Designation: C1193 – 16

Standard Guide for Use of Joint Sealants[1]

This standard is issued under the fixed designation C1193; 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 use of a cold liquid-applied sealant for joint sealing applications. Including joints on buildings and related adjacent areas, such as plazas, decks, and pavements for vehicular or pedestrian use, and types of construction other than highways and airfield pavements and bridges. Information in this guide is primarily applicable to a single and multi-component, cold liquid-applied joint sealant and secondarily to a precured sealant when used with a properly prepared joint opening and substrate surfaces.

1.2 An elastomeric or non-elastomeric sealant described by this guide should meet the requirements of Specification C834, C920, or C1311.

1.3 This guide does not provide information or guidelines for the use of a sealant in a structural sealant glazing application. Guide C1401 should be consulted for this information. Additionally, it also does not provide information or guidelines for the use of a sealant in an insulating glass unit edge seal used in a structural sealant glazing application. Guide C1249 should be consulted for this information.

1.4 Practice C919 should be consulted for information and guidelines for the use of a sealant in an application where an acoustic joint seal is required.

1.5 This guide also does not provide information relative to the numerous types of sealant that are available nor specific generic sealant properties, such as hardness, tack-free time, or curing process, among others.

1.6 The values stated in SI units are to be regarded as the standard. The values given in parenthesis are provided for information only.

1.7 The Committee with jurisdiction for this standard is not aware of any comparable standards published by other organizations.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 The committee with jurisdiction over this standard is not aware of any comparable standards published by other organizations.

1.10 *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]

C510 Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants

C603 Test Method for Extrusion Rate and Application Life of Elastomeric Sealants

C661 Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer

C711 Test Method for Low-Temperature Flexibility and Tenacity of One-Part, Elastomeric, Solvent-Release Type Sealants

C717 Terminology of Building Seals and Sealants

C719 Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)

C731 Test Method for Extrudability, After Package Aging, of Latex Sealants

C732 Test Method for Aging Effects of Artificial Weathering on Latex Sealants

C734 Test Method for Low-Temperature Flexibility of Latex Sealants After Artificial Weathering

C792 Test Method for Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants

C793 Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants

[1] This standard 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.

Current edition approved Jan. 1, 2016. Published January 2016. Originally approved in 1991. Last previous edition approved in 2013 as C1193–13. DOI: 10.1520/C1193-16.

[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.

C794 Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
C834 Specification for Latex Sealants
C919 Practice for Use of Sealants in Acoustical Applications
C920 Specification for Elastomeric Joint Sealants
C1083 Test Method for Water Absorption of Cellular Elastomeric Gaskets and Sealing Materials
C1087 Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
C1135 Test Method for Determining Tensile Adhesion Properties of Structural Sealants
C1184 Specification for Structural Silicone Sealants
C1216 Test Method for Adhesion and Cohesion of One-Part Elastomeric Solvent Release Sealants
C1241 Test Method for Volume Shrinkage of Latex Sealants During Cure
C1247 Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids
C1248 Test Method for Staining of Porous Substrate by Joint Sealants
C1249 Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazing Applications
C1253 Test Method for Determining the Outgassing Potential of Sealant Backing
C1257 Test Method for Accelerated Weathering of Solvent-Release-Type Sealants
C1265 Test Method for Determining the Tensile Properties of an Insulating Glass Edge Seal for Structural Glazing Applications
C1311 Specification for Solvent Release Sealants
C1330 Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants
C1369 Specification for Secondary Edge Sealants for Structurally Glazed Insulating Glass Units
C1382 Test Method for Determining Tensile Adhesion Properties of Sealants When Used in Exterior Insulation and Finish Systems (EIFS) Joints
C1401 Guide for Structural Sealant Glazing
C1442 Practice for Conducting Tests on Sealants Using Artificial Weathering Apparatus
C1472 Guide for Calculating Movement and Other Effects When Establishing Sealant Joint Width
C1481 Guide for Use of Joint Sealants with Exterior Insulation and Finish Systems (EIFS)
C1519 Test Method for Evaluating Durability of Building Construction Sealants by Laboratory Accelerated Weathering Procedures
C1521 Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
C1681 Test Method for Evaluating the Tear Resistance of a Sealant Under Constant Strain
D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
D2203 Test Method for Staining from Sealants
D2453 Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds
E2114 Terminology for Sustainability Relative to the Performance of Buildings

3. Terminology

3.1 *Definitions*—Refer to Terminology C717 for definitions of the following terms used in this guide: adhesive failure, bicellular sealant backing, blooming, bond-breaker, bridge sealant joint, butt sealant joint, cell, cellular material, chalk, chalking, chemically curing sealant, closed cell, closed cell material, closed cell sealant backing, cohesive failure, compatibility, compatible materials, compound, control joint, creep, cure, cured, dirt pick-up, durability, durability limit, elastomeric, elongation, expansion joint, fillet sealant joint, gasket, hydrostatic pressure, isolation joint, fluid migration, joint filler, laitance, latex sealant, modulus, non-sag sealant, open cell, open cell material, open cell outgassing, premature deterioration, primer, reversion, rundown, seal, sealant, sealant backing, self-leveling sealant, service life, shelf-life, shrinkage, silicone sealant, skin, solvent release sealant, structural sealant, substrate, tooling, tooling time, weathertight, working life (pot life).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *precured sealant, n*—a preformed, factory cured, elastomeric material.

4. Significance and Use

4.1 This guide provides information and guidelines for consideration by the designer or applicator of a joint seal. It explains the properties and functions of various materials, such as sealant, sealant backing, and primer, among others; and, procedures such as, substrate cleaning and priming, and installation of the components of a sealed joint. It presents guidelines for the use and application of the various materials, design of a sealant joint for a specific application, and environmental conditions and effects that are known to detrimentally affect a sealant joint. The information and guidelines are also useful for those that supply accessories to the sealant industry and for those that install sealants and accessory materials associated with sealant use.

4.2 In addition to the design and installation data in this guide, consult the sealant manufacturer about applications for its products and their proper use and installation. Considering the range of properties of commercially available sealants, the variety of joint designs possible, and the many conditions of use, the information contained herein is general in nature.

4.3 It should be realized that a sealant and sealant joint are expected to have a design life during which they remain functional. However, a sealant and sealant joint will also have a service life. The intent is for service life to meet or exceed design life. There are many factors that can affect service life including type of sealant polymer, sealant formulation, compatibility with adjacent materials, installation techniques or deficiencies, sealant joint design (or lack thereof), proper maintenance (or lack thereof), and environmental exposure, among others. The designer of a joint seal should take the above into consideration when designing and specifying sealants for certain applications.

4.4 The design life of a sealant or sealant joint should be considered in conjunction with the design life of the structure for which it is used. For example, a building owner may require a new courthouse building to have an expected design life of 50 years. Therefore, elements of the building's exterior envelope should, with proper maintenance, be expected to perform for that time period. As a result of the information in 4.3 it should be realized that a sealant or sealant joint may not perform for that time period without proper maintenance. Proper maintenance could include replacement of localized sealant and sealant joint failures and conceivably complete sealant replacement, perhaps more than once, during that 50 year time period depending on a sealant's polymer base and its particular formulation. Sealant replacement needs to be considered and when needed should be easily accomplished.

4.5 To assist the user of the guide in locating specific information, a detailed listing of guide numbered sections and their descriptors are included in Appendix X1.

5. General Considerations

5.1 *General*—Proper selection and use of a sealant is fundamental to its ultimate performance, service life, durability, and sustainability. A sealant joint subjected to movement and other similar performance factors should be designed for the particular application to avoid compromising the sealant's performance capability and causing failure of the sealant (See 15). If not designed for the particular application, failure is a possibility. Of equal importance is the proper selection and use of other materials and products associated with sealant use. These include substrate cleaner, surface conditioner or primer, type of sealant backing material, bondbreaker, and joint filler, among others. The ability of a sealant installation to remain weathertight is critically dependent on proper preparation, continuity, durability of the substrates to which the sealant will adhere, and compatibility of the sealant with the materials it will contact, including the substrates. The proper application and installation of the various sealant materials and products, following the established joint design criteria, is fundamental to realizing the intended service life of the sealant. For a sealant joint that is difficult or expensive to access (for example, tall buildings and certain roofs) a sealant should be selected that provides the optimum combination of performance characteristics (for example, adhesion, movement capability and resistnce to environmental conditions) appropriate for that application.

5.2 *Durability*—The durability of a sealant and a sealant joint is related to many factors. For example, environmental exposure to solar radiation, ozone, heat-aging, and atmospheric contaminants can lessen sealant durability. Inadequate construction tolerances and improper sealant joint design for movement and other effects can contribute to sealant joint failure, which is usually expressed as adhesive or cohesive failure of the sealant. Inadequate installation (for example, where the sealant profile is inappropriate for movement, where substrates have not been properly cleaned and, if required, primed, and the sealant inadequately tooled, among others) is a common cause of failure. Conditions of exposure and design (where, for example, a sealant joint is exposed to constant wetting or to pedestrian or other traffic) can lessen sealant and sealant joint durability. The type of sealant, its primary polymer backbone, and the particular sealant formulation can also contribute to lessened durability, especially if a sealant is used in an application, or under conditions of use, not appropriate for it. Frequently, various combinations of environmental exposure and conditions of use occur which can result in lessened durability. For example, depending on sealant type, joint movement combined with heat aging and cold weather exposure or joint movement combined with heat aging and moisture can result in failure. To enhance durability, it is important that the sealant type is matched to the conditions of use and exposure and that the sealant joint is of proper design for those conditions of use and exposure. In any event, eventual replacement of a sealant that has reached its durability limit must be planned for in the initial design and installation to facilitate future remedial work.

5.2.1 *Durability Testing*—Presently, testing for sealant durability consists of exposing small-scale sealant samples to conditions intended to simulate the effects of movements (as in Practice C719), and to artificial weathering by actinic radiation, moisture, and heat, without cycling movement, in a laboratory accelerated weathering device according to Practice C1442. Laboratory artificial weathering and heat aging can be useful in the evaluation of the effects on sealants related to wash out, cracking, discoloration, and adhesion failure. The applicable ASTM test methods are Test Method C732 for sealants conforming to Specification C834, Test Method C1257 for solvent release sealants conforming to C1311, and Test Methods C792 and C793 for sealants conforming to Specification C920. Additionally, environmental exposure at various locations (for example Florida, Arizona, Texas, and certain sites in northern latitudes) is also conducted. Correlation of artificial weathering to environmental exposure is important to assess the relevance of laboratory test results to predicting sealant performance during environmental use (**1, 2**). Laboratory tests to date indicate that at least several thousand hours of artificial weathering exposure is necessary to adequately predict a minimum level of environmental performance. For example, if changes occur five times faster in a laboratory device than under environmental conditions (a typical average acceleration factor for a number of materials), and the desired lifetime of a material is about five years, as much as one year of artificial weathering may be necessary to qualify a material for the application. The latest ASTM weathering standards recommend as a minimum exposure time, the duration necessary to produce a substantial change in the property of interest for the least stable material being evaluated. However, this may not be long enough to qualify a material for the desired application. Environmental performance will vary with latitude. For example, a sealant used in Chicago will perform differently than the same sealant used in Florida for a similar application. Compass orientation also has an effect, with a northerly exposure sealant tending to last longer than a southerly exposure in the northern hemisphere. The incident solar radiation is a primary contributing factor, among others, to lessened durability. The ability of a sealant to resist degradation due to solar radiation may also be dependent on the sealant manufacturer's requirements, such as thickness of the installed sealant. Other conditions being equal, the sealant in Chicago will in general perform for a longer time period than the same sealant used in Florida.

5.2.1.1 The latest durability testing programs indicate that artificial weathering performed concurrently with movement of a sealant joint sample seems to more realistically predict sealant and sealant joint environmental performance (**3**, **4**, **5**, **6**). Current ASTM laboratory test methods, that include a durability component, such as C719, do not provide an adequate prediction of sealant long-term environmental performance and therefore potential sealant and joint durability.

5.2.1.2 Test method C719 evaluates the movement of a new sealant without the benefit of any aging or weathering and thereby provides data only for an unaged sealant.

5.2.1.3 The user of a sealant should realize that most manufacturers' data sheets report laboratory testing data conducted in an idealized, as-cured state and not in a weathered condition that represents how the sealant will actually appear and perform on a building. Additionally, the performance and other properties reported on many data sheets does not include movement during the curing process.

5.2.1.4 Almost all building sealant applications have movement-during-cure. These natural movements during cure almost always decrease the performance capability of a sealant. Therefore, data sheet performance properties, if correct, generally overstate the expected environmental and cyclic movement performance of a sealant. With this in mind, a sealant joint design should always be performed with mitigating design factors included in the design to account for movement-during-cure (See 12.5).

5.3 *Adhesion*—Obtaining and then maintaining long-term adhesion of a sealant is the primary variable in a successful installation. A sealant manufacturer will determine what is necessary to achieve adequate adhesion to a particular substrate, and if a primer or surface conditioner is necessary, by using laboratory test methods. In some applications, glass, metal or other substrates may have coatings, surface treatments or difficult-to-remove contaminants requiring special cleaning techniques or primers. Due to this surface variability, the substrates should be sampled and tested by the sealant manufacturer from actual production runs of the materials. Specification C920 requires a sealant to be rated as Use M, A, G, or O. When listed by a sealant manufacturer it indicates that, in general, the sealant has been found to adhere to and is suitable for use with that substrate type. This is not necessarily a guarantee of adhesion. Samples of the actual substrate should always be tested for adhesion before use, since materials and finishes can be variable or products can change with time and formulation from that as previously tested. Consideration should also be given to identifying a sealant which, without the use of primers if possible, will provide adequate adhesion.

5.3.1 *Adhesion Testing*—Adhesion of a sealant to a substrate surface or another material or component is determined using laboratory Test Methods C794 and C719. Adhesion testing by a sealant manufacturer typically will be performed after one day or 7 days of water immersion. For many applications this is not an adequate test exposure to predict long term sealant joint performance. It is the user's responsibility to evaluate the water immersion condition of an adhesion test conducted by the sealant manufacturer and determine if it is applicable to a particular use. If not, the user should obtain appropriate data consistent with the intended application. In general, for most materials, sealant manufacturers have extensive previous adhesion testing experience and can usually indicate if their sealant will or will not adhere to a generic material's surface. Therefore, pre-qualification testing, prior to specifying, is usually not necessary unless the manufacturer does not have relevant data for a particular material or if the adhesion to a generic substrate varies significantly. Careful review of a sealant manufacturer's data sheet is important, since some only report extension or simple cyclic movement performance not including all the Test Method C719 parameters and conditions. To monitor for any subsequent surface changes, consideration should be given to evaluating substrate adhesion on the installed substrates at the project site prior to beginning the installation of the sealant and periodically during the installation. Practice C1521 describes project site adhesion testing methods.

5.4 *Compatibility*—A sealant must be compatible with the materials and surfaces with which it will be in contact. Occasionally, materials that are in close proximity, but not in contact with the sealant, can have an effect on the installed sealant. Incompatibility can cause, as a minimum, a discoloration of the sealant or, at its extreme, sealant deterioration or adhesion loss. Compatibility must never be assumed but always established by a formal program of testing by the sealant manufacturer, since there are no "always compatible" combinations of a sealant with other materials. A sealant should be tested for compatibility with other sealants which it may contact and with materials and finishes it contacts or is in close proximity. Materials and finishes, with time and exposure to the ultraviolet component of sunlight, can exude or release plasticizers or other materials into a sealant, which can cause a sealant to change color or lose adhesion. Also, these accessories can have surface residues or contaminants from manufacturing that can migrate into the sealant. A change of sealant color is evidence of a potentially detrimental chemical reaction, and although adhesion may not be initially lost, the color change could be predictive of a future loss of adhesion. Other sealant characteristics that could also be affected by incompatibility include the ability of a sealant to cure fully, its ultimate strength development, and its aesthetic qualities.

5.4.1 *Compatibility Testing*—Materials or components that are nearby or touch the sealant should be tested for compatibility using Test Method C1087. This test is performed in the laboratory with prepared samples of substrate finishes, gaskets, and various accessory materials, among others. Any color change of the sealant after testing, is sufficient evidence to cause additional evaluation for use of the candidate material or finish. This test is usually performed to prequalify a material or component for use. In general, for most materials, sealant manufacturers have extensive previous compatibility testing