Designation: D 2523 – 00

Standard Practice for Testing Load-Strain Properties of Roofing Membranes[1]

This standard is issued under the fixed designation D 2523; 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 is a guide for determining the load-strain properties of roofing membranes and their components at various temperatures. Test specimens may be prepared in the laboratory or cut from samples obtained in the field.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units 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 Distillation[2]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension[3]

E 178 Practice for Dealing with Outlying Observations[4]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *roofing membrane*—that part of the roofing system whose primary function is to exclude water; it does not include field-applied aggregate.

4. Significance and Use

4.1 This practice is designed to aid those interested in the engineering properties of roofing membranes.

4.2 The data obtained will not permit prediction of the service life of a membrane under field conditions. The data will provide a basis for study of the mechanical properties of the membrane. Note that if strain rates, specimen dimensions, initial clear distance between clamps, or temperatures and moisture contents are varied, the data may not be strictly comparable.

5. Sampling

5.1 Take field membrane sample at least 100 by 250 mm (4 by 10 in.) in accordance with good roofing practices. In cases where field-applied aggregate is in place, remove it with a scraper such as a heated putty knife.

5.1.1 Sample those areas of the membrane that are expected to represent the extremes in load/strain characteristics.

5.1.2 At least one sample is required for each test temperature at which it is desired to determine load/strain properties.

5.2 Prepare laboratory samples at least 100 by 250 mm (4 by 10 in.) in strict accordance with the roofing specification being tested. Observe all cautions specified, such as not overheating the bitumen. Do not oven condition any of the components or the final sample.

5.2.1 Select those areas of the membrane that are expected to represent the extremes in load - strain characteristics. Prepare at least one sample of each type for each proposed test temperature. If there is any doubt about these areas, include all possible variations. The samples must be uniform in cross section.

5.2.2 Select materials at random when possible. Components should be conditioned at 50 ± 5 % relative humidity and 25 ± 2.5°C (77 ± 4.5°F) for 24 h prior to constructing samples.

5.2.3 The quantity of material in any layer should be within ± 10 %, and the entire sample should be within ± 5 % of the quantities specified.

6. Test Specimens

6.1 Condition the samples at room temperature at 50 ± 5 % relative humidity for a minimum of 16 h for non-solvent-containing membranes, and until constant mass has been reached for solvent-containing membranes.

6.2 Die-cut three tension test specimens from each sample. The shape of the specimens for membranes with less than 50 % ultimate elongation is shown in Fig. 1. Where the membrane has an ultimate elongation greater than 50 %, use Die C of Test Methods D 412.

6.3 At least three specimens must be tested at each selected temperature from each sample. If any sample is too small to permit the removal of three specimens, more than one sample of that type must be prepared or obtained in the field to yield

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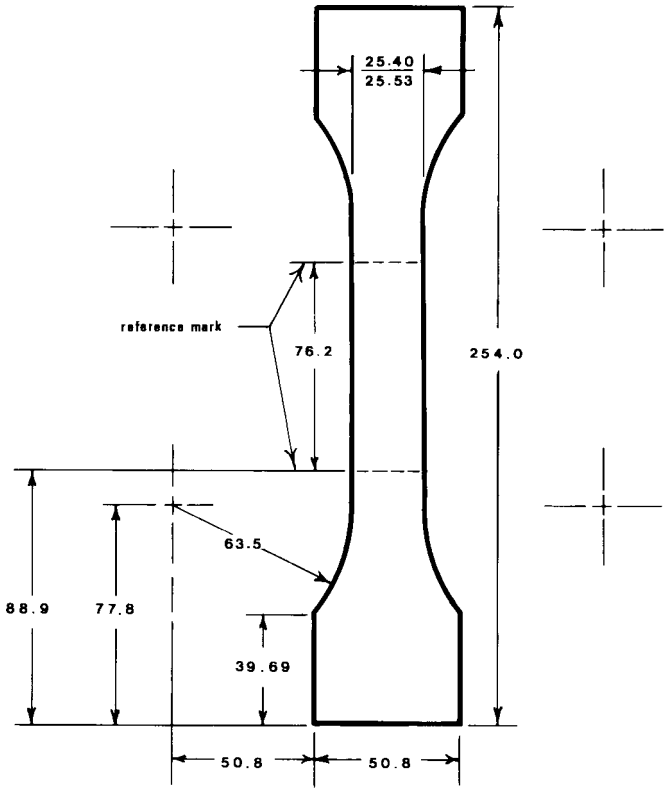
[2] *Annual Book of ASTM Standards*, Vol 05.01.

[3] *Annual Book of ASTM Standards*, Vol 09.01.

[4] *Annual Book of ASTM Standards*, Vol 14.02.



NOTE 1—All dimensions are in millimetres.
FIG. 1 Tension Test Specimen.

the required three specimens.

7. Procedure

7.1 Condition each specimen at least 1 h at the selected test temperature.

7.2 Control the following standard test temperatures to a tolerance of ± 2.5°C (4.5°F): −18°C (0°F), 0°C (32°F), and 25°C (77°F). Recommended additional test temperatures, where appropriate, are: −34.4°C (− 30°F), 50°C (122°F) and 70°C (158°F).

7.3 Use a tension testing machine, preferably with automatic load and strain recording equipment, and clamps that permit a uniform clamping pressure on the specimen without slipping. The clamps should be 178 ± 5 mm (7 ± 0.2 in.) apart at the start of the test.

7.4 Maintain a rate of elongation of 1.0 ± 0.3 %/min for bituminous membranes or other materials having under 50 % ultimate elongation. This rate will be achieved if the jaws are separated at 1.3 mm/min (0.05 in./min).

7.5 Use a rate of elongation of 500 mm/min (20 in./min) for membranes whose ultimate elongation exceeds 50 %.

7.6 Measure the elongation of dumbbell specimens as the change in distance between reference marks on the constricted area of the specimen (see Fig. 1). Discard all specimens breaking outside the reference marks.

7.7 Test a minimum of three specimens from each sample at each selected temperature.

7.8 Measure the moisture content of broken bituminous membrane specimens in accordance with Test Method D 95.

8. Calculation

8.1 Calculate the strain by the following equation:

$$s = 100(c - c_0)/c_0 \quad (1)$$

where:
s = specimen strain, %,
c_0 = distance between reference marks before application of load, and
c = distance between reference marks at a given load.

8.2 Calculate the load/strain modulus by dividing one half the maximum load per unit specimen width by the strain at that load in consistent units. Due to the difficulty of measuring the thickness of roofing membranes, and their nonhomogeneity, loads should be reported in force per unit specimen width.

9. Report

9.1 Report the following information:

9.1.1 Source and type of all components of the membrane,

9.1.2 Specification for the membrane tested,

9.1.3 Details of sample construction, including component orientation and dimensions, specimen shape, test temperature, rate of strain, number of specimens tested, and moisture content,

9.1.4 Strain corresponding to each increase in load of 1.75 kN/m (10.0 lbf/in.) for each specimen,

9.1.5 Load and strain at failure for each specimen,

9.1.6 Load - strain diagram and modulus for each specimen, and

9.1.7 Compute and report the average of all tests on specimens from each sample at each temperature. Disregard individual values exceeding the 5 % level of significance as defined and computed in Practice E 178, and compute a new average without them. The new average must be based on not less than three tests, and preferably more. Comment on any observable factors which may have contributed to large differences from the average.

10. Keywords

10.1 elongation; load-strain; moisture content; roofing membrane; temperature