



SLOVENSKI STANDARD

SIST ISO 9096:1995

01-december-1995

Emisije nepremičnih virov - Določanje koncentracije in količine skupnega prahu v odvodnikih - Gravimetrična metoda

Stationary source emissions -- Determination of concentration and mass flow rate of particulate material in gas-carrying ducts -- Manual gravimetric method

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Émissions de sources fixes -- Détermination de la concentration et du débit-masse de matières particulaires dans des veines gazeuses -- Méthode gravimétrique manuelle

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Ta slovenski standard je istoveten z: **ISO 9096:1992**

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13.040.40 Emisije nepremičnih virov Stationary source emissions

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INTERNATIONAL STANDARD

**ISO
9096**

First edition
1992-06-15

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

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*Émissions de sources fixes — Détermination de la concentration et du
débit-masse de matières particulaires dans des veines gazeuses —*

Méthode gravimétrique manuelle
<https://standards.iteh.ai/en/standard/ISO/9096/1995/8fb1e3ac6a1d/sist-iso-9096-1995>



Reference number
ISO 9096:1992(E)

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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.

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.

International Standard ISO 9096 was prepared by Technical Committee ISO/TC 146, *Air quality*, Sub-Committee SC 1, *Stationary source emissions*.

[SIST ISO 9096:1995](https://standards.iso.org/standards/std/37195/iec/9096-1992.html)

<https://standards.iso.org/standards/std/37195/iec/9096-1992.html> Annexes A, B, C, D, E and F form an integral part of this International Standard. Annex G is for information only.

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

WARNING — SAFETY PRECAUTIONS

GENERAL

Sampling operations may involve a variety of hazards depending on the circumstances. All those concerned, e.g. management, sampling operators and control authorities, shall consider the likely hazards adequately beforehand.

If hazards cannot be eliminated, it will be necessary to make appropriate safety arrangements with regard to any specific local, national or international regulations before sampling operations commence.

The hazards most likely to be encountered and the means of reducing them include those described below.

On every occasion, plant management and plant operators should be aware that sampling operations are taking place. Management should consider what appropriate safety procedures, e.g. work permits, should be adopted and ensure that they are understood by all those likely to be concerned.

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HAZARDS TO SAMPLING OPERATORS

- a) Working at heights or under conditions of difficult access — Consider a means of escape and the need for guard rails and base boards (see 9.5), warning systems, etc. Telecommunication will be desirable at remote locations. It is recommended that operators do not work alone.
- b) Exposure to toxic, corrosive or hot gases or dusts from the access ports or from elsewhere in the processing plant — Consider circumstances, monitoring or warning systems, personal protective equipment, etc.
- c) Electrical hazards, from electrical equipment or electrostatic charge — Consider equipment protection, earthing, etc. (see 9.5).
- d) Noise and heat from the plant or equipment — Consider protective measures.
- e) Handling of heavy or bulky equipment — Consider lifting arrangements and accessibility of sampling location.

HAZARDS TO OTHER PERSONNEL

- a) Objects falling from the platform — Consider warning signs, barricading, etc.
- b) Presence of temporary equipment, e.g. cables causing trip hazards — Consider warning signs etc.

HAZARDS TO PLANT

- a) Ignition of flammable gases — Consider using non-sparking equipment, etc.
- b) Equipment dropped into duct system — Take special care that sampling heads etc. cannot become detached.

1 Scope

This International Standard specifies a manual gravimetric method for the measurement of the concentration and mass flow rate of particulate matter in a moving gas stream in confined spaces such as ducts, chimneys and flues. This method can be used to determine concentrations ranging from 0,005 g/m³ to 10 g/m³. For concentrations under

0,050 g/m³, the inaccuracy of this method will be greater than $\pm 10\%$ (see clauses 12 and 14).

It is primarily a reference method for the determination of particulate matter emitted from stationary sources and it can also be used for calibrating automatic continuous particulate monitors. The method should be applied as much as possible under steady state conditions of the gas flow in the

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duct. It is not suitable for use on ventilation or air conditioning systems, indoor atmospheres, or gases carrying droplets.

This International Standard also sets out requirements for the design features of apparatus which can be used for the determinations if correctly used and indicates basic requirements for the positioning of sampling facilities.

If any of the requirements of this International Standard are not fulfilled, the method can still be applied in special cases but the uncertainty on particulate concentration or flow rate may be larger (see clause 14).

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 access port: A hole in the duct at the extremity of a sampling line, through which the sampling probe is inserted [see figure 1 and *sampling line* (3.15)].

3.2 actual conditions: Temperature and pressure at the sampling points.

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; flue; chimney; stack: An enclosed structure through which gases travel.

3.5 effective pressure: The difference between the pressure at the sampling point and the pressure of the ambient air at equal altitude.

3.6 gas: A mixture of gaseous compounds or elements which may carry particulate matter flowing in a duct.

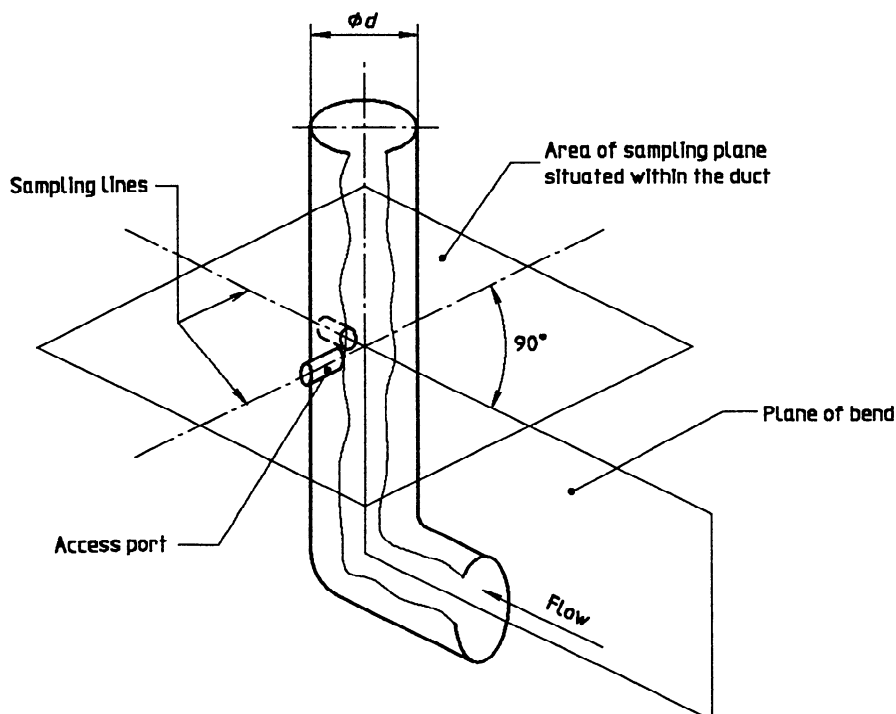


Figure 1 — Illustration of definitions in relation to a circular duct

3.7 hydraulic diameter: The characteristic dimension of a duct cross-section defined by

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

3.8 incremental sampling: The collection and removal of individual samples from each sampling point.

3.9 isokinetic sampling: Sampling at a rate such that the velocity and direction of the gas entering the sampling nozzle (v'_N) is the same as that of the gas in the duct at the sampling point v'_a (see figure 2).

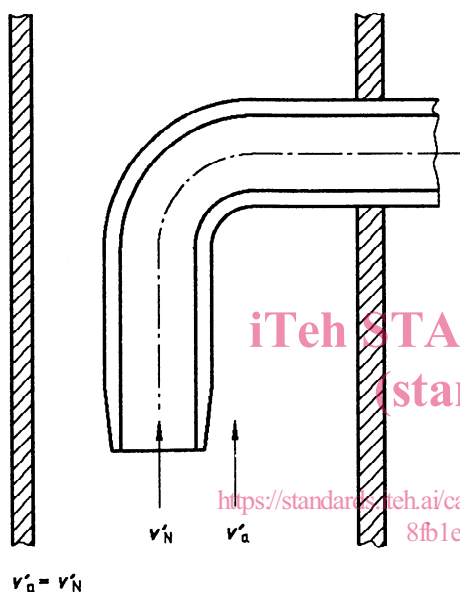


Figure 2 — Isokinetic sampling

3.10 particulate concentration: Mass of particulate matter per unit volume of duct gas at defined gas temperature and pressure.

3.11 particulate flow rate: Mass of particulate matter contained in a duct gas flow per unit time.

3.12 particles; particulate matter: Solid particles, of any shape, structure or density, dispersed in the continuous gas phase.

3.13 representative gas sample: A gas sample having the same mean particulate concentration as prevails in the sampling plane during sampling.

3.14 sampling plane: The plane normal to the centreline of the duct at the sampling position (see figure 1).

3.15 sampling line: The line in the sampling plane along which the sampling points are located (see figure 1), bounded by the inner duct wall.

3.16 sampling point: Specific location on a sampling line at which a sample is extracted.

3.17 sampling location: A suitable position for carrying out sampling in the duct.

3.18 site: Works or plant where sampling is to be carried out.

3.19 standard conditions: Standard temperature and pressure of the gas, i.e. 273 K and 101,3 kPa.

4 Symbols with their corresponding units, subscripts and index

4.1 Symbols and their corresponding units

See table 1.

4.2 Subscript and index

See table 2.

Table 1 — Symbols and their corresponding units

Symbol	Meaning	Unit
a	Effective nozzle area	m^2
A	Sampling plane area	m^2
c	Particulate concentration	g/m^3
δ	Thickness of nozzle wall at the tip	m
d	Duct diameter at sampling plane	m
d_H	Hydraulic duct diameter at sampling plane	m
d_{N1}	Inner nozzle diameter	m
d_{N2}	Outer nozzle diameter	m
d_o	Orifice diameter	m
f	Water vapour concentration	kg/m^3
i	Individual position on sampling line (diameter or radius)	—
K	Calibration factor	—
l	Characteristic length	m
l_1	Greater side length of sampling plane	m
l_2	Smaller side length of sampling plane	m
m	Collected particulate mass	g
M	Molar mass	$kg/kmol$
n_d	Number of sampling points on sampling diameter	—
n_{dia}	Number of sampling diameters (sampling lines)	—
n_r	Number of sampling points on sampling radius ($0,5d$)	—
n_1	Number of divisions of l_1	—
n_2	Number of divisions of l_2	—
p	Absolute pressure	Pa
p_{am}	Ambient pressure	Pa
p_e	Effective pressure ($p_e = p - p_{am}$)	Pa
Δp	Differential pressure across flow measuring device	Pa
q_m	Particulate flow rate in duct	g/h
q_V	Gas volumetric flow rate	m^3/h
r	Volume fraction of gaseous component	—
ρ	Gas density	kg/m^3
t	Sampling time (total)	h
Δt	Sampling time per sampling point	h
T	Temperature (absolute)	K
Θ	Temperature	$^{\circ}C$
v	Gas velocity	m/s
V	Gas volume	m^3
V_m	Molar volume of a gas	$m^3/kmol$
x_i	Distance from wall to individual sampling point along diameter or radius	m

Table 2 — Subscript and index

Subscript or index	Meaning
a	Actual conditions in sampling plane
g	Any gas measuring device
i	Individual value
n	Standard conditions
N	Nozzle
o	Orifice
Pt	Pitot tube
w	Water vapour
'	Moisture included