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# Standard Guide for Selecting Aerospace and General Purpose Adhesives and Sealants<sup>1</sup>

This standard is issued under the fixed designation D6465; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This guide is intended to assist design engineers, manufacturing/industrial engineers, and production managers in selecting the best-fit adhesive/sealant or bonding/sealing process. The guide takes into account environmental pollution prevention and occupational health and safety factors in a selection process.

1.2 This guide is not to be considered as a database of acceptable materials. It will guide the engineers and managers through the adhesive/sealant material selection process, calling for engineers to customize their selection based on the bonding or sealing performance requirements for the specified application. A comprehensive selection process will allow for the establishment of a more efficient production process, and may eliminate unnecessary process steps. A total life cycle cost analysis or performance/cost of implementation study is recommended to compare the available alternatives.

1.3 This guide is for aerospace and general purpose operations. It is not intended to be used for automotive, carpet, construction, electronics, medical/dental, optical, or structural and nonstructural wood applications. Note that this guide is not specifically for these applications, but the general methodology may be used in the selection process for these applications.

1.4 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

[D56 Test Method for Flash Point by Tag Closed Cup Tester](#)

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.60 on Adhesive Material Classification System.

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<sup>2</sup> 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.

- [D896 Practice for Resistance of Adhesive Bonds to Chemical Reagents](#)
- [D897 Test Method for Tensile Properties of Adhesive Bonds](#)
- [D903 Test Method for Peel or Stripping Strength of Adhesive Bonds](#)
- [D905 Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading](#)
- [D907 Terminology of Adhesives](#)
- [D950 Test Method for Impact Strength of Adhesive Bonds](#)
- [D1002 Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading \(Metal-to-Metal\)](#)
- [D1062 Test Method for Cleavage Strength of Metal-to-Metal Adhesive Bonds](#)
- [D1084 Test Methods for Viscosity of Adhesives](#)
- [D1144 Practice for Determining Strength Development of Adhesive Bonds](#)
- [D1146 Test Method for Blocking Point of Potentially Adhesive Layers](#)
- [D1151 Practice for Effect of Moisture and Temperature on Adhesive Bonds](#)
- [D1183 Practices for Resistance of Adhesives to Cyclic Laboratory Aging Conditions](#)
- [D1184 Test Method for Flexural Strength of Adhesive Bonded Laminated Assemblies](#)
- [D1310 Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus](#)
- [D1337 Practice for Storage Life of Adhesives by Viscosity and Bond Strength](#)
- [D1338 Practice for Working Life of Liquid or Paste Adhesives by Consistency and Bond Strength](#)
- [D1780 Practice for Conducting Creep Tests of Metal-to-Metal Adhesives](#)
- [D1781 Test Method for Climbing Drum Peel for Adhesives](#)
- [D1828 Practice for Atmospheric Exposure of Adhesive-Bonded Joints and Structures](#)
- [D1875 Test Method for Density of Adhesives in Fluid Form](#)
- [D1876 Test Method for Peel Resistance of Adhesives \(T-Peel Test\)](#)
- [D1879 Practice for Exposure of Adhesive Specimens to Ionizing Radiation](#)

- D1916** Test Method for Penetration of Adhesives (Withdrawn 2005)<sup>3</sup>
- D1994** Test Method for Determination of Acid Numbers of Hot-Melt Adhesives
- D1995** Test Methods for Multi-Modal Strength Testing of Autohesives (Contact Adhesives)
- D2093** Practice for Preparation of Surfaces of Plastics Prior to Adhesive Bonding
- D2095** Test Method for Tensile Strength of Adhesives by Means of Bar and Rod Specimens
- D2240** Test Method for Rubber Property—Durometer Hardness
- D2293** Test Method for Creep Properties of Adhesives in Shear by Compression Loading (Metal-to-Metal)
- D2294** Test Method for Creep Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal)
- D2295** Test Method for Strength Properties of Adhesives in Shear by Tension Loading at Elevated Temperatures (Metal-to-Metal)
- D2556** Test Method for Apparent Viscosity of Adhesives Having Shear-Rate-Dependent Flow Properties
- D2557** Test Method for Tensile-Shear Strength of Adhesives in the Subzero Temperature Range from  $-267.8$  to  $-55^{\circ}\text{C}$  ( $-450$  to  $-67^{\circ}\text{F}$ )
- D2583** Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
- D2651** Guide for Preparation of Metal Surfaces for Adhesive Bonding
- D2674** Methods of Analysis of Sulfochromate Etch Solution Used in Surface Preparation of Aluminum
- D2918** Test Method for Durability Assessment of Adhesive Joints Stressed in Peel
- D2919** Test Method for Determining Durability of Adhesive Joints Stressed in Shear by Tension Loading
- D2979** Test Method for Pressure-Sensitive Tack of Adhesives Using an Inverted Probe Machine
- D3111** Test Method for Flexibility Determination of Hot-Melt Adhesives by Mandrel Bend Test Method
- D3121** Test Method for Tack of Pressure-Sensitive Adhesives by Rolling Ball
- D3163** Test Method for Determining Strength of Adhesively Bonded Rigid Plastic Lap-Shear Joints in Shear by Tension Loading
- D3164** Test Method for Strength Properties of Adhesively Bonded Plastic Lap-Shear Sandwich Joints in Shear by Tension Loading
- D3165** Test Method for Strength Properties of Adhesives in Shear by Tension Loading of Single-Lap-Joint Laminated Assemblies
- D3166** Test Method for Fatigue Properties of Adhesives in Shear by Tension Loading (Metal/Metal)
- D3167** Test Method for Floating Roller Peel Resistance of Adhesives
- D3278** Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
- D3310** Test Method for Determining Corrosivity of Adhesive Materials
- D3433** Test Method for Fracture Strength in Cleavage of Adhesives in Bonded Metal Joints
- D3528** Test Method for Strength Properties of Double Lap Shear Adhesive Joints by Tension Loading
- D3632** Test Method for Accelerated Aging of Adhesive Joints by the Oxygen-Pressure Method
- D3762** Test Method for Adhesive-Bonded Surface Durability of Aluminum (Wedge Test)
- D3807** Test Method for Strength Properties of Adhesives in Cleavage Peel by Tension Loading (Engineering Plastics-to-Engineering Plastics)
- D3929** Test Method for Evaluating Stress Cracking of Plastics by Adhesives Using the Bent-Beam Method
- D3931** Test Method for Determining Strength of Gap-Filling Adhesive Bonds in Shear by Compression Loading
- D3933** Guide for Preparation of Aluminum Surfaces for Structural Adhesives Bonding (Phosphoric Acid Anodizing)
- D3983** Test Method for Measuring Strength and Shear Modulus of Nonrigid Adhesives by the Thick-Adherend Tensile-Lap Specimen
- D4027** Test Method for Measuring Shear Properties of Structural Adhesives by the Modified-Rail Test
- D4317** Specification for Polyvinyl Acetate-Based Emulsion Adhesives
- D4339** Test Method for Determination of the Odor of Adhesives
- D4497** Test Method for Determining the Open Time of Hot Melt Adhesives (Manual Method)
- D4498** Test Method for Heat-Fail Temperature in Shear of Hot Melt Adhesives
- D4499** Test Method for Heat Stability of Hot-Melt Adhesives
- D4501** Test Method for Shear Strength of Adhesive Bonds Between Rigid Substrates by the Block-Shear Method
- D4562** Test Method for Shear Strength of Adhesives Using Pin-and-Collar Specimen
- D4689** Specification for Adhesive, Casein-Type
- D4690** Specification for Urea-Formaldehyde Resin Adhesives
- D4783** Test Methods for Resistance of Adhesive Preparations in Container to Attack by Bacteria, Yeast, and Fungi
- D4800** Guide for Classifying and Specifying Adhesives
- D5041** Test Method for Fracture Strength in Cleavage of Adhesives in Bonded Joints
- D5267** Test Method for Determination of Extrudability of Cartridge Adhesives
- D5363** Specification for Anaerobic Single-Component Adhesives (AN)
- D5573** Practice for Classifying Failure Modes in Fiber-Reinforced-Plastic (FRP) Joints
- D5648** Test Method for Torque-Tension Relationship of Adhesives Used on Threaded Fasteners (Lubricity)
- D5649** Test Method for Torque Strength of Adhesives Used on Threaded Fasteners

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

- D5656 Test Method for Thick-Adherend Metal Lap-Shear Joints for Determination of the Stress-Strain Behavior of Adhesives in Shear by Tension Loading
- D5657 Test Method for Fluid Tightness Ability of Adhesives Used on Threaded Fasteners
- D5868 Test Method for Lap Shear Adhesion for Fiber Reinforced Plastic (FRP) Bonding
- D6195 Test Methods for Loop Tack
- D6361 Guide for Selecting Cleaning Agents and Processes
- E229 Test Method for Shear Strength and Shear Modulus of Structural Adhesives (Withdrawn 2003)<sup>3</sup>

**3. Terminology**

3.1 *Definitions*—For technical terms pertaining to adhesives and sealants, see Terminology D907.

3.2 *Classifications*—For the identification and classification system of adhesives and sealants, see Guide D4800. (Related documents: Specification D4317; Specification D4689; Specification D4690; Specification D5363; and Test Method D1994.)

**4. Summary of Guide**

4.1 Table 1 is a summary of the five step approach for selecting adhesives/sealants and bonding or sealing processes for use in aerospace and general purpose operations. This guide is based on adhesive/sealant performance in accordance with specific adherends and substrates. The user’s performance requirements play a key role in the process, along with the environmental, and safety and health parameters. Adherend/substrate material surface preparation and cleaning also play a key role in the performance of adhesives/sealants, and are factored-in as part of this selection process. For each step the user of the guide will provide specific information on a particular aspect of their process. Then the user should consult

**TABLE 1 Summary of Guide**

Step	Defined User Requirements	Procedure
1	Define the Environmental, Safety, & Health, Physical and Chemical Requirements of the Application	Physical and Chemical Properties Tests – Verify that the prospective adhesive or sealant is acceptable
2	Define the Reason for Bonding or Sealing	Performance Requirements – Determine the required performance levels for the specific application and prospective adhesive/sealant
3	Define the Material(s) to be Bonded or Sealed	Performance/Material Compatibility Test(s) – Verify that the prospective adhesive/sealant will not harm the component(s) being bonded or sealed and will perform to the desired level of bonding or sealing for the particular application
4	Determine Configuration, Cleaning, and Preparation Requirements	Applicable processes and equipment. Cleaning levels and preparation of the adherend and substrate critical to the performance of the adhesive or sealant
5	Select Adhesive or Sealant	Validate performance, environment, cost, preparation, and worker health and safety

the guide, which will provide appropriate guidance on evaluation criteria that should be followed in order to evaluate the potential adhesive or sealant. Table 1 provides a summary of the user-defined requirements information and the procedures to be provided by the guide. The order of the steps presented in Table 1 is suggested, but not crucial to the successful use of the guide. Section 6 will provide greater details on both the user input and the guidance provided.

**5. Significance and Use**

5.1 The guide is to be used by anyone developing bonding or sealing requirements for specifications for manufacturing, maintenance or overhaul. This guide has been designed to be application specific for each bonding or sealing application, and allows the design engineer to rest assured that the product(s) or process(es) selected by the industrial or manufacturing engineer will be compatible with both the part material and the subsequent processes, such as adherend/substrate cleaning and preparation. It allows the industrial or manufacturing engineer to customize the selection of the adhesive or sealant product based on the materials of the parts being bonded or sealed, the conditions required for the subsequent process(es), environmental, cost, and health and safety concerns.

**6. Procedure**

6.1 *Step 1—Define the Requirements of the Application*—The first step taken in selecting an adhesive/sealant is to determine the requirements of the application. These requirements include environmental, safety and health, and the physical and chemical properties of the adhesive/sealant itself, the application’s performance levels, and surface preparation/cleaning.

6.1.1 *Environmental, Safety, and Health Requirements*—Table 2 presents some of the more common concerns regarding adhesive and sealant and their effects on the environment, and worker safety and health. To use Table 2, the engineer should find their concerns on the left-hand column of the table, and ensure that the adhesive/sealant meets the requirements listed in the right-hand column.

6.1.2 *Physical, Chemical, and Performance Properties*—Table 3 presents some of the more common concerns regarding adhesives/sealants and their physical, chemical, and performance properties, and the corresponding tests required to evaluate those properties. To use Table 3, the engineer should

**TABLE 2 Environmental, Safety and Health Requirements**

Concern	Requirement
Environment	Compliance with all federal, state, and local laws and regulations, and manufacturer’s recommendations concerning the procurement, use and disposal of the adhesive or sealant and associated materials
Worker Safety and Health	Compliance with OSHA and other regulatory & non-regulatory sources including manufacturer’s exposure recommendations ACGIH, etc.; provide sufficient personal protective equipment to ensure the health and safety risks of using the adhesive or sealant are minimized