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Buildings and Civil Engineering Works — Sealants — Determination of changes in adhesion, cohesion and appearance of elastic weatherproofing sealants after exposure of statically cured specimens to artificial weathering and mechanical cycling

Construction immobilière — Produits pour joints — Méthode d'essai pour évaluer la durabilité des mastics pour construction

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Foreword

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ISO 11617 was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 8, *Sealants*.

This second/third/... 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.

Buildings and Civil Engineering Works — Sealants — Determination of changes in adhesion, cohesion and appearance of elastic weatherproofing sealants after exposure of statically cured specimens to artificial weathering and mechanical cycling

1 Scope

This International Standard specifies laboratory exposure procedures for determining the effects of cyclic movement and artificial weathering on cured, elastic weatherproofing joint sealants (one- or multi-component).

2 Normative reference

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.

ASTM G152 (2006) *Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Non-Metallic Materials*

ASTM G154 (2006) *Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Non-Metallic Materials*

CIE Publication No. 85: 1989, *Recommendations for the Integrated Irradiance and the Spectral Distribution of Simulated Radiation for Testing Purposes; Solar Spectral Irradiance*, *ISBN 3 900 734 224*

ISO 4892-1: 1999 *Plastics - Methods of Exposure to Laboratory Light Sources - Part 1: General Guidance*

ISO 4892-2: 2006 *Plastics - Methods of Exposure to Laboratory Light Sources - Part 2: Xenon Lamps*

ISO 4892-2:2006/Amd.1:2009 *Plastics - Methods of Exposure to Laboratory Light Sources - Part 2: Xenon Arc Lamps*

ISO 4892-3: 2006 *Plastics - Methods of Exposure to Laboratory Light Sources - Part 3: Fluorescent UV Lamps*

ISO 4892-4: 2004/Cor 1:2005 *Plastics - Methods of Exposure to Laboratory Light Sources – Part 4: Open-flame Carbon-arc Lamps*

ISO 6927: 2012 *Buildings and Civil Engineering Works – Sealants - Vocabulary*

ISO 8339: 2005 *Building Construction – Sealants – Determination of Tensile Properties (Extension to Break)*

ISO 11431: 2002 *Building Construction — Jointing Products — Determination of Adhesion/Cohesion Properties of Sealants after Exposure to Heat, Water and Artificial Light Through Glass*

ISO 11600: 2002 *Building Construction — Jointing products — Classification and Requirements for Sealants* , ISO 11600: 2002/Amd 1:2011

ISO 13640: 1999 *Building Construction — Jointing Products — Specifications for Test Substrates*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 6927 apply.

Any notation in this standard shown as 'target set value x ± operational fluctuation y' shall be interpreted as follows: set the experimental parameter at the target value x and maintain the experimental parameter during the test procedure at ± y from the specified setting x. If the operational fluctuations exceed the maximum allowable value after the equipment has stabilized, discontinue the test and correct the cause of the problem before continuing.

4 Principle

Test specimens are prepared in which the sealant to be tested adheres to two parallel support surfaces (substrates). The specimens are conditioned statically (no movement) in a laboratory controlled climate. The conditioned specimens are then exposed to repetitive cycles of artificial weathering (light, heat and moisture) and cyclic movement under controlled environmental conditions. Weathering is carried out for six weeks in an artificial weathering machine. Simultaneously with the weathering, mechanical cycling is carried out by changing the position of the extension/compression once a week. After completion of each degradation cycle (each lasting six weeks), the specimens (in their extended/compressed state) are visually examined for changes in appearance, cohesion and adhesion of the sealant beads. The rating for quantity, width and depth of cohesive cracks for a specific extension/compression value achieved along the length of the specimen as well as the depth, length and range of any very significant loss of cohesion or adhesion (defined as >3 mm crack depth) is determined and the general condition of the sealant is reported. The weathering and mechanical cycling exposure and the examination for failures constitute a degradation cycle and the degradation cycle is repeated as often as desired to achieve a certain exposure.

5 Apparatus

5.1 Support

Anodized aluminium support (as shown in Figure 1) for the preparation of test specimens, consisting of two pivoting, L-shaped anodized aluminium support elements of dimensions 120 mm x 18 mm x 18 mm (length x width x height) and 2 mm thickness riveted onto an anodised aluminium base-plate of 2 mm thickness such that a cavity of dimensions 120 mm x 20 mm x 18 mm (length x width x height) is formed. Riveting of the support elements on the base-plate shall be such that they can be turned freely with minimal friction on the pivot (fulcrum). The base plate holds five (5) equally spaced holes of 5 mm diameter (for improved ventilation of the back face of the sealant such as to ensure better cure or drying of the sealant) and two (2) 3 mm holes for fixation of the spacers. For the specification of the anodised aluminium, refer to ISO 13640. All surfaces of the anodized aluminium support to be later in contact with the sealant shall be cleaned according to the sealant manufacturer's recommendation.

NOTE Achieving optimum adhesion on the support substrate is important in order to obtain reproducible ratings for surface and bulk degradation (cracking, crazing, cohesive failure, et cetera) that is induced or influenced by mechanical cycling. Even a partial loss of adhesion will cause a section of the test specimen to be exposed to no or a lower degree of mechanical cycling than intended for the movement rating of the sealant and invalidate the results obtained for this movement exposure (as assessed along the extended leg of the test specimen). Currently, no cleaning procedure and cleaning agent(s) have been identified that provide optimum adhesion on the support substrate for all sealant products. Therefore, no cleaning procedure is specified in this standard. If the manufacturer does not provide a recommendation for the cleaning procedure, the following method is suggested for consideration by the experimenter: Clean all surfaces of the anodized aluminium support to be later in contact with the sealant with high purity acetone (purity (GC): 99.8%) as follows: (a) saturate a clean, lint-free paper tissue or cloth with the solvent, (b) clean the substrate with the solvent-saturated cloth or tissue by wiping a minimum of four times, (c) dry wipe the substrate surface thoroughly using a dry, clean, lint-free paper tissue or cloth before the solvent completely evaporates. After completion of this procedure, repeat steps (a) to (c).

If other support materials are to be used, they must be characterised and must be described in the test report. If other support dimensions are used, they must be described in the test report.

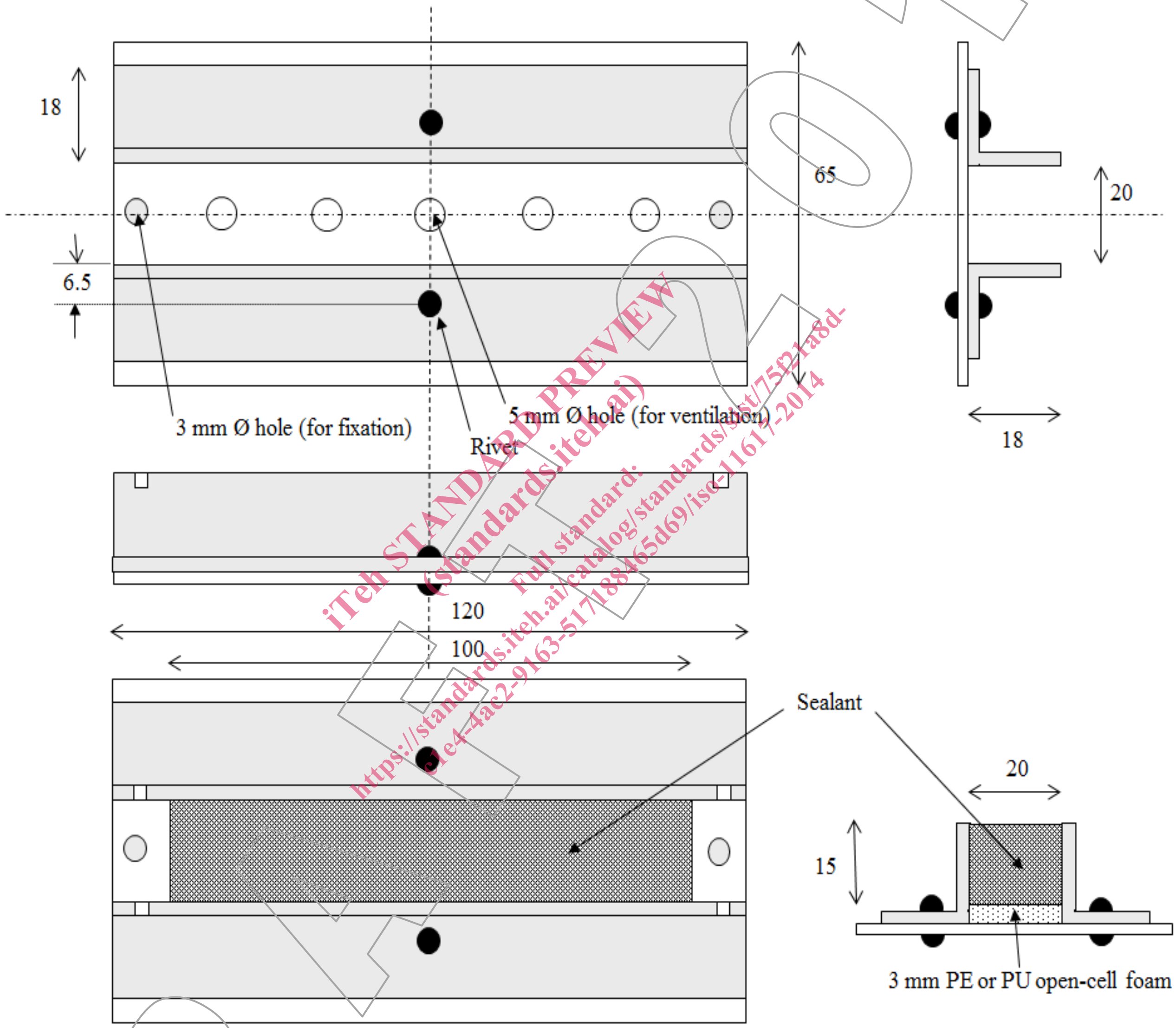

Figure 1 — Schematic drawing of test specimen: sealant in anodised aluminium support used for cyclic mechanical movement of sealant (all units in mm)

5.2 Spacers

Spacers for the preparation of the specimens, of dimensions 20 mm x 18 mm x 10 mm, with anti-adherent surface (see Figure 1) shall be used. If the spacers are made of material to which the sealant adheres, their surface must be made anti-adherent, e.g. by a thin wax coating.

5.3 Backing material (bond breaker)

Open-cell foam backing material (polyethylene (PE) or polyurethane (PU) foam) of 3 mm thickness for the preparation of test specimens shall be used. The foam backing material shall not restrict the movement of the L-shaped pivoted support elements.

5.4 Separators

Separators, of appropriate dimensions, shall be used to hold the test specimens in extension up to the rated movement capability of the sealant.

5.5 Container

Container filled with demineralised or distilled water shall be used for conditioning according to Method B.

5.6 Ventilated convection-type oven

Ventilated convection-type oven, capable of being maintained at (70±2) °C, shall be used for conditioning according to Method B.

5.7 Fully automated test chamber with an artificial light source

Fully automated test chamber with an artificial light source (see 5.8), 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, Parts 1, 2, 3 and 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 as described in sections 5.8 and 8.2 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[1,2]. Contamination of the water is to be avoided. The purity of the water to be used is described in ISO 4892, Part 1. The water temperatures are typically (21 ± 5) ºC for the spray water and typically (40 ± 5) ºC for the re-circulated immersion water[3].

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[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 standard when placed in fluorescent UV/condensation device operating at conditions specified in this 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 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 equipments have adaptable spray manifolds, which allow installation of lower flow type nozzles, thus reducing the amount of pure water used.

[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.

[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

Suitable equipment and test procedures for cyclic exposures to water are described in ISO 4892, Parts 1, 2, 3 and 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)% r.h. (see ISO 4892-2, Table 3, Method A, Cycle Number 1). [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 system shall be made from corrosion resistant materials that do not contaminate the water employed.

5.8 Artificial light source

Light sources 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 ISO 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 to maintain constant irradiation conditions.

5.8.1 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, Part 2, Method A. Irradiance at the surface of the test specimens between the wavelengths of 300 and 800 nm shall be set at 550 W/m^2 and maintained at ±75 W/m^2. The equivalent irradiance setting for 300-400 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.

5.8.2 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, Part 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.

5.8.3 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

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.

[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.