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Buildings and civil engineering works — Sealants — Durability to extension compression cycling under accelerated weathering

Bâtiments et ouvrages de génie civil — Mastics — Durabilité à un cycle d'extension-compression dans des conditions de vieillissement accéléré

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 8, *Sealants*.

Buildings and civil engineering works — Sealants — Durability to extension compression cycling under accelerated weathering

1 Scope

This International Standard specifies a method for the determination of classification of durability of sealants used in exterior joints in building construction.

2 Normative reference

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4892-1[1)], *Plastics — Methods of Exposure to Laboratory Light Sources — Part 1: General Guidance*

ISO 4892-2:2013, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 4892-3[2)], *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

ISO 4892-4, *Plastics — Methods of exposure to laboratory light sources — Part 4: Open-flame carbon-arc lamps*

ISO 6927, *Buildings and civil engineering works — Sealants — Vocabulary*

ISO 13640, *Building construction — Jointing products — Specifications for test substrates*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6927 apply.

4 Principle

Test specimens are prepared such that the sealant to be tested adheres to two parallel contact surfaces. The cured and conditioned test specimens are compressed to a defined width and this compression is maintained under accelerated weathering conditions. The test specimens are then extended to a defined width and this extension is maintained under accelerated weathering conditions. The samples are evaluated to record any loss of adhesion or cohesion is recorded along with recording if light can be visible through the specimen.

1) To be published. (Revision of ISO 4892-1:1999)

2) To be published. (Revision of ISO 4892-3:2013)

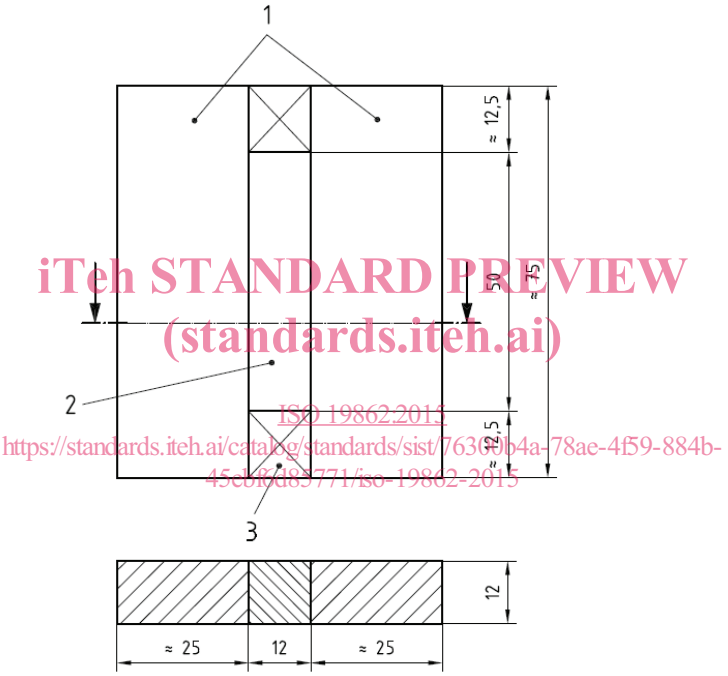
5 Apparatus

5.1 Substrate materials, for the preparation of test specimens as defined in ISO 13640. The substrate materials shall be selected from mortar type 1 or type 2. Other substrate materials may be used as agreed by the parties concerned.

For each test specimen, two substrate pieces of the same material are required with a cross section of dimensions as shown in Figure 1. Test substrates of other dimensions may be used, but then the dimensions of the sealant bead and the area of adhesion shall be the same as those shown in Figure 1.

5.2 Spacers, cross section (12 mm × 12 mm) with anti-adherent surface. For the preparation of test specimens see Figure 1.

Dimensions in millimetres



Key

1 mortar substrates
2 sealant
3 spacer

Figure 1 — Test specimen with mortar substrates

5.3 Anti-adherent substrate, for the preparation of the test specimens, e.g. polyethylene (PE) film, according to the advice of the sealant manufacturer. (See ISO 8339, 5.3).

5.4 Tensile test machine, with recording device, capable of extending the test specimens at a rate of (5,5 ±0,7) mm/min.

5.5 Ventilated convection-type oven, capable of being maintained at (70 ± 2) °C for conditioning according to method B (see 7.3).

5.6 Container, for immersing test specimens in distilled water for conditioning according to method B (see 7.3).

5.7 Separators and clamps, with appropriate dimensions to hold the test specimens extended or compressed to 12,5%, 20%, or 25 % of the original width or any other width agreed between the parties concerned.

5.8 Measuring device, accuracy to ±0,5 mm.

5.9 Light device, capable of shining light on the back surface of the specimen.

5.10 Fully automated artificial weathering test chamber with an artificial light source, fully automated test chamber with an artificial light source (see 5.11), shall be used, capable of exposing the test specimens to radiation under controlled conditions of temperature, relative humidity, and water, complying with the requirements of ISO 4892-1, ISO 4892-2, ISO 4892-3, and ISO 4892-4. The radiation is always directed towards the same surface of the sealant specimen. Standard practices for operating such accelerated weathering chambers are described in ISO 4892-1.

The level of irradiance and water exposure at the specimen surface may not be altered.

In fully automated test equipment, exposure to water for this test method is accomplished by water spraying the specimen surface or immersing the test specimens in water (see Note 1 and Note 2). Contamination of the water is to be avoided. The purity of the water to be used is described in ISO 4892-1. The water temperatures are typically (21 ± 5) °C for the spray water and typically (40 ± 5) °C for the re-circulated immersion water (see Note 3).

Suitable equipment and test procedures for cyclic exposures to water are described in ISO 4892-1, ISO 4892-2, ISO 4892-3, and ISO 4892-4. Water is a key factor contributing to the ageing of sealants, especially in combination with exposure to light. In xenon arc devices that use water spray for wetting, relative humidity during the light period shall be maintained at (50 ± 10) % RH, (see ISO 4892-2:2013, Table 3, Method A, Cycle Number 1) (see Note 4).

In the immersion technique, the test specimens are placed in a chamber that is periodically flooded with re-circulated water. During immersion, the specimens are completely covered by water. The water temperature is measured below the water surface with the black standard thermometer. The immersion spray water can be at a higher temperature. The uncontrolled temperature of the re-circulated immersion water during operation of the weathering device is typically (40 ± 5) °C. It can be controlled by heating the water to a higher temperature. However, heating is not desirable because the water immersion temperature would then differ to a larger extent from the spray water temperature.

NOTE 1 Adequate heat transfer between the test specimen and the environment is essential during the lower temperature period in the fluorescent UV/condensation device in order for condensation on the sealant to occur. This places restrictions on the thermal mass and, consequently, on the dimensions of a specimen. No experimental data have been generated on the time-of-wetness of sealant test specimens of the kind specified in this International Standard when placed in fluorescent UV/condensation device operating at conditions specified in this International Standard. However, testing conducted by ASTM C24 on ISO 8339 specimens appears to suggest that the condensation process provided in the fluorescent UV/condensation apparatus is generally not applicable to the type of sealant specimens tested. Therefore, wetting in this International Standard is carried out by water spray on the exposed specimen surface (default method). However, the front surface water spray accessory was not designed for this purpose and requires an unreasonable amount of pure water for the wet period specified. Therefore, often the equipment is modified to allow re-circulation of the water during the exposure period. Some fluorescent UV equipment have adaptable spray manifolds, which allow installation of lower flow type nozzles, thus reducing the amount of pure water used.

NOTE 2 Data generated with these two methods of water exposure (spray or immersion) in a round robin test on a set of sealants for revision of ISO 11431 showed acceptable correlation, although contributions to the various degradation mechanisms acting in the specimens (e.g. hydrolysis, thermal shock, leaching of formulation components, et cetera) can differ between these exposures. The degree of correlation between these two methods thus may vary depending on the specific sealant tested.

NOTE 3 Spray water can be fresh or re-circulated from a holding tank. Immersion water is generally in a holding tank for re-circulation. The temperature of the spray water is uncontrolled and for fresh water is typically (21 ± 5) °C. Re-circulated water should maintain a temperature of (40 ± 5) °C.

NOTE 4 Generally, automated weathering equipment based on xenon-arc light with water immersion exposure and fluorescent UV lamp type equipment do not allow control of humidity during the light period.

5.11 Artificial light source, for the simulation of the global radiation at the surface of the earth are subject to development. The degree of approximation to the spectral power distribution according to CIE publication No. 85,Table 4 depends on the type of lamp. Xenon-arc lamps with suitable filters are preferred and are considered the default for the purpose of this International Standard.

Several factors can change the intensity and the spectral power distribution of the artificial light source during service. Comply with the manufacturer's recommendations and the requirements of ISO 4892 (all parts) to maintain constant irradiation conditions.

5.11.1 Xenon-arc light source (default), Xenon-arc light source with daylight filters, shall be used for the simulation of terrestrial daylight as defined in the CIE publication No. 85. The spectral power distribution of the radiation shall comply with the requirements outlined in ISO 4892-2, Method A. Irradiance at the surface of the test specimens between the wavelengths of 300 nm and 800 nm shall be set at 550 W/m^2 and maintained at ±75 W/m^2. The equivalent irradiance setting for (300 to 400) nm shall be 60 W/m^2 maintained at ±2 W/m^2 and the setting for 340 nm shall be 0,51 W/ (m^2. nm) maintained at ±0,02 W/ (m^2. nm). If, exceptionally, other intensities will be used, these shall be stated in the test report. Irradiance below 300 nm shall not exceed 1 W/m^2. The irradiance shall not vary by more than ±10% over the whole specimen exposure area.

5.11.2 Fluorescent ultraviolet source (option), fluorescent UVA-340 lamp(s), shall be used. The radiation of UVA-340 lamp(s) is mainly in the ultraviolet region between 300 and 360 nm with negligible visible and infrared radiation. The spectral power distribution of the radiation shall comply with the requirements outlined in ISO 4892-3 for a lamp with 343 nm peak emission. Irradiance below 300 nm shall not exceed 1W/m^2. The irradiance shall not vary by more than ±10% over the whole specimen exposure area.

5.11.3 Open-flame carbon arc source (option), open-flame carbon arc light sources typically use carbon rods, which contain a mixture of metal salts. An electric current is passed between the carbon rods, which burn and give off ultraviolet, visible, and infrared radiation. Use carbon rods recommended by the device manufacturer. The spectral power distribution of the radiation shall comply with the requirements outlined in ISO 4892-4, open-flame carbon arc light source with daylight type filter (Type 1 Filter).

NOTE The chemical composition of the carbon rods can affect the spectral power distribution of open flame carbon arc light sources.

6 Preparation of test specimens

The sealant and test substrates shall be brought to (23 ± 2) °C. Three test specimens shall be prepared. For each specimen two substrates (5.1) and two spacers (5.2) shall be assembled (see Figure 1) and set on the anti-adherent substrate (5.3).

The instructions of the sealant manufacturer concerning, for instance, whether a primer is to be used and the mixing procedure for multi-component sealants shall be followed. The hollow volume formed by the substrates and the spacers shall be filled with the sealant.

The following precautions shall be taken:

a) the formation of air bubbles shall be avoided;

b) the sealant shall be pressed on the inner surfaces of the substrates;

c) the sealant surface shall be trimmed so that it is flush with the faces of the substrates and spacers.

The test specimens shall be set on the edge of one of the supports. The anti-adherent substrate shall be removed as soon as possible. The specimens shall be placed in this position to allow curing or optimum drying of the sealant. The spacers shall be maintained in place during conditioning.

7 Conditioning of test specimens

7.1 General

The test specimens shall be conditioned either in accordance with method A (see 7.2) or method B (see 7.3), as agreed between the parties concerned.

7.2 Method A

The test specimens shall be conditioned for 28 days at (23 ± 2) °C and (50 ± 10) % relative humidity.

7.3 Method B

The test specimens shall be conditioned according to method A and shall then be subjected three times to the following storage cycle:

a) three days in the oven (5.6) at (70 ± 2) °C;

b) one day in distilled water (5.7) at (23 ± 2) °C;

c) two days in the oven (5.6) at (70 ± 2) °C;

d) one day in distilled water (5.7) at (23 ± 2) °C.

Alternatively, this cycle may be carried out in the order c), d), a),b).

After conditioning according to method B, the test specimens shall be stored for 24 h at (23 ± 2) °C and (50 ± 10) % relative humidity before testing.

NOTE Method B is a normal conditioning procedure using the influence of heat and water. It is not suitable for giving information on the durability of the sealant.

8 Test procedure

8.1 General

Three specimens shall be tested. The cyclic movement cycle is 7 d duration. During a cycle, the specimens are initially compressed to the specified dimension and placed in the accelerated weathering device for 3 d. The specimens are then removed from the accelerated device and extended to the specified dimension (the extension process must be done within 2 h), and placed back in the chamber for 4 d. At the completion of the seven day cycle, the specimens are removed and recorded for adhesion and cohesive failure. A light is shone from behind the specimen to determine if any full failure of the specimen has occurred. This is one cycle. This process is repeated up to 10 times for durability rating of 1-10.

8.2 Test Procedure

Compress the specimens to the specified dimension at a rate of (5,5 ± 0,7) mm/min. See Table 1. Maintain the compression and place in the accelerated weathering device for 3 d.