



Wheel Fastener Torque Tension Test – Reuse/Abuse

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. To determine the dynamic torque/tension characteristics of the threaded fastener joint for in-service wheel attachments. This procedure begins with new components (wheels, nuts, and studs) and performs tightening iterations per the specified schedule.

1.2 Applicability. Unless otherwise specified, this procedure applies to in-service wheel attachment tightening events. This standard does not apply to pulse or impact tools. Unless otherwise specified, any requirements or direction provided in the test request documentation will supercede this test procedure.

1.2.1 Road Wheels. The total number of tightening iterations shall be twenty-five (25). The initial rundown of joints is to use new threaded fasteners with new thread and bearing surfaces and new clamped members, and then apply twenty-four (24) additional rundowns on the same components.

1.2.2 Temp/Spare Wheels. The total number of tightening iterations shall be ten (10). The initial rundown of joints is to use new threaded fasteners with new thread and bearing surfaces and new clamped members, and then apply nine (9) additional rundowns on the same components.

1.2.3 Abuse. The purpose of the abuse section is to understand the potential performance in the field of a joint that is overtightened. It is typically tested at 60 Nm above the specified service torque and follows the rundown counts from above.

1.3 Remarks. This test is based on SAE J1965 (Road Vehicles – Wheels for Commercial Vehicles and Multipurpose Passenger Vehicles – Fixing Nuts – Test Methods), SAE J2315 (Wheel Nut Seat Strength Test), SAE J2283 (Mechanical and Material Requirements for One Piece Wheel Nuts), SAE J2316 (Wheel Nut Seat System Test Procedures and Performance Requirements for Passenger Cars and Light Trucks) and ISO 898-2 (Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel – Part 2: Nuts with Specified Property Classes – Coarse thread and Fine Pitch Thread).

2 References

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

2.1 External Standards/Specifications.

ISO 898-2 SAE J2283 SAE J2315 SAE J2316
SAE J1965

2.2 GM Standards/Specifications.

GMW16590

3 Resources

3.1 Facilities.

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.

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3.2 Equipment.

3.2.1 Dynamic tightening tool.

3.2.2 Appropriate wheel test fixture, bedplate, or slotted table.

3.2.3 Torque angle transducer.

3.2.4 Data acquisition system capable of collecting data and identifying data at various points on the data curve.

3.2.5 Torque tension load cell.

3.2.6 Optional, strain gauged fastener, or fastener prepared for ultrasonic measurement.

3.2.7 Optional, ultrasonic measurement devices.

3.2.8 Optional, strain indicator.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time.

Calendar time: 1 day

Test hours: 6 hours

Coordination hours: ¾ hour

3.5 Test Required Information. Not applicable.

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

4 Procedure

4.1 Preparation.

4.1.1 Each section (Reuse and Abuse) consists of five (5) samples be tested in the as received condition. 'Samples' in this case includes one each of new stud, nut and wheel attachment hole.

4.1.2 Steel Wheels should have nut bosses free of burrs. If burrs are found, DO NOT test; notify requestor.

4.1.3 Non-steel wheels must be verified to be free of paint and clear coat in the cone seats. If either paint or clear coat are found, DO NOT test; notify requestor.

4.1.4 Any modifications to parts, not specifically requested in the test request, that may affect test results, are prohibited. All test configurations, parts and deviations shall be approved prior to executing test. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.2 Conditions.

4.2.1 Environmental Conditions. Test Area shall be clean, dry, and between 10 °C and 37.7 °C (50 °F and 100 °F).

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.

4.3 Instructions.

4.3.1 Review pre-test condition of all test material. Verify that the nut boss areas are free of debris and severe abrasion. The nut boss areas on non-steel wheels are to be free of clear coat and/or other paint products. Additionally, wheels must be fully cured, including paint oven cure.

4.3.2 Install wheel or wheel coupon onto wheel test support fixture. Unless otherwise specified, test setup is to be mounted on the wheel test support fixture.

4.3.3 Select proper dynamic drive tool, torque transducer with angle encoder and torque tension load cell.

4.3.4 Measure and adjust as needed, the free spinning tool speed to less than 200 rpm.

4.3.5 Measure and adjust as needed, the final drive tool speed to 5 rpm ± 1 rpm.

4.3.6 Configure data acquisition system to collect torque, tension, and angle data (e.g., PCB Load & Torque, Model 9504 Lab Master Recorder and Controller). Typical run time is approximately 15 s per tightening event.

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5 Data

5.1 Calculations.

5.1.1 Calculate, tabulate and plot fastener clamp load (bolt tension) at the requested torque value showing mean tension, mean tension ± 3 standard deviations values, and percent (%) from first new tension value at specified nut torque for twenty-five (25) rundowns for each fastener bolt hole (refer to Appendix B, Figure B1).

5.1.2 Calculate, tabulate and plot fastener rotation angle from the threshold torque to the requested torque value showing averages, and averages ± 3 standard deviations values for each fastener bolt hole (refer to Appendix B, Figure B2).

5.2 Interpretation of Results. See sourcing documents.

5.3 Test Documentation. The test results documentation should include the following:

- Test Results Report (generated by Global Tire Wheel Test System (GTWTS)), if submitting Extensible Markup Language (.xml) files
- Provide detail of test incidents consisting of, but not limited to, fastener fracture, component fracture, component distortion or internal or external thread stripping (as applicable).
- Torque Tension Data and Chart Summary (Appendix B, Figure B1).
- Torque Tension Angle Data and Chart Summary (Appendix B, Figure B2).
- Photographs required as noted in Appendix B, Figures B3 and B4.
- Optional, import header and data file Appendix C, Figures C1 and C2, respectively. Figure C1 and Figure C2 shall be in Comma Separated Variable (.csv) format.

Required test data parameters are given in Appendix B. A sample report is given in Appendix A; Figure A1, Figure A2, Figure A3, Figure 4, and Figure A5.

Note: For data being loaded into the GTWTS, submit electronically the test results data files (.xml format or optional method shown above) and other supporting files listed above. GMW16590 defines the electronic file details (e.g., file types, file naming convention, and detailed file formats for .xml files) for the GTWTS.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary.

Dynamic Drive Tool: Power tool capable of tightening a threaded fastener at a controlled speed.

Failure Modes: May consist of, but are not limited to, fastener fracture, component fracture, component distortion or internal or external threaded member stripping.

Final Drive Tool Speed: Final (slower) rotational dynamic drive tool speed used to perform the final tightening sequence, measured in rpm. This value shall be set to 5 rpm $\pm$ 1 rpm.

Fracture: Partial or complete separation of one or more of the joint components.

Free Spinning Tool Speed: Non-loaded (free) rotational dynamic drive tool speed, measured in rpm. This value shall be set to less than 200 rpm.

Maximum Torque: The maximum torque value observed during testing of the joint.

Threshold Torque: Torque value at which two functions occur. First, the angle value is zeroed for the analysis process. Secondly, the dynamic drive tool speed changes from the free spinning to final drive tool speed. The threshold torque value shall be set to 10 Nm.

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Torque Tension Load Cell: Load sensing member capable of measuring both load (fastener tension) and torque inputs, simultaneously.

Ultimate Torque: The maximum torque the joint can tolerate prior to fracture, deformation or strip.

Zero Angle Reference Torque: Torque value at which the angle of all samples recorded is set to zero for analysis purposes.

7.2 Acronyms, Abbreviations, and Symbols.

.csv	Comma Separated Value
GSSLT	Global Subsystem Leadership Team
GTWTS	Global Tire Wheel Test System
.xml	Extensible Markup Language

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW14995

9 Release and Revisions

This standard was originated in January 2006. It was first approved by Global Chassis Engineering Center in September 2006. It was first published in 2007.

Issue	Publication Date	Description (Organization)
1	APR 2007	Initial publication.
2	JUL 2012	Revise to Current Template. Revised Paragraphs 3.2.1, 3.2.3, 3.2.6, 3.2.7, 3.2.8, 4.1.1, 4.1.2, 4.2.2.2, 4.2.2.3, 4.3.4, 4.3.5, 4.3.6, 4.3.7, 4.3.12, 5.1.1, 5.1.2, 5.1.3, 5.1.3.1, 5.2, 5.2.1, 5.2.1.2, 5.2.1.3, 5.2.1.4, 5.2.1.4.1, 5.2.1.4.2, 5.2.1.4.3, 5.2.1.4.4, 5.2.1.4.5, 5.2.2.2, 5.3, 5.4 7.1, 7.2, Appendices A, B and C. (Tire and Wheel GSSLT)
3	APR 2017	Added Abuse definition, photo requirements and samples. Added wheel classification (road and temp/spare) and rundown counts. Clarified language in various sections. Added '/Abuse' to title. (Chassis – Tire & Wheel Global Subsystem Leadership Team (GSSLT))

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Appendix A: Sample Report – REUSE shown, ABUSE would be similar but with ABUSE in place of REUSE in title

Note: Any references to specific names, part numbers, specifications, etc., are for example purposes only.

Figure A1: Report Header Example

Test Request Number: W13-01288
PQMS Activity Number: 2012-01-06-16929

GMW14995 Torque-Tension Reuse Report



TEST REQUEST DETAIL									
Model Year / Program: 2013 / All-All Programs		Requester: Robert Gilley Requester's Phone: +1 2484975557							
Test Purpose: Evaluation		WHEEL PART DETAILS							
Supplier: Superior Industries - Fayetteville, AR		Part Number (P/N): 20937768							
Wheel Diameter / Rim Size: 18 X 8.5		Chart Number: 20937963							
Offset: 24		Broadcast Code: AAJD							
Wheel Finish: Polished		Steel Gauge Rim / Disc (mm): /							
Material Rim / Disc: CAST ALUMINUM / CAST ALUMINUM		FASTENER PART DETAIL							
Attachment: 6-M14X1.5-139.7		Wheel Bolt P/N: 11588811							
Wheel Nut P/N: See Comment		TEST CONDITIONS							
Requested Nut Torque (Nm): 190		Requested Number of Reuses: 25							
TR Comment: Evaluate chrome lock nuts with NoTex lubricant.		Requested Tool Speed (rpm): 5							
TEST RESULTS									
Wheel IDs: 1		Wheel Nut Torque (Nm): 190		Tested Fastener Details:					
Tester / Site: GMNA-TWS / GMNA-MPG		Tool Speed (rpm): 5		Wheel Bolt Size: M14X1.5					
Machine Name / ID: Torque Tension Elec / STA 1		Test Number:		Wheel Bolt P/N: 11588811					
Test Date: 19 Sep 2013		Technician: EEH		Wheel Bolt Finish:					
TIP Approved: N/A		Wheel Nut P/N: See Comment		Wheel Nut Finish:					

Run	TENSION AT NUT TORQUE				ROTATION ANGLE TO NUT TORQUE FROM 10Nm			
	MEAN (kN)	STD DEV (kN)	+3 SIGMA	-3 SIGMA	MEAN (Deg)	STD DEV (Deg)	+3 SIGMA	-3 SIGMA
1	25	5.8	42	8	120	17.7	173	67
2	17	0.5	18	16	91	7.3	113	69
3	17	0.2	17	17	97	6.7	117	77
4	17	0.6	19	15	99	7.4	121	77
5	18	0.7	20	16	102	5.1	117	87

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