Designation: D 617 – 84 (Reapproved 1998)

An American National Standard

# Standard Test Method for Punching Quality of Phenolic Laminated Sheets[1]

This standard is issued under the fixed designation D 617; 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.

*This standard has been approved for use by agencies of the Department of Defense.*

## 1. Scope

1.1 This test method covers the determination of the punching quality of phenolic laminated sheets ⅛ in. (3.2 mm) and under in thickness. It involves the use of a standard punching die and standard punching practice to form punched specimens both at room temperature, designated as cold punching, and at an elevated temperature of 135°C, designated as hot punching, and a standard system for rating the punched specimens produced.

1.2 The values stated in inch-pound units are to be regarded as the standard.

1.3 *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:*

D 229 Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation[2]

D 785 Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials[3]

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials[4]

## 3. Significance and Use

3.1 This test method further provides for a control test on uniformity of punching quality after this property has been determined with the punching die for a particular grade and thickness. The control test consists in the determination of Rockwell hardness at room temperature, and Rockwell hardness at 135°C under a definitely prescribed procedure.[5]

## 4. Apparatus

4.1 *Punching Die*—A compound die.[6]

4.2 *Oven*—An oven that will provide a temperature of 135 ± 2°C.

4.3 *Hardness Tester*—A Rockwell hardness tester conforming to the requirements prescribed in Test Methods E 18.

## 5. Test Specimens

5.1 *Punching Test Specimens*—Use two strips of the material, each 1⅝ in. (41 mm) in width by 12 in. (305 mm) in length, one cut lengthwise and one cut crosswise from the sheet for punching out specimens in the compound die. The dimensions of the punched specimen are shown in Fig. 1.

5.2 *Hardness Test Specimens*—The specimen for the cold Rockwell hardness test and hot Rockwell hardness test shall conform to that prescribed in Test Method D 785, except that the specimen for the hot Rockwell hardness test shall be 1 in. (25 mm) square.

## 6. Preparation of Apparatus

6.1 The results obtained with this test method will depend upon the care taken in properly assembling the die as well as in the condition of the punch and die. It is recommended that a standard die set be used in order to ensure proper alignment of the punch and die at all times. Examine the cutting edges of the punches, as well as those of the die, for sharpness. If the surfaces are not flat and if the edges are not sharp, it is advisable to grind the surfaces of both the punch and die to ensure good punching.

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[1] This test method is under the jurisdiction of ASTM Committee D-9 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.07 on Flexible and Rigid Insulating Materials.

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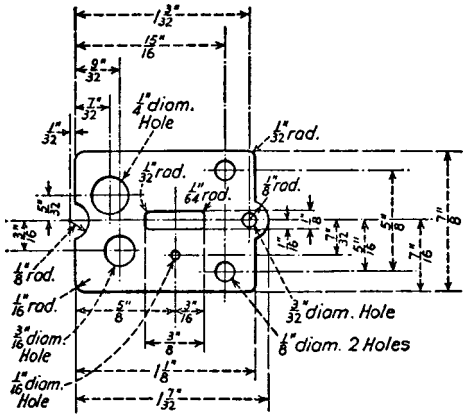
[2] *Annual Book of ASTM Standards*, Vol 10.01.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 03.01.

[5] Another punching method in use is the German punchability rating system DIN 53-488. Copies are obtainable at a nominal cost from ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Request Adjunct No. ADJD0617.

[6] Detailed drawings of the dimensions of the compound die are available at a nominal cost from ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Request adjunct No. ADJD0617.




Inch-Millimetre Equivalents

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| in. | 0.005 | 1/64 | 1/32 | 1/16 | 3/32 | 1/8 | 5/32 | 3/16 | 7/32 | 1/4 | 9/32 |
| mm. | 0.13 | 0.4 | 0.8 | 1.6 | 2.4 | 3.2 | 4.0 | 4.8 | 5.6 | 6.4 | 7.1 |
| in. | 5/16 | 3/8 | 7/16 | 5/8 | 15/16 | 1 3/32 | 1 1/8 | 1 7/32 | | | |
| mm | 7.9 | 9.5 | 11.1 | 15.9 | 23.8 | 27.8 | 28.6 | 31.0 | | | |

**FIG. 1 Punched Test Specimen**

6.2 Set the punching die in the press in a vertical or slightly inclined position and align it well. The punch shall enter the die about 1/64 to 1/32 in. (0.038 to 0.8 mm). The clearances maintained between the punch and die shall be 0.002 in. (0.05 mm).

## 7. Procedure for Punching

7.1 Punch specimens out individually by means of foot release of the press. Do not use continuous punching of specimens. Guide the strips so that the punched specimen is in the center of the strip. Punch no specimens closer together than twice the thickness of the strip. The length of stroke of the punch shall be between 1½ to 2 in. (38 to 50 mm) and the speed running idle shall be between 100 to 150 rpm.

7.2 *Cold Punching*—When strips are punched at room temperature, record the temperature. It is advisable to avoid punching the harder materials in thicknesses over 3/32 in. (2.4 mm) at room temperature, in order to prevent undue stress on the die.

7.3 *Hot Punching*—When strips are punched at elevated temperatures, they shall be heated for 15 min in an oven at 135 ± 2°C, removed one at a time from the oven, and punched immediately. The strips shall be heated for not less than 15 min nor more than 20 min. Stagger the placing of these strips in the oven so that the heating time will be within the required period (see Appendix X1).

## 8. Rating Punching Quality

8.1 To evaluate punching quality, the edges, surfaces, and holes of the punched specimens shall be rated separately in accordance with a point rating system ranging from 100 or excellent to 0 or worthless in accordance with Table 1. The average of these three ratings on each specimen shall constitute the measure of the punching quality of the material. (See Fig. X2.1, Fig. X2.2, and Fig. X2.3, in Appendix X2 illustrating typical characteristics of punched specimens and point ratings of these characteristics.)

## 9. Procedure for Rockwell Hardness Control Test

9.1 *Rockwell Hardness Test*—Use Rockwell hardness as a control test for keeping a check on the punching quality. When the material is to be punched cold, determine the Rockwell hardness at room temperature and when punched, hot, determine the hardness at an elevated temperature.

9.2 *Cold Rockwell Hardness*—Determine the cold Rockwell hardness as described in Test Method D 229.

9.3 *Hot Rockwell Hardness*—Determine the hot Rockwell hardness in general as described in Test Method D 229 with the following additional precautions necessitated by the elevated temperature:

9.3.1 Place enough pieces to make a ¼-in. (6.3-mm) pile-up for the test specimen one layer deep in the oven at 135 ± 2°C for not less than 15 min nor more than 20 min. Discard any pieces left in the oven for more than 20 min since any extra

**TABLE 1 Point Rating of Punched Specimens**

| Rating | Point Score | Edge | Surface | Holes |
|---|---|---|---|---|
| Excellent | 100 | Clean cut | Unaffected | Clean cut, no bulging |
| Very good | 90 | Very slight chipping or very slight drag | Microscopic cracks around edges of piece or holes | Slight chipping in walls of holes or very slight bulging around hole |
| Good | 80 | Slight chipping or slight drag | Very slight surface cracks around edge of piece or holes or slight raising of surface | Some chipping in walls of holes or slight bulging around hole |
| Fair | 70 | Some chipping or drag | Slight surface cracks or some raising of surface around holes | Considerable chipping in walls of holes, some bulging around holes or slight tapering of hole |
| Poor | 50 | Objectionable chipping or drag | Surface cracks around edges of piece or holes or distinct raising of surface | Bad chipping in walls of holes, pronounced bulging around hole, or pronounced tapering of hole |
| Very poor | 25 | Bad chipping or slight cracking of edges | Pronounced surface cracks or pronounced raising of surface at edges or around holes | Slight cracks extending in body of material from holes, severe bulging around holes, or very pronounced tapering of hole |
| Worthless | 0 | Severe chipping or cracking of edges | Very severe surface cracking or raising of surface | Body of material cracked at holes, very severe bulging at holes or closing up to hole with material |

heating may cause an appreciable change in the properties of the material under test and lead to erroneous results.

9.3.2 After heating for 15 min, remove the pieces from the oven, pile up to form a specimen ¼ in. (6.3 mm) in over-all thickness, and start a stop watch the instant the pieces are taken from the oven shelf. Place the specimen pile-up immediately on the Rockwell anvil, and the minor load brought to bear by screwing up the anvil. At the instant the dial indicates zero, apply the major load and as soon as fully applied, that is the instant the crank handle mechanism comes to a stop, remove the major load. Record the number of seconds between the time the specimens were removed from the oven until the maximum hardness value is reached on the scale, together with the reading of the Rockwell hardness value to the nearest 0.5. In good practice, the time for the first test will be between 30 and 50 s.

9.3.3 Release the minor load and move the specimen slightly so that depressions will be at least 3⁄16 in. (4.8 mm) apart. Take a second Rockwell hardness reading and record the time and the Rockwell hardness value to the nearest 0.5 at which an appreciable increase in scale reading ceases.

NOTE 1—Do not wait too long for the needle to stop moving, since an error of 0.5 to 1.0 in the Rockwell hardness value will affect the curve less than 10 to 15 s error in time.

9.3.4 Take a third reading followed by additional readings up to a period of 4 to 5 min with a minimum of five readings. When five readings are taken, complete the third reading between 110 and 130 s, the fourth between 170 and 190 s, and the last between 220 and 260 s. Plot a curve with the time after removal from the oven as abscissas and the Rockwell hardness values as ordinates, using equal scale divisions for 10 Rockwell units and 50 s. (See Appendix X3 for typical curve showing change of Rockwell hardness, M scale, with time after removal of the specimen from the oven.)

## 10. Report

10.1 *Punching Quality Test*—Report the following information:

10.1.1 Thickness of specimen,

10.1.2 Point rating of each punched specimen for edge, surface, and holes, average rating for each of these three, and general average rating for punched specimens,

10.1.3 Room temperature for cold punching test, and

10.1.4 Oven temperature for hot punching test.

10.2 *Rockwell Hardness Control Test*— Report the following information:

10.2.1 Thickness of the specimen pile-up and number of layers of strip in the pile-up,

10.2.2 Cold Rockwell hardness, that is, the average of five readings for each grade of material tested,

10.2.3 Hot Rockwell hardness, 120 s after removal from oven as determined from the curve, that is, the average of two readings for each grade of material tested.

10.2.4 Room temperature for cold Rockwell test, and

10.2.5 Oven temperature for hot Rockwell test.

## 11. Precision and Bias

11.1 Statements of precision and bias are not applicable to this test method since the criterion for acceptability is either pass or fail established quality levels for performance.

## 12. Keywords

12.1 cold punching; hot punching; phenolic laminated sheets; punching quality; Rockwell hardness