

WORLDWIDE FASTENER STANDARD

Date: 2002-06-11

WZ 101 Steel Metric Threaded Fasteners Torque/Clamping Force Performance

1. SCOPE

This Worldwide Standard provides two test programs for determining the torque/clamping force performance of lubricated finishes on ISO Metric coarse threaded steel fasteners tested at room temperature as specified in ISO 1.

- (a) With thread sizes M3 to M24 inclusive.
- (b) With strength requirements in accordance with WA 950 or WE 952.
- (c) With dimensions as specified in the Worldwide Product Standards.

Substance restrictions imposed by law, regulations or Ford apply to the materials addressed by this document. The restrictions are defined in Engineering Material Specification WSS-M99P9999-A1.

NOTE: Set screws and similar threaded fasteners not under tensile stresses, screws that form a mating thread, and threaded fasteners having additional self locking features are excluded from the provisions of this specification.

2. PURPOSE

To establish a referee test method for determining the torque/clamping force performance of fastener finishes consisting of either a surface-applied lubricant or an integral lubricant on ISO metric coarse threaded steel fasteners. There are two basic test programs.

2.1 SPECIFIC FASTENER/FINISH (TEST PROGRAM A) - To test the torque/clamping force performance of a specified fastener/finish combination under uniform test conditions. This test may be used where it is necessary to control the frictional properties of both the fastener and the finish.

2.2 PROCESS CONTROL OF FINISH (TEST PROGRAM B) - To test the torque/clamping force performance of a specified finish under uniform test conditions. This test program may be used as a process control tool of the frictional performance of the finish.

The results obtained by these tests are relevant to the test conditions only and should not be utilized for determining the torque specification of specific applications.

3. REFERENCES

ISO 1	-	Standard Reference Temperature for Industrial Length Measurement.
ISO 1302	-	Technical Drawing - Method of Indicating Surface Texture on Drawings.
ISO 965/1	-	General Purpose Metric Screw Threads - Tolerances - Part 1: Principles and Basic Data.
ASTM A 109/109M	-	Standard Specifications for Steel, Strip, Carbon, Cold-Rolled.
WA 900	-	Dimensional Requirements for Hexagon and Flanged Hexagon Bolts and Screws, and Hexagon Screw and Washer Assemblies
WA 950	-	Material Requirements and Mechanical Properties of Bolts, Screws, Studs and Screw and Washer Assemblies.
WE 950	-	Prevailing Torque-Type Steel Hexagon Nuts and Hexagon Flange Nuts - Mechanical and Performance Properties.
WE 952	-	Mechanical Properties of Nuts with Specified Proof Load Values.
WX 100	-	Finish Specifications.
WSD-M13P7-A	-	Torque/Clamping Force Control
WSS-M99P9999-A	-	Substance Restrictions

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4. DEFINITIONS

- 4.1 CLAMPING FORCE, F** - The clamping force is the axial tension acting on the bolt shank or the compression applied by the bearing face of the fastener on the clamped members after application of a specified tightening torque.
- 4.2 TIGHTENING TORQUE, T** - The tightening torque is the overall applied torque to the fastener during tightening. It is commonly called the wrenching torque or applied torque.
- 4.3 TORQUE COEFFICIENT, K** - The torque coefficient is determined from the torque/clamp force relation using the following formula:

$$K = T/(Fd) \quad \text{where } d \text{ is the nominal thread diameter}$$

- 4.4 COEFFICIENT OF TOTAL FRICTION, μ_{tot}** - The coefficient of total friction is determined from the tightening torque/clamp force ratio using the following formula:

$$\mu_{tot} = \frac{(T/F) - (P/2\pi)}{0.578d_2 + 0.5D_b}$$

$$\text{where } P \text{ is the thread pitch, } d_2 \text{ is the basic pitch diameter and } D_b = \frac{D_o + d_h}{2}$$

where D_o is the outer bearing diameter and d_h is the nominal clearance hole diameter

The formula for the coefficient of total friction is based upon the assumption that the coefficient of friction between the threads and between the bearing surfaces are equivalent.

5. TORQUE/CLAMPING FORCE CONTROL LUBRICANTS

5.1 SURFACE-APPLIED LUBRICANTS

Unless otherwise specified, surface-applied lubricants shall be in accordance with the requirements of WSD-M13P7-A and shall meet the torque/clamping force requirements specified in **Table 1**.

5.2 INTEGRAL LUBRICANTS

Integral lubricants shall meet the torque/clamping force requirements outlined in the individual material/performance standards or those specified on the engineering drawing.

6. TORQUE/CLAMPING FORCE PERFORMANCE REQUIREMENTS

6.1 SPECIFIC FASTENER/FINISH (TEST PROGRAM A)

To determine the torque/clamping force performance of a specific fastener/finish combination, the torque/clamping force test shall be conducted at room temperature (See ISO 1) using the test equipment specified in Clause 7, the appropriate test material specified in Clause 8, and the test procedure specified in Clause 9.

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6.2 PROCESS CONTROL OF FINISH (TEST PROGRAM B)

To determine the torque/clamping force performance of a specific finish process, the torque/clamping force test shall be conducted at room temperature (See ISO 1) using the test equipment specified in Clause 7, a surrogate bolt as specified in Clause 8.4, the appropriate test nut and test plate specified in Clause 8, and the test procedure specified in Clause 9.

7. TEST EQUIPMENT

7.1 TORQUE MEASURING DEVICE

The torque measuring device shall be a strain gage torque transducer. The accuracy of the torque measurement shall be within 2.0% of the torque being read.

7.2 CLAMPING FORCE MEASURING DEVICE

The force measuring device shall be a tension test fixture with a strain gage load cell. The accuracy of load measurement shall be within 2.0% of the load being read.

The bolt clearance hole in the backing plate shall be the same diameter and tolerance as the test plate. The face against which the test plate bears shall be smooth, flat within 0.1/100 and square with the axis of the test bolt within a tolerance of 0.1/100. The axis of the test bolt and test plate must be aligned so as to avoid contact between the fillet radius of the bolt and the hole in the test plate.

7.3 DATA COLLECTION DEVICE

The data collection device shall have the capability to simultaneously record torque and tension. The sampling rate and frequency response of the recording system shall be such that, at the test speeds (RPM) specified in Clause 7.4, the measurements of torque and load shall meet the accuracies specified in Clauses 7.1 and 7.2.

7.4 DRIVE TOOL

The drive tool shall be capable of producing torques greater than the requirements of the parts to be tested and must be able to maintain a continuous speed for the duration of the test. Unless otherwise specified, the initial tightening speed shall be 30 ± 10 RPM for sizes M3 to M16 and 10 ± 5.0 RPM for sizes greater than M16.

Sockets shall not be allowed to contact the test plate during the rundown.