

KTMR-11 ROTATIONAL CAPACITY TESTING OF HIGH STRENGTH FASTENERS (FHWA DEVELOPED SPECIFICATION) (Kansas Central Lab Test KT-MR-11)

a. SCOPE

This procedure describes the method of the rotational capacity testing of high strength nut, bolt and washer assemblies utilizing both long and short bolts. In either case, the assemblies are installed in the test equipment for tightening from the end utilized in the field application, i.e. the nut or the bolt head. The values shown in the included tables assume the use of an ASTM F 3125 Grade A325 bolt with a minimum tensile strength of 120 ksi.

Long Bolts

b. APPARATUS

b.1. Calibrated bolt tension measuring device of size required for bolts to be tested. Mark off a vertical line and lines 1/3 of a turn, 120 degrees; and 2/3 of a turn, 240 degrees, from vertical in a clockwise direction on the face plate of the calibrator.

b.2. Calibrated torque wrench; dial or digital continuous torque indicating as opposed to adjustable or preset type. Access to torque wrench verification equipment is also recommended.

b.3. Spacers and/or washers with hole size no larger than 1/16 inch greater than bolt to be tested.

b.4. Steel section to mount bolt calibrator. Flange or girder or cross frame accessible from the ground is satisfactory.

c. PROCEDURE

c.1. Install nut on bolt and measure stickout of bolt when 3 to 5 full threads of the bolt are located between the bearing face of the nut and the bolt head. Measure the bolt length, the distance from the end of the threaded shank to the underside of the bolt head.

c.2. Install the bolt into the tension calibrator and install the required number of shim plates and/or washers (one washer under the nut must always be used) to produce the thread stickout measured in Step **c.1**.

c.3. Tighten bolt using a hand wrench to the snug tensions listed below, -0 kips, +2 kips.

BOLT DIA. (IN.)	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Snug Tension (kips)	1	2	3	4	5	6	8	10	12

c.4. Match mark the nut to the vertical stripe on the face plate of the bolt calibrator.

c.5. Using the calibrated manual torque wrench, tighten the bolt to at least the tension listed below. Record the measured tension and the torque required to attain the measured tension. Torque must be measured with the nut in motion.

BOLT DIA. (IN.)	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Tension (kips)	12	19	28	39	51	64	81	97	118

c.6. Further tighten the bolt to the rotation listed below. The rotation is measured from the initial marking in Step **c.4**. Record the bolt tension. Assemblies, which fail prior to this rotation either by stripping or fracture, fail the test.

BOLT LENGTH (MEASURED IN STEP C.1)	4 X BOLT DIA. OR LESS	GREATER THAN 4 BUT NO MORE THAN 8 X BOLT DIA.	GREATER THAN 8 X BOLT DIA.
REQUIRED ROTATION	2/3 (240°)	1 (360°)	1-1/6 (420°)

c.7. The bolt tension measured in Step **c.6**. after the required rotation must equal or exceed the values in the table shown below. Assemblies, which do not meet this tension, have failed the test.

BOLT DIA. (IN.)	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Tension (kips)	14	22	32	45	59	74	94	112	136

c.8. Loosen and remove nut and examine the threads on the nut and bolt. No signs of thread shear failure, stripping, or torsional failure of the bolt may be evident. Assemblies with evidence of stripping have failed the test.

c.9. Calculate and record the value of 0.25 X the tension (pounds = kips X 1000) measured in Step **c.5**. X the bolt diameter in feet; $T = CFD$, $C = 0.25$, $F =$ measured bolt tension or clamping force in pounds, $D =$ bolt dia. in feet. The torque measured and recorded in Step **c.5**. must be equal to or less than this calculated value. Assemblies with torque values exceeding this calculated value failed the test.

Short Bolts

Bolts with insufficient length to properly install in tension measuring device.

d. APPARATUS

d.1. Calibrated torque wrench and a spud wrench or equivalent. The torque wrench should be of the dial or digital continuous torque indicating as opposed to adjustable or preset type. Access to torque wrench verification equipment is also recommended.

d.2. Spacers and/or washers with hole size no larger than 1/16 inch greater than bolt to be tested.

d.3. Steel section with normal size hole to install bolt. Any available splice hole can be used with a plate thickness that will provide the number of threads under the nut required in Step **e.1.** below. Mark off a vertical line and lines 1/3 of a turn, 120 degrees; 1/2 of a turn, 180 degrees; and 2/3 of a turn, 240 degrees, from vertical in a clockwise direction.

e. PROCEDURE

e.1. Install nut on bolt and measure stickout of bolt when 3 to 5 full threads of the bolt are located between the bearing face of the nut and the bolt head. Measure the bolt length, the distance from the end of the threaded shank to the underside of the bolt head.

e.2. Install the bolt into the hole and install the required number of shim plates and/or washers (one washer under the nut must always be used) to produce the thread stickout measured in Step **e.1.**

e.3. Snug the bolt using a hand wrench. The snug condition should be the normal effort applied to a 12-inch long wrench. The applied torque should not exceed 20 percent of the value shown in Step **e.5.**

e.4. Match mark the nut to the vertical stripe on the plate.

e.5. Tighten the bolt by turning the nut using the torque wrench to the rotation listed below. A second wrench must be used to prevent rotation of the bolt head during tightening. Record the torque required to reach this rotation. Torque must be measured with the nut in motion.

BOLT LENGTH (MEASURED IN STEP E.1.)	4 X BOLT DIA. OR LESS	GREATER THAN 4 BUT NO MORE THAN 8 X BOLT DIA.
REQUIRED ROTATION	1/3 (120°)	1/2 (180°)

The measured torque should not exceed the values listed below. Assemblies, which exceed the listed torque's, have failed the test.

BOLT DIA. (IN.)	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Torque (lb-ft)	150	290	500	820	1230	1730	2450	3210	4250

e.6. Tighten the bolt further to the rotation required below. The rotation is measured from the initial marking in Step **e.4**. Assemblies, which fail prior to this rotation either by stripping or fracture, fail the test.

BOLT LENGTH (MEASURED IN STEP E.1.)	4 X BOLT DIA. OR LESS	GREATER THAN 4 BUT NO MORE THAN 8 X BOLT DIA.
REQUIRED ROTATION	2/3 (240°)	1 (360°)

e.7. Loosen and remove nut and examine thread on the nut and bolt. No signs of thread shear failure, stripping, or torsional failure of the bolt should be evident. Assemblies, which have evidence of stripping, have failed the test.

(MTU - Physical Test Section – revised CFN 5-30-18)