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Standard Guide for In-Situ Structural Silicone Glazing Evaluation[1]

This standard is issued under the fixed designation C1394; 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.

INTRODUCTION

~~SSG is popular because of its~~Structural Sealant Glazing (SSG) is a unique method of retaining glass or other panels ~~in smooth exterior walls, interrupted only by narrow sealant joints. The first four-sided SSG in commercial construction is on the former corporate headquarters building of SHG Incorporated (formerly known as Smith, Hinchman & Grylls) in Detroit, MI, built in 1971.~~ via adhesive bonding using a structural sealant. Emerging in the mid-to-late 1960s, SSG applications used silicone sealants to transfer wind loads along two opposing sides of glass; a construction method which came to be known as "two-sided" SSG. By 1971, the technique began incorporating load transfer along all four sides of glass and the first "four-sided" SSG installation was built at 455 West Fort Street in Detroit, Michigan. Since then, buildings containing two- or four-sided (or, occasionally, other numbers of ~~sides of nonrectangular-shaped panels)~~ sides) SSG walls have been constructed within ~~most~~many cities, some ~~as tall as 80 stories.~~exceeding 100 stories

While SSG popularity ~~increases, the sealant industry remains concerned~~ has increased since its inception, concerns remain over potential failures due to the increasing number of buildings ~~containing structural glazing~~ constructed using this method that are aging; unknown overall structural sealant durability; and the ~~level of understanding of the principles of SSG by glazers.~~ fact that the adhesive bond in the SSG system remains largely concealed from visual inspection, creating concern on SSG systems in general. This guide addresses these concerns by providing suggestions for ~~in situ~~ in-situ evaluations of completed installations of any age.

1. Scope

1.1 ~~It is recommended to periodically evaluate the~~ The existing condition of ~~structural sealant glazing (hereinafter called SSG) installations in situ to detect problems~~ SSG installations should be periodically evaluated in-situ to detect if problems exist, and if so found, to address them before they become severe or pervasive. Evaluation of existing SSG installations ~~are~~is required by certain building codes and local ordinances. This guide provides a program to evaluate the existing conditions, lists typical ~~conditions, which might be found,~~ conditions that may exist, and suggests times when such evaluations are appropriate. Presently, only a silicone sealant that is specifically formulated, tested and marketed as a structural glazing sealant is allowed for structural sealant glazing. The committee with jurisdiction over this standard is not aware of any comparable standards published by any other organizations.

1.2 *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

C1392 Guide for Evaluating Failure of Structural Sealant Glazing

[1] This guide is under the jurisdiction of ASTM Committee C24 on Building Seals and Sealants and is the direct responsibility of Subcommittee C24.10 on Specifications, Guides and Practices.

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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.

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C1401 Guide for Structural Sealant Glazing
C1521 Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints

3. Terminology

3.1 *Definitions:*The definitions of the following terms used in this guide are found in Terminology C717: structural sealant; structural sealant glazing; two-sided structural sealant glazing; four-sided structural sealant glazing; fluid migration.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *qualified person*—one with a recognized degree or professional registration and extensive knowledge and experience in the field of structural sealant glazing, and who is capable of design, analysis, evaluation, and interpretation of specifications in the subject.

4. Significance and Use

4.1 Guidelines are provided for the procedures to evaluate existing SSG installations, including two- and four-sided installations. Due to the unlimited range of materials that may be used in a particular building, the information contained in this guide is general in nature. For a discussion of new SSG installations, refer to Guide C1401.

4.2 Typical conditions are listed that might be discovered during, or suggest the need for, such evaluations. Guidelines are also suggested for times to perform evaluations. These guidelines are also necessarily general. Professional judgment of a qualified person should be used in determining the appropriate time to perform an evaluation on a particular building.

4.3 This guide should not be the only reference consulted when determining the scope of a proposed evaluation. For example, the local building code and the manufacturers' product literature for the actual materials used (if known) should also be considered.

4.4 This document is not a substitute for experience and judgment in assessing the condition of the specialized types of construction discussed.

5. Reasons to Perform an Evaluation

5.1 There are numerous reasons that a building owner or manager (hereinafter "owner") may choose to evaluate an SSG system, whether discretionary or to comply with an ordinance. The recommended evaluation levels, as discussed in Section 7, are referenced for each situation. The findings from one level of investigation may trigger the need for a more in-depth investigation. At a minimum, it is recommended that an existing SSG installation be evaluated when triggered by any of the following events:

5.1.1 After a natural disaster, such as an earthquake or major wind storm, or a man-made disaster such as a bomb blast, Level 2;

5.1.2 After a recall or published concern over a specific product or system, Level 1;

5.1.3 Upon a change of property ownership, Level 1;

5.1.4 Before repeating a ~~new~~ novel, unique or atypical design, Level 1;

5.1.5 As dictated by government regulations, Level 1 or 2; or

5.1.6 When distress is discovered (see Section 8), Level 2, or, if prevalent distress is found, Level 3.

5.2 In addition to event-triggered evaluations, it is recommended that proactive owners also perform periodic evaluations at the following intervals: (Note that some of these periods may overlap. If distress is found during any evaluation, then more frequent and more in-depth evaluations should be considered.)

5.2.1 When convenient, such as in conjunction with occasional glass replacement, or when access is available, Level 1;

5.2.2 Immediately after installation of a new system, Level 2;

5.2.3 Just before expiration of the warranty period, Level 2;

5.2.4 Between 1 and 2 years after substantial completion, Level 1;

5.2.5 After 5 years, Level 1;

5.2.6 After 10 years, Level 2;

5.2.7 After 15 years, Level 1 (if Level 2 was performed as recommended after 10 years); and

5.2.8 After 20 years, and each successive 10 years, Level 2.

6. Symptoms of Problems With SSG

6.1 Whether due to original construction mistakes or latent defects, SSG installations sometimes exhibit distress. The following list summarizes conditions that may indicate poor original construction or a subsequent failure of the structural sealant, and therefore require evaluation. This list may not be all-inclusive.

6.1.1 *Glass breakage from an unknown cause*—There are numerous potential causes of spontaneous glass breakage; if the cause is unknown, then it should be investigated prior to glass replacement whether an SSG defect contributed to the failure.

6.1.2 *Air or water infiltration*—If air or water migrates through or to the structural sealant joint, then it must also have lost its structural function—at least for part of its length. Symptoms of air or water leakage include:

6.1.2.1 Visible accumulation of liquid water during or following storms;

6.1.2.2 Wet insulation;

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6.1.2.3 Organic growth;
6.1.2.4 Water stains or salt deposits;
6.1.2.5 Audible rattle or whistle;
6.1.2.6 Discoloration of laminated glazing;
6.1.2.7 Condensation or frost on glazing;
6.1.2.8 Fogging of insulated glass units;
6.1.2.9 *Opacifier failure on spandrel or other glass*—Moisture is a factor in the failure of some opacifiers, and may indicate water infiltration; and
6.1.2.10 *Visible sealant failures*— Sealant failures may be observed from inside or outside, depending on the design, and may involve the weather-seal joint as well as the structural joint. Visible manifestations of sealant failures include:
(1) Intermittent loss of adhesion—Nonadhered sealant may differ in iridescence or reflectivity compared to adhered sealant when viewed through the glass;
(2) Fluid migration or exudation—The accumulation of a fluid residue on the sealant or glass may indicate a chemical reaction between the sealant and an incompatible adjacent material;
(3) Discoloration of the sealant—A color change may indicate a chemical reaction between the sealant and an incompatible adjacent material;
(4) Cohesive failure—Although difficult to observe from inside or outside, cohesive failure could indicate overstressing of the sealant;
6.1.2.11 Disengaged or nonaligned lites, or displaced spacers or setting blocks, which may indicate glass displacement; and
6.1.2.12 *Poor dimensional control of a structural sealant joint*—When viewed from inside or outside, the structural sealant should have uniform dimensions and full joints. Varying dimensions may indicate poor original installation practices, or improper/inadequate cure of the sealant.

7. Procedures for Evaluating Existing Conditions

7.1 The following evaluation procedures are recommended to be performed in determining the condition of an SSG installation. Depending on the reason for the evaluation and the type of installation, only certain procedures may be necessary; for example, more scrutiny is warranted for high-rise, 4-sided SSG than for low-rise, 2-sided SSG. The objective of the evaluation is to obtain a reasonable degree of confidence in the existing system, since one hundred percent certainty is not possible.

7.2 Different levels of expertise are needed to perform the various levels of evaluation, but in all cases a qualified person should supervise the evaluation.

7.3 *Level 1*—Perform all of the following evaluation procedures:
7.3.1 Review project ~~documentation,~~ record drawings/documents, including original design drawings, as-built drawings, shop drawings, mock-up testing report, and previous evaluation reports. Review original SSG design calculations, or if not available, perform calculations to determine stress on sealant from thermal and wind loading (and, where appropriate, seismic loading);
7.3.2 ~~Interview building management and maintenance personnel and tenants regarding~~ Review with building management, maintenance personnel, tenants, and any others with knowledge of the building's history, the breakage history of lites and other observed, suspected or known distress. Map findings on elevation drawings, and assess whether a pattern exists; and
7.3.3 Perform a cursory visual assessment from the interior, and from the exterior ground, roofs, setbacks, and balconies.

7.4 *Level 2*—Perform the following, plus all of the procedures of Level 1 (unless a Level 1 evaluation has been performed previously and the documentation recommended to be kept by the owner in 8.2 is available):
7.4.1 Perform close-up visual evaluation from the interior;
7.4.2 Observe weatherseal joints and structural joints from the exterior. Document distress, and assess whether a pattern exists. Utilize ~~high-powered~~suitable optical tools (scope, binocular, magnifier, camera, drone, etc.) to assist in observing from remote viewing areas, or from suspended scaffolding. Choose scaffold "drops" to represent the entire building, including different wind zones, elevations, exposures, details, and construction times; and
7.4.3 Qualitatively ~~measure~~evaluate the sealant adhesion by pressing in with a ~~thumb.~~ thumb or by the use of a rolling device as described in the Nondestructive Continuous Inspection Procedure in Practice C1521. Alternatively, semi-quantitative adhesion strength data can be obtained using a ~~Chatalon~~suitable spring load ~~indicator,~~ indicator tool, or by pulling cut tabs to failure and measuring the ~~elongation.~~elongation using the procedures and techniques outlined in Practice C1521.

7.5 *Level 3*—Perform all of the following procedures under the field supervision of a qualified person, plus the procedures of Levels 1 and 2 (except that Level 1 may be eliminated if it has been performed previously and the documentation recommended to be kept by the owner in 8.2 is available:
7.5.1 Consider whether the existing conditions indicate that evaluation of all lites is warranted. If not, develop a rational approach for evaluating a representative sample of the total lites. There is a trade-off between accuracy and the cost of the study. For quantitative tests and measurements, it is recommended that the number of specimens or tests be selected to ensure achieving at least a 90 % confidence interval with a maximum 20 % margin of error. Different levels of study may require stricter parameters; and

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