Procedure for Testing of Deformed Steel Bars for Concrete Reinforcement

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1. Scope:

This test method covers the procedure for mechanical testing of deformed steel bars used in concrete reinforcement. The mechanical test herein is used to determine properties required in the product specifications.

2. Apparatus:

2.1 Tension testing machine (Conforming to AASHTO T244).

2.2 Extensometer (Conforming to AASHTO T244).

2.3 Elongation gauge or calipers.

3. Procedure:

3.1 Initial sample data.

A. Collect all samples received and examine:

1. Sample size must come as a pair (2) either epoxy or black.
2. Sample size pair must be matching designation bar numbers and grade.
3. Each sample size has a separate DOT-1, sample ID number, and representing not more than 3 sizes to be tested.
4. Minimum length of 24 inches.

NOTE: Do not test higher than a #8 bar.

B. Record the length (1/16”), weight (0.0001 lb.), designation bar number (Size), grade, and weight per foot using the following equation:

Weight per foot = (Weight/length) = (0.001) lb./ft.

C. Each bar must be gauge marked 8 inches. The gauge marks shall be on longitudinal ribs, if present, or in clear spaces of the deformation pattern. The marks shall not be put on transverse deformations. Black bars shall be marked with a file and epoxy bars marked with a permanent marker.

NOTE: Light marks are desirable on black bars because deep marks may affect the results.

3.2 Testing.

A. The jaws of the tension machine must line up with the 8 inch gauge marks and be tightened.

B. An extensometer is attached to the bar between the 8 inch gauge marks. To minimize slipping of the extensometer, do not clamp on a deformation or a longitudinal rib.

C. Run the machine at a correct continuous and uniform ideal force rate depending on the bar designation number as seen in table 1.

Table 1 - Ideal force rate

Size	Min. force rate (Lbf./Min)	Max. force rate (Lbf./Min)	Ideal force rate (Lbf./Min)
#3	1,080	11,040	6,000
#4	1,980	19,620	10,800
#5	3,060	30,660	16,800
#6	4,440	44,160	24,600
#7	6,000	60,120	33,000
#8	7,860	78,540	43,200

D. Remove the extensometer once yield has begun or when the tensile testing machine displays a message to remove.

E. Once the extensometer has been removed, keep the tensile testing machine at the correct continuous and uniform ideal force rate until fracture occurs.

F. Test only one bar from the sample size. If rejection of results occurs, the second bar shall be tested.

3.3 Determination of tensile properties.

A. The extensometer will produce an autographic stress-strain diagram showing the yield strength (PSI) and ultimate strength (PSI).

1. Yield strength is determined by the extensometer attached to the specimen. When the load producing the specified extension .005 in./in. is reached, record the stress corresponding to that load as the yield strength.

2. However, if the above method cannot be determined due to errors during the testing, the yield strength is determined by the .2% offset method using the autographic stress-strain curve drawn. The yield strength is determined from a line at .2% offset on the strain axis that is drawn parallel to the stress-strain curve. The yield strength is the point where the parallel line intersects the stress-strain curve as seen in figure 1.

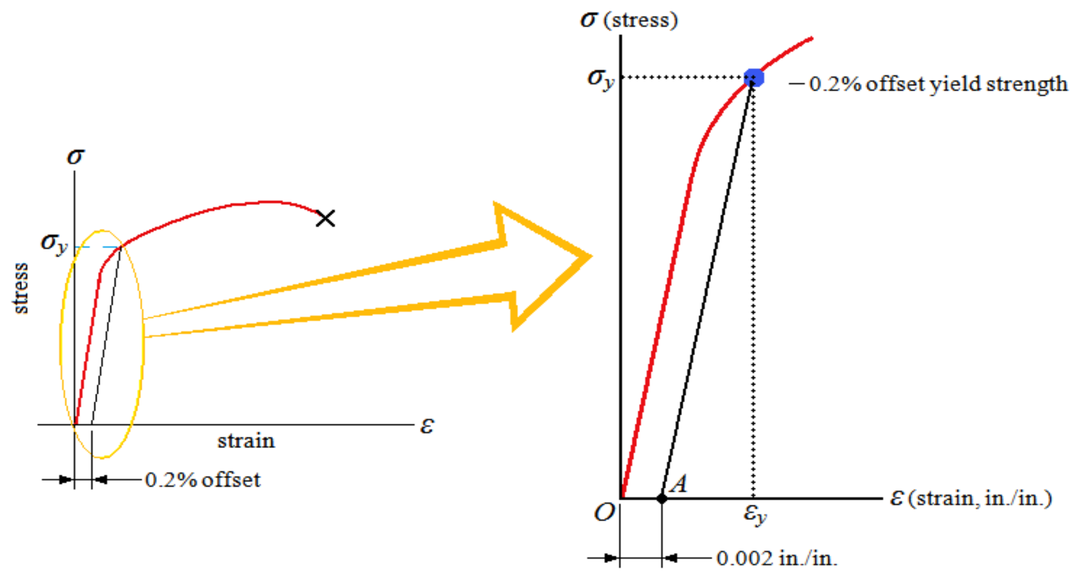

Figure 1

(Stress-strain diagram for determination of yield strength by the .2% offset method)

3. Ultimate strength is calculated by dividing the maximum load the specimen sustains by the nominal bar cross-sectional area (Table 2).

Table 2 - Nominal bar cross-sectional area

Size	Cross-Sectional Area (in²)
#3	0.11
#4	0.2
#5	0.31
#6	0.44
#7	0.6
#8	0.79

B. Percent elongation is determined by fitting the ends of the fractured bar together carefully and measure the final gauge marks with the elongation gauge to the nearest whole number.

1. If using calipers, percent elongation is determined by the following equation:

Percent elongation =

((Final gage length – Initial gage length) / Initial gage length) x 100.

NOTE: If fracture takes place outside of the gauge length, fit the ends together and measure from the point of fracture to the furthest gauge mark.

4. Report:

A. MS&T

1. DOT-7

Report the following:

I. Grade.

II. Size.

III. Percent elongation to nearest whole number.

IV. Yield strength to nearest hundred (psi).

V. Ultimate strength to nearest hundred (psi).

VI. Weight per foot to nearest thousandths (0.001 lb./ft.).

NOTE: Report first bar's data if all minimum specifications are met. If second bar is tested, report the second bar's results if all minimum specifications are met. However, if a failure occurs on any of the second bar results then report the passing specifications of the second bar and report failure portion with the average of the two bars.

5. References:

AASHTO T 244
AASHTO M 31
ASTM A370
DOT-1
DOT-7