



Compression Properties of Metal Center Tubes and Contact Surfaces of Metal Parts with Bolt Through Holes

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. This test procedure shall be used to determine the compression properties of metal center tubes and contact surfaces of metal parts with bolt through holes.

1.1.1 Definition. The compression properties of metal center tubes and contact surfaces of metal parts with bolt through holes as determined by this test procedure shall be defined as the permanent length change of a part mentioned previously, when subjected to an axial pressure applied at a fixed velocity.

The compression properties can be expressed by a force-displacement hysteresis curve.

1.2 Applicability. Unless otherwise specified, this procedure applies to the initial tightening event of joints using new (unused) parts for each joint.

2 References

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

2.1 External Standards/Specifications.

ISO 898-2

ISO 898-6

ISO 9513

ISO 7500-1

2.2 GM Standards/Specifications.

GMW15011

3 Resources

3.1 Facilities. Not applicable.

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 Universal testing machine capable of stressing center tubes to a force at a constant velocity of ≤ 10 mm/minute maximum test forces according to 4.3.2 of this procedure.

3.2.1.1 The testing machine shall comply with ISO 9513 and ISO 7500-1, Sheet 1.

The testing machine shall also comply with the following requirements:

- Total accuracy of the force measuring equipment $\pm 1\%$ of the measured value.
- Displacement measuring equipment: ± 0.01 mm. If possible, the displacement measuring device should be mounted so that it measures directly across the test part. Fixturing deflection may be erroneously interpreted as test part deflection if care is not taken during the setup.
- The measuring instruments shall function with a low moment of inertia.

3.2.2 Coordinate recorder (x-y recorder) or similar data acquisition software which records the force-displacement characteristics of the part. The reading accuracy of the compiled diagram shall be 0.01 mm

minimum for displacement 1 cm approximately equal to 0.1 mm. The gradient of the curve shall be in a range of 20 degrees to 45 degrees.

3.2.2.1 Optional. Digital recording device for simultaneous recording of load and displacement.

3.2.3 A test jig, consisting of two plane, parallel tool steel plates, between which the center tubes shall be loaded. To avoid measuring errors, the device shall be as rigid as possible. Test plates should be sufficiently hardened to not allow embedment within test load range.

3.3 Test Vehicle/Test Piece. Samples shall be tested to the criteria outlined in 4.3.2 of this document unless otherwise specified by the part drawing, Vehicle Technical Specification, Subsystem Technical Specification, Component Technical Specification or specified standard.

3.4 Test Time.

Calendar time: 3 days

Test time: 12 h

Coordination time: 12 h

3.5 Test Required Information. Test request documentation should outline specific test data requirements. Data should be reported in format similar to what is contained in Appendix A, Data Sheet A1.

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation. Not applicable.

4.2 Conditions.

4.2.1 Environmental Conditions. The test shall be performed at $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

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 The part shall be installed so that the following conditions are met:

- The direction of the force shall run axially.
- During loading, there shall be no misalignment which may result in measuring errors.
- Rate of force application shall be $\leq 0.6\text{ mm/minute}$ (0.01 mm/s).

4.3.2 Using the strain rate specified in 3.2, the part shall be subjected to the maximum force F_a (refer to Table 1 and Table 2). This force shall then be reduced to give 50% of the maximum force F_m . Stress for steel center tubes corresponds to the test force for nut thread according to:

- ISO 898-2 for coarse thread.
- ISO 898-6 for fine thread.

4.3.3 The permanent compression shall be taken from the resulting force-displacement curve.

4.3.4 Photograph the test setup and the test parts after test. An example of a test setup is shown in Figure 1.



Figure 1: Example of Test Setup

Table 1: Maximum Force F_a for Coarse Thread (Values Rounded)

Thread Dimension	Fastening Screw for Bolted Joints of Steel Center Tubes		
	Property Class		
	8.8	10.9	12.9
	Property Class for Nut		
	8	10	12
M5	12 kN	15 kN	16 kN
M6	17 kN	21 kN	23 kN
M8	32 kN	38 kN	43 kN
M10	51 kN	60 kN	67 kN
M12	74 kN	89 kN	100 kN
M14	101 kN	121 kN	137 kN
M16	138 kN	165 kN	187 kN
M18	177 kN	204 kN	230 kN*
M20	225 kN	260 kN	294 kN*

Table 2: Maximum Force F_a for Fine Thread (Values Rounded)

Thread Dimension	Fastening Screw for Bolted Joints of Steel Center Tubes		
	Property Class		
	8.8	10.9	12.9
	Property Class for Nut		
	8	10	12
M8x1	37 kN	43 kN	47 kN
M10x1.25	58 kN	67 kN	73 kN
M12x1.5	84 kN	98 kN	106 kN
M14x1.5	119 kN	139 kN	150 kN*
M16x1.5	160 kN	185 kN	200 kN*
M18x1.5	222 kN	232 kN*	-
M20x1.5	280 kN	294 kN*	-

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