/m^3 for sampling Method A and less than 5 mg/m^3 for sampling Methods B1 and B2.

Reference should be made to the measurement equipment manufacturer in respect of the applicability of the equipment.

The gravimetric method deals with the separation and the weighing of solid particles that are present in a compressed air sample. The influence of temperature, pressure, humidity and other contaminants of compressed air shall be taken into consideration.

7.2 Test equipment

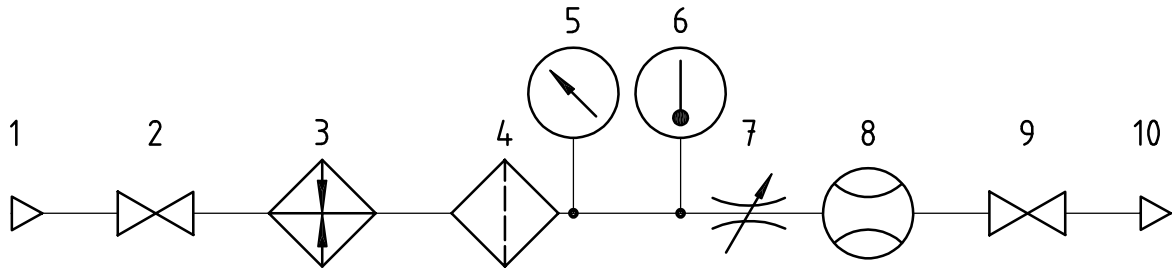
7.2.1 General

Air flow is passed through the test equipment via suitable in-line valves which have been previously checked to ensure they do not contribute to the level of contamination already present.

The general arrangement of the test equipment for the gravimetric method shall be in accordance with Figure 1.

NOTE The numbers given between parentheses in the subclause titles refer to the numbering of the elements in Figure 1.

For symbols, see ISO 1219-1.



Key

1 sampling point
2 shut-off valve
3 heater (if required)
4 membrane holder
5 pressure gauge
6 thermometer
7 flow control valve
8 air flowmeter
9 shut-off valve
10 discharge outlet

Figure 1 — Circuit diagram of test equipment for gravimetric method

7.2.2 Membrane holder (4)

The membrane shall be manufactured from hydrophobic high-efficiency material.

NOTE For a description of a typical membrane and its holder, see ISO 8573-2.

7.2.3 Flow control valve (7)

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

7.2.4 Pressure gauge (5)

The pressure values shall be recorded during the entire period of the test.

The accuracy of measurement of the pressure shall be better than ± 2 % of reading.

7.2.5 Thermometer (6)

The temperature values shall be recorded during the entire period of the test.

The accuracy of measurement of the temperature shall be better than ± 1° C.

7.2.6 Air flowmeter (8)

The flow rate values shall be recorded during the entire period of the test.

The accuracy of measurement of the flow rate shall be better than ± 5 %.

7.2.7 Pipes, connectors, shut-off valves (2 and 9)

The requirements for pipes, connectors and shut-off valves shall be according to ISO 8573-2.

7.2.8 Heater (3)

The heater may be used to decrease the level of liquid water and oil contaminant content in the compressed air sample to the value specified in 7.1. Reducing the amount of liquid water and oil content by heating and/or the reduction of the pressure of the compressed air shall not have an influence on solid particle content in the compressed air sample.

7.3 Test procedure

7.3.1 Preparation for measuring

The procedures for preparation for measuring shall be in accordance with ISO 8573-2. The weight of the dry membrane shall be determined before the sample is taken.

7.3.2 Duration of test

The optimum duration of the compressed air sampling may be determined after the first proof measurement to determine the tentative solid particle concentration.

Approximate duration of test, t, in minutes can also be determined by the following inequality:

$$\frac{m_{\min}}{c_{p\,\lim}\ q} < t < \frac{m_{\max}}{c_{p\,\lim}\ q} \qquad (1)$$

where

m_{min} is the minimum required amount of solid particle content on the membrane, in milligrams;

m_{max} is the maximum permitted amount of solid particle content on the membrane, in milligrams;

$C_{p\,lim}$ is the assumed or maximum permitted amount of solid particle content in the compressed air, in milligrams per cubic metre;

q is the compressed air discharge through the membrane, in cubic metres per minute.

The mass of solid particles collected on the membrane shall be in range 1 mg $\leqslant$ m $\leqslant$ 5 mg on 1 cm^2 of the membrane surface.

7.3.3 Measurement of solid particle mass concentration

If liquid water and oil contaminants are absent in the compressed air flow, the solid particle mass concentration for each sample is determined as a difference between masses of the test membrane before and after air sampling, divided by the total volume of air passed through the membrane. After air sampling and before weighing, the test membrane should be placed in a desiccator over a suitable desiccant, e.g. silica gel, for 10 - 15 min or until the mass of membrane is stable.

If there are liquid water and oil contaminants in the compressed air flow, they shall be removed after air sampling and before weighing of the test membrane. For this purpose, the test membrane shall be placed in the desiccator over sulphuric acid for 2 h. Then, the test membrane is carried in the chemical funnel on the conical wall (the filtrate is over the membrane), pressed to the conic wall with the glass stick and treated several times by small portions of a suitable solvent of total volume 10 - 15 ml for dissolving and removing of the oil. After that, the test membrane shall be maintained for 2 - 3 min at a temperature of 20 - 30 °C and then weighed.

Other methods for removal of water and oil from the test membrane are permitted if they have no influence on solid particle content of the test membrane after sampling the compressed air.

The maximum uncertainty of measurement of mass shall be better than ± 2 %.

7.4 Calculation of results

It is necessary to ensure that results are stable, repeatable and presented in a form that shows that they are so.

The solid particle mass concentration c_{pn} in mg/m^3 for each measurement shall be determined by the formula:

$$c_{pn} = \frac{m_n - m_0}{q_n t_n} \qquad (2)$$

where

m_0 is the mass of test membrane before sampling, in milligrams;

m_n is the mass of test membrane after sampling, in milligrams;

q_n is the flow rate of sampling air through the membrane, in cubic metres per minute;

t_n is the sampling time, in minutes.

7.5 Determination of maximum diameter of solid particles

The measurement methods of maximum diameter of solid particles identified in Table 1 shall be carried out in accordance with ISO 8573-4.

8 Evaluation of test results

8.1 Reference conditions

The reference conditions for solid particle mass concentration volume statements are as follows:

— Air temperature: 20 °C;

— Air pressure: 1 bar (a);

— Relative water vapour pressure: 0 %.

8.2 Influence of humidity

The measured solid particle mass concentration shall be recalculated to refer to the dry air volume as given by the partial pressure of the air at the sampling point. Under normal conditions, the effect of humidity on volume can be small and the requirement to calculate its effect is usually not required.

8.3 Influence of pressure

The solid particle mass concentration shall be recalculated to reference pressure conditions.

The solid particle mass concentration will vary in direct proportion in the ratio of system to sample absolute pressure.

8.4 Influence of temperature

The solid particle mass concentration shall be recalculated to reference temperature conditions.

Temperature could also affect solid particle measurement results if the temperature exceeds the stability of the particles measured or the rating of the sampling equipment.

8.5 Average values

Depending on the reproducibility of the method, the measurement facility and the experience of the parties involved in the provision of the measurement facility, the average of several consecutive measurements at the sample point shall be used.

The average solid particles mass concentration c_p in milligrams per cubic metre shall be determined by the results of no less than three measurements using the formula:

$$c_p = \frac{c_{p1}t_1 + c_{p2}t_2 + \ldots + c_{pn}t_n}{t_1 + t_2 + \ldots + t_n} \quad (3)$$

where

$c_{p1}, c_{p2}, \ldots, c_{pn}$ are the solid particle content in the air samples, in milligrams per cubic metre;

$t_1, t_2, \ldots, t_n$ are the sampling times, in minutes.

9 Uncertainty

The uncertainty of the method depends on the equipment used and the accuracy of the result calculation. The total uncertainty of the authorized results of the test shall be ± 10 %.

10 Test report

10.1 Statements

Statements of the solid particle mass concentration and the maximum solid particle diameter in the compressed air shall be made such that the values can be verified in accordance with the procedures of this part of ISO 8573.

The influence of any factors — e.g. oil contaminants or sample pipe — present in the sample that could affect the result of particle concentration measurement shall be recorded.

10.2 Statement format

The test report used to declare solid particle mass concentration according to this part of ISO 8573 shall contain the following:

a) A description of the compressed air system and its working conditions, with sufficient detail for the determination of the validity of the declared mass concentration value:

   1) volume flow rate;

   2) sampling time;

   3) pressure;

   4) temperature;

   5) other contaminants (including water and oil).

b) A description of the sampling point where the samples were taken.

c) A description of the sampling and measurement system used, in particular the materials and equipment used, and details of its calibration record.

d) The phrase “Declared solid particle mass concentration in accordance with ISO 8573-8”, followed by

   1) the figure for the actual, average measured value evaluated in accordance with Clause 8 and calculated to refer to the *reference* conditions;

   2) the figure for the actual, average measured value evaluated in accordance with Clause 8, referring to the *actual* conditions;

   3) the solid particle concentration, expressed in milligrams per cubic metre at actual and reference conditions;

   4) the pressure and temperature to which the measurement refers;

   5) the figure followed by a statement regarding the applicable uncertainty; and

   6) the date of the calibration record.

e) The date of the sampling and measurements.

A sample test report is presented in Annex A.

Annex A
(informative)

Sample test report

Content of solid particles in compressed air by mass concentration

General description of compressed air system, test condition, sample point: _____

_____

_____

Test method applied: _____

Sampling method applied: _____

List of test equipment used and respective calibration dates: _____

_____

_____

_____

_____

_____

Test results of solid particles mass concentration in accordance with ISO 8573-8

Test No.	Test date and time	Compressed air parameters			Maximum solid particles diameter	Solid particles mass concentration mg/m^3	
		Temperature °C	Pressure bar(e)	Total sample volume m^3	µm	Actual condition	Reference condition
1							
2							
3							
...							
...							
...							
...							
	Average value:						
Reported by:				Date:			
Authorized by:				Date:			
If the measurement is outside a particular range, then identify as being “not measured”.							

blank

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL