GM	WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW15698

Clamp Load Retention of the Fastened Joint

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. Evaluate clamp load retention in a threaded fastener joint.

1.2 Applicability. This procedure applies to initial tightening of threaded fastener joints; all joint components must be new/unused unless otherwise specified.

1.3 Remarks. Any special instructions provided in Test Request documentation will supercede this test procedure unless otherwise specified

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW25 GMW14165

2.3 Additional References.

- Data Acquisition System Manufacturers Operating Procedure.
- Direct Current (D.C.) Electric Tool Manufacturers Operating Procedure.

3 Resources

3.1 Facilities. GM approved laboratory or location for this test procedure.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Torque angle transducer.

3.2.2 Data acquisition system – 1000 Hz minimum sampling rate. Data plotted at user specified scales. All points on curve shall be identifiable.

3.2.3 Tightening tool.

3.2.4 Appropriate fixtures, bedplate, or slotted table.

3.2.5 Strain indicator (if applicable).

3.2.6 Strain-gaged fastener, force washer, or fastener prepared for ultrasonic measurement.

3.3 Test Vehicle/Test Piece.

3.3.1 Required test pieces will be specified in Test Request documentation (reference Appendix A, Data Sheet A1).

3.3.2 Test a minimum of eight (8) samples, unless otherwise specified.

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3.4 Test Time.

Calendar time:	7 d
Test time:	24 h
Coordination time:	8 h

3.5 Test Required Information. Specific conditions and requirements shall be detailed in Test Request documentation (reference Appendix A, Data Sheet A1, or use similar format).

3.6 Personnel/Skills. Test Technician shall be qualified on basis of appropriate education, training, experience, and/or demonstrated skills.

4 Procedure

4.1 Preparation.

4.1.1 Samples shall be tested in as-received condition, unless otherwise specified in Test Request documentation. This excludes any condition specifically caused by material storage or configuration (e.g., if debris falls into a threaded hole, it is acceptable to remove debris).

4.1.2 All test configurations, parts, and noted deviations shall be approved before testing. Any modifications made that are not described in Test Request shall be documented in test report.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.2.2.1 Additional or modified test conditions shall be outlined in Test Request documentation. Deviations from requirements of this test procedure shall have been agreed upon.

4.2.2.2 Optional. Strength of fasteners with respect to minimum material specifications may be evaluated prior to this testing by one (1) or more of methods outlined in GMW25 Mechanical Properties and Material Requirements for Externally Threaded Fasteners.

4.3 Instructions.

4.3.1 Review part quantities and condition.

4.3.2 Secure test part to T-slot table or fixture.

4.3.3 Select proper tool, fastener prepared for ultrasonic measurement, and transducer, or strain gaged fasteners. (Reference GMW14165 and Data Acquisition System Manufacturers Operating Procedure.)

Note: Ultrasonic measurement and strain gaged fasteners are not suitable for determination of tension in plastic area. (Reference D.C. Electric Tool Manufacturers Operating Procedure.)

4.3.4 If applicable, configure ultrasonic measurement device to capture tension values.

4.3.5 If applicable, configure strain indicator to capture tension values.

4.3.6 Configure tooling to reproduce requested torque/angle strategy of fastener.

4.3.7 Align tool and torque transducer to prevent side loading.

4.3.8 For ultrasonic measurement, verify fasteners have been length referenced and proper bolt files are in use.

4.3.9 Unless otherwise specified, test requestor is to approve test setup.

4.3.10 Unless otherwise specified, run first sample to desired tightening specification, recording torque and angle. Index fasteners to identify rotations as testing progresses. Proceed when requestor has reviewed and approved results.

4.3.11 Complete test matrix, tighten fasteners in approved tightening sequence. Reference applicable Master Process Document.

4.3.12 Measure tension values of fasteners and record on Appendix B, Data Sheet B1 or similar.

4.3.13 Repeat 4.3.10 and 4.3.11 for any remaining test samples.

4.3.14 Summarize results.

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4.3.15 Tension values of fasteners to be re-measured when:

4.3.15.1 Sample has reached test hour checkpoint.

4.3.15.2 Sample has reached test cycle checkpoint.

4.3.15.3 Sample has reached end of test.

4.3.15.4 At any point specified by requestor.

4.3.15.5 Upon disassembly of joint to determine if tension has returned to pre-test zero reference point.

4.3.16 Repeat 4.3.11 through 4.3.13 for all test checkpoints up to and including end of test.

4.3.17 Summarize all results.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results.

5.2.1 Summary of Results.

5.2.1.1 Provide statistical analysis of maximum torques. Calculate averages, minimum values, maximum values, and standard deviation.

5.2.1.2 Provide detail of failure modes consisting of, but not limited to, fastener fracture, component fracture, component distortion or internal or external thread stripping (if applicable).

5.2.1.3 Test incidents to be recorded on Test Data Summary Sheet (reference Appendix B, Data Sheet B1, or use similar format).

5.2.1.4 Test data summarization to be on Test Data Log Sheet (reference Appendix C, Data Sheet C1, or use similar format) and Torque vs. Tension Data Sheet (reference Appendix D, Data Sheet D1, or use similar format).

5.2.1.5 Required plots and tabular data tables include items shown in Table 1.

5.2.2 Summary of Results - Optional. After reviewing required data summarization, requestor may ask for additional items including, but not limited to, following:

5.2.2.1 Summary of results including, but not limited to: tension vs. torque data, upper proportional limit torques, lower proportional limit torques, ultimate torques, and prevailing torques (reference Appendix D, Appendix E and Appendix F (Data Sheet D1, Data Sheet E1 and Data Sheet F1) or use similar formats).

5.2.2.2 Optional sample plots and tabular data tables include items shown in Table 2.

5.2.2.3 Magnified Scale Plots - additional plots re-scaled to magnify desired detail of curves.

5.3 Test Documentation. Any deviations to this procedure are to be entered in test notes or log sheets.

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Table 1: Torque Tightening Strategy

Y-Axis \ X-Axis	Torque	Tension	Angle	Compression	Load	Displacement	RPM	Time
Torque	-	T5	-	-	-	-	-	-
Slip Torque	-	-	I	-	-	-	-	-
Tension	M	-	M	-	-	-	-	-
Angle	-	-	-	-	-	-	-	-
Compression	-	-	-	-	-	-	-	-
Load	-	-	-	-	-	-	-	-
Displacement	-	-	-	-	-	-	-	-
RPM	-	-	-	-	-	-	-	-

Legend:
I = Individual sample plot.
D = Dual Y axis plot.
M = Multiple sample plot.
S = Statistical plot.
T = Tabular data table followed by incremental value.

Table 2: Torque Angle Tightening Strategy

Y-Axis \ X-Axis	Torque	Tension	Angle	Compression	Load	Displacement	RPM	Time
Torque	-	T10	DMT10	-	-	-	-	-
Slip Torque	-	-	DMT10	-	-	-	-	-
Tension	-	-	-	-	-	-	-	-
Angle	-	-	-	-	-	-	-	-
Compression	-	-	-	-	-	-	-	-
Load	-	-	-	-	-	-	-	-
Displacement	-	-	-	-	-	-	-	-
RPM	-	-	DIM	-	-	-	-	-

Legend:
I = Individual sample plot.
D = Dual Y axis plot.
M = Multiple sample plot.
S = Statistical plot.
T = Tabular data table followed by incremental value.

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