BS ISO 7504:2015

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Gas analysis — Vocabulary

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National foreword

This British Standard is the UK implementation of ISO 7504:2015. It supersedes BS ISO 7504:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PTI/15, Natural Gas and Gas Analysis.

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

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 158, *Analysis of gases*.

This third edition cancels and replaces the second edition (ISO 7504:2001), which has been technically revised for alignment with the terminology used in other International Standards, including ISO/IEC Guide 98-3 and ISO/IEC Guide 99:2007.

Gas analysis — Vocabulary

1 Scope

This International Standard defines terms related to gas analysis, with the main focus on terms related to calibration gas mixtures for use in gas analysis and gas measurements. It does not cover terms which relate only to specific applications.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 99:2007, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

ISO 10715:1997, *Natural gas — Sampling guidelines*

3 Terms relating to general concepts

Terms used in the field of gas analysis that are well defined by either ISO/IEC Guide 98-3 or ISO/IEC Guide 99 are included in Annex A.

3.1
homogeneity
state of a gas mixture wherein all of its *components* (3.3) are distributed uniformly throughout the volume occupied by the gas mixture

3.2
stability
attribute of a gas mixture, under specified conditions, to maintain its *composition* (3.5) within specified uncertainty (Annex A) limits for a specified period of time (*maximum storage life* (7.5))

3.3
component
chemical entity at a defined physical state present in a material or in a mixture

3.4
content
amount-of-substance fraction (3.5.1.1), *mass fraction* (3.5.1.2), *volume fraction* (3.5.1.3), *amount-of-substance concentration* (3.5.2.1), *mass concentration* (3.5.2.2), *volume concentration* (3.5.2.3) of a *component* (3.3) in a gas or gas mixture

Note 1 to entry: See ISO 14912[7] for further information about this concept.

EXAMPLE 1 The hydrogen content in a mixture of hydrogen and nitrogen, expressed as an *amount-of-substance fraction* (3.5.1.1), is $x(H_2) = 0{,}1$.

EXAMPLE 2 The content of sulfur dioxide in air at p = 101,325 kPa and T = 288,15 K, expressed as a *mass concentration* (3.5.2.2), is $\gamma(SO_2) = 1\ mg/m^3$.

3.5
composition
identity and *content* (3.4) of each *component* (3.3) that constitute a particular gas mixture

3.5.1 Fractions

3.5.1.1
amount-of-substance fraction
mole fraction
x_B, y_B
quotient of the amount of substance of a component B and the sum of the amounts of substance of all *components* (3.3) of the gas mixture

[SOURCE: ISO 80000-9:2009, 9-14]

3.5.1.2
mass fraction
w_B
quotient of the mass of a component B and the sum of the masses of all *components* (3.3) of the gas mixture

[SOURCE: ISO 80000-9:2009, 9-12]

3.5.1.3
volume fraction
φ_B
quotient of the volume of a component B and the sum of the volumes of all *components* (3.3) of the gas mixture before mixing, all volumes referring to the pressure and the temperature of the gas mixture

[SOURCE: ISO 80000-9:2009, 9-15]

3.5.2 Concentrations

3.5.2.1
amount-of-substance concentration
mole concentration
c_B
quotient of the amount of substance of a component B and the volume of the gas mixture

[SOURCE: ISO 80000-9:2009, 9-13]

3.5.2.2
mass concentration
γ_B
quotient of the mass of a component B and the volume of the gas mixture

[SOURCE: ISO 80000-9:2009, 9-11.2]

3.5.2.3
volume concentration
σ_B
quotient of the volume of a component B before mixing and the volume of the gas mixture, both volumes referring to the same pressure and the same temperature

Note 1 to entry: The volume concentration and the *volume fraction* (3.5.1.3), both referring to the same pressure and the same temperature, have identical values if, and only if, the sum of the component volumes and the volume of the whole gas mixture are identical.

4 Terms relating to physical properties

4.1
equation of state
mathematical relationship between the state variables (pressure and temperature) of a gas or gas mixture and the volume occupied by a given amount of substance, written as $pV = ZnRT$

Note 1 to entry: In this relationship

p is the pressure;

V is the volume;

Z is the *compressibility factor* (4.2);

n is the amount of substance;

R is the molar gas constant;

T is the absolute temperature.

4.2
compressibility factor
compression factor
***Z*-factor**
real-gas factor
quotient of the volume of an arbitrary amount of gas at specified pressure and temperature and the volume of the same amount of gas, at the same state conditions, as calculated from the ideal gas law

4.3
reference conditions
definite values of pressure and temperature (state conditions) of gases and gas mixtures to which the results of measurements and/or calculations should refer

EXAMPLE In the field of gas analysis and gas measurement, the following conditions are commonly preferred:

— normal conditions: p = 101,325 kPa, T = 273,15 K;

— metric standard conditions: p = 101,325 kPa, T = 288,15 K (see ISO 13443[5]).

4.4
density
ρ_B
quotient of the mass and the volume occupied by that mass at specified state conditions

[SOURCE: ISO 80000-9:2009, 9-11.1]

4.4.1
relative density
quotient of the gas density and the density of dry air of standard composition, specified at the same state conditions

[SOURCE: ISO 6976:1995, 2.4, modified — Language aligned with other definitions]

4.5
saturation vapour pressure
pressure exerted by the vapour of a chemical substance in equilibrium with a condensed phase (liquid or solid or both) in a closed system

Note 1 to entry: For each pure substance, saturation vapour pressure is a function of temperature only.

4.6
dew point
temperature at or below which, at a specified pressure, condensation from the gas phase will occur

Note 1 to entry: For pure substances, dew point and *bubble point* (4.7) coincide. At that temperature, the pressure equals the *saturation vapour pressure* (4.5).

4.7
bubble point
pressure and temperature condition at which the liquid phase is in equilibrium with the first appearing bubbles of gas

Note 1 to entry: For pure substances, *dew point* (4.6) and bubble point coincide. At that temperature, the pressure equals the *saturation vapour pressure* (4.5).

4.8
critical point
single point in pressure-temperature space at which the *composition* (3.5) and properties of the gas and liquid phases in equilibrium are identical

Note 1 to entry: The pressure at this point is known as the "critical pressure p_c" and the temperature as the "critical temperature T_c", respectively.

Note 2 to entry: For a pure substance, the critical temperature is that temperature above which only the gas phase can exist irrespective of the applied pressure.

4.9
cricondenbar
maximum pressure at which two-phase separation (condensation) can occur

Note 1 to entry: The phase coordinates cricondenbar and *cricondentherm* (4.10) apply to gas mixtures (with the binary system as the simplest case). For a gas mixture, the *critical point* (4.8) is no longer the maximum pressure, as well as the maximum temperature for vapour-liquid coexistence (see Figure 1).

Note 2 to entry: It is the highest pressure in the two-phase envelope and generally higher than the critical pressure.

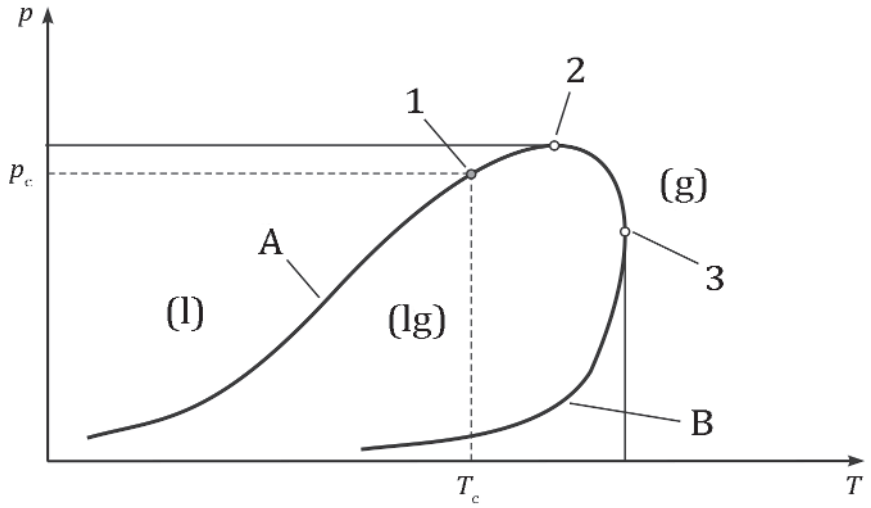
Note 3 to entry: For a pure substance, *cricondentherm* (4.10), cricondenbar, and *critical point* (4.8) are represented by a single point, i.e. the critical point.

4.10
cricondentherm
maximum temperature at which two-phase separation (condensation) can occur

Note 1 to entry: The phase coordinates *cricondenbar* (4.9) and cricondentherm apply to gas mixtures (with the binary system as the simplest case). For a gas mixture, the *critical point* (4.8) is no longer the maximum pressure, as well as the maximum temperature for vapour-liquid coexistence (see Figure 1).

Note 2 to entry: It is the highest temperature in the two-phase envelope and generally higher than the critical temperature.

Note 3 to entry: For a pure substance, cricondentherm, *cricondenbar* (4.9), and *critical point* (4.8) are represented by a single point, i.e. the critical point.



Key

1	critical point	B	dew point curve
2	cricondenbar	(l)	liquid phase
3	cricondentherm	(g)	gaseous phase
A	bubble point curve	(lg)	two-phase (liquid-vapour) region

Figure 1 — The *p*,*T* phase envelope of a binary system

5 Terms relating to calibration gases

5.1
calibration gas mixture
gas mixture of known *stability* (3.2) and *homogeneity* (3.1) whose *composition* (3.5) is well established for use in the calibration (Annex A) or *verification* (9.2) of a measuring instrument or for the *validation* (9.3) of a measurement

Note 1 to entry: Calibration gas mixtures are measurement standards (Annex A) as defined in ISO/IEC Guide 99.

5.2
reference gas mixture
calibration gas mixture (5.1) whose *composition* (3.5) is well established and stable to be used as a reference standard of composition from which other composition data measurements are derived

Note 1 to entry: Reference gas mixtures are *reference* measurement standards (Annex A) as defined in ISO/IEC Guide 99.

5.3
parent gas
gas, vapour, or gas mixture used for preparation of other gas mixtures

5.4
complementary gas
balance gas
diluent gas
major gas
matrix gas
component (3.3) of a gas mixture which is usually added at the completing step of the mixture preparation or used as a diluent in preparation of the mixture by *dynamic method* (6.4)

Note 1 to entry: Generally, the particular application of the gas mixture determines the selection of the complementary gas.

Note 2 to entry: The complementary gas may also be a mixture (e.g. air).

5.5
impurity
undesired minor *component* (3.3) present in a *parent gas* (5.3) and thus detectable in a gas mixture made of this parent gas

5.5.1
critical impurity
impurity affecting the intended use of a gas mixture

Note 1 to entry: The criteria for a critical impurity are given in ISO 19229.

5.5.2
significant impurity
impurity that is predicted to contribute more than 10 % of the target uncertainty in the final gas mixture

5.6
zero gas
gas or gas mixture with sufficiently low content of the *component(s)* (3.3) of interest, used to produce the zero *response* (8.3.2) of a given instrument for a given range of *content* (3.4)

6 Terms relating to methods for the preparation of gas mixtures

6.1
gravimetric method
method in which the mass of each *component* (3.3) present is determined by weighing

6.2
manometric method
method in which the *content* (3.4) of each *component* (3.3) present is determined by the increase of pressure after its addition

6.3
static volumetric method
method which combines known volumes of two or more gases at the same pressure and temperature

6.4
dynamic method
method which combines two or more gas streams having known flow rates into a single stream under specific conditions (pressure and temperature to be specified)

7 Terms relating to storage in gas cylinders

7.1
maximum filling pressure
pressure up to which a gas mixture can be compressed into a cylinder

Note 1 to entry: The maximum acceptable filling pressure of a gas mixture is limited by the confirmed pressure resistance of the cylinder and the ability of the gas (mixture) to display condensation.

7.2
minimum pressure of utilization
pressure of a gas mixture within a cylinder below which the properties of interest cannot be warranted to lie within their limits

Note 1 to entry: The minimum pressure of utilization is set with regard to the potential for alteration of the *composition* (3.5) of the gas mixture, by either

a) desorption of the *component* (3.3) of interest, or

b) desorption of other substances, such as water, from the inner surface of the cylinder.

7.3
minimum applicable temperature
temperature below which the properties stated for a gas mixture cannot be warranted to lie within their limits

Note 1 to entry: The minimum applicable temperature is set with regard to its potential for alteration of the *composition* (3.5) of the gas mixture by, for example:

a) sorption of one or more *components* (3.3) by the inner surface of the cylinder;

b) condensation of one or more components.

7.4
maximum applicable temperature
temperature above which the properties stated for a gas mixture cannot be warranted to lie within their limits

Note 1 to entry: The maximum applicable temperature is set with regard to its potential for alteration of the *composition* (3.5) of the gas mixture by physical or chemical interactions of the *components* (3.3) with each other or with the inner surface of the cylinder.

7.5
maximum storage life
period after which the properties stated for a gas mixture cannot be warranted to lie within their limits

Note 1 to entry: This period is usually identified as that for which the producer assures that the gas mixture maintains its *composition* (3.5) within the specified limits when it is stored in accordance with the requirements based upon the concepts defined in 7.1 to 7.4.

Note 2 to entry: The end of this period may be indicated by an “expiry date” (see also ISO 6142-1[1]).

8 Terms relating to gas analysis

8.1
gas analytical system
equipment including gas handling and sampling system designed for gas composition measurement

8.2
sampling
terms and definitions related to sampling are included in Annex B

8.3 Measurement

8.3.1
analytical unit
analyser
assembly which enables qualitative and/or quantitative determinations (measurements) of substances on the basis of their chemical or physical properties

Note 1 to entry: A typical assembly can comprise

— lines permitting the introduction and removal of a sample and/or calibration gas(es),

— a measuring cell which, from the physical or chemical properties of the *components* (3.3) present in the sample, gives signals allowing their identification or measurement, and

— signal processing devices (e.g. amplifiers, integrators, recorders) and/or data processing devices.

8.3.2
response
output signal of a measuring system

8.3.3
quantification limit
lowest value of which an instrument is able to quantify the *content* (3.4) of a *component* (3.3)

Note 1 to entry: The ability to quantify is generally expressed in terms of a component-content (true) value that produces estimates having a specified uncertainty (Annex A).

8.4 Calibration

8.4.1
calibration function
mathematical description of the relationship between component *content* (3.4) and *response* (8.3.2) established by calibration, expressing response as a function of content

8.4.2
analysis function
the inverse of the *calibration function* (8.4.1), expressing component *content* (3.4) as a function of *response* (8.3.2)

8.4.3
calibration point
pair of values attributed to the component *content* (3.4) and the corresponding *response* (8.3.2)

8.5 Calibration methods

8.5.1
multipoint calibration
establishment of a *calibration function* (8.4.1) using more than two *calibration points* (8.4.3) establishing a range within which the values of the component *content* (3.4) are expected to lie

8.5.2
two-point calibration
bracketing
establishment of a straight-line *calibration function* (8.4.1) using two *calibration points* (8.4.3) defining a range

Note 1 to entry: The range is established so that the *content* (3.4) of a *component* (3.3) is expected to lie between the contents of the component in the *calibration gas mixtures* (5.1).

8.5.3
single-point calibration
establishment of a straight-line *calibration function* (8.4.1) through the origin using a single *calibration gas mixture* (5.1)

8.5.4
exact-match calibration
establishment of a calibration coordinate with a *response* (8.3.2) statistically indistinguishable from that of the sample to be investigated using a single *calibration gas mixture* (5.1)

8.5.5
two-point calibration with a blank
establishment of two calibration coordinates: a single calibration coordinate with a *response* (8.3.2) close to that of the sample to be investigated and a blank *matrix gas* (5.4)

9 Terms from metrology

9.1
certified reference material
CRM
reference material (RM; Annex A) characterized by a metrologically valid procedure for one or more specified properties, accompanied by an RM certificate that provides the value of the specified property, its associated uncertainty (Annex A), and a statement of metrological traceability (Annex A)

[SOURCE: ISO Guide 30:2015, 2.2, modified — Notes to entry have been omitted]

9.2
verification
provision of objective evidence that a given item fulfils specified requirements

EXAMPLE Confirmation that performance properties or legal requirements of a measuring system are achieved.

Note 1 to entry: When applicable, measurement uncertainty (Annex A) is taken into consideration.

Note 2 to entry: The item can be, e.g. a process, measurement procedure, material, *component* (3.3), or measuring system.

Note 3 to entry: The specified requirements can be, e.g. that a manufacturer's specifications are met.

Note 4 to entry: Verification in legal metrology, as defined in VIM, and in conformity assessment in general, pertains to the examination and marking and/or issuing of a verification certificate for a measuring system.

Note 5 to entry: Verification should not be confused with validation; not every verification is a *validation* (9.4).

Note 6 to entry: In chemistry, verification of the identity of the entity involved, or of activity, requires a description of the structure or properties of that entity or activity.

[SOURCE: ISO 14532:2014, 2.5.1.12, modified — "compound" replaced with "component" in Note 2 to entry and "calibration" replaced with "validation" in Note 5 to entry]

9.3
verification of composition
provision of experimental evidence, demonstrating that the *composition* (3.5) of the sampled *calibration gas* (5.1) is consistent with the *composition* calculated from the preparation process

9.4
validation
confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled

Note 1 to entry: In gas composition analysis, validation refers to the confirmation that the method, as applied, is fit for the intended purpose.

Note 2 to entry: The concept of "validation" is more demanding than the concept of "*verification*" (9.2). A validated measurement result can be compared to another validated measurement result for the same measurand in order to establish their metrological compatibility.[11]

[SOURCE: ISO 9000:2005, 3.8.5, modified — Notes 1 and 2 to entry have been replaced with two other notes]

Annex A
(normative)

List of terms defined in ISO/IEC Guide 98-3 and ISO/IEC Guide 99

Table A.1 lists the terms used in the field of gas analysis that are well defined by either ISO/IEC Guide 98-3 or ISO/IEC Guide 99.

Table A.1 — Terms used in the field of gas analysis and source for definition

Term	Source	Reference
accuracy (of measurement)	ISO/IEC Guide 99:2007	2.13
calibration	ISO/IEC Guide 99:2007	2.39
combined standard uncertainty	ISO/IEC Guide 98-3:2008	2.3.4
	ISO/IEC Guide 99:2007	2.31
coverage factor	ISO/IEC Guide 98-3:2008	2.3.6
	ISO/IEC Guide 99:2007	2.38
detection limit	ISO/IEC Guide 99:2007	4.18
discrimination threshold	ISO/IEC Guide 99:2007	4.16
expanded uncertainty	ISO/IEC Guide 98-3:2008	2.3.5
	ISO/IEC Guide 99:2007	2.35
measurement standard	ISO/IEC Guide 99:2007	5.1
metrological traceability	ISO/IEC Guide 99:2007	2.41
primary standard	ISO/IEC Guide 99:2007	5.4
reference material	ISO/IEC Guide 99:2007	5.13
reference measurement standard	ISO/IEC Guide 99:2007	5.6
repeatability	ISO/IEC Guide 99:2007	2.21
reproducibility	ISO/IEC Guide 99:2007	2.25
resolution	ISO/IEC Guide 99:2007	4.14
secondary standard	ISO/IEC Guide 99:2007	5.5
sensitivity	ISO/IEC Guide 99:2007	4.12
standard uncertainty	ISO/IEC Guide 98-3:2008	2.3.1
	ISO/IEC Guide 99:2007	2.30
uncertainty (of measurement)	ISO/IEC Guide 99:2007	2.26

Annex B
(normative)

Sampling definitions

Table B.1 lists the terms related to sampling that are well defined by ISO 10715.

Table B.1 — Terms related to sampling and reference to ISO 10715

Term	Reference
direct sampling	2.1
indirect sampling	2.7
line	[a]
sample container	2.14
sample line	2.15
sample probe	2.16
sampling point	2.17
transfer line	2.19

[a] Line is not defined in ISO 10715. Definition of line is a gas-tight system of tubing equipped with accessories, such as valves, manometers, etc., enabling gas to be transported from one point to another.

Annex C
(informative)

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Bibliography

[1] ISO 6142-1[1)], *Gas analysis — Preparation of calibration gas mixtures — Part 1: Gravimetric method for Class I mixtures*

[2] ISO 6143, *Gas analysis — Comparison methods for determining and checking the composition of calibration gas mixtures*

[3] ISO 6976:1995, *Natural gas — Calculation of calorific values, density, relative density and Wobbe index from composition*

[4] ISO 9000:2005, *Quality management systems — Fundamentals and vocabulary*

[5] ISO 13443, *Natural gas — Standard reference conditions*

[6] ISO 14532:2014, *Natural gas — Vocabulary*

[7] ISO 14912, *Gas analysis — Conversion of gas mixture composition data*

[8] ISO 19229, *Gas analysis — Purity analysis and the treatment of purity data*

[9] ISO 80000-9:2009, *Quantities and units — Part 9: Physical chemistry and molecular physics*

[10] ISO Guide 30:2015, *Reference materials — Selected terms and definitions*

[11] De Bièvre P., Dybkaer R., Fajgelj A., Hibbert D. B. Metrological traceability of measurement results in chemistry: Concepts and implementation (IUPAC Technical Report), *Pure Appl. Chem.* 83, 1873, 2011.

1) To be published; replacing ISO 6142, *Gas analysis — Preparation of calibration gas mixtures — Gravimetric method*.

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