Designation: ~~D3776/D3776M – 09a (Reapproved 2017)~~ D3776/D3776M – 20

Standard Test Methods for Mass Per Unit Area (Weight) of Fabric[1]

This standard is issued under the fixed designation D3776/D3776M; 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 U.S. Department of Defense.

1. Scope

1.1 These test methods cover the measurement of fabric mass per unit area ~~(weight) and is~~(traditionally referred to as "fabric weight") and are applicable to most fabrics.

1.2 There are four approved options:

1.2.1 *Option A*—Full Piece, Roll, Bolt or Cut (Section 7).

1.2.2 *Option B*—Full Width Sample (Section 8).

1.2.3 *Option C*—Small Swatch of Fabric (Section 9).

1.2.4 *Option D*—Narrow Fabrics (Section 10).

1.3 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~~are not ~~be~~necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the ~~other. Combining~~other, and values from the two systems ~~may result in non-conformance with the standard.~~shall not be combined.

1.4 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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 Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

D1776 Practice for Conditioning and Testing Textiles

D3773 Test Methods for Length of Woven Fabric

D3774 Test Method for Width of Textile Fabric

2.2 *Other Standard:*

ANSI/ASQC Z1.4 Inspection by Attributes[3]

3. Terminology

3.1 The following terms are relevant to this standard: cut; weight.

3.2 For definitions of all other textile terms see Terminology D123.

4. Summary of Test Methods

4.1 Fabric ~~mass~~weight is calculated from the mass of a specimen which has also had the length and ~~width of which have been measured as directed in one of the procedures in Test Method~~ width, or diameter measured.~~D3773 and D3774~~.

---

[1] These test methods are under the jurisdiction of ASTM Committee D13 on Textiles and are the direct responsibility of Subcommittee D13.60 on Fabric Test Methods, Specific.

Current edition approved ~~July 15, 2017~~July 1, 2020. Published ~~August 2017~~August 2020. Replaces Sections 35 to 41 of Methods D1910 – 64 (1975). Originally approved in 1979. Last previous edition approved in ~~2013~~2017 as D3776 – 09a~~(2013).~~(2017). DOI: ~~10.1520/D3776_D3776M-09AR17.~~10.1520/D3776_D3776M-20.

[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.

5. Apparatus

~~5.1 *Scale,* with a capacity and sensitivity sufficient to weigh the full piece, roll, bolt, or cut units to within ±0.1 % of their gross mass. The accuracy of the scale should be certified by a recognized authority.~~

5.1 *Balance,* having ~~a~~ an appropriate capacity and sensitivity to ~~weigh within ±0.1 % of the~~ measure mass of the specimens being ~~tested.~~tested within ±0.1 % of the true value. The balance should be verified and calibrated periodically.

5.2 *Cutting Die,* either square or round with an area of at least 13 cm^2 ~~or 2~~ (2 $in.^2$), for Option C.

6. Conditioning

6.1 Condition test specimens as directed in Practice D1776.

6.2 All ~~weighing~~ tests should be made in the standard atmosphere for testing textiles ~~(21 ± 1°C (70 ± 2°F), 65 ± 2 % RH),~~ (21 ± 2°C (70 ± 4°F), 65 ± 5 % RH), after the specimens have been conditioned in the same atmosphere. It may be impractical to condition the specimens in Option A or nonconditioned testing may be agreed upon by the purchaser and supplier. When the full rolls or bolts of fabric cannot be properly conditioned in a reasonable time with available facilities, perform the tests without conditioning and report the actual conditions prevailing at the time of the test. Such results may not correspond with the results obtained after testing ~~adequately conditioned~~ adequately-conditioned specimens in the standard atmosphere for testing textiles.

7. Option ~~A—Full~~ A – Full Piece, Roll, Bolt, or Cut

7.1 *Significance and Use*

7.1.1 Option A for the determination of ~~mass per unit area of woven fabrics~~ fabric weight may be used for acceptance testing of commercial shipments since it has been used extensively in the trade.

7.1.2 In case of a dispute arising from differences in reported test values when using Test Methods D3776 for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens which are as homogeneous as possible, and which are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using student's *t*-test for unpaired data and an acceptable probability level chosen by the two parties before testing is begun. If a bias is found, either its cause must be found and corrected, or the purchaser and the supplier must agree to interpret future test results in the light of the known bias.

7.2 *Sampling*—As a lot sample for acceptance testing, take at random the number of rolls (or pieces, bolts, cuts) of fabric as directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider rolls of fabric to be the primary sampling units. Consider the rolls of fabric in the lot sample as the laboratory sample and as the test specimens.

7.3 *Procedure:*

7.3.1 Measure the length of the full piece, roll, bolt, or cut by the hand procedure in Test Method D3773.

7.3.2 Measure the width by the tension-free alternative of Option A of Test Method D3774~~.~~, including selvage, if any.

7.3.3 ~~Weigh the~~ Measure the total mass of the fabric, with shell and holder, if any, to ~~the nearest~~ within 0.1 % of its mass.

7.3.4 ~~Weigh the~~ Measure the mass of the holder, if any, to the nearest 0.1 % of its mass.

7.4 *Calculations:*

7.4.1 Determine the net ~~weight~~mass of the fabric by subtracting the ~~weight~~mass of the holder from the total ~~weight.~~mass.

7.4.2 Dimensions and mass may all be determined in SI units and ~~mass per unit area~~ grams per square metre, grams per linear metre, or linear metres per kilogram calculated using Eq 1, Eq 2, or Eq 3, as follows:

$$g/m^2 = 10^3 M/LW \quad (1)$$

$$g/m = 10^3 M/L \quad (2)$$

$$m/kg = L/M \quad (3)$$

where:

~~*M* = mass of fabric, in kilograms,~~
~~*L* = length of fabric, in metres, and~~
~~*W* = width of fabric, in metres.~~

M = mass of fabric, kg,
L = length of fabric, m, and
W = width of fabric, m.

7.4.3 ~~Calculate the mass per unit area, mass~~Alternatively, determine dimensions and mass in inch-pound units. Calculate the ounces per square yard, ounces per linear yard, or linear yards per pound to three significant figures, unless otherwise specified, using Eq 4, Eq 5, ~~Eq 6, or~~or Eq 6 ~~Eq 7,~~ as follows:

~~Mass per unit area:~~

$$oz/yd^2 = 576M/LW \quad (4)$$

~~Mass per yard:~~

$$oz/yd = 16M/L \quad (5)$$

~~Linear yards per pound:~~

$$yd/lb = L/M \quad (6)$$

~~yd/lb = 16 oz/yd (7)~~

where:

~~*M* = mass of fabric, in pounds,~~
~~*L* = length of fabric, in yards, and~~
~~*W* = width of fabric, in inches.~~

M = mass of fabric, lb,
L = length of fabric, yd, and
W = width of fabric, in.

~~7.4.4 If preferred, convert the U.S. customary units to SI units using Eq 8, Eq 9, or Eq 10, as follows:~~

~~Mass, g/m^2 = oz/yd^2 × 33.906 (8)~~

~~Mass, g/m = oz/yd × 31.000 (9)~~

~~m/kg = yd/lb × 2.016 (10)~~

8. Option ~~B—Full~~ B – Full Width Sample

8.1 *Significance and Use:*

8.1.1 This procedure is applicable to a full-width sample cut from a full piece, roll, bolt, or cut. Unless otherwise specified, these results will include selvages and will be on the basis of conditioned fabric.

8.1.2 Option B is not recommended for the acceptance testing of commercial shipments, since Option A is regularly used for that purpose.

8.2 *Sampling:*

8.2.1 *Lot Sample*—As a lot ~~sample for acceptance testing,~~ sample, take at random the number of rolls (or pieces, bolts, cuts) of fabric as directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider the ~~roll~~rolls of fabric to be the primary sampling units.

8.2.2 *Laboratory Sample*—From each roll ~~or piece~~ in the lot sample, cut—don't tear—at least one laboratory sample the full width of the fabric and at least 250 mm (10 in.) in length. The cut edges must be a straight line, free of indentations or bulges, unless both edges have been made to trace parallel filling yarns. In this procedure the complete laboratory sample is used as the specimen.

8.3 *Procedure:*

8.3.1 Measure the length of ~~the~~each conditioned specimen by the hand procedure of Test Method D3773.

8.3.2 Measure the width by the tension-free alternative of Option A of Test Method D3774~~.~~, including selvage, if any.

8.3.3 ~~Weigh the specimen in grams on a scale or balance to the nearest 0.1 % of its mass (weight).~~Measure the mass of the specimen on a balance to within 0.1 %.

8.4 *Calculations:*

8.4.1 ~~Calculate the mass per unit area, mass per linear yard, or linear yards per pound to three significant figures, unless otherwise specified,~~ Dimensions and mass may all be determined in SI units and grams per square metre, grams per linear metre, or linear metres per kilogram calculated using Eq ~~11~~7, Eq ~~12~~8, ~~Eq 13,~~ or Eq ~~14~~9, as follows:

~~Mass per unit area:~~

~~oz/yd^2 = 45.72G/L_sW (7)~~

g/m^2 = $10^6G/L_sW$ (7)

~~Mass per linear yard:~~

~~oz/yd = 1.27G/L_s (8)~~

g/m = $10^3G/L_s$ (8)

~~Linear yards per pound:~~

~~yd/lb = 16/oz per linear yd (13)~~

~~yd/lb = 12.6L_s/G (9)~~

m/kg = L_s/G (9)

where:

~~*G* = mass of specimen, in grams,~~
~~L_s = length of specimen, in inches, and~~
~~*W* = width of specimen, in inches.~~

G = mass of specimen, g,
L_s = length of specimen, mm, and
W_s = width of specimen, mm.

~~8.4.2 If preferred, convert the U.S. customary units to SI units using Eq 4, Eq 5, or Eq 6 in 7.4.3.~~

8.4.2 Alternatively, determine dimensions and mass ~~may all be determined in SI units and calculated~~ in inch-pound units. Calculate ounces per square yard, ounces per linear yard, or linear yards per pound to three significant figures, unless otherwise specified, using Eq ~~15~~10, Eq ~~16~~11, ~~or~~ Eq ~~17~~12~~,~~ as follows:

~~Mass per unit area:~~

$$~~g/m^2 = 10^6 G/L_s W~~ \quad (10)$$

$$oz/yd^2 = 1296 G/L_s W_s \quad (10)$$

~~Mass per linear metre:~~

$$~~g/m = 10^3 G/L_s~~ \quad (11)$$

$$oz/yd = 36 G/L_s \quad (11)$$

~~Linear metres per kilogram:~~

$$~~m/kg = L_s/G~~ \quad (12)$$

$$yd/lb = 16 L_s/G \quad (12)$$

where:

~~*G* = mass of specimen, g~~
~~L_s = length of specimen, mm, and~~
~~*W* = width of specimen, mm.~~

G = mass of specimen, oz,
L_s = length of specimen, in., and
W_s = width of specimen, in.

8.4.3 If more than one specimen is measured, average the results calculated for all specimens in 8.4.1 or 8.4.2.

9. Option ~~C—Small~~ C – Small Swatch of Fabric

9.1 *Significance and Use:*

9.1.1 This procedure is applicable when a small swatch of fabric is sent to the laboratory to be used as the ~~test specimen.~~ sample. The results are considered to be applicable to the sample only and not necessarily to the lot from which the sample was taken.

9.1.2 Measurements by this ~~method~~option do not include selvages and should be reported as such, unless a selvage allowance is specified.

9.1.3 Option C is not recommended for acceptance testing of commercial shipments since Option A is regularly used for that purpose.

9.2 *Sampling*—Option C is used only when limited fabric is available and should not be used for acceptance sampling. Prepare such specimens from ~~small swatches as is possible.~~available swatches.

9.3 *Preparation of Specimens*—Prepare a conditioned specimen having an area of at least ~~130~~100 cm^2 ~~(20~~(15.5 $in.^2$) or a number of smaller die cut specimens taken from different locations in the sample and having a total area of at least ~~130~~100 cm^2 ~~(20~~(15.5 $in.^2$) Do not take these specimens closer than one tenth of the fabric width to a selvage or cut edge. If insufficient fabric is available to meet these criteria, note that fact in the report.

9.4 *Procedure:*

9.4.1 Determine the area of the specimen(s) used. For die-cut specimens, the area of the die is normally given. For ~~other specimens, multiply~~square or rectangular specimens, use Eq 13~~the length~~.

$$A = nLW \quad (13)$$

where:

A = area of specimen, mm^2 ($in.^2$),
n = number of specimens,
L_s = length of specimen, mm (in.), and

W_s = width of specimen, mm (in.).
~~by the width.~~

For circular specimens, use Eq 14.

$$A = n3.14(d/2)^2 \quad (14)$$

where:

A = area of specimen, mm^2 (in.^{2}),
n = number of specimens, and
d = diameter of specimens, mm (in.).

9.4.2 ~~Weigh~~Measure the mass of specimen(s) to within ±0.1 % ~~of mass (weight)~~ on a balance. ~~Specimens of a fabric may be weighed~~ Measure all specimens from a sample together.

9.4.3 If mass per linear distance (g/m, oz/yd) or linear distance per mass (m/kg, yd/lb) is required, measure the full width of the fabric by the tension-free alternative of Option A of Test Method D3774. If full-width sample is not available, nominal width may be used in the calculations below, but must be noted as such in the test report.

9.5 *Calculations:*

9.5.1 Dimensions and mass may be determined in SI units and grams per square metre, grams per linear metre, or linear metres per kilogram calculated using Eq 15 ~~(, 8.4.3),~~ Eq ~~18~~16, or Eq ~~19~~17, as follows:

~~Mass per linear metre:~~

~~$$g/m = 10^3 GW/L_s W_s \quad (15)$$~~

$$g/m^2 = 10^6 G/A \quad (15)$$

~~Linear metre per kilogram:~~

~~$$m/kg = L_s W_s/GW \quad (16)$$~~

$$g/m = 10^3 GW/A \quad (16)$$

$$m/kg = 10^3 A/GW \quad (17)$$

where:

~~G = mass of specimen, g~~
~~W = width of fabric, mm~~
~~L_s = length of specimen, mm, and~~
~~W_s = width of specimen mm.~~

G = total mass of specimen(s), g
W = width of fabric, mm, and
A = area of specimen, mm^2 (see Eq 13 or Eq 14).

9.5.2 Calculate the mass in ounces per square yard, ounces per linear yard, or linear yards per pound to three significant figures using Eq ~~11~~18 ~~(, 8.4.1),~~ Eq 19, or Eq 20, as follows:

$$oz/yd^2 = 1296G/A \quad (18)$$

~~Mass per linear yard:~~

~~$$oz/yd = 1.27GW/L_s W_s \quad (19)$$~~

$$oz/yd = 36GW/A \quad (19)$$

~~Linear yards per pound:~~

~~$$yd/lb = 12.6L_s W_s/GW \quad (20)$$~~

$$yd/lb = 16A/36GW \quad (20)$$

where:

~~G = mass of specimen, g,~~
~~W = width of fabric, in.~~
~~W_s = width of specimen, in., and~~
~~L_s = length of specimen, in.~~

G = mass of specimen, oz,
W = width of fabric, in., and
A = area of specimen, in.^{2} (see Eq 13 or Eq 14).

~~9.5.3 If preferred convert the U.S. customary units to SI units by using Eq 8, Eq 9, or Eq 10 in 7.4.4.~~

10. Option D—Narrow Fabrics

10.1 *Significance and Use:*