

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS A 1905-1 : 2015

**Performance test of sorptive
building materials of reducing
indoor air pollution with small
chamber—Part 1: Measurement of
adsorption flux with supplying
constant concentration of
formaldehyde**

ICS 13.040.20;71.040.40

Reference number : JIS A 1905-1 : 2015 (E)

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Date of Establishment: 2007-02-01
Date of Revision: 2015-03-20
Date of Public Notice in Official Gazette: 2015-03-20
Investigated by: Japanese Industrial Standards Committee
Standards Board for ISO area
Technical Committee on Architecture

JIS A 1905-1:2015, First English edition published in 2016-02

Translated and published by: Japanese Standards Association
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In the event of any doubts arising as to the contents,
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Printed in Japan

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law.

Consequently **JIS A 1905-1:2007** is replaced with this Standard.

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JIS A 1905 series consists of the following 2 parts under the general title “*Performance test of sorptive building materials of reducing indoor air pollution with small chamber*”:

Part 1: Measurement of adsorption flux with supplying constant concentration of formaldehyde

Part 2: Measurement of capability for suppressing formaldehyde emission

Performance test of sorptive building materials of reducing indoor air pollution with small chamber— Part 1: Measurement of adsorption flux with supplying constant concentration of formaldehyde

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **ISO 16000-23** published in 2009 with addition of some test conditions and test methods not included in the **ISO** that are required to satisfy the needs unique to Japan, along with modifications of other technical contents.

The portions given sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with the explanations is given in Annex JA. The comparison table between previous and current editions of this Standard on technically significant revisions is given in Annex JB.

1 Scope

This Standard specifies a general laboratory test method for evaluating the concentration reduction performance of sorptive building materials via sorption or decomposition of formaldehyde in the indoor air of a building using the chamber specified in **JIS A 1901**. The method specified in this Standard employs formaldehyde-spiked air supply to determine the sorption flux.

It is applicable to building boards, wall papers, floor materials and coating materials, and not applicable to materials capable of decomposing formaldehyde by catalytic reaction in the presence of ultraviolet and visible rays.

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 16000-23:2009 *Indoor air—Part 23: Performance test for evaluating the reduction of formaldehyde concentrations by sorptive building materials* (MOD)

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 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS A 1901 *Determination of the emission of volatile organic compounds and aldehydes by building products—Small chamber method*

NOTE : Corresponding International Standard: ISO 16000-9 *Indoor air—Part 9: Determination of the emission of volatile organic compounds from building products and furnishing—Emission test chamber method* (MOD)

JIS A 1902-1 *Determination of the emission of volatile organic compounds and aldehydes by building products—Sampling, preparation of test specimens and testing condition—Part 1: Boards, wallpaper and floor materials*

JIS A 1902-2 *Determination of the emission of volatile organic compounds and aldehydes by building products—Sampling, preparation of test specimens and testing condition—Part 2: Adhesives*

JIS A 1902-3 *Determination of the emission of volatile organic compounds and aldehydes by building products—Sampling, preparation of test specimens and testing condition—Part 3: Paints and coating materials*

JIS A 1902-4 *Determination of the emission of volatile organic compounds and aldehydes by building products—Sampling, preparation of test specimens and testing condition—Part 4: Heat-Insulating material boards*

JIS A 1962 *Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air—Active sampling method*

NOTE : Corresponding International Standard: ISO 16000-3 *Indoor air—Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air—Active sampling method* (MOD)

JIS K 0124 *General rules for high performance liquid chromatography*

JIS K 0557 *Water used for industrial water and wastewater analysis*

JIS K 8872 *Formaldehyde solution (Reagent)*

NOTE : Corresponding International Standard: ISO 6353-3 *Reagents for chemical analysis—Part 3: Specifications—Second series* (MOD)

JIS Z 8703 *Standard atmospheric conditions for testing*

NOTE : Corresponding International Standard: ISO 554 *Standard atmospheres for conditioning and/or testing—Specifications* (MOD)

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in JIS A 1901, and the following apply. The target pollutant is formaldehyde.

3.1 living environment

atmospheric environment of a space or a site where a building material to be tested is expected to be set

3.2 testing material

building material or product to be tested

3.3 chamber

See the definition given in **JIS A 1901**. In this Standard, however, the term specifically refers to a chamber used for concentration reduction (sorption, decomposition) performance test of sorptive building material.

3.4 formaldehyde

a kind of organic compound, and the most simple aldehyde

3.5 supply air concentration

concentration of target pollutant in test air supplied to the chamber

NOTE: The test specified in this Standard is carried out using a standard gas of the target pollutant or a gas containing a known specific concentration of the target pollutant which is generated using a gas generator, etc.

3.6 sorption flux

mass of the target pollutant sorbed per time per area at the specified elapsed time from the test start

3.7 total mass per area of sorption

integral over time of sorptive flux from the start of the test to the specified elapsed time measured with the test chamber

3.8 equivalent ventilation rate per area

increased clean air ventilation rate giving the same reduction in concentration of the target pollutant as the building material

3.9 test specimen

See the definition given in **JIS A 1901**. In this Standard, the term specifically refers to a test specimen used for concentration reduction (sorption, decomposition) performance test.

3.10 saturation mass per area

theoretical maximum mass of the target pollutant that could be removed per area of the sorptive material

3.11 degradation coefficient

ratio of the mass of the target pollutant removed by the initial performance divided by the mass of the same substance lost by deterioration

3.12 guideline concentration

guideline indoor air concentration for pollutants in general living environment as specified by the Ministry of Health, Labour and Welfare

The test specified in this Standard is targeted for formaldehyde, the guideline concentration for which is $100 \mu\text{g}/\text{m}^3$.

3.13 breakthrough time

time at which the concentration of the target pollutant in the air eluting from the sample tube reaches 0.5 % of the concentration in the supplied air

3.14 half-lifetime

time elapsed from the start of the test until the concentration of the target pollutant decreases to one-half of the initial concentration

3.15 lifetime

time period over which the test material continues to reduce the concentration of the target pollutant

NOTE 1 The lifetime is given in days or years.

NOTE 2 The lifetime is estimated from the sorption flux and saturation mass per area measured by the sample tube test.

3.16 sorption capacity

total mass of the target pollutant sorbed at breakthrough time per mass of sorbent

4 Symbols and units

For the purpose of this Standard, the symbols and units specified in JIS A 1901 and the following apply.

F_m : sorption flux per area [$\mu\text{g}/(\text{m}^2 \cdot \text{h})$]

ρ_A : mass of sorptive material per area (surface density) (g/m^2)

ρ_{Aa} : saturation mass per area ($\mu\text{g}/\text{m}^2$)

ρ_{Ac} : total mass per area of sorption measured by chamber test ($\mu\text{g}/\text{m}^2$)

w_s : sorption capacity ($\mu\text{g}/\text{g}$)

$\rho_{\text{out},t}$: concentration of target pollutant at the test chamber outlet at elapsed time t ($\mu\text{g}/\text{m}^3$)

$\rho_{\text{in},t}$: concentration of target pollutant at the test chamber inlet at elapsed time t ($\mu\text{g}/\text{m}^3$)

ρ_s : target pollutant concentration in supply air at the time of determination of saturation mass per area ($\mu\text{g}/\text{m}^3$)

q_s : air flow rate of sample tube (L/min)

$F_{v,\text{eq}}$: equivalent ventilation rate [$\text{m}^3/(\text{h} \cdot \text{m}^2)$]

t_b : breakthrough time (min)

t_l : lifetime (hours or days)

5 Principle

The performance of a building material with respect to its ability to reduce the concentration of formaldehyde is determined by its concentration reduction performance and long-term reduction performance. Therefore the test specified by this Standard includes an assessment of both the initial reduction performance of the test material and how long that performance continues.

In this test method, air spiked with the target pollutant is supplied to a test chamber containing the test material. The supplied air should be prepared approximately at the guideline concentration for the target pollutant in indoor air. Performance is determined by monitoring the difference in concentration of the target pollutant at the inlet and outlet of the test chamber. Testing should be continued for the half-lifetime, i.e. until the concentration of the target pollutant drops to half that at the start of the test under constant ventilation conditions. With this test, sorption flux, F_m , and the total mass per area of sorption, ρ_{Ac} , at the half-lifetime are determined. The measured ρ_{Ac} at the half-lifetime is defined as the saturation mass per area, ρ_{As} , determined by the breakthrough test.

If a test material continues to reduce the target pollutant concentrations for longer than 28 days, alternative methods specified in Annex A for determining ρ_{As} may be applied instead of performing measurement for the entire corresponding period.

The concentration reduction performance of sorptive building materials is mainly determined by the target pollutant concentration, mass transfer coefficient of the target pollutant to the surface, and the sorption characteristics of the building materials themselves (sorption isotherm, diffusion resistance, and so on). Therefore, the concentration reduction performance test method shall specify both the concentration of the target pollutant and the mass transfer coefficient associated with the sorptive building material.

This method does not apply to materials capable of decomposing the target pollutant by catalytic reaction in the presence of ultraviolet and visible rays.

NOTE 1 The long-term target pollutant reduction performance is represented by the saturation mass per area, ρ_{As} , and, if necessary, the lifetime of the pollutant-removing performance, t_h , as the subsidiary index.

NOTE 2 Annex C shows an example of determination of the long-term reduction performance by column breakthrough test.

6 Apparatus

6.1 General

Principal laboratory equipment used for determination of the performance of the test material to reduce the target pollutant concentration by sorption or decomposition shall be as follows:

- chamber;
- sealing material for test specimens;
- air purifier;
- test air supply unit;
- temperature and humidity control system;
- air flow meter;
- air sampling device;
- oven;
- analytical instrument.

6.2 Chamber, complying with relevant specifications and requirements of **JIS A 1901**. See Figure 1 for outline of test chamber system. No air shall be allowed to circulate from the outlet back to the inlet.

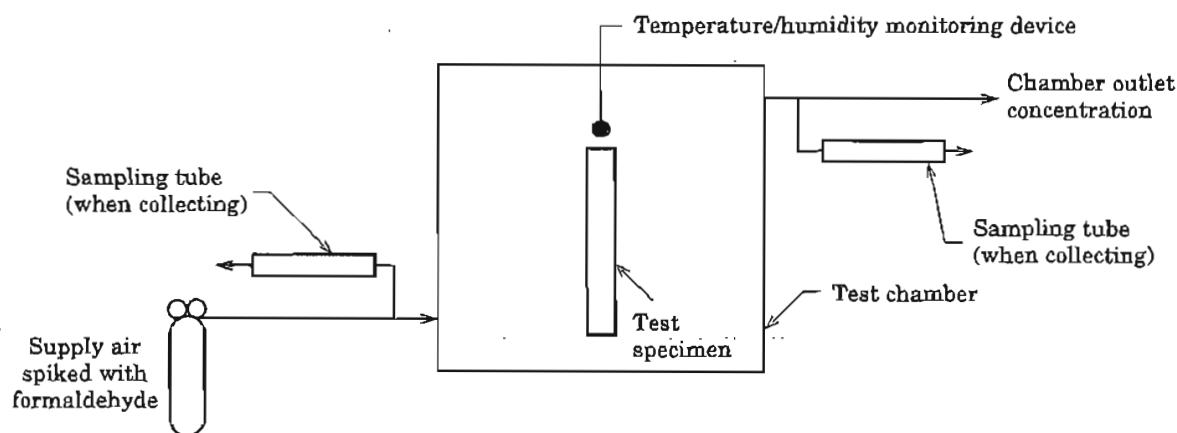


Figure 1 Outline of test chamber system

6.3 Sealing material for test specimens, such as aluminium foil to cover the edges and the back of the test specimen, if only the surface normally directly exposed to the indoor environment under intended condition of use is the subject of the test.

6.4 Air purifier The purifier shall ensure the supply air is as clean as possible before being spiked with the target pollutant. In order to prevent a rise in background concentration, an air purifier shall be provided or a cylinder of clean air shall be used.

6.5 Test air supply unit Either a standard gas with a known target pollutant concentration or gas spiked with the target pollutant generated by a gas generator should be supplied to the chamber so that the concentration of the supplied gas can be maintained stable. If a standard gas is not available, use other stable source that can generate equivalent air.

6.6 Temperature and humidity control system Temperature shall be maintained either by installing a test chamber in a place maintained at the required temperature, such as a constant-temperature climate chamber, or by maintaining the required temperature in the chamber. Relative humidity shall be maintained at the required humidity of the supply air. Temperature and relative air humidity shall be continuously monitored independently of the systems for controlling the temperature and air humidity.

Precautions shall be taken to avoid condensation or spray of water in the chamber.

6.7 Air flow meter, installed at the outlet of the chamber to measure correctly the air flow rate through the chamber. Alternatively, use other device having an equivalent or better performance.

6.8 Air sampling device Use the inlet and outlet air of the chamber for sampling. When a multiple sampling manifold is used, sample directly from the inlet or outlet of the chamber. If a duct or tube is used, it shall be as short as possible and maintained at the same air temperature as that in the chamber.

Such a duct or tube shall be made of a material with a very low sorption capacity, e.g. polytetrafluoroethylene.

If the sampling air flow rate is smaller than the air flow rate into the chamber, the air flow rate shall be maintained constant by using a multiport sampling manifold or other means.

NOTE 1 Ensure that exhaust from the test chamber is isolated from the laboratory environment.

NOTE 2 A multiport sampling manifold may be used to provide flexibility for duplicate air sampling.

6.9 Oven, used to evaporate volatile organic compounds (hereafter referred to as "VOCs"), formaldehyde and other carbonyl compounds attached to the inner wall of the chamber.

6.10 Analytical instrument A high performance liquid chromatograph (HPLC), as specified in 6.3.1 of **JIS A 1962** or clause 5 of **JIS K 0124**, shall be used for analysis of the target pollutant.

Alternatively, use other device having an equivalent or better accuracy.

7 Test conditions

7.1 General matters of concentration reduction performance test

The test conditions shall comply with 7.2 and 7.3. This test shall be conducted under conditions near atmospheric pressure conditions.

7.2 Concentration reduction performance test

7.2.1 Temperature and relative humidity

The standard temperature inside the chamber shall be 28 °C. The relative humidity during the test shall be 50 % as specified in **JIS Z 8703**.

The chamber shall be capable of being controlled within the following tolerance range:

temperature: (28 ± 1.0) °C, relative humidity: (50 ± 5) %.

To check the dependence of temperature and humidity on material performance, measurements at other temperatures and air humidity conditions should be made.

Initial variations can be observed in the chamber climate after opening the chamber door and loading a test specimen, due to the temperature difference between the inner temperature of the chamber and test site temperature. These variations should be recorded. The tolerance range for temperature and relative humidity is given for the change over time, and temperature and humidity variation within the chamber should be strictly avoided.

NOTE : Temperature and relative humidity can significantly affect sorption flux and re-desorption from the test material.

7.2.2 Supply air quality and background concentration

The background concentration of the supply air for the chamber and the air prior to spiking with the target pollutant shall be low enough not to interfere with the test.

Purified water used for humidification shall contain no or little interfering VOC, formaldehyde or other carbonyl compounds. It shall be water of A1 or better specified in JIS K 0557, and shall be free from detection of target element.

7.2.3 Mass transfer coefficient

Determine the mass transfer coefficient (water vapour) over the test specimen surface. The mass transfer coefficient in terms of ambient air velocity over the surface of the test specimen inside the chamber should be in the range (15 ± 3) m/h when determined using water vapour.

To check the dependence of the mass transfer coefficient on material performance, take measurements under other conditions that influence in an appropriate manner the mass transfer coefficient.

NOTE 1 Concentration reduction performance largely depends on the mass transfer coefficient.

NOTE 2 Mass transfer coefficient depends on the indoor concentration of the substance, air flow, and the surface area of the test material.

NOTE 3 The mass transfer coefficient (15 ± 3) m/h is equivalent to the wind velocity (0.25 ± 0.05) m/s of the ambient air flowing over the surface of test material.

7.2.4 Area specific ventilation rate and air change rate

The air change rate shall be kept constant at $0.5 /h \pm 0.05 /h$. The standard product loading factor shall be $2.2 \text{ m}^2/\text{m}^3$.

For comparison of results from different test chambers, the air change rate, n , and the product loading factor, L , shall be the same for each test chamber. The air change rate, n , and the product loading factor, L , may affect the sorption flux.

NOTE : The selection of air flow rate per area, which is made in setting the sorption and decomposition conditions in test, affects the steady-state concentration of the target pollutant in the test chamber air.

7.2.5 Supply air concentration

The concentration of the target pollutant vapour in the air supplied to the chamber shall be approximately equal to the guideline concentration. Other concentrations may be applied if relevant for the purpose of the test. This shall be stated explicitly in the test report.

7.3 Factors affecting the concentration reduction performance

7.3.1 General

For evaluation of the effect of temperature, humidity, and contaminants in air on the performance of reducing target pollutant concentration, modify each of the factors listed separately in 7.3.2 to 7.3.4.

7.3.2 Effects of temperature and humidity

The temperature in the chamber should be set to $(23 \pm 1.0)^\circ\text{C}$ and $(18 \pm 1.0)^\circ\text{C}$ with the relative humidity in the chamber as specified in 7.2.1 and the supply air concentration in the chamber set as specified in 7.2.5.

The relative humidity in the chamber should be set to $(25 \pm 5)\%$, $(50 \pm 5)\%$ and $(75 \pm 5)\%$, with the temperature in the chamber as specified in 7.2.1 and the supply air concentration in the chamber set as specified in 7.2.5.

7.3.3 Effect of target pollutant concentration in supply air

The target pollutant supply air concentration should be set to twice the guideline concentration specified in 7.2.5, and then to one-half of the guideline concentration, with the chamber temperature and relative humidity set as specified in 7.2.1.

7.3.4 Effects of interfering gases

Various interfering gases are expected to exist in indoor environments. It is possible to measure their effect on the performance of test materials in concentration reduction of target pollutant by measuring such performance while varying the concentration of each such interfering gas.

8 Verification of test conditions

8.1 Monitoring of test conditions

Temperature, relative humidity, and air flow rate shall be monitored and recorded continuously with instruments meeting the following accuracy specifications:

- temperature: $\pm 0.5^\circ\text{C}$
- relative humidity: $\pm 5\%$
- air flow rate: $\pm 10\%$

Temperature and relative humidity of air may be measured in the inlet or outlet of the chamber.

8.2 Air tightness of chamber

Air tightness of the chamber should be checked with a minimum frequency of every 12 months as specified in JIS A 1901 either by pressure drop measurements, by comparison of simultaneous measurement of flow rates at the inlet and the outlet ports, or by measuring tracer gas dilution.

8.3 Air change rate in test chamber

The air change rate shall be regularly checked as specified in JIS A 1901. The ratio of the volume Q of clean air brought into chamber measured by means of an air flow meter set at the chamber outlet and the chamber volume V shall be taken as the air change rate n .

The variation of the air change rate from the set value should be as small as possible. Checks of air change rate using tracer gas shall normally be made with a minimum frequency of every 12 months.