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Rigid cellular plastics — Spray-applied polyurethane foam for thermal insulation —

Part 3: Test methods

Plastiques alvéolaires rigides — Mousse de polyuréthanne projetée pour l'isolation thermique —

Partie 3: Méthodes d'essai

[Revision of first edition (ISO/PRF 8873-3)]

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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 8873-3 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 10, *Cellular plastics*.

This second edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

ISO 8873 consists of the following parts, under the general title *Rigid cellular plastics — Spray polyurethane foam*:

— *Part 1: Material specification*

— *Part 2: Applications and installation*

— *Part3: Test methods*

Introduction

This part of ISO8873 provides test methods required for ISO 8873-1: Material specification. These test methods are currently not stand-alone test standards. In the future, when these test methods become stand alone ISO International Standards, this part of ISO 8873 will be withdrawn.

Rigid cellular plastics — Spray-applied polyurethane foam for thermal insulation —

Part 3: Test methods

1 Scope

This part of ISO 8873 specifies the test procedures that are not in existing ISO standards, which are to be used when testing spray polyurethane foam medium density materials to verify that they meet the requirements listed in ISO 8873-1.

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 8873-1, Rigid cellular plastic – Spray applied polyurethane foam for thermal insulation – Part 1: Material specification

3 Terms and definitions

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.

3.1
air exchange rate (AER)
the volume of clean air brought into the chamber in one hour divided by the chamber volume measured in identical volume units, normally expressed in air changes per hour (AC/h).

3.2
air permeance
the rate of air flow (L/s), per unit area (m^2) and per unit static pressure differential (Pa).total exposed

3.3
chamber loading ratio
the total exposed surface area of each cellular plastic product specimen divided by the test chamber volume. Since the cellular plastic product is intended to be installed in large continuous areas, only the face of the insulation is exposed in the test procedure (see Clause 4.11).

3.4
clean air
air that does not contain any volatile organic compounds at a concentration in excess of the allowable background level (i.e. 1% of the permissible indoor air concentration limit for each compound identified).

3.5
dynamic chamber
a chamber where a material specimen can be placed and tested to determine the volatile organic compound emission rate under controlled environmental conditions.

3.6
GC/MS-SCAN
a gas chromatograph/mass spectrometer operated in scan mode.

3.7
head-space analysis
a procedure for measuring the VOCs present in the air space enclosed within a static, airtight chamber. (The chamber is assumed to contain VOCs in equilibrium with the VOCs emitted by the specimen in the chamber.)

3.8
head-space (static) chamber
an airtight chamber where a specimen can be placed and tested to determine the volatile organic compounds emitted under controlled environmental conditions.

3.9
internal standard
a volatile organic compound (other than that identified in the head-space analysis) which is injected at a known rate into the dynamic chamber in order to verify sample collection and analysis procedures.

3.10
permissible indoor air concentration
the maximum allowable indoor air concentration of a volatile organic compound.

3.11
tracer gas
a gaseous chemical (e.g. SF_6 and N_2O) used to study the mixing characteristics of the dynamic chamber and to provide a crosscheck of the air exchange rate measurements.

3.12
TLV® (threshold limit value)
the time weighted average concentration for a normal 8 h workday and a 40 h workweek, which nearly all workers may be repeatedly exposed to without adverse effects, day after day. (Also called TLV-TWA, Threshold limit value -- Time-weighted average.)

3.13
volatile organic compound (VOC)
An organic compound with a saturation vapour pressure at room temperature and/or with a boiling point less then 260 °C.

4 Standard laboratory guide for the determination of volatile organic compound emissions from cellular plastic products.

This laboratory guide has been developed for the assessment of *volatile organic compound* emissions from materials. It outlines a test procedure for the determination of *volatile organic compounds* from the specimen and explains why certain test conditions have been selected.

This laboratory guide is based on using a procedure using small-scale environmental chambers to determine *volatile organic compound* emissions from a variety of materials. The chamber methodology only presents a simple picture of the complex nature and interactions of emissions that may exist in home and work environments. Therefore, the results from these tests cannot fully represent “real life” conditions and they will err on the side of conservatism. However, data from the chamber procedure is useful for identifying potential sources of chemicals that may adversely affect the health of the occupants.

4.1 DYNAMIC CHAMBER TESTS

Dynamic chamber tests are useful for evaluating *volatile organic compound* emissions from materials. The *volatile organic compounds* emitted are studied to determine whether the emission concentrations show a trend to decrease or increase. It is essential that the use of these chambers and test protocols closely model the actual field conditions. Important parameters that must be considered include size and installation effects, ventilation rate, temperature and humidity, time from installation to occupancy and other site-specific factors.

The conditions selected for the procedures herein represent those encountered by the materials, when it is installed in residential buildings. Although materials installed in walls and ceilings will normally be covered with an interior finish, the gas transport properties of the finishes cannot be controlled.

In general, the closer the *dynamic chamber* conditions (temperature, humidity, *air exchange rate*, product loading and time) match the actual environmental conditions of the installation, the more accurate the data is.

4.2 HEAD-SPACE ANALYSIS (INITIAL SCREENING)

The headspace analysis is done on a specimen that has incubated in the sealed dynamic chamber for 24 h at 40 ±2 ºC using gas chromatography -- mass spectroscopy in the scan mode (GC-MS) or equivalent techniques in order to:

A Determine the number of *volatile organic compounds* emitting from the material, which has been just produced;

B Identify some of the *volatile organic compounds* from the product literature;

C Estimate the relative concentrations of the emitted compounds; and

D Determine the presence of *volatile organic compounds* that may adversely affect human health of the occupants.

This data enables the analyst to decide which peaks in the chromatograms of subsequent analyses should be investigated further. For example, very small peaks that represent trace amounts (amounts which are not quantifiable and/or identifiable) are noted. However, if the substances found in trace amounts show a trend to increase in the subsequent *dynamic chamber* test, identification and quantification may be necessary. If the permissible concentration of the found *volatile organic compound* is not known, the data from the headspace analysis shall be submitted for toxicological evaluation.

4.3 TIME FRAMES USED

For new residential construction, a conditioning period of 30 d has been chosen before analyzing the specimen as it represents the average time before a new home would be completed and occupied after the installation of the product.

For retrofit applications, a time emission profile is used to assess the nature of the volatile *organic compounds*. In this case, the specimens are tested at intermittent times up to 30 d to assess the decay pattern of the *volatile organic compounds*.

4.4 SCOPE

This laboratory guide has been developed for the assessment of *volatile organic compound* emissions from materials used in residential buildings.

This laboratory guide specifies recommended procedures for the use of test chambers to evaluate emissions from the material at a point in time following its installation. The guide contains the following:

A A *head-space analysis* procedure for initial identification of *volatile organic compounds* released by the material;

B Two *dynamic chamber* procedures (A and B) for characterizing the rate of *volatile organic compound* emissions from the material; and

C A methodology for calculating the estimated indoor air concentrations of *volatile organic compounds* based on the results of *dynamic chamber* testing.

The headspace analysis is a static test to identify significant amounts of emitted compounds from the material. It is followed by either *dynamic chamber* Procedure A or B.

Procedure A measures the typical *VOC* emission characteristics of the material. The test is conducted after conditioning the specimen for 30 d.

Procedure B measures the typical *VOC* emission profile of the material commencing 24 h after installation and continuing for 30 d thereafter.

The results of Procedures A or B are used to calculate indoor air *VOC* concentration profiles and to determine the acceptability of the material for new construction and/or retrofit use.

Procedure A is used to evaluate the material in new residential construction when there is a minimum of 30 d from the installation to building occupancy.

Procedure B is a more complex evaluation of the material when the normal 30 d minimum airing-out time associated with new construction is not provided (e.g. occupied buildings).

In these special cases (e.g. occupied buildings), the application and installation standard will provide the requirements for isolation and ventilation, if necessary. The test results of Procedure B will determine the length of time that these requirements are necessary.

The methodology for assessing the acceptability of the material utilizes comparison of the estimated indoor air concentration of *volatile organic compounds* (*VOCs*) with permissible concentration.

4.5 APPARATUS AND EQUIPMENT

General Product Requirements -- All equipment and apparatus in contact with the specimen or the associated air stream including the air exchange system, chambers, sample holder, and air sampling system shall be of glass, stainless steel, or other inert material. Special care should be taken to ensure that gaskets, seals, sealants, valve and pump components and other associated items are chemically inert.

Head-Space (Static) Chamber -- The headspace chamber shall be a small container (approximately 1 L) and be constructed of materials that meet the requirements of Clause 4.6. The interior should be smooth and easy to clean. The container must have an airtight opening of sufficient size to allow loading/unloading of the specimen and chamber cleaning. Two ports to allow the removal and return of an air sample shall be provided.

Dynamic Chamber -- The chamber and all associated hardware shall meet the requirements of Clause 4.6. The interior should be smooth and easy to clean. All gaskets shall be of chemically inert material.

The chamber size is not critical; however, a chamber volume of 0.1 to 1.0 m^3 will provide a reasonable compromise between specimen size and complexity of testing.

The chamber shall be equipped with an airtight opening large enough to allow specimen loading/unloading and chamber cleaning. Ports for temperature and humidity probes and air and gas supply/exhaust connections shall be provided as required.

The chamber design must allow for complete mixing of the air and this shall be verified (with a specimen in place) using a *tracer gas* decay test (ASTM E 741).

The surface air velocity over the specimen should be between 0.04 and 0.05 m/s. This velocity shall be verified using a thermal anemometer or other appropriate air velocity measurement instrument.

Sample Storage Enclosure -- This enclosure shall be large enough to contain the sample panels and shall contain shelves to hold the other storage vessels. The enclosure shall be lined with chemically inert material that is easy to clean and shall be provided with environmental control and monitoring systems that maintain a temperature of 23 ± 2°C, a relative humidity of 50 ± 5%, and a *clean air exchange rate* of 0.3 ± 0.015 air changes per hour.

Environmental Enclosure -- This enclosure shall be large enough to contain the *dynamic chamber* and all associated equipment, including air sampling equipment, and bottled gas supplies. The enclosure shall be lined with material that is easy to clean and it shall be provided with environmental control systems that maintain a temperature of 40 ± 2°C.

4.6 AIR EXCHANGE SYSTEM

This system shall be capable of supplying a controlled flow of *clean air* through the test chamber and associated equipment. *Clean air* can include air supplied from compressed gas cylinders or ambient air, which is conditioned by removing moisture and trace organic chemicals through charcoal filtration or other means.

The equipment shall include:

A A humidification system that maintains the relative humidity (RH) of the air flow at 50 ± 5% using deionised water (or equivalent), and a humidity indicator/recorder accurate to ± 5% RH;

B A temperature recorder/indicator system that can accurately measure air flow temperatures to ± 2°C at 40°C. Due to compressed gas expansion cooling effects, a reheating system may be required to ensure that the air entering the chamber is at a temperature of 40 ± 2°C;

C An air pump or pumps (unless a compressed air supply system is used), set to supply an air flow rate equivalent to 0.3 air changes per hour, based on the volume of the emissions test chamber. The flow rate shall be controllable to within 5% of the specified value. The chamber is to be operated and verified to be at a slight positive pressure to avoid contamination of the test chamber and sampling systems;