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Indoor air — Sampling strategy for formaldehyde

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Land, Infrastructure and Transport through deliberations at the Japanese Industrial Standards Committee.

This Standard has been made based on **ISO/DIS 16000-2 : 2001 *Indoor air—Part 2 : Sampling strategy for formaldehyde*** for the purpose of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

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Indoor air — Sampling strategy for formaldehyde

Introduction This Japanese Industrial Standard has been prepared based on the first edition of **ISO/DIS 16000-2** *Indoor air—Part 2 : Sampling strategy for formaldehyde* published in 2001 with some modifications of the technical contents.

The portions given sidelines or dotted underlines are the matters in which the contents of the original International Standard have been modified. A list of modifications with the explanations is given in Annex 1 (informative).

JIS A 1960 describes the important conditions to be observed before sampling or during sampling concerning the general requirements and individual contaminant or contaminant group with regard to the measurement of contaminant in indoor air. The concept of quantitative analysis (sampling and analysis) and the sampling strategy of specific contaminant or contaminant group are described after **JIS A 1961** (**ISO/DIS 16000-2**).

This Standard describes the basic matters to be considered when the sampling strategy is carried out to analyze the formaldehyde⁽¹⁾ in indoor air. It is intended to relate with **JIS A 1960** (*Indoor air—General aspects of sampling*). It is intended to related with **JIS A 1962** and **JIS A 1963** which deal with the active sampling or diffusive sampling respectively. This Standard presupposes the knowledge of **JIS A 1960**.

Note (1) See Annex A for the properties of formaldehyde.

1 Scope This Standard is intended as an aid to planning formaldehyde indoor pollution measurements. In the case of indoor air measurements, careful planning of sampling is of particular significance, since measurements can have far-reaching applications, for example, the examination of trapping effects.

Remarks : The International Standard corresponding to this Standard is as follows :

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO/DIS 16000-2 : 2001 *Indoor air—Part 2 : Sampling strategy for formaldehyde* (MOD)

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For these referred standards, only the edition of the indicated year constitutes the provision of this Standard but the revision and amendment made thereafter do not apply. However, those who comply with **JIS A 1961** shall be requested to apply the most recent normative references shown below all of the time.

JIS A 1960 *Indoor air—General aspects of sampling strategy*

Remarks : **ISO/DIS 16000-1** : 2000 *Indoor air—Part 1 : General aspects of sampling strategy* is equivalent to the said standard.

JIS A 1962 *Indoor air—Determination of formaldehyde and other carbonyl compounds—Active sampling method*

Remarks : **ISO 16000-3** : 2001 *Indoor air—Part 3 : Determination of formaldehyde and other carbonyl compounds—Active sampling method* is equivalent to the said standard.

JIS A 1963 *Indoor air—Determination of formaldehyde—Diffusive sampling method*

Remarks 1 **ISO/DIS 16000-4** : 1999 *Indoor air—Part 4 : Determination of formaldehyde—Diffusive sampling method* is equivalent to the said standard.

2 The term “formaldehyde” is used in this Standard instead of the term “methanol”, as specified by IUPAC (International Union of Pure and Applied Chemistry) regulations.

JIS Q 17025 : 2000 *General requirements for the competence of testing and calibration laboratories*

Remarks : **ISO/IEC 17025** : 1999 *General requirements for the competence of testing and calibration laboratories* is identical with the said standard.

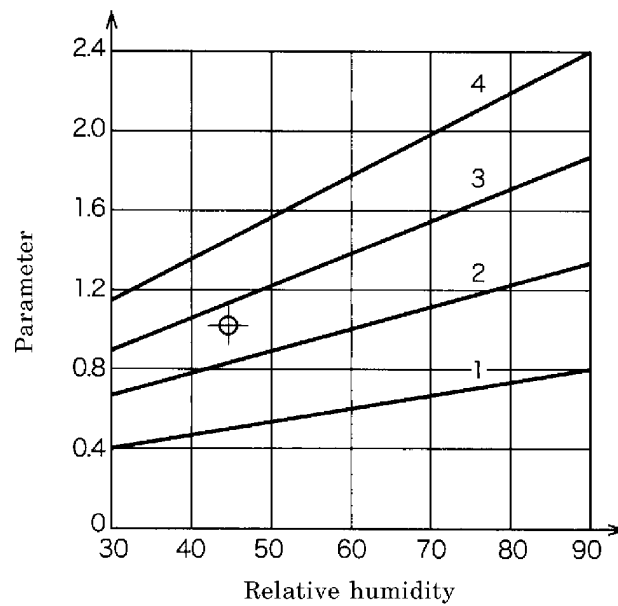
ISO 6879 : 1995 *Air quality—Performance characteristics and related concepts for air quality measuring methods*

3 Sources and occurrence of formaldehyde The occurrence of formaldehyde in indoor air is often due to the use of certain wood-based board material for construction and for work on the interior and furnishing of a room. Increased concentrations may also be caused by other products, including use of certain disinfectants and paints. Tobacco smoke is an additional important intermittent source of formaldehyde. Details are given in Annex table B.1.

Whereas an intermittent emission source (e.g. the use for a limited period of time of disinfectant spray containing formaldehyde) will cause an increased formaldehyde concentration in indoor air for only a short period of time during and after use, a continuous emission source (e.g. a particleboard used for indoor furnishings) will contribute to the formaldehyde concentration over a longer period. The concentration is easily affected by both the room temperature and the relative humidity.

Figure 1 shows the influence of humidity and temperature on the emission rate of formaldehyde from particleboard ; by increasing humidity and temperature, formaldehyde emission increases considerably. The concentration is easily affected by both the room temperature and the relative humidity.

i.e., C (Equivalent value) = C (Observed value, 23°C, 45 %RH) $\times K$ (Parameter) in ppm



- 1 temperature = 15 °C
- 2 temperature = 20 °C
- 3 temperature = 25 °C
- 4 temperature = 30 °C

Remarks : Conditions to be $K = 1$ shall be temperature, 23 °C; relative humidity, 45 %; air exchange rate, 1 h⁻¹; loading, 1 m²/m³.

Figure 1 Plot of rate of emission of formaldehyde from particleboards in relation to temperature and relative humidity [3], [4]

Figure 2 shows the formaldehyde equilibration concentration as a function of the air exchange rate after placing a 23 m² particleboard emitting 2.3 mg/h formaldehyde into a room of 23 m³ [4], [5]. Curves A, B and C show the outcome with ventilation rates of 0.5 h⁻¹, over 0.5 h⁻¹ and under 0.5 h⁻¹, respectively.

The guideline value in Japan and the recommended World Health Organization (WHO) guideline value for formaldehyde for indoor/ambient air quality is not exceeding 0.1 mg/m³, expressed as the 30 min average concentration [6].

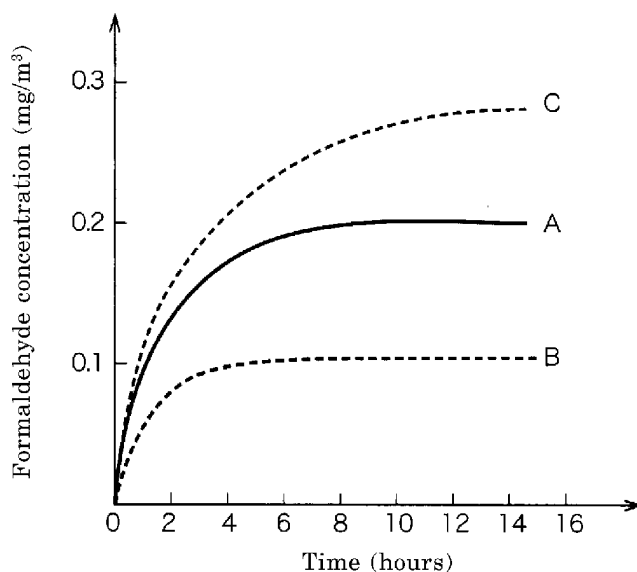


Figure 2 Formaldehyde equilibration concentration in relation to the ventilation rate

Generally, outdoor sources of formaldehyde are not significant sources of formaldehyde in indoor air. Outdoor air may be contributory only if strong formaldehyde sources (e.g. heavy road traffic) are nearby.

Annex table B.2 shows the comparison example of the median and the range of concentrations measured indoors with concentrations observed in outdoor air.

4 Measurement techniques There are several methods for measuring formaldehyde. Basically, they meet different demands and can be divided into short-term measurements with active sampling, long-term measurements with active or diffusive samplers, continuous measurements, and screening tests with direct-reading detection tubes. High concentrations of interfering gases (in special cases ozone, NO, etc.) shall be taken into account.

Analytical methods for the determination of formaldehyde in the air that can be used to determine compliance with the guideline are described in **JIS A 1962**.

4.1 Short-term monitoring Short-term monitoring is generally conducted for less than one hour.

The method described in **JIS A 1962** is considered to be a multicomponent measurement technique. After formaldehyde reacts with 2,4-dinitrophenylhydrazine to form a hydrazone, it can be determined by High Performance Liquid Chromatograph (HPLC) method. In addition to formaldehyde, other aldehydes and ketones can also be analysed by this method. This method can be used for checking compliance with the WHO guideline value.

4.2 Long-term monitoring Long-term monitoring is preferably done with diffusive samplers. Sampling relies on the principle of gaseous diffusion into a reactive adsorbent [8], [9], [10], [11], [12]. With diffusive samplers, formaldehyde concentrations are measured over a time period of several hours to a few days. Results are obtained as mean values. The active measurement described in 4.1 is applicable for sampling periods of 24 h or less.

4.3 Methods for screening tests Screening tests provide an immediate, although not necessarily sufficient, indication of the formaldehyde concentration. Commercially available test tubes and direct-reading diffusive samplers are available that are relatively simple to use and give results that can inform decisions about the need for further measurements. The results of screening tests facilitate the determination on to the extent of further measurements required. A formaldehyde concentration near or above a given guideline value would make it necessary to determine, with the help of measurement techniques described in **JIS A 1962**, whether there is compliance with the guideline value, or by how much the value is exceeded.

When using methods for screening tests, the requirements for design of an appropriate strategy shall be considered. Clause 5 refers to the required conditions. Examples of screening tests are given in Annex E.

5 Sampling strategy The sampling strategy selected depends on the problem to be solved as well as the nature of the source. Since long-term and continuously emitting surface-area sources are most important, the methods discussed in this Standard are confined only to these kinds of sources. If intermittent sources, e.g., tobacco smoke, are or have been recently present, they shall be removed before sampling and formaldehyde emitted by them is to be removed by intensive ventilation.

5.1 Objectives of the measurement and conditions Before an indoor air measurement can be carried out, its objective has to be defined clearly. The measurement is usually required because of one of the following objectives.

- A to check compliance with the guideline value in Japan
- B to check compliance with the WHO guideline value
- C to determine the average concentration over a longer period of time
- D to determine concentrations in certain situations
- E to check the efficiency of remediation

A To check the compliance with the guideline value in Japan

In the measurement of newly built housing, the objective interior of room is hermetically closed at least for 5 h after the ventilation for 30 min, and afterwards the air is sampled approximately for 30 min. For the time of sampling, 2 pm or 3 pm is desirable. While it is hermetically closed after the ventilation, all openings facing to the outdoor air shall be shut, and all the indoor fittings and doors and the doors of built-in furniture, fixtures or the like other than those shall be opened.