

## TENSILE TEST SPECIMENS

**Foreword**—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

- 1. Scope**—When required, unless otherwise specified in the SAE Standards or Recommended Practices, tensile test specimens for metals shall be selected and prepared in accordance with this report. ASTM E 8, Methods of Tension Testing of Metallic Materials, gives more detailed information on tensile testing procedure, and ASTM E 4, Methods of Load Verification of Testing Machines, provides information on testing equipment calibration.

In recommending these specimens for use in tensile tests it is not intended to exclude entirely the use of other test specimens for special materials or for special forms of material. It is, however, recommended that these specimens be used wherever it is feasible.

Machining of specimens shall be done in such a manner as to avoid leaving severe machining strains in the material. Specimens shall be finished so that the surfaces are smooth and free from nicks and tool marks. All ragged edges shall be smoothed.

## 2. References

- 2.1 Applicable Publications**—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

ASTM E 4—Methods of Load Verification of Testing Machines

ASTM E 8—Methods of Tension Testing of Metallic Materials

- 3. Full Section Test Specimens**—For wire, rod, and bars less than 19 mm (3/4 in) diameter or distance between flats, specimens having the full cross section of the material are recommended. It is permissible to reduce the cross section slightly by grinding or machining throughout the test section to insure fracture between gage marks. This may be done either without changing shape of cross section or, on squares, hexagons, or octagons by turning to a round. The following limits apply to such reduction:

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- a. If the same cross sectional shape is retained the final area must be not less than 90% of the original area and the diameter or distance between flats must not be reduced more than 0.3 mm (0.01 in).
- b. If the rod is turned to a round, the final area must be not less than 90% of the area of the maximum inscribed circle and the final diameter must not be less than the original distance between flats minus 0.3 mm (0.01 in).

Fillets must be used at the ends of the reduced section. The fillet radius should be not less than the section diameter.

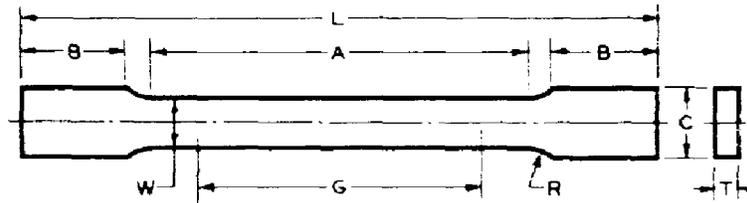
4. **Flat Test Specimens**—The tensile test specimen shown in Fig. 1 [200 mm (8 in) gage length] is recommended for plates, shapes, and flat material having a thickness 4.8 mm (3/16 in) or over.

The tensile test specimen shown in Fig. 1 [50 mm (2 in) gage length] is recommended for sheet, plate, flat wire, strip, band, and hoop ranging in thickness from 0.13–16 mm (0.005–5/8 in) in either case. Where size of material permits, one of the specimens shown in Fig. 2 may also be used.

5. **Round Test Specimens**—The 12.5 mm (1/2 in) diameter round test specimen shown in Fig. 2 is considered standard and is recommended for general testing of metals. Small size specimens proportional to the standard specimen should be used only when it is necessary to test material from which the standard specimen or the specimens shown in Fig. 1 cannot be prepared. Examples of small size specimens are given in Fig. 2.

Smaller miniature specimens for so-called microtensile tests may be used on agreement between supplier and user.

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DIMENSIONS FOR FIG. 1

Dimensions	50 mm Gage Length	2 in Gage Length	200 mm Gage Length	8 in Gage Length
G, Gage length	50.0 ± 0.10 mm	2.000 ± 0.005 in	200 ± 0.25 mm <sup>a</sup>	8.00 ± 0.01 in <sup>a</sup>
W, Width <sup>b</sup>	12.5 ± 0.25 mm <sup>c</sup>	0.500 ± 0.010 in <sup>c</sup>	40 + 3 mm <sup>d</sup> - 6 mm <sup>d</sup>	1-1/2 + 1/8 in <sup>d</sup> - 1/4 in
T, Thickness	Thickness of material	Thickness of material	Thickness of material	Thickness of material
R, Radius of fillet	13 mm min	1/2 in min	25 mm min <sup>e</sup>	1 in min <sup>e</sup>
L, Overall length	200 mm min	8 in min	450 mm min	18 in min
A, Length of reduced section	60 mm min	2-1/4 in min	225 mm min	9 in min
B, Length of grip section <sup>f</sup>	50 mm min	2 in min <sup>g</sup>	75 mm min	3 in min
C, Width of grip section <sup>h</sup>	20 mm approx <sup>h</sup>	3/4 in approx <sup>h</sup>	50 mm approx	2 in approx <sup>i</sup>

<sup>a</sup> Punch mark for measuring elongation after fracture shall be made on the flat or on the edge of the specimen and within the reduced section. Either a set of nine or more punch marks 25 mm (1 in) apart, or one or more pairs of punch marks 200 mm (8 in) apart may be used.

<sup>b</sup> When necessary, a narrower specimen may be used. In such case the width should be as great as the width of the material being tested permits. In such cases, the sides may be parallel throughout the length of the specimen.

<sup>c</sup> The ends of the reduced section shall not differ in width by more than 0.05 mm (0.002 in). There may be a gradual taper in width from the ends to the center, but the width at either end shall not be more than 0.13 mm (0.005 in) greater than the width at the center.

<sup>d</sup> The ends of the reduced section shall not differ in width by more than 0.1 mm (0.004 in). There may be a gradual taper in width from the ends to the center, but the width at either end shall not be more than 0.38 mm (0.015 in) greater than the width at the center.

<sup>e</sup> A 13 mm (1/2-in) min radius at the ends of the reduced section is permitted for steel specimens under 690 MPa (100 000 psi) tensile strength when a profile cutter is used to machine the reduced section.

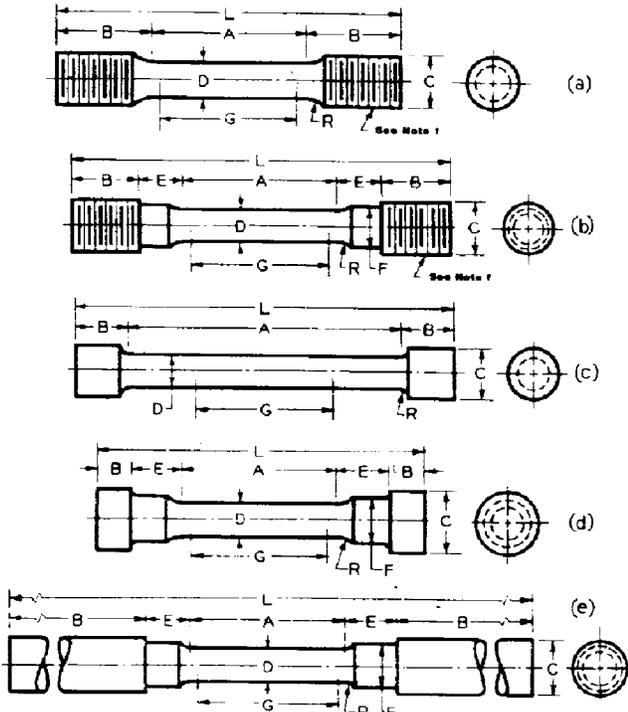
<sup>f</sup> It is desirable, if possible, to make the length of the grip section great enough to allow the specimen to extend into the grips a distance equal to two-thirds or more of the length of the grips.

<sup>g</sup> If the thickness of the specimen is over 10 mm (3/8 in) longer grips and correspondingly longer grip sections of the specimen may be necessary to prevent failure in the grip section.

<sup>h</sup> The ends of the specimen shall be symmetrical with the centerline of the reduced section within 0.03 mm (0.01 in). However, for steel if the ends are symmetrical within 1.3 mm (0.05 in), a specimen may be considered satisfactory for all but referee testing.

<sup>i</sup> The ends of the specimen shall be symmetrical with the centerline of the reduced section within 2.5 mm (0.10 in).

FIGURE 1—STANDARD RECTANGULAR TENSILE TEST SPECIMEN



DIMENSIONS FOR FIG. 2

Standard 12.5 mm Round Tensile Test Specimen					
Dimensions, mm	(a)	(b)	(c)	(d)	(e)
G, Gage length <sup>a</sup>	50.0 ± 0.10	50.0 ± 0.10	50.0 ± 0.10	50.0 ± 0.10	50.0 ± 0.10
D, Dia <sup>b</sup>	12.5 ± 0.25	12.5 ± 0.25	12.5 ± 0.25	12.5 ± 0.25	12.5 ± 0.25
R, Radius of fillet <sup>c</sup>	10	10	2	10	10
A, Length of reduced section	60 min	60 min	100 approx	60 min	60 min
L, Overall length	125	140	140	120	240
B, Length of end section <sup>d</sup>	35 approx	25 approx	20 approx	13 approx	75 min
C, Dia of end section	20	20	18	22	20
E, Length of shoulder and fillet section	—	16 approx	—	20 approx	16 approx
F, Dia of shoulder	—	16	—	16	15

Examples of Small Size Specimens Proportional to Standard				
Dimensions, mm	8.75 mm Round	6.25 mm Round	4.00 mm Round	2.87 mm Round
G, Gage length	35.0 ± 0.10	25.0 ± 0.10	16.0 ± 0.10	11.0 ± 0.10
D, Dia <sup>b</sup>	8.75 ± 0.18	6.25 ± 0.12	4.00 ± 0.08	2.87 ± 0.05
R, Radius of fillet	6 min	5 min	4 min	2 min
A, Length of reduced section <sup>e</sup>	45	32	20	16

Standard 1/2 in Round Tensile Test Specimen					
Dimensions, in	(a)	(b)	(c)	(d)	(e)
G, Gage length <sup>a</sup>	2.000 ± 0.005	2.000 ± 0.005	2.000 ± 0.005	2.000 ± 0.005	2.000 ± 0.005
D, Dia <sup>b</sup>	0.500 ± 0.010	0.500 ± 0.010	0.500 ± 0.010	0.500 ± 0.010	0.500 ± 0.010
R, Radius of fillet <sup>c</sup>	3/8 min	3/8 min	1/16 min	3/8 min	3/8 min
A, Length of reduced section	2 1/4 min	2 1/4 min	4 approx	2 1/4 min	2 1/4 min
L, Overall length	5 approx	5 1/2 approx	5 1/2 approx	4 3/4 approx	9 1/2 approx
B, Length of end section <sup>d</sup>	1 3/8 approx	1 approx	3/4 approx	1/2 approx	3 min
C, Dia of end section	3/4	3/4	23/32	7/8	3/4
E, Length of shoulder and fillet section	—	5/8 approx	—	3/4 approx	5/8 approx
F, Dia of shoulder	—	5/8	—	5/8	19/32

Examples of Small Size Specimens Proportional to Standard				
Dimensions, in	0.350 in Round	0.250 in Round	0.160 in Round	0.113 in Round
G, Gage length	1.400 ± 0.005	1.000 ± 0.005	0.64 ± 0.005	0.45 ± 0.005
D, Dia <sup>b</sup>	0.350 ± 0.007	0.250 ± 0.005	0.160 ± 0.003	0.113 ± 0.002
R, Radius of fillet	1/4 min	3/16 min	0.15 min	0.09 min
A, Length of reduced section <sup>e</sup>	1 3/4 min	1 1/4 min	3/4 min	5/8 min

<sup>a</sup> The gage length and fillets shall be as shown, but the ends may be of any form to fit the holders of the testing machine in such a way that the load shall be axial. If the ends are to be held in grips it is desirable, if possible, to make the length of the grip section great enough to allow the specimen to extend into the grips a distance equal to two-thirds or more of the length of the grips.

<sup>b</sup> The reduced section may have a gradual taper from the ends toward the center, the ends not more than 0.13 mm (0.005 in) larger in diameter than the center.

<sup>c</sup> On specimen (e) it is desirable, if possible, to make the length of the grip section great enough to allow the specimen to extend into the grips a distance equal to two-thirds or more of the length of the grips.

<sup>d</sup> The reduced section may have a gradual taper from the ends toward the center, the ends not more than 0.08 mm (0.003 in) larger in diameter than the center.

<sup>e</sup> If desired, on the small size specimens the length of the reduced section may be increased to accommodate an extensometer. However, reference marks for the measurement of elongation should nevertheless be spaced at the indicated gage length.

<sup>f</sup> Specimens (a) and (b) may use any standard thread that provides proper alignment and assures that the specimen will break within the reduced section.

FIGURE 2—ROUND TENSILE TEST SPECIMENS WITH VARIOUS TYPES OF ENDS