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Compressed air —

Part 6: Test methods for gaseous contaminant content

Air comprimé —
Partie 6: Méthodes d'essai pour la détermination de la teneur en polluants gazeux

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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 8573-6 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 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*

Introduction

This part of ISO 8573 is one in a series of standards (planned or published) with the ambition of harmonizing air contamination measurements. It is also intended to be used for reference when stating purity classes according to ISO 8573-1.

In this part of ISO 8573, *gaseous contamination of compressed air* means that a sample of compressed air could contain small quantities of carbon monoxide (CO), carbon dioxide (CO_2), sulphur dioxide (SO_2), hydrocarbons and oxides of nitrogen (NO_x) — the latter being a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2), without a specified ratio between the two components. It is possible to obtain separate concentration values for NO and NO_2 using either the laboratory equipment recommended here or on-site equipment, while under the recommended laboratory analytical procedure, hydrocarbons are the sum of a variety of species assuming a ratio of $C_1H_{1,85}$.

Compressed air —

Part 6:
Test methods for gaseous contaminant content

1 Scope

This part of ISO 8573 provides a selection of suitable test methods from those available for the measurement of contamination gases in compressed air. It specifies sampling technique, measurement and evaluation, uncertainty considerations and reporting for the applicable gaseous contaminants carbon monoxide, carbon dioxide, sulphur dioxide, nitric oxide, nitrogen dioxide and hydrocarbons in the range C_1 to C_5 (see ISO 8573-5 for C_6 and above). The methods given are also suitable for other gases.

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 2602, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*

ISO 2854, *Statistical interpretation of data — Techniques of estimation and tests relating to means and variances*

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

3 Terms, definitions, units and symbols

For the purposes of this document, the terms and definitions given in ISO 8573-1, and the symbols given in ISO 1219-1 apply. See Table 1 for an explanation of the units and other symbols used.

Table 1 — Preferred units and symbols (and their non-preferred equivalents) used in this part of ISO 8573

Unit/symbol	Explanation
MPa [bar]	1 bar = 100 000 Pa = 0,1 MPa
ml/m^3 (= ppm$_V$) [a]	Volume fraction expressed in millilitres per cubic metre [= one part per million (1 ppm) on a volume basis: 1/10^6 (m^3/m^3)]
ml/m^3 (= ppm$_V$) C_1	Volume fraction expressed in millilitres per cubic metre [= one part per million (1 ppm) on a volume basis: 1/10^6 (m^3/m^3)], referred to a theoretical C_1-molecule
µg/g (= ppm$_W$)	Mass fraction expressed in micrograms per gram [= parts per million on a weight basis[b]]
1 % by volume	Volume fraction of 1 %: 1/10^2 (m^3/m^3)
MPa(e) [bar(e)]	Effective pressure
MPa(a) [bar(a)]	Reference condition absolute pressure

[a] Parts per million (ppm) is a deprecated unit, i.e. not accepted by the International System of Units, SI. See, for example, ISO 31-0:1992, 2.3.3.

[b] In common parlance, the word "weight" continues to be used to mean *mass*, but this practice is deprecated. See ISO 31-3.

4 Selection guide and available methods

There are two options for the measurement of contaminant content:

a) sampling and analysis on-site;

b) sampling on-site, analysis in the laboratory.

The recommended methods and equipment within these options are given in Table 2.

Table 2 — Recommended measurement methods/equipment

	Gaseous contaminant	Measurement equipment
Off-site	Carbon monoxide (CO)	Non-dispersive infrared (NDIR) absorption spectrometer
	Carbon dioxide (CO_2)	Non-dispersive infrared (NDIR) absorption spectrometer
	Sulphur dioxide (SO_2)	Non-dispersive infrared (NDIR) absorption spectrometer
		UV-fluorescence
	Hydro-carbons (HC) (C_1 to C_5)	Heated flame ionisation detector (HFID)
	Nitrogen oxides (NO_x)	Chemiluminescent detector (CLD) with an NO_2/NO converter, and in a heated version (HCLD)
On-site	All identified gases	Gas detector tubes with colour change

5 Sampling techniques

5.1 Gas sampling in bags

The gas sample shall be taken at atmospheric conditions and collected in a special gas sampling bag made for the purpose. A sample of the compressed air shall be collected in a gas sampling bag for the evaluation of the contaminant concentration values. All measurements on the sample shall be carried out under atmospheric pressure conditions.

Use of a commercially available gas sampling bag (e.g. one made of fluoroethylene propylene) to collect a sample of air for analysis should be made by the following method.

The gas sampling bag should be of the type suitable for gas collection. Turbulent flow conditions are required in the main system pipe to ensure a mixing of the gaseous contaminants to give a representative sample of the air.

Connect the gas sampling bag to the sampling point using a probe (see Figure 1), through a pressure reducing valve, by a polytetrafluoroethylene (PTFE) tube and a PTFE, or stainless steel, connector, depending upon the expected gas impurities. The piping should be protected from the possible formation condensation. The bag should have a vent valve to allow for flushing. Flushing should take place for 5 min with system air before taking the sample. Care should be taken to ensure that the bag is not over-inflated and of a size consistent with the sample required. The bag should only be re-used if permitted by the manufacturer.

Together with the filled gas-sampling bag an empty unused gas-sampling bag shall be brought to the laboratory for a blind test.

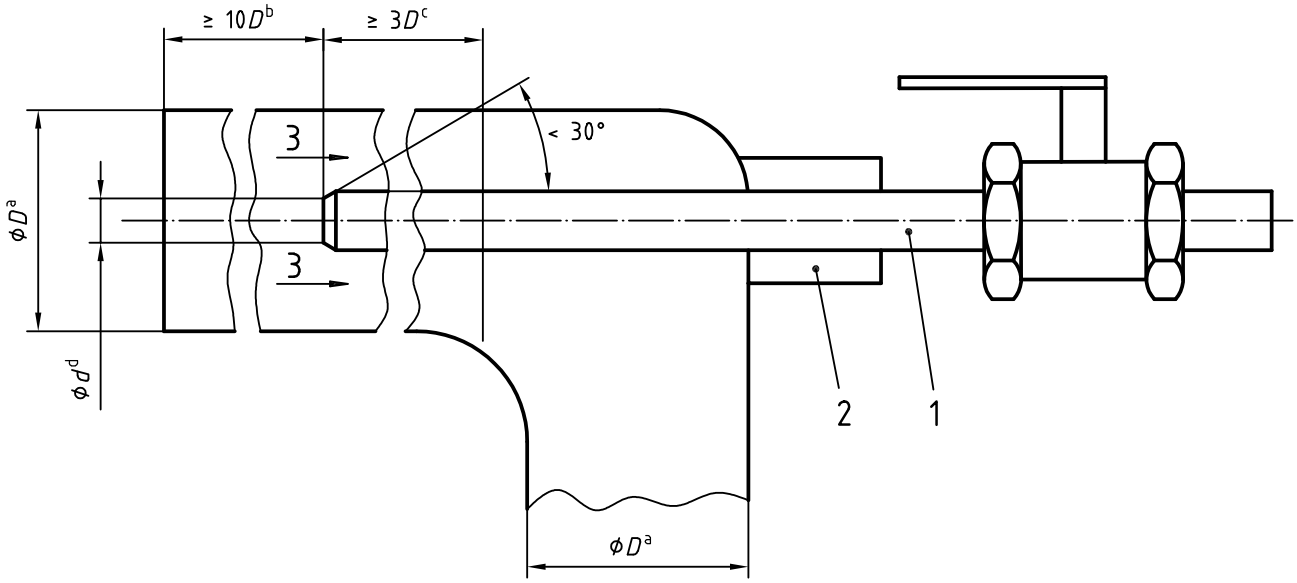
5.2 On-line sampling

The gas sample shall be taken at system pressure using a stainless steel probe (see Figures 1 and 2). The end of the probe outside the compressed air pipe shall have a valve, which shall be suitable for all pressure conditions of the compressed air pipe. The probe shall be free from contaminants affecting the readings.

See Annex C for the procedure.

5.3 Sampling in gas detector tube

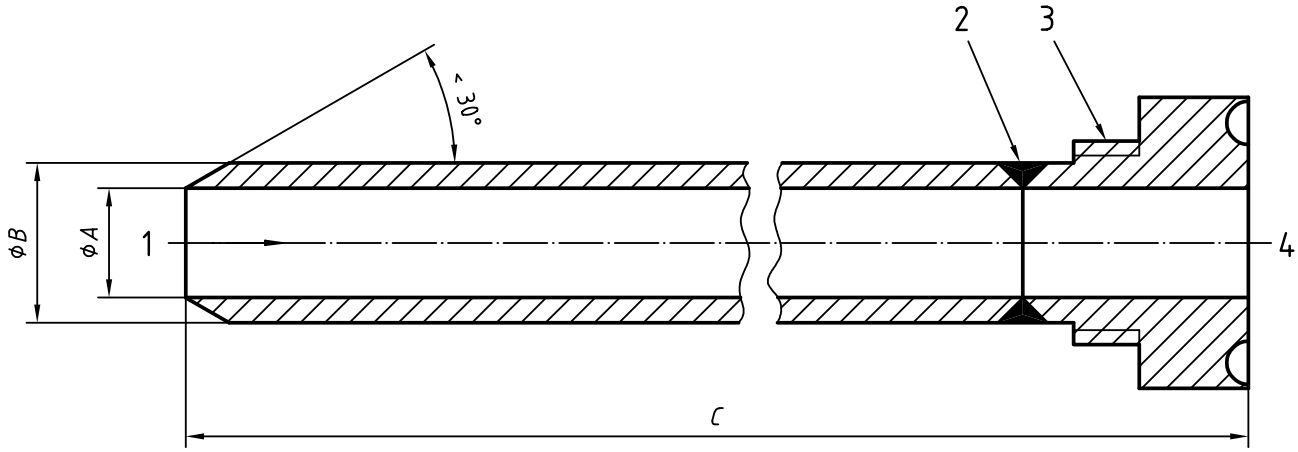
See Annex D for the procedure.



Key

1 sampling probe in the main pipe
2 adjustable gland to allow adjustment of probe
3 direction of air flow
a main pipe diameter, D
b minimum straight length before probe, $10 \times D$
c probe insertion point at minimum of $3 \times D$
d internal probe diameter, d

Figure 1 — Equipment set-up of probe insertion for sampling



Key

1 direction of flow
2 crevice-free joint
3 suitable pressure-tight thread connection
4 to membrane holder

Probe size	A mm	B mm	C mm
1	7	9,6	200
2	10	12,6	200
3	17	19,6	400

Figure 2 — Stainless steel sampling probe

6 Measurement methods

The recommended procedure for the evaluation of the contaminant concentration values in a laboratory is given in Annex C. The analytical equipment proposed for use by Annex C is based on the detector principles identified in Table 2.

Consideration shall be given to the measurement system integrity and the calibration requirements of the measurement equipment, which shall be used in accordance with the applicable instructions and to the degree of gaseous contamination measured.

For the measurement of the concentration values, on-site gas detector tubes may be employed. This offers a direct reading from a scale via a chemical reaction with a colour change proportional to the actual contaminant concentration in the actual compressed air sample taken. See Annex D.

7 Reference conditions

Unless otherwise agreed, the reference conditions for gaseous contaminant concentration shall be in accordance with Table 3:

Table 3 — Reference conditions

Air temperature	20 °C
Air pressure	0,1 MPa(a) [1 bar(a)]
Relative water vapour pressure	0

8 Evaluation of test result

The results of the measurements are given as concentration values of the contaminants as volume fractions or percentages by volume. See Table 1.

9 Uncertainty

NOTE A calculation of the probable error according to this clause is not always necessary.

Due to the very nature of physical measurements it is impossible to measure a physical quantity without error or, in fact, to determine the true error of any particular measurement. However, if the conditions of the measurement are sufficiently well known, it is possible to estimate or calculate a characteristic deviation of the measured value from the true value, such that it can be asserted with a certain degree of confidence that the true error is less than the said deviation. The value of such deviation (normally 95 % confidence limit) constitutes a criterion of the accuracy of the particular measurement.

It is assumed that all systematic errors that may occur in the measurement of the individual quantities measured and of the characteristics of the gas can be compensated for by corrections. A further assumption is that the confidence limits in errors in reading and integration errors may be negligible if the number of readings is sufficient: the (small) systematic errors that could occur are covered by the inaccuracy of measurements.

The information about asserting the uncertainty of measurement of individual quantities measured and on confidence limits of the gas properties are approximations. These approximations can only be improved by efforts of disproportionate expense (see ISO 2602 and ISO 2854).