



Designation: D1828 – 01 (Reapproved 2021)

Standard Practice for Atmospheric Exposure of Adhesive-Bonded Joints and Structures¹

This standard is issued under the fixed designation D1828; 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 practice covers the procedure for the direct exposure of adhesive bonded joints and structures to natural atmospheric environments.

1.2 The procedure for sheltered atmospheric exposure, such as a Stevenson screen (**1**),² of adhesive-bonded joints and specimens is the same except for the requirements of facing south and measurement of solar radiation.

1.3 This practice is limited to the procedure by which samples are exposed and does not cover the tests that may be used to evaluate the effects of atmospheric exposure on these adhesive-bonded joints and structures. These samples could be any one of several varieties.

1.3.1 A complete structure for test,

1.3.2 A section of a structure for test,

1.3.3 A complete structure or section with strength observations on specimens cut therefrom,

1.3.4 Test specimens themselves, or

1.3.5 Any of the above, mounted under stress.

1.4 Suitable test methods for evaluation of the effects of exposure include nondestructive qualitative or quantitative observations on the same sample at prescribed intervals, or destructive tests on separate sets of specimens in accordance with such tests as Test Method **D1002**.

NOTE 1—See Test Methods **D896** and **D897**.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *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 This practice is under the jurisdiction of ASTM Committee **D14** on Adhesives and is the direct responsibility of Subcommittee **D14.40** on Adhesives for Plastics.

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² The boldface numbers in parentheses refer to the list of references at the end of this practice.

1.7 *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:*³

D896 Practice for Resistance of Adhesive Bonds to Chemical Reagents

D897 Test Method for Tensile Properties of Adhesive Bonds

D907 Terminology of Adhesives

D1002 Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)

2.2 *ASTM Adjuncts:*

ASTM Standard Racks and Pipe Frames Blueprints⁴

3. Terminology

3.1 *Definitions:*

3.1.1 Many terms used in this practice are defined in Terminology **D907**.

4. Significance and Use

4.1 The atmospheric exposure tests described in this practice will evaluate the stability of the adhesive bond only in terms of a particular natural atmosphere. Since the atmospheric conditions vary greatly from year to year, these results will not be as reproducible as those derived from laboratory aging procedures. Considerable research has shown that laboratory artificial weathering tests will not give consistently good correlation with outdoor test exposures (**2, 3, 4**).

³ 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.

⁴ Blueprints of ASTM standard racks and pipe frames may be obtained from ASTM International Headquarters. Order Adjunct No. **ADJD1828**. Original adjunct produced in 1957.

5. Exposure Sites

5.1 The choice of exposure sites is dependent upon the objective of the particular test program.

5.2 In the cases of both metallic and nonmetallic adherends, choose exposure sites to include variations in average temperature (and temperature range), relative humidity, and precipitation.

6. Apparatus

6.1 *Racks*—Expose the sample on racks⁴ which are so positioned that the exposed surfaces are at an angle of 45° to the horizontal and facing true south. Exceptions to the direction that the specimens face will be permitted in the case of beach exposures, where the specimens usually face parallel to the beach. Place racks on a supporting frame high enough and so constructed that there will be no background for a distance of at least 30 cm (11.8 in.) in any direction from the back of specimens mounted on them. When the frame is positioned on soil, ensure that the distance between the bottom edge of any specimen and the plane of the cleared area great enough to prevent any undesirable effects of grass or plant growth during the period of exposure. In case of roof exposure, ensure that surrounding walls do not shade the specimens or impede the air flow over them. Design the racks that samples or specimens will be affixed directly to the rack by means of a clamping device made of an inert, insulating material that will allow them to expand or contract with thermal and humidity changes.

6.2 *Climatological Instruments*—If detailed information is necessary, operate instruments suitable for determining average daily temperature, average daily relative humidity, and total daily rainfall at or near each of the exposure sites (5, 6, 7). If such instruments are available at some already existing installation or U. S. Weather Bureau Station in the vicinity of any site, the records from these are to be considered satisfactory (Note 2). If complete characterization of climatological conditions is necessary (for transparent adherends, for instance), make a record of total daily solar radiation, reported MJ/m² (langleys) (Note 3).

NOTE 2—Weather may vary appreciably at two locations only a relatively short distance apart. It must be established to the satisfaction of the operator that no significant error will be introduced by using climatological data from a site other than the exposure site.

NOTE 3—A pyrheliometer in conjunction with a recording potentiometer has been found suitable for recording solar radiation (8).

7. Test Specimens

7.1 In cases where quantitative evaluation is to be made on specimens cut or machined from the exposed sample, prepare the specimen in accordance with the specific test method. Recognize that this is not as severe a test as when the specimen edges have been exposed before evaluation. In cases where it is desired to know the effect of the exposure on exposed edges, expose test specimens rather than samples prior to testing. Where specimens are cut from an exposed sample, record the relative location of the specimens in the sample, as effects that depend on the distance of the specimen from the exposed edge of the sample have been noted.

7.2 Provide for the number of specimens required by each test method plus at least one additional specimen for each test method with the number of specimens cut from each sample. The additional specimens serve as spares in the event of an anomalous or faulty specimen.

NOTE 4—It is recommended that control specimens of a material of known behavior be included in each exposure test to serve as at least a qualitative measure of weather variability.

7.3 The number of samples is based on a statistical analysis of the test program consistent with the number of specimens in each sample. The number of specimens for each removal period is in accordance with the number required by each test method and includes specimens from at least two exposed samples.

7.4 Evaluation intervals for exposed specimens depend on the purpose and test duration. Generally, at least three withdrawal intervals are needed to give a reasonable indication of a material's weathering characteristics (9).

8. Procedure

8.1 Prior to exposure, condition all samples at the standard conditions of 23.0 ± 1°C (73.4 ± 1.8°F) and 50 ± 2 % relative humidity for not less than 40 h. Then test a control of the number of specimens required by the test specifications and record the results. Store a second control at standard conditions of 23.0 ± 1°C (73.4 ± 1.8°F) and 50 ± 2 % relative humidity to be tested at the conclusion of the exposure period.

8.2 Inscribe the specimens to be exposed with an identifying number, letter, or symbol so that they are readily identified after exposure. Ensure that the identifier does not interfere with either the exposure or subsequent testing.

8.3 Measure the dimensions and note the appearance of the test specimens in accordance with the exposure test specifications and record these values.

NOTE 5—If appearance of the adhesive as observed through the adherend is one of the factors of the test program, develop a system of uniform observation based on intensity and discoloration on an area basis.

8.4 Affix the specimens to the exposure racks by means of inert insulating materials with the edge of the overlap on the exposed face parallel to the ground and facing downward.

8.5 Test for a minimum of one year, unless a shorter time is necessary because of the lack of durability of the adherends. Where tests of less than one year duration are to be used, start exposure in the spring and continue for the first few weeks of cool weather. In southern areas, such as Florida, where climatic conditions are more uniform throughout the year, the time of year when short-term exposure is carried out may be less critical. In all localities, the longer period of exposure produces more reliable results.

8.6 After exposure, again note and record the appearance of the specimens. When performing other than visual appearance tests, condition the specimens for not less than 40 h at 23.0 ± 1°C (73.4 ± 1.8°F) and 50 ± 2 % relative humidity. Measure the dimensions, including warpage if any, of the specimens after the conditioning period just prior to testing.