



Designation: D6117 – 23

Standard Test Methods for Mechanical Fasteners in Plastic Lumber and Shapes¹

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INTRODUCTION

The use of plastic lumber and shapes often involves the use of mechanical fasteners, such as nails, screws, bolts, lag screws, and connectors. Data on the strength and performance of such fasteners are frequently needed for design and for comparative purposes. Presented herewith are methods of conducting tests for nail, staple and screw withdrawal resistance and lateral load transmission by nail, staple, screw, and bolt. The use of standard methods for these tests is recommended as a means of obtaining comparable data and of eliminating variables in test results because of variation in testing methods.

1. Scope*

1.1 These test methods cover the evaluation of fastener use with “as manufactured” plastic lumber and shapes through the use of two different testing procedures.

1.2 The test methods appear in the following order:

	Sections
Test Method A—Nail, Staple, or Screw Withdrawal Test	4 to 13
Test Method B—Nail, Staple, or Screw Lateral Resistance Test	14 to 22

1.3 Plastic lumber and plastic shapes are currently made predominately from recycled plastics. However, these test methods would also be applicable to similar manufactured plastic products made from virgin resins where the product is non-homogeneous in the cross-section.

1.4 The values stated in inch-pound units are to be regarded as standard. The SI units given in parentheses are for information only.

1.5 *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.*

NOTE 1—There is no known ISO equivalent to this standard.

1.6 *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 Recom-*

mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 *ASTM Standards:*²

D883 Terminology Relating to Plastics

D1761 Test Methods for Mechanical Fasteners in Wood and Wood-Based Materials

D6111 Test Method for Bulk Density And Specific Gravity of Plastic Lumber and Shapes by Displacement

D6341 Test Method for Determination of the Linear Coefficient of Thermal Expansion of Plastic Lumber and Plastic Lumber Shapes Between –30 and 140°F (–34.4 and 60°C)

E4 Practices for Force Calibration and Verification of Testing Machines

2.2 *ANSI Standards:*³

B18.6.1 American National Standard for Slotted and Recessed Head Wood Screws

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms relating to plastics used in this test method, refer to Terminology D883.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *plastic shape, n*—a manufactured product made primarily from plastic materials (filled or unfilled), which is not necessarily rectangular in cross section.

¹ These test methods are under the jurisdiction of ASTM Committee D20 on Plastics and are the direct responsibility of Subcommittee D20.20 on Plastic Lumber.

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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.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

*A Summary of Changes section appears at the end of this standard

TEST METHOD A—NAIL, STAPLE, OR SCREW WITHDRAWAL TEST

4. Scope

4.1 This test method provides a basic procedure for evaluating the resistance of plastic lumber and shapes materials to direct withdrawal of nails, staples, and screws. Spikes are included as nails in this test method.

4.2 This test method also provides a basis for determining comparable performance of different types and sizes of nails, staples, and screws in direct withdrawal from plastic lumber and shapes.

5. Summary of Test Method

5.1 Specimens consist of “as manufactured” plastic lumber and shapes, with nails, staples, or screws driven at right angles to one or more faces. The fasteners are withdrawn at a uniform rate of speed by means of a testing machine, and the maximum load is recorded. Supplementary physical properties of the plastic lumber and shapes are also determined.

6. Significance and Use

6.1 The resistance of plastic lumber and shapes to direct withdrawal of nails, staples, or screws is a measure of its ability to hold or be held to an adjoining object by means of such fasteners. Factors that affect this withdrawal resistance include the physical and mechanical properties of the plastic lumber and shapes; the size, shape, and surface condition of the fasteners; the speed of withdrawal; physical changes to plastic lumber and shapes or fasteners between time of driving and time of withdrawal; orientation of fiber axis; the occurrence and nature of prebored lead holes; and the temperatures during insertion and withdrawal. These factors will be as circumstances dictate, and representative of the normal manufacturing process.

6.2 By using a standard size and type of nail, staple, or screw, withdrawal resistance of plastic lumber and shapes can be determined. Throughout the method this is referred to as the basic withdrawal test. Similarly, comparative performances of different sizes or types of nail, staple, or screw can be determined by using a standard procedure with a particular plastic lumber and shape, which eliminates the plastic lumber and shapes product as a variable. Since differences in test methods can have considerable influence on results, it is important that a standard procedure be specified and adhered to, if test values are to be related to other test results.

7. Apparatus

7.1 *Testing Machine*—Any suitable testing machine that is capable of operation at a constant rate of motion of the movable head and has an accuracy of $\pm 1\%$ when calibrated in accordance with Practices E4.

7.2 *Grips*—A gripping device shaped to fit the base of the fastener head and of such a design as to allow accurate clamping assembly that will hold the specimen to one platen of the machine is also required. A suitable test mechanism for screw withdrawal is illustrated in Fig. 1.

8. Test Nails, Staples, or Screws

8.1 Nails:

8.1.1 Nails used for basic withdrawal tests shall be diamond-point round-wire, low-carbon-steel nails nominally 0.148 in. (3.76 mm) in diameter and 3 in. (76 mm) in length (See Note 2). Use each nail only once.

NOTE 2—A 10d galvanized common steel wire nail meets this requirement.

8.1.2 For determining holding ability of different sizes or types of nails in plastic lumber and shapes, the respective sizes and types of nail will be as circumstances dictate. These nails shall be representative of the normal manufacturing process, and special cleaning of the shank shall normally not be undertaken.

8.2 Staples:

8.2.1 Staples used for basic leg withdrawal resistance shall be nominally 2.0-in. (51-mm) long, $\frac{7}{16}$ -in. (11-mm) crown, 15 gage (0.072-in. (1.83-mm)) galvanized steel staples. Use each staple only once.

8.2.2 For determining holding ability of different types or sizes of staples in plastic lumber and shapes, the respective staples shall be representative of the normal manufacturing process, and special cleaning of the legs shall not normally be undertaken.

8.3 Screws:

8.3.1 Screws used for basic withdrawal tests shall be nominally 1-in. (25-mm) No. 10-gage flathead low-carbon-steel wood screws as described in ANSI B18.6.1. Use each screw only once.

8.3.2 For determining holding ability of different sizes and types of screws in plastic lumber and shapes, the respective size and types of screw will be as circumstances dictate. These screws shall be representative of the normal manufacturing process.

9. Sampling

9.1 Sampling needs to provide for selection of representative test materials on an objective and unbiased basis, covering an appropriate range in density and properties as circumstances suggest.

9.2 The tests need to be sufficiently extensive to provide reliable results. Where analysis by statistical procedures is contemplated, experience and sometimes advance estimates can be used to establish the scope of testing and type of sampling needed to achieve the expected reliability.

NOTE 3—The precision required, and thus the manner of sampling and number of tests, will depend upon specific objectives. No specific criteria therefore can be established. General experience indicates that the coefficient of variation from tests of fasteners ranges from about 15 to 30 %. When such is the case, precision of 5 to 10 %, with 95 % confidence (an often-accepted general measure of reliability for testing of wood products) cannot be achieved without making a rather large number of tests. The present recommendation is to make at least ten replications for each variable as a minimum requirement.

10. Test Specimen

10.1 Nail and Staple Withdrawal