
**Corrosion of metals and alloys —
Corrosivity of atmospheres —
Measurement of environmental
parameters affecting corrosivity of
atmospheres**

*Corrosion des métaux et alliages — Corrosivité des atmosphères —
Mesurage des paramètres environnementaux affectant la corrosivité
des atmosphères*



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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 9225 was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

This second edition cancels and replaces the first edition (ISO 9225:1992), which has been technically revised.

Introduction

The ability of an atmosphere to cause corrosion of metals and alloys is controlled by the following factors: the temperature-humidity complex and pollution. A basic requirement for the estimation of the corrosivity of atmospheres is standardized measurement of the important parameters describing the correlation between the corrosion and the environmental characteristics.

The methods included in this International Standard have been chosen for their easy applicability and good comparability of results. It is important to stress that the methods for estimation of the atmospheric corrosivity given in ISO 9223 are based on the measurement methods described in this International Standard.

Corrosion of metals and alloys — Corrosivity of atmospheres — Measurement of environmental parameters affecting corrosivity of atmospheres

WARNING — Some of the procedures included in this International Standard entail the use of potentially hazardous chemicals. It is emphasized that all appropriate safety precautions should be taken.

1 Scope

This International Standard specifies methods for measuring the parameters needed for corrosivity estimation used for classification of the corrosivity of atmospheres in ISO 9223.

This International Standard specifies methods for the measurement of environmental parameters for

- normative corrosivity estimation based on calculated first-year corrosion rates of standard metals, and
- informative corrosivity estimation based on characterization of the exposure environment.

This International Standard does not describe the usual analytical techniques for the measured parameters since this depends on the available analytical techniques used in laboratories. Specific methods for deposition measurement of SO₂ and Cl⁻ deposition rates and conversional factors for comparison of different measuring methods are presented in Annexes A, B, C, D, E and F.

For methods pertaining to the characterization of the atmospheric exposure site in general, see ISO 8565.

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 9223, *Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation*

ISO 11844-3, *Corrosion of metals and alloys — Classification of low corrosivity of indoor atmospheres — Part 3: Measurement of environmental parameters affecting indoor corrosivity*

3 Principle

Different environmental parameters and their combinations affect the corrosivity of the atmosphere. Two methods for corrosivity estimation (normative and informative) are specified in ISO 9223.

In general, two groups of parameters are obtained or measured for standardized procedures of corrosivity estimation:

- humidity and temperature;
- airborne contaminants.

Standardized corrosivity estimation is based on information on levels of the dominating environmental parameters: the temperature-humidity complex, and pollution with SO_2 and airborne chlorides. Measurements of these parameters are mandatory for the purpose of corrosivity estimation.

Contaminants other than SO_2 and Cl^- , such as NO_x , O_3 , H_2S , HNO_3 , can also exert an effect on the corrosion rate. Corrosion active components of dust deposits (SO_4^{2-} , NO_3^- , Cl^-) react with metals in the presence of humidity. These factors are considered as accompanying factors (see ISO 9223). These environmental parameters, which contribute to the effect on corrosion of standard metals in multi-pollutant situations, are not included as mandatory parameters for corrosivity estimation in ISO 9223. Information on levels of these parameters can help in informative corrosivity estimation.

Methods for the measurement of environmental parameters to be used specifically for the estimation of low corrosivity of indoor atmospheres (IC) are given in ISO 11844-3.

4 Humidity and temperature parameters

4.1 Relative humidity

Reliable long-term average values for relative humidity can often be obtained from the meteorological authorities in the country. Several types of measuring devices can be used if collection of new data for the locality is needed. There are several continuous measuring devices, such as hygrographs, thermohygrographs or logging hygrometers, available on the market.

The period of measurement is preferably one year in order to cover seasonal variations and because the classification system is based on yearly average values. The data shall be expressed as yearly mean values.

4.2 Temperature

Reliable long-term average values for temperature can often be obtained from the meteorological authorities in the country. Several types of measuring devices can be used if collection of new data for the locality is needed. There are several continuous measuring devices, such as thermohygrographs or logging thermometers, available on the market.

The period of measurement is preferably one year in order to cover seasonal variations and because the classification system is based on yearly average values. The data shall be expressed as yearly mean values.

5 Airborne contaminants

5.1 Principle

The gas concentration or deposition rate may be measured using several techniques:

- continuous gas concentration measuring instruments;
- average gas concentration with active sampler and air pump;
- average gas concentration with diffusive (passive) sampler;
- average deposition rate equipment.

The results from concentration measurements are typically given in micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) and, for deposition measurements, in milligrams per square metre per day [$\text{mg}/(\text{m}^2\cdot\text{d})$].

5.2 Placement of measurement equipment

5.2.1 Continuous gas concentration measurement instruments

The instrument shall be located in a place that is sheltered from the rain and protected from unauthorized people. Preferably, the instrument should be placed indoors with a tube leading out to the ambient air. Polyethylene or PTFE tubing is recommended and the length of the tubing should not exceed 2 m. The inlet shall be facing down with a wider hood at the inlet to reduce the risk of sucking particulates into the tube.

5.2.2 Measurement instruments with active sampler

The active sampler equipment shall be placed according to the same rules as the continuous gas-measuring instrument.

5.2.3 Measurement instruments with diffusive sampler

The sampling device shall be placed with the open end facing downward under appropriate shelter. The air flow influences the gas diffusion in the sampler.

5.2.4 Deposition rate equipment

The equipment shall be sheltered from setting particles and from washing out by rain for outdoor deposition measurements. The air flow influences the deposition rate.

5.3 Measurement methods and duration

5.3.1 Continuous measurement

The measurements shall preferably be carried out for one year in order to record the seasonal variation of the gas pollutants. The data from continuous measuring instruments shall be recorded as monthly average values. For the corrosivity estimation, the data shall be expressed as yearly mean values.

Standard instruments have detection limits in a range from 4×10^{-5} volume fractions to 1×10^{-6} volume fractions.

5.3.2 Measurement with active sampler

The methods are based on pumping air through an absorption unit with a reactive surface or liquid, with subsequent laboratory analysis of the amount absorbed. The sampling period shall be one week. The data shall be collected over the sampling periods and summarized to monthly average values. The result is given as an average concentration for the measuring period.

The measuring period is preferably one year or at least one month for each season of the year. For the corrosivity estimation, the data shall be expressed as yearly mean values.

NOTE The detection limits for air concentrations depend on the sensitivity of the analysing instruments and the duration of the sampling. For an analytical instrument with normal sensitivity, it is possible to obtain weekly average values with a detection limit better than $0,1 \mu\text{g}/\text{m}^3$.

5.3.3 Measurement with diffusive sampler

Mean gas concentrations can be calculated using diffusive sampling devices. The principle used for diffusive sampling is shown in Figure 1. The recommended sampling period is one month, but can be extended to three months, corresponding to one measurement for each season of the year. The measurement period is preferably one year.