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Standard Guide for Improved Laboratory Accelerated Tests to Predict the Weathering and for Use in Developing Protocols to Predict the Design Life of Building Sealant Systems[1]

This standard is issued under the fixed designation C1850; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide describes the steps for developing improved laboratory accelerated weathering tests for predicting the natural weathering effects on building sealant systems and for using those tests in development of methods for design life prediction of the systems.

1.2 This guide outlines a systematic approach to development of laboratory accelerated weathering tests of building sealant systems including the identification of needed information, the development of accelerated tests, the application of data, and the reporting of results.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C717 Terminology of Building Seals and Sealants

G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminologies C717 and G113.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *biological degradation factor*—degradation factors directly associated with living organisms, including microorganisms, fungi, and bacteria.

3.2.2 *building sealant system component*—a part of a building sealant system that may include a combination of building materials, such as cladding, substrates or the sealant.

3.2.3 *building sealant system material*—a material that may be used in a building sealant system.

3.2.4 *critical performance characteristic(s)*—a property, or group of properties, of a building sealant system that must be maintained above a certain minimum level.

3.2.5 *degradation mechanism*—the chemical reactions induced in a building component or material by one or more degradation factors resulting in changes in one or more of the critical performance characteristics.

3.2.6 *incompatibility factor*—any of the group of degradation factors that result from detrimental chemical and physical interactions between building components or materials.

3.2.7 *in-service test*—a test in which building components or materials are exposed to degradation factors under in-service conditions.

3.2.8 *performance criterion*—a quantitative statement of a level of properties for a selected characteristic of a component or material needed to ensure compliance with a functional requirement.

3.2.9 *property measurement test*—a test for measuring one or more properties of building components or materials.

3.2.10 *load stress factor*—any degradation factors that result from externally applied sustained or periodic mechanical loads.

3.2.11 *use factor*—any factor that affects the material as a result of the design of the system, installation and maintenance procedures, normal wear and tear, and user abuse. (Example: abrasion of foot traffic.)

3.2.12 *weathering factors*—any degradation factors associated with the natural environment, including radiation, temperature, rain and other forms of water, freezing and thawing.

4. Significance and Use

4.1 This guide is intended to serve as a reference of recommended methodology for users developing relevant, reliable and valid tests for predicting natural weathering effects

[1] This guide is under the jurisdiction of ASTM Committee C24 on Building Seals and Sealants and is the direct responsibility of Subcommittee C24.20 on General Test Methods.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

and for use in developing methods to determine design life of building sealant systems through the use of accelerated test protocols. The proposed standard corrects for some of the deficiencies of existing laboratory accelerated tests of sealants.

4.2 The development of accelerated weathering tests capable of being used in protocols to reliably and accurately predict the long-term in-service performance of building sealant systems have limitations due to:

4.2.1 The external factors that affect functional properties, which are numerous and require effort to quantify, so that many existing accelerated procedures do not include all factors of importance, and

4.2.2 The sealant specimens are often tested in configurations different from those used in-service.

5. Procedure

5.1 This guide describes a recommended sequence of steps for users to follow for developing laboratory accelerated weathering tests for predicting the effects of natural weathering on sealants and for use in development of methods for estimating design life (see Fig. 1 for a flow chart).

6. Scope

6.1 The scope describes the intentions of the test and the degradation factors that should be included.

I–Problem Definition

7. Definition of In-Service Performance Characteristic Requirements and Criteria

7.1 The critical performance characteristic criteria define the minimum acceptable levels of in-service functional properties stated in terms of absolute values or changes from the initial test.

8. Characterization of the Sealant

8.1 Characterize the sealant system in terms of composition, critical performance characteristics, and physical properties the

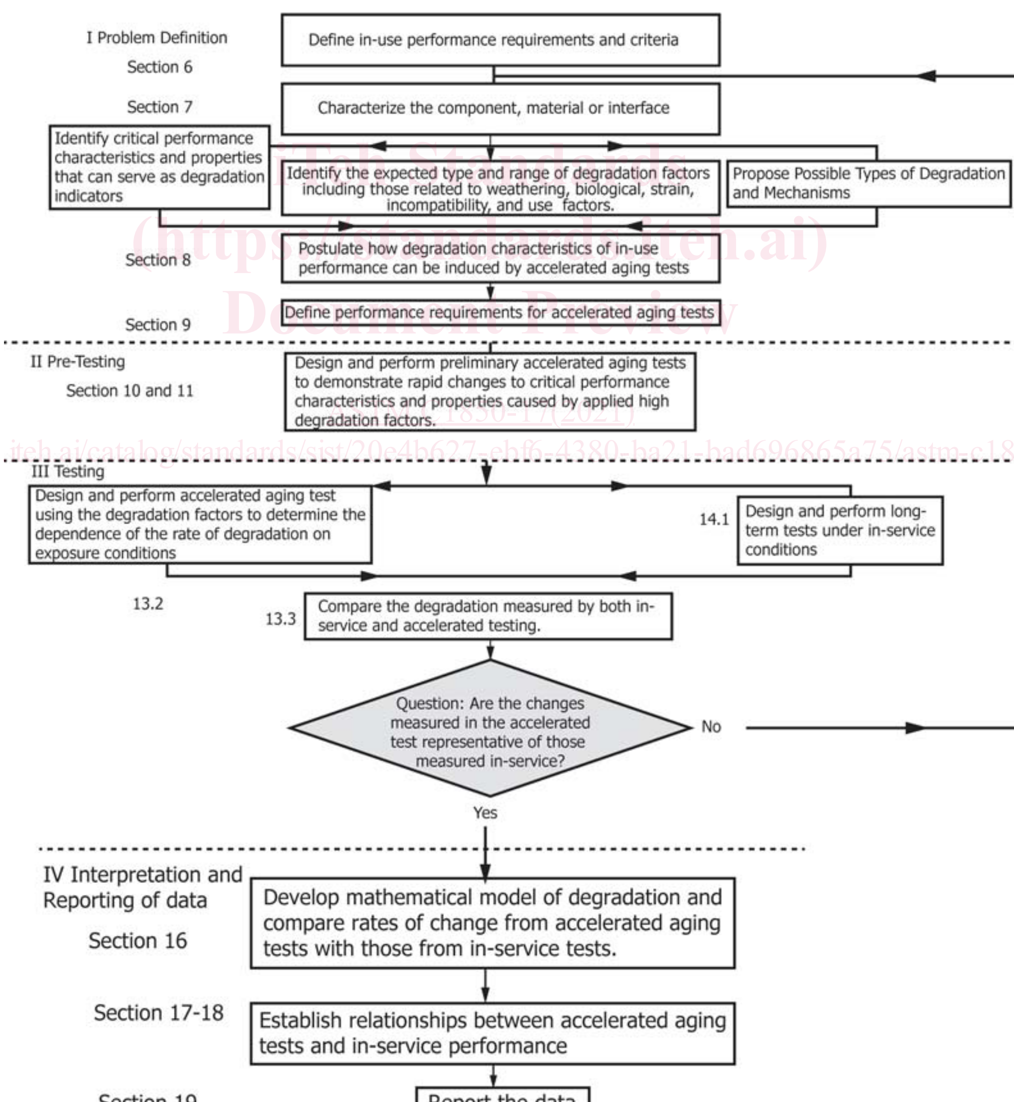

FIG. 1 Recommended Steps for Developing Improved Artificial Accelerated Weathering Tests to Predict Natural Weathering Effects and for Use in Developing Protocols for Predicting Design Life

changes of which will serve as degradation indicators, the range and type of degradation factors to which the sealant responds, and all possible types of degradation and mechanisms by which the degradation factors induce changes in the critical performance properties.

8.1.1 *Critical Performance Characteristics and Properties:*

8.1.1.1 Properties used as measures of degradation must be the same as or directly linked to the critical performance characteristic. Fig. 2 provides a matrix for use in identifying properties that indicate degradation.

8.1.1.2 *The Vertical Axis of the Matrix*—An alphabetical letter is used in the matrix to designate individual building elements and interfaces as part of a building sealant system. For example, a wall element may include an exterior coating (A), an exterior substrate (B), a structural member (C), insulation (D), an interior substrate (E), and an interior coating (F). The interfaces between each pair of materials can then be designated, for example, A-B, B-C, A-C, etc.

8.1.1.3 Consider the characteristics of the sealant and interfaces with other building components in the evaluation. Fig. 2 lists changes in properties that may be useful as measures of degradation. These include both visual changes (chalking, crazing, cracking, checking, flaking, scaling, blistering) and instrumentally measurable changes (color, gloss, tensile modulus, etc.).

8.1.2 *Type and Range of Degradation Factors:*

8.1.2.1 Identify the type of degradation factors to which the sealant will be exposed in-service and their range. A list of common degradation factors is presented in Table 1. This list is not exhaustive and other possible important factors should be sought in each specific case.

8.1.2.2 Quantitative information on weathering factors is available from published weather and climatological data. These data will usually be sufficient to indicate the ranges of intensities to which the component or material will be exposed in-service.

8.1.2.3 Stress factors consist of sustained stress, developed from seasonal changes, and periodic stress, such as daily temperature or moisture variation. The intensities of stress factors can be estimated.

8.1.2.4 *Chemical and Physical Incompatibility between Dissimilar Materials*—This includes stress caused by the different thermal expansion coefficients of rigidly connected dissimilar materials that can be estimated.

8.1.2.5 Use factors include the design of the system, installation and maintenance procedures, normal wear and tear and abuse.

8.1.2.6 Biological, incompatibility, and use factors and their range of in-service intensity can be difficult to quantify but upper limits of common in-service conditions can usually be estimated from a technical assessment and engineering judgment. Consider each of the degradation factors that the sealant may experience in-service within the given building system in designing the assessment protocol.

TABLE 1 Degradation Factors Affecting the Design Life of Sealant Systems

Weathering Factors
Radiation Solar Nuclear Thermal
Temperature Cycles
Water
Solid (such as snow, ice)
Liquid (such as rain, condensation, standing water)
Vapor (such as high relative humidity)
Mechanical Movements
Normal Air Constituents Oxygen and ozone Carbon dioxide
Air Contaminants
Gases (such as oxides of nitrogen and sulfur)
Mists (such as aerosols, salt, acids, and alkalies dissolved in water)
Particulates (such as sand, dust, dirt)
Freeze-thaw
Wind
Biological Factors Microorganisms Fungi
Bacteria
Strain
Static strain of seasonal cycles
Dynamic strain of daily cycles
Stress Factors, sustained or periodic
Physical action of water, as rain, hail, sleet, and snow
Physical action of wind
Combination of physical action of water and wind
Movement due to other factors
Incompatibility Factors
Chemical
Physical
Use Factors
Design of system
Installation and maintenance procedures
Normal wear and tear
Abuse by the user

Observable Change	Visual Inspection											Measured Change																												
Building Element	Micro–organisms growth	General appearance	Chalking	Crazing	Cracking	Checking	Flaking	Scaling	Blistering	Efflorescence	Rupture	Color	Gloss	Reflectance	Haze	Texture	Transparency	Abrasion resistance	Hardness	Washability	surface wettability	Water absorption	Vapor permeance	Dimensions	Thermal properties	Electrical properties	Creep rupture	Creep deformation	Peel strength	Flexural strength	Tear strength	Impact resistance	Fatigue strength	Tensile strength	Compressive strength	Shear strength	Tensile modulus	Compressive modulus	Shear modulus	Adhesion
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A-B																																								
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FIG. 2 Example of a Matrix for Identifying Observable Changes of Sealants