

TECHNICAL REPORT

ISO
TR 4227

First edition
1989-11-15

Planning of ambient air quality monitoring

Planification du contrôle de la qualité de l'air ambiant



Reference number
ISO/TR 4227 : 1989 (E)

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International Organization for Standardization

Case postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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.

The main task of ISO technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the necessary support within the technical committee cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development requiring wider exposure;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical reports are accepted for publication directly by ISO Council. Technical reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standard. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 4227, which is a technical report of type 2, was prepared by Technical Committee ISO/TC 146, *Air quality*.

Annexes A, B and C form an integral part of this Technical Report.

Introduction

In order to protect the environment, many different aspects of air quality have to be examined. These may include obtaining information on the existing local, regional or global air quality, forecasting the quality of air likely to be expected in the future, evaluating monitoring possibilities, or considering the complicated relationship within the context of formation and drift of airborne pollution. In each country such tasks may be formulated differently depending on its type of industry, and topographical or climatic situation. Accordingly every country has created a different type of ambient air monitoring system. The data obtained often cannot be compared directly. It is for this reason that some standardization has been undertaken (see ISO 7168) to establish a useful international exchange of ambient air quality data. In this Technical Report a classification which could be used as a basis for standardization of ambient air quality monitoring tasks is introduced.

Standardization of air quality monitoring is only reasonable and possible for those air quality monitoring systems which deal with equivalent tasks. Air quality monitoring tasks are considered to be equivalent if they fall into one class of the classification scheme which covers the task as well as the major aspect of the actual measuring scheme. Using these classifications, all likely air quality monitoring systems are arranged in the form of a matrix, where each column represents a particular task and each row a specific aspect of the measuring scheme. This representation enables detailed comparisons to be made of different aspects of air quality monitoring.

Planning of ambient air quality monitoring

1 Scope

This Technical Report establishes a classification scheme which should form a general basis for international standardization of ambient air quality monitoring and permits comparison between existing and planned ambient air quality monitoring systems. The results of such comparisons may be used as guidelines for standardization.

2 Normative references

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

ISO 4225 : 1980, *Air quality — General aspects — Vocabulary*.

ISO 4226 : 1980, *Air quality — General aspects — Units of measurement*.

ISO 6879 : 1983, *Air quality — Performance characteristics and related concepts for air quality measuring methods*.

ISO 7168 : 1985, *Air quality — Presentation of ambient air quality data in alphanumeric form*.

ISO 8601 : 1988, *Data elements and interchange formats — Information interchange — Representation of dates and times*.

ISO 9359 : 1989, *Air quality — Stratified sampling method for assessment of ambient air quality*.

3 General considerations

All ambient air quality monitoring tasks are designed for the assessment of environmental effects. It is therefore not sufficient merely to measure air pollutants. It is also necessary to relate the results of these measurements to observed effects. On the other hand, it is well-known that the ground-level concentration of an air pollutant can be correlated with emission rates and propagation conditions. This means that there exists a causal relationship between the source, the propagation and the effects of the air pollution.

In order to quantify any relationship, three basic concepts are introduced: emission, transmission and immission. These concepts are generally explained as follows (see also ISO 4225).

Emission is the transfer of air pollution from the source into the free atmosphere.

Immission is the transfer of air pollution from the free atmosphere to a receptor such as a human being, plant or building. The summation of immission rate over an interval of time gives the immission dose, the total air pollutant intake by the receptor.

The sites at which emission or immission take place are defined by the enveloping surface of the source or the receptor.

Transmission describes collectively phenomena affecting the air pollutants in the free atmosphere between the source and the receptor. These phenomena include all dynamic physical effects such as dilution of the pollutant with air, as well as any physical or chemical reactions that might occur.

In order to describe these concepts quantitatively, mass or other quantifiable property flux and their derivatives have to be used. Units of measurement are given in ISO 4225. An illustration of emission, transmission and immission is given in figure 1. Detailed explanations of the mathematical concepts are given in annex A.

According to these definitions, immission is a mass or other quantifiable property rate per unit interval of time, which should be measured, if possible, at the receptor. Usually, it is necessary to know the immission to a number of different receptors and not confine measurements to just one receptor. An air pollution survey should be designed to measure the immission to receptors and the possible effects. One may introduce a "virtual receptor" with unit surfaces and unit properties and study, for each such receptor, the possible immission as a function of space and time. A virtual receptor might be simulated by a special measuring system or have a defined correlation with a ground-level concentration or deposition.

4 Formulating the tasks

4.1 Establishing the objectives

Before starting measurements it is essential to establish what problem has to be solved and what constraints may have to be imposed on an "ideal" measuring system.

The following is a summary of questions to be considered.

- a) Has the basic problem been defined?
 - 1) Is there an air pollution problem or a potential problem?
 - 2) Does a need exist for a monitoring system?

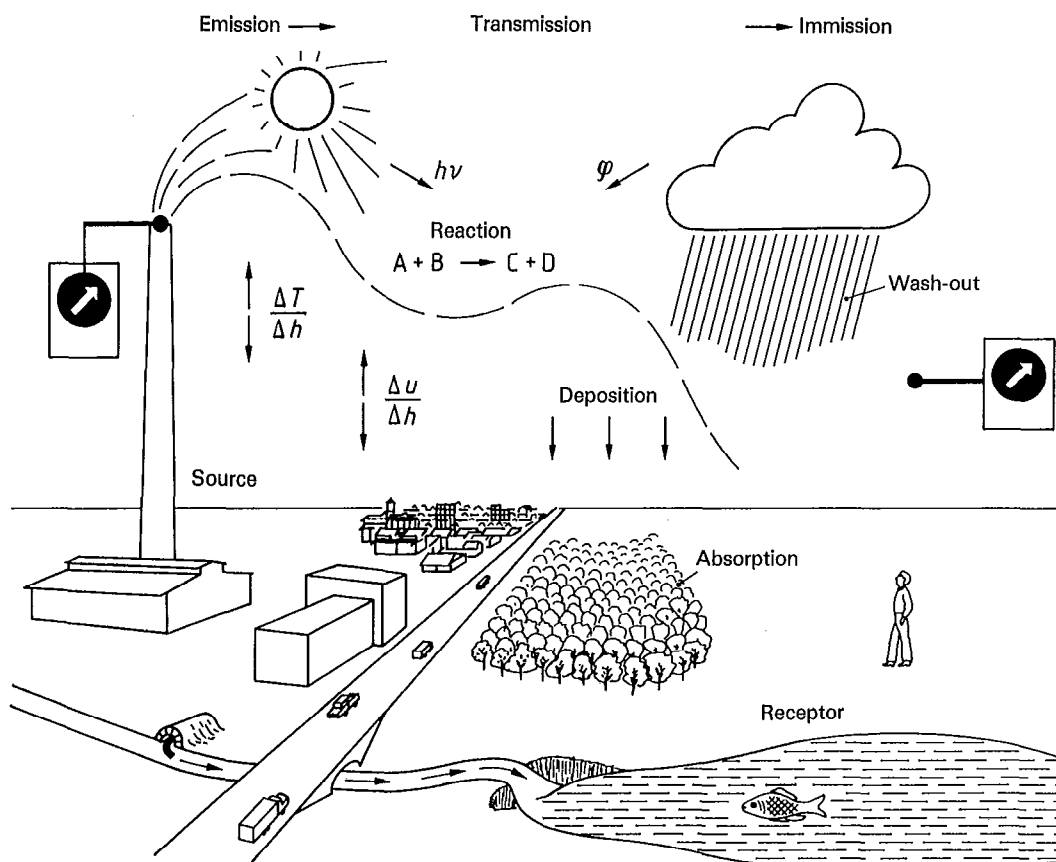


Figure 1 — Illustration explaining the concepts emission, transmission and Immission

- 3) What should be the scope and limitations for monitoring?
- b) To what extent does the basic problem relate to the following monitoring functions?
 - 1) To quantify ambient air quality and its variation in space and time?
 - 2) To provide a basis for air pollution control regulation?
 - 3) To provide data for an integrated monitoring system?
 - 4) To determine the effectiveness of control action on ambient air quality?
 - 5) To provide real-time data for an alert and warning system?
 - 6) To determine source-receptor relations?
 - 7) To analyse local circulation characteristics and effects?
 - 8) To provide trends for zoning and urban planning requirements?
 - 9) To provide input data for operational urban models?
 - 10) To provide data for interjurisdictional information exchange?
 - 11) To interface with other monitoring systems?
- c) What are the economic and technical constraints?
 - 1) What funding is available and how does this relate to the confidence in the ambient air quality data to be obtained?
 - 2) What restrictions exist on procurement?
 - 3) What are the manpower requirements for operation, maintenance, repair, calibration and ambient air quality data evaluation?
 - 4) What are the staff capabilities?
 - 5) What are the training requirements for staff?
 - 6) Is a realistic timetable achievable?

4.2 Basic classification

Once the objective of the monitoring has been established, the task has to be formulated. In order to do this, it is first of all essential to answer a number of questions concerning the objectives of the survey, the area over which air quality is to be