Designation: C120/C120M – 15a

Standard Test Methods for Flexure Testing of Structural and Roofing Slate[1]

This standard is issued under the fixed designation C120/C120M; 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.

INTRODUCTION

Breaking load test results of roofing slate under this test method are only valid for the commercial supply of slates of that thickness or greater. For the commercial supply of thinner roofing slates, testing on samples of the minimum specified thickness must be conducted.

When comparing roofing slates of equal thickness, but from various sources, slates which meet the required breaking load at the lowest specimen thickness will yield the best performance on the roof in terms of resistance to impact damage.

The reliability of the data produced under this test method is largely influenced by the care and protocol used in obtaining and preparing the test specimens.

1. Scope

1.1 These test methods cover determination of the breaking load of roofing slate and modulus of rupture of structural slate by use of simple three-point loading.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with 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:*[2]

C119 Terminology Relating to Dimension Stone
C406 Specification for Roofing Slate
C629 Specification for Slate Dimension Stone
E4 Practices for Force Verification of Testing Machines
E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

3. Terminology

3.1 *Definitions*—All definitions are in accordance with Terminology C119.

4. Summary of Test Method

4.1 Prepared and conditioned test specimens are placed on two support blocks in a test stand and loaded vertically at their center point by a third block.

5. Significance and Use

5.1 These test methods are useful in indicating the differences in flexure (breaking load, modulus of rupture) between various slates. These test methods also provide one element in the comparison of roofing slates under Specification C406 and structural slates under Specification C629.

6. Apparatus

6.1 *Ventilated Oven*—Conforming to the requirements of the applicable sections of Specification E145, and capable of maintaining a temperature of 140 ± 4°F (60 ± 2°C) and large enough to accommodate the test specimens.

6.2 *Testing Machine*—(see Fig. 1), conforming to the requirements of the applicable sections of Practices E4. The three-point loading method shall be used in conducting flexure tests employing support and loading blocks that will ensure that forces applied to the beam sill be vertical only and applied without eccentricity. The apparatus should be capable of maintaining the span length and distances between the loading block and support blocks within ±0.05 in. (±1 mm). The load

[1] These test methods are under the jurisdiction of ASTM Committee C18 on Dimension Stone and are the direct responsibility of Subcommittee C18.01 on Test Methods.

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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.

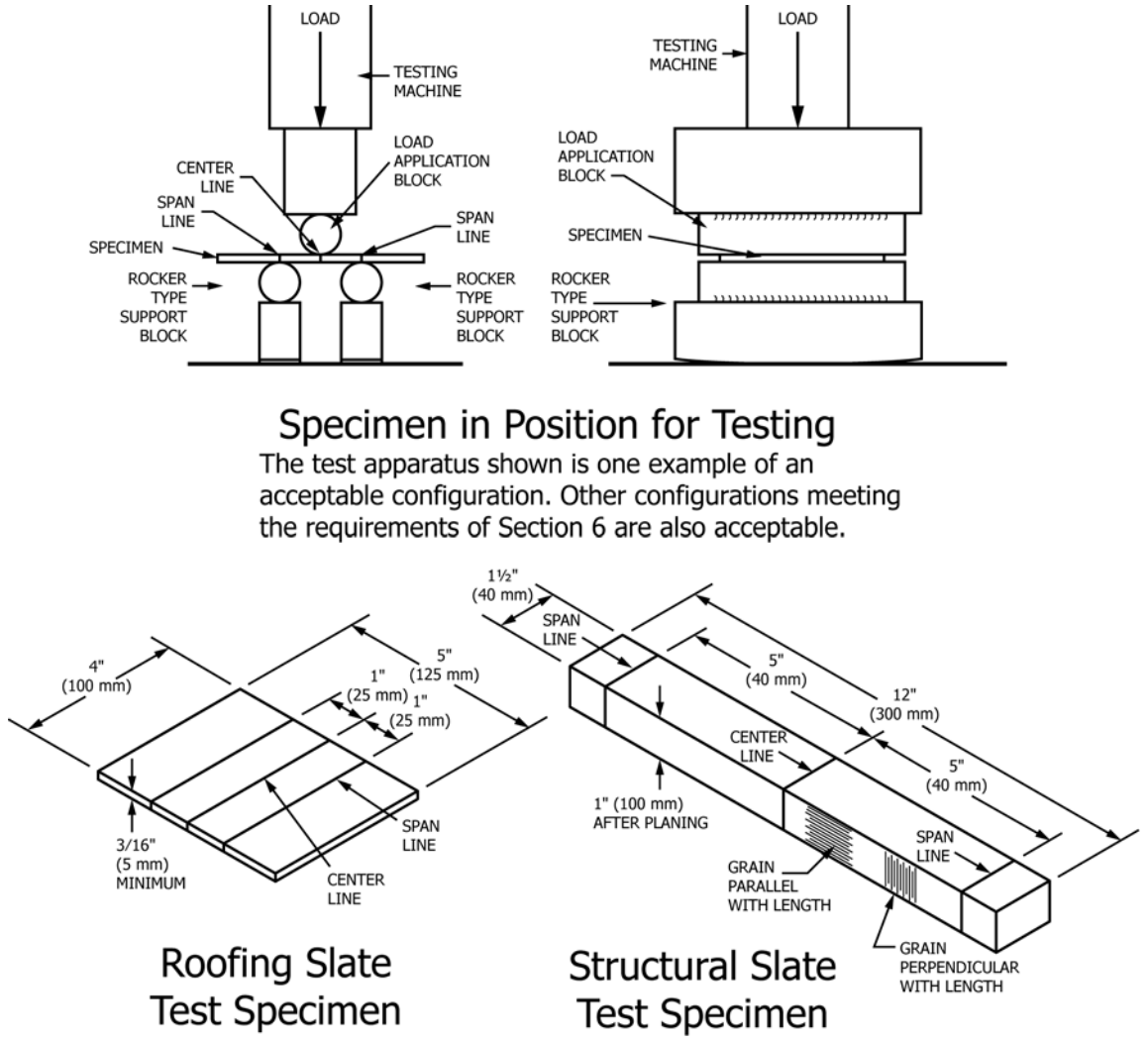

FIG. 1 Specimens and Preferred Type of Loading Application and Support Blocks for Determining the Breaking Load and Modulus of Rupture of Slate

should be capable of being applied at a uniform rate and in such a manner as to avoid shock. The accuracy of the testing machine shall be within 1 % for the range from 10 to 1000 lbf [50 to 5000 N] and capable of being read to the nearest 5 lbf (20 N).

6.3 *Load Application and Support Blocks*—The supports for the specimens shall be of the rocker type (Fig. 1) with the edges at least as long as the width of the specimen. The load application block may be of either the rocker or rigid type. The portions of the load application and support blocks contacting the specimen shall be rounded, with a nominal radius of ½ in. [13 mm].

7. Conditioning

7.1 Dry the specimens for 48 h in a ventilated oven (meeting the requirements of E145) at a temperature of 140 ± 4°F (60 ± 2°C). At the 46th, 47th and 48th hour, weigh the specimens to ensure that the weight is the same. If the weight continues to drop, continue to dry the specimens until there are three successive hourly readings with the same weight. After removing the specimens from the oven, cool them to room temperature in a desiccator prior to testing.

ROOFING SLATE BREAKING LOAD

8. Sampling, Test Specimens, and Test Units

8.1 Select the sample to represent a true average of the slate shingles under consideration and of the quality supplied to the market under the type designation to be tested. The sample may be selected by the purchaser, their authorized representative, or the producer, from shingles fabricated from the quarried stone and shall be of adequate size to permit the preparation of the desired number of test specimens.

8.2 Not less than ten specimens 4 in. [100 mm] in width, 5 in. [125 mm] or greater in length and minimum 3⁄16 in. [5 mm]

thick are required. When perceptible variations occur, as many samples as are necessary may be selected for determining the variation in flexure.

8.3 Cut one 4 by 5 in. [100 by 125 mm] specimen from each shingle. The saw blade shall be a continuous rim, diamond impregnated type, mounted to a water-cooled sliding bed saw capable of making a clean cut with no lacerated edges. Cut no part of the specimen nearer than 1 in. [25 mm] to a sheared edge or nail hole. The 5 in. [125 mm] or longer dimension is to be measured and cut parallel with the long dimension of the slate shingle. Do not resurface the split faces.

8.4 Condition specimens in accordance with 7.1.

9. Procedure

9.1 Rule the center line with a try-square perpendicular to one of the 5 in. [125 mm] edges of each specimen. Rule span lines parallel to, and 1 in. [25 mm] from both sides of the center line.

9.2 Measure the specimen thickness at three points along the center line to the nearest 0.01 in. [0.1 mm] and record the average as the specimen thickness.

9.3 Measure the width of the specimen along the center line to the nearest 0.01 in. [0.1 mm] and record this as the specimen width.

9.4 Lay the specimen flat on the rocker type support blocks as shown in Fig. 1. Apply load at the center of the span through a rocker or fixed type load application block. When the load of 10 lbf [50 N] has been applied, stop the loading and make all the blocks coincide with the marks on the specimen by centering the specimen under the load application block and moving the support blocks under the span marks. Apply loads at rates not exceeding 1000 lbf/min [5000 N/min] until failure and record the breaking load to the nearest 5 lbf [20 N].

NOTE 1—When all three load application and support blocks are of the rocker type, care must be taken to adjust all three until the top face of the specimen is horizontal when loaded.

10. Report

10.1 Report the span length, width of specimen, average thickness of specimen along the center line, breaking load of each specimen and average of the breaking loads. All determinations, conditioning time and weight data for each specimen shall be reported as information.

10.2 The following additional information shall also be reported: Identification of the sample, date when the sample was taken, and the trade name or commercial description of the slate. If available, the name and location of the quarry should also be reported.

STRUCTURAL SLATE MODULUS OF RUPTURE

11. Sampling, Test Specimens, and Test Units

11.1 Select the sample to represent a true average of the structural slate under consideration and of the quality supplied to the market under the type designation to be tested. The sample may be selected by the purchaser, their authorized representative, or the producer from quarried stone or block at the quarry. The samples should be split at the time of extraction to approximately 1¼ in. [30 mm] thickness and a minimum 14 by 14 in. [350 by 350 mm] to permit the preparation of the desired number and size of test specimens. Mark the direction of the grain on each sample in permanent marker.

11.2 Not less than six specimens 1½ in. [40 mm] wide, 12 in. [300 mm] or greater in length and 1 in. [25 mm] thick are required. When perceptible variations occur, as many samples as are necessary may be selected for determining the variation in modulus of rupture.

11.3 Cut one 1½ by 12 in. [40 by 300 mm] specimen from each sample piece. The saw blade shall be a continuous rim, diamond impregnated type, mounted to a water-cooled sliding bed saw capable of making a clean cut with no lacerated edges. Cut three samples with the length parallel to the grain as previously marked, and three samples with the length perpendicular to the grain as previously marked. Mark the grain direction in permanent marker on the 1¼ in. [30 mm] edge of each newly sawn specimen. Machine gauge the 1½ by 12 in. [40 by 300 mm] faces to a thickness of approximately 1 in. [25 mm].

11.4 Condition specimens in accordance with 7.1.

12. Procedure

12.1 Rule the center lines with a try-square perpendicular to one of the 12 in. [300 mm] edges of each specimen. Rule span lines parallel to, and 5 in. [125 mm] from both sides of the center lines.

12.2 Measure the specimen thickness at three points along the center line to the nearest 0.01 in. [0.1 mm] and record the average as the specimen thickness.

12.3 Measure the width of the specimen along the center line to the nearest 0.01 in. [0.1 mm] and record this as the specimen width.

12.4 Lay the specimen flat on the rocker type support blocks as shown in Fig. 1. Apply load at center span through a rocker or fixed type load application block. When the load of 10 lbf [50 N] has been applied, stop the loading and make all the blocks coincide with the marks on the specimen by centering the specimen under the load application block and moving the support blocks under the span marks. Apply loads at rates not exceeding 1000 lbf/min [5000 N/min] until failure and record the breaking load to the nearest 5 lbf [20 N].

NOTE 2—When all three load applications and support blocks are of the rocker type, care must be taken to adjust all three until the top face of the specimen is horizontal when loaded.

13. Calculation

13.1 Calculate the modulus of rupture as follows:

$$R = (3Wl/2bd^2) \quad (1)$$

where:

R = modulus of rupture, psi [MPa],
W = breaking load, lbf [N],
l = span length between support blocks, in. [mm],
b = width of specimen at the center, in. [mm], and
d = thickness of specimen at the center, in. [mm].

14. Report

14.1 Report the span length, width of specimen, average thickness of specimen along the center line, and breaking load of each specimen. Report all modulus of rupture values and the average of all modulus of rupture values for specimens cut parallel to the grain as the modulus of rupture "across the grain." Report all modulus of rupture values and the average of all modulus of rupture values for specimens cut perpendicular to the grain as the modulus of rupture "with the grain." All determinations, conditioning time and weight data for each specimen shall be reported as information.

14.2 The following additional information shall also be reported: Identification of the sample, date when the sample was taken, and the trade name or commercial description of the slate. If available, the name and location of the quarry should also be reported.

15. Precision and Bias

15.1 Individual variations in a natural product may result in deviations from accepted values. A precision section will be added when sufficient data is available to indicate acceptable tolerances in repeatability and reproducibility.

16. Keywords

16.1 breaking load; conditioning; dimension stone; flexure; modulus of rupture; sampling; slate; specimen; testing