



Standard Test Methods for Asphalt Roll Roofing, Cap Sheets, and Shingles¹

This standard is issued under the fixed designation D 228; 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 These test methods cover the procedures for the physical testing and analyses of roofing and shingles composed of asphalt saturated or glass fiber felt coated to various extents with asphalt and having the coated portion surfaced with powders, laminates or granules.

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

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 95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation²
- D 224 Specification for Smooth-Surfaced Asphalt Roll Roofing (Organic Felt)³
- D 225 Specification for Asphalt Shingles (Organic Felt) Surfaced with Mineral Granules³
- D 249 Specification for Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules³
- D 371 Specification for Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules; Wide Selvage³
- D 1079 Terminology Relating to Roofing, Waterproofing, and Bituminous Materials³
- D 2178 Specification for Asphalt Glass Felt Used in Roofing and Waterproofing³
- D 2626 Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing³
- D 3018 Specification for Class A Asphalt Shingles Surfaced with Mineral Granules³
- D 3462 Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules³
- D 3909 Specification for Asphalt Roll Roofing (Glass Felt)

Surfaced with Mineral Granules³

D 4601 Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing³

D 4897 Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing³

D 6380 Specification for Asphalt Roll Roofing (Organic Felt)³

3. Terminology

3.1 For definitions of terms used in this test method, see Terminology D 1079.

4. Significance and Use

4.1 These test methods cover the sampling, physical testing, and compositional analyses of asphalt roofing products fabricated with asphalt coatings. Other components may include, but are not limited to, felts, mats, films, foils, mineral stabilizers, papers, and mineral surfacing.

4.2 Five random samples are required from lots equal to or less than 1000 packages. The number of samples required for lots greater than 1000 packages is dependent on the variation in the unit mass within the lot and is determined by the two-step sampling plan in 6.5.

4.3 The results of a visual examination, physical testing and compositional analysis are required for each sample. The analytical data are further used to compute the probable minimum and the probable range for the average mass of each of the components.

5. Types of Roofing

5.1 Asphalt coated roll roofing and shingles are divided into the following types for the purposes of this test method (see Fig. 1).

5.1.1 *Type 1*—A single thickness of glass felt, coated with asphalt and mineral surfacing such as in Specifications D 2178, D 3462, D 3909, D 4601 and D 4897. The backing material (designated “Fine Mineral Surfacing” in Fig. 1) shall be permitted to be any suitable material that prevents these products from sticking together while packaged.

5.1.2 *Type 2*—A single thickness of asphalt saturated felt coated with asphalt and mineral surfacing such as in Specifications D 224, D 225, D 249, D 2626, and some of the products in Specification D 6380. The backing material (designated “Fine Mineral Surfacing” in Fig. 1) shall be permitted to be any suitable material that prevents these products from sticking

¹ These test methods are under the jurisdiction of ASTM Committee D08 on Roofing, Waterproofing, and Bituminous Materials and are the direct responsibility of Subcommittee D08.02 on Prepared Roofing, Shingles, and Siding Materials.

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² *Annual Book of ASTM Standards*, Vol 05.01.

³ *Annual Book of ASTM Standards*, Vol 04.04.

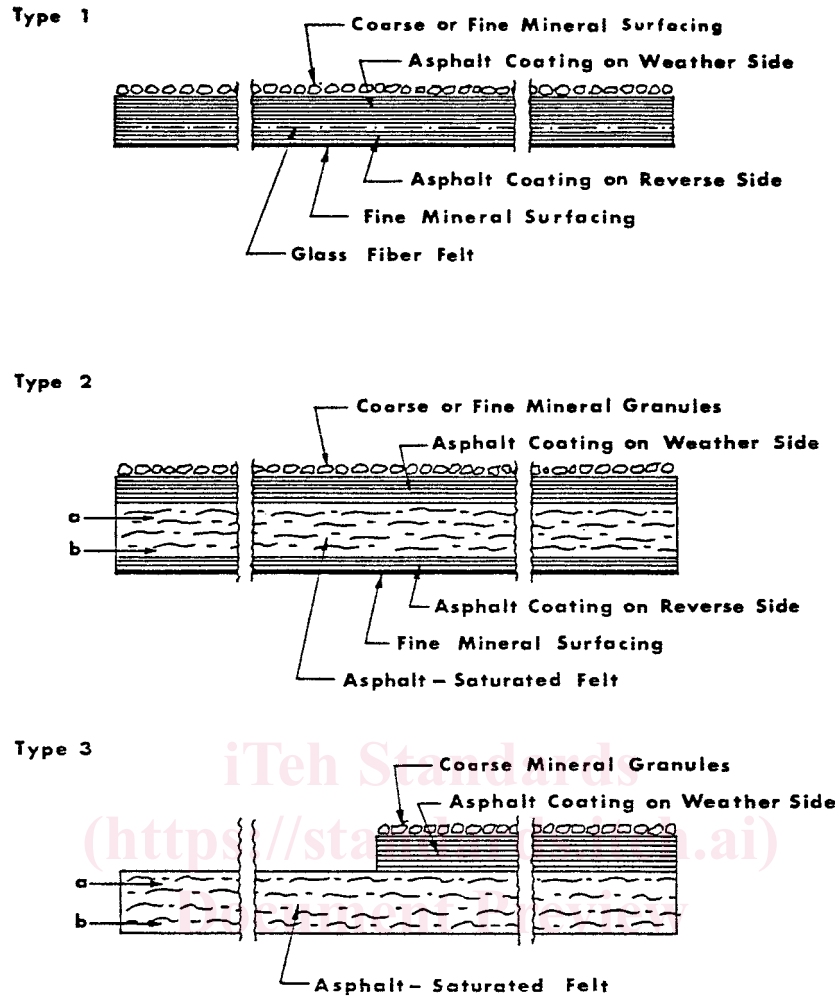


FIG. 1 Types of Asphalt-Coated Roll Roofing and Shingles

<https://standards.iteh.ai/catalog/standards/sist/aa8bf8a4-c756-43c6-aafa-a7cee564edbe/astm-d228-00b>

together while packaged.

5.1.3 *Type 3*—Similar to *Type 2*, but asphalt coated and surfaced with mineral granules for part of one side of the saturated felt such as in Specification D 371.

6. Sampling

6.1 The rolls or bundles selected in accordance with this section constitute the representative sample used in Sections 7 and 8. See Fig. 2.

6.2 The lot is defined as a shipment or fraction thereof representing a product of the same kind, class, and mass.

6.3 Select five rolls or packages from the lot at random. Determine the average net mass per g/m^2 ($\text{lb}/100 \text{ft}^2$) and the standard deviation in accordance with 7.1 to 7.8.

6.4 If the lot is 1000 or fewer rolls or packages proceed to Section 7. If the lot is 1001 or greater in number, follow the second part of the sampling plan in 6.5.

6.5 Calculate the required number of samples based on the standard deviation (s) of the preliminary sampling by:

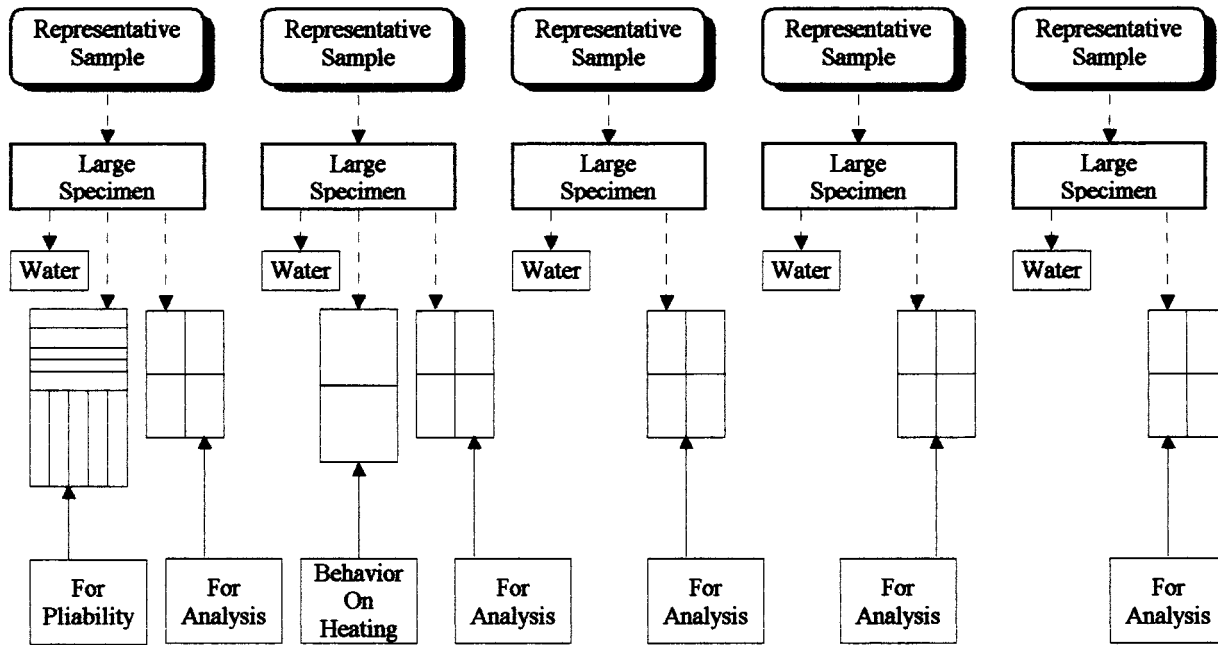
$$n = \frac{t^2 s^2}{d^2} \quad (1)$$

where:

n = total number of samples required ($n - 5$ more rolls or packages must be selected at random as samples),

t = test statistic for number of samples in the preliminary test series for 4° and a 95 % confidence that the calculated average mass will not exceed d ($t = 2.776$), and

d = 100 g/m^2 ($2 \text{ lb}/100 \text{ft}^2$) (the mean mass obtained from the analysis should be within $\pm 100 \text{ g/m}^2$ of the true value, with 95 % confidence).



In Section 6, initial "Representative Samples" are selected (typically 5 per lot). These are full bundles or rolls. These are the samples used in Section 7. In Section 8, one large "Specimen" is taken from each Representative Sample (full shingles from Section 7.5 or a portion of each roll selected in Section 6). These are confirmed to be within 1.5 % of the mass per area (from Section 7.6) for the corresponding Representative Sample. In Section 9, (where product standards require measurement of water content per D 95) 50 gram samples are taken from each "Large Specimen" for determination of water. In Section 10, 5 MD and 5 CD small test specimens are cut from one of the "Large Specimens" for evaluation of pliability. In Section 11, 2 test specimens are cut from one of the "Large Specimens" for evaluation of Behavior on Heating. In Section 12, small test specimens (3 for glass felt, 4 for organic felt) are cut from each of the "Large Specimens" for "analysis" by Section 13 (for glass felt) or by Section 14 (for organic felt).

FIG. 2 Sample selection summary and flow diagram
(See individual sections for sample selection details)

7. As Received Mass and Area Determinations, All Types of Roofing

7.1 *Gross Mass*—Determine and record the mass of each roll or package in the sample to the nearest 0.1 kg (0.2 lb).

7.2 *Net Mass*—Disassemble each package or unroll each roll; shake off any loose surfacing and determine and record the net mass of all the shingles or the entire roll to the nearest 0.1 kg (0.2 lb.). Where a product standard requires it, the loose surfacing is to be collected and the mass determined.

7.3 *Packaging and Fixture Mass*—Determine and record the mass to the nearest 0.1 kg (0.2 lb) of the packaging and all associated fixtures shipped with the roll or package, such as nails and adhesive.

7.4 *Dimensions of Roll Products*—Measure and record the length and width of each roll of roofing and the selvage width to the nearest 3 mm (1/8 in.).

7.5 *Shingle Count and Dimensions*—From each of the representative sample packages generated in Section 6, count and record the number of shingles in each package. Select one shingle randomly from each package. Measure the width, length, and cutout dimensions for each of these selected shingles to the nearest 1 mm (1/32 in.). Calculate and record the average for each of these measurements.

7.6 Calculate the area of the roofing and the net mass of the roofing per g/m² (lb/100 ft²) in each roll or package (without packaging, cut outs or loose surfacing).

7.7 Calculate and record the average net mass of the roofing in g/m² (lb/100 ft²).

7.8 Calculate and record the estimate of the standard deviation by:

$$s = \sqrt{\frac{\sum X^2}{n-1} - \frac{(\sum X)^2}{n(n-1)}} \quad (2)$$

where:

- s = unbiased estimate of the standard deviation,
- $\sum X^2$ = sum of the squares of the individual mass determinations,
- $(\sum X)^2$ = square of the sum of the individual mass determinations, and
- n = number of samples.

7.9 Calculate the 95 % confidence interval for the average mass by:

$$\frac{\sum X}{n} \pm \frac{ts}{\sqrt{n}} \quad (3)$$

where:

- $\sum X$ = sum of the individual mass determinations, and
- t = appropriate t statistic for 95 % confidence and $n - 1$ dF ($t = 2.776$ for $n = 5$; consult standard reference table for other values of n).

8. Selection of Representative Specimens, All Roofing Types

8.1 Several product standards reference sampling as designated in accordance with these Test Methods for tests which are not specifically covered by Test Methods D 228. Unless

otherwise specified in these test methods, the samples or specimens for testing shall all be selected from the representative sample (roll or package selected in Section 6) which has the individual net mass per unit area closest to the average net mass per unit area for the combined representative samples as determined in Section 7. If more than one roll or package needs to be selected to provide sufficient specimens for all the tests dictated within the product standard, any additional specimens shall be selected from the representative sample that has the net mass per unit area that is next closest to the average net mass per unit area of the combined representative samples.

NOTE 1—It is the intent of these test methods that whenever not specifically directed to select specimens in some other manner, specimens shall be selected from the representative sample which is the closest in mass per unit area to the average mass per unit area of the combined representative samples.

8.2 For roll products, select a specimen of roofing, the full sheet width and at least 1m (3 ft) in length from each roll, starting a minimum of three wraps into the roll. For shingle products, the shingles from 7.5 shall be used.

8.3 Determine the mass of each specimen and calculate the mass in g/m^2 ($\text{lb}/100 \text{ ft}^2$).

8.4 Discard all specimens that differ by more than 1.5 % from the net mass determined in 7.6, select replacements, and determine the mass as in 8.3.

8.5 Continue this process until five representative specimens are obtained, no more than one from each package or roll, that reflect that roll or package's average net weight as determined in 7.6.

8.6 If fewer than five specimens are available, use all the available specimens and adjust the final calculations to reflect the lower number of samples tested.

ALL ROOFING TYPES

9. Moisture

9.1 Determine the water in each sample in accordance with Test Method D 95; use 50 g (0.11 lb) of product for each determination, cut up to fit in the flask. Report the water content as a percent of the dry (water free) product mass.

ASPHALT ROLL ROOFING AND CAP SHEETS

10. Pliability

10.1 From a large specimen selected in Section 8, cut ten small test specimens 25.4 mm (1 in.) in width by 203 mm (8 in.) in length, five in the direction of and five across the length of the roll. Immerse in water at 25°C (77°F) for 25 to 30 min; then remove and immediately bend each specimen, with the weather side up, at a uniform speed through 90° in approximately 2 s over the rounded edge of a block. The block shall be 76.2 mm (3 in.) square by 50.8 mm (2 in.) thick with rounded corners of 12.7 mm ($\frac{1}{2}$ in.) radius for Type 2 roofing and 19 mm ($\frac{3}{4}$ in.) radius for Types 1, 3, and 4 roofing. When bending, hold the specimens by hand tightly against the upper face of the block, and bend the projecting end of the specimen over the rounded corner without exerting any stress other than that required to keep the specimen in contact with the block and to avoid kinking. For felts, any surface rupture exceeding 3 mm

($\frac{1}{8}$ in.), as measured while bent over the block, is considered a failure. For coated products, failure is defined as cracking of the filled coating asphalt which exposes the reinforcement of the specimen. The cracking shall be visible to the naked eye when the specimen is viewed in the bent condition on the mandrel block. Separation of granules or other superficial fissures which do not extend through the filled coating asphalt surface to the reinforcement do not constitute cracking. Fracture through the specimen is considered a failure. Report the number of specimens failing.

ASPHALT ROLL ROOFING, CAP SHEETS, AND SHINGLES

11. Weight Loss and Behavior on Heating

11.1 Cut two test specimens, each approximately 100 by 100 mm (4 by 4 in.) from a large specimen selected in accordance with Section 8. Condition the smaller specimens for 24 h in a desiccator, weigh to the nearest 0.1 g, and then by means of a thin wire fastened through holes punctured near one edge, suspend them vertically in the center of an air oven maintained at $80 \pm 3^\circ\text{C}$ ($176 \pm 5^\circ\text{F}$) with the cross machine direction vertical. The internal dimensions of the oven shall be not less than 305 by 305 by 305 mm (12 by 12 by 12 in.). The oven shall be electrically heated with forced draft. Insert a thermometer in the center of the oven to such a depth that its bulb is in line with the center of the specimens. Maintain the specimens at the prescribed temperature for $2 \text{ h} \pm 5 \text{ min}$, then cool in a desiccator and weigh each specimen. Calculate the average loss of volatile matter as percentage of the final specimen mass. Record any change in appearance of the specimen such as blistering, absorption of the asphalt coatings, or sliding of coating or granular surfacing. Record the extent of the latter to the nearest 1.6 mm ($\frac{1}{16}$ in.).

METHODS OF ANALYSIS

12. Preparation and Selection of Small Specimens for Analyses

12.1 *Materials of Uniform Composition*—Each of the 5 large specimens selected in Section 8 is to have small specimens cut for composition analysis. Cut 50 by 100 ± 1 -mm ($2 \text{ by } 4 \pm \frac{1}{32}$ -in.) small specimens from each of the large specimens. Compare the equivalent mass per unit area of the small specimens to the mass per unit area previously generated for the large specimens (Section 8). For products that contain organic felt, 4 small specimens must be cut from each large specimen that are within 1.5 % of the equivalent mass per unit area of the large specimen. For products that contain only glass felt, 3 small specimens must be cut from each of the corresponding large specimens that are within 1.5 % of the equivalent mass per unit area of the large specimen. The small specimens from each large specimen are to be kept together as a unit, separate from the small specimens cut from the other large specimens. The “top” of each product is the surface that is applied toward the weather.

12.2 *Materials of Nonuniform Composition*—Cut 50 by 100 ± 1 -mm ($2 \text{ by } 4 \pm \frac{1}{32}$ -in.) small test specimens that are representative of the different materials, types of surfacing or