Test Procedure for

TESTING MECHANICAL COUPLERS FOR
REINFORCING STEEL

TxDOT Designation: Tex-744-I

Effective Date: February 2019

1. SCOPE
1.1 This test method outlines the procedure for testing mechanical couplers for slip, fatigue, and ultimate tensile strength.

1.2 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard

2. APPARATUS
2.1 Tensile testing machine, with grips capable of holding the specimen in place with minimal twisting and minimal distortion, and including operating software capable of inducing sine wave fatigue loading and measuring the tensile force required to fracture the specimen. Verify calibration is in accordance with ASTM E4.

2.2 Slip-measuring device, consisting of at least two calibrated length measure devices that measure displacement across the coupler to the nearest 0.001 in. A typical test set-up is shown in Figure 1.

2.3 Metal cutting saw.

2.4 Tape measure, accurate to 1/16 in.

2.5 Permanent marker.
3. SPECIMEN PREPARATION

3.1 Determine the minimum specimen length in accordance with Section 5.

3.2 Center the coupler body within the length of the desired specimen.

3.3 Mark and cut each end of the specimen to achieve the minimum specimen length.

3.4 Mark each end of the cut specimen to define the gripping length.

4. PROCEDURE

4.1 Unless otherwise specified, perform slip, fatigue, and ultimate tensile strength testing on the same mechanical coupler assembly.

4.2 Slip

4.2.1 Assemble the slip-measuring device on the test specimen so that the dial indicators are 180° apart. Ensure that the slip-measuring device is securely attached to the test specimen.

4.2.1.1 The slip-measuring device reference points shall be established 1.0 ± 0.5 in. clear of the coupler body on the connecting bars.

4.2.2 Insert the specimen into the grips in an axial position until the gripping marks are flush with the end of the grips.

4.2.3 Apply an appropriate gripping pressure such that the specimen is held tight without being distorted and does not move within the grips during the testing.

Figure 1—Slip measuring device
4.2.4 Set the loading stress rate to between 10,000 and 100,000 psi/min.

*Note: The Department uses a loading rate of 85,000 psi/min*

4.2.5 Load the specimen to 3,000 psi tensile stress and hold.

4.2.6 Zero the gauges on the slip-measuring device.

4.2.7 Continue loading the specimen to 30,000 psi tensile stress and hold for 30 seconds.

4.2.8 Unload the specimen to 3,000 psi tensile stress and hold.

4.2.9 Read and record the measurements displayed on both dial gauges.

4.2.10 Calculate average slip in accordance with Section 5.

4.3 Fatigue

4.3.1 Remove the slip-measuring device from the test specimen.

4.3.2 Cyclically load the test specimen from 5,000 psi tension to 30,000 psi tension in a sine wave form at a maximum frequency of 5 Hz for 80,000 cycles.

*Note: The Department typically uses a frequency of 1 Hz for all coupler sizes*

4.3.3 If the test specimen fractures before completing 80,000 cycles, record the number of cycles completed.

4.3.4 If the test specimen completes 80,000 cycles, continue testing the test specimen for ultimate tensile strength.

4.4 Ultimate Tensile Strength

4.4.1 Apply a tensile stress at a rate between 10,000 and 100,000 psi/min. until the specimen fractures. Record the ultimate tensile strength (UTS).

*Note: The Department uses a loading rate of 85,000 psi/min*

4.4.2 Note the fracture type as one of the following:

- Fracture of the bar away from the coupler body,
- Fracture across the threads of the bar,
- Fracture of the coupler body, or
- Pullout (one bar is pulled out of the coupler body).

4.4.3 Calculate percent yield in accordance with Section 5.

5. CALCULATIONS

5.1 Calculate minimum specimen length:
Minimum specimen length, in. = 8d + Lc + 2Lg + 16

d = nominal bar diameter, in.
Lc = coupler length, in.
Lg = gripping length, in.

5.2 Calculate average slip:

Average slip, in. = \frac{S_1 + S_2}{2}

S_1 = slip measurement from dial 1, in.
S_2 = slip measurement from dial 2, in.

5.3 Calculate percent yield:

Percent yield = \frac{UTS/A}{YS} \times 100

Where:
UTS = ultimate tensile strength, lbf
A = nominal cross-sectional area of reinforcing bar size, in.²
YS = minimum required yield strength for grade of reinforcing bar, psi.
6. REPORT

6.1 Record the following information:

- Producer, type, and brand name of coupler,
- Shape/profile of coupler body,
- Producer, grade, type, and size of reinforcing bar,
- Mill markings on reinforcing steel,
- Assembly condition of mechanical coupler bar assembly (tight, loose, unassembled),
- Average slip,
- Number of fatigue cycles completed,
- Break location,
- Ultimate tensile strength (UTS), and
- Percent yield.