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Aerospace series — Dynamic testing of the locking behaviour of bolted connections under transverse loading conditions (vibration test)

Aéronautique et espace — Essai dynamique des caractéristiques de freinage des éléments de fixation, dans des conditions de charge transversale (essai de vibration)

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 4, *Aerospace fastener systems*.

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Aerospace series — Dynamic testing of the locking behaviour of bolted connections under transverse loading conditions (vibration test)

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1 Scope

This International Standard applies to the dynamic testing of the locking behaviour of bolted connections in order to investigate the self-loosening behaviour of fasteners for aerospace applications and is mainly intended for development work.

As test apparatuses are different (e.g. stiffness distribution), testing in accordance with this International Standard, therefore, does not allow an absolute statement to be made on the locking behaviour of bolted assemblies under service loads.

Thus, the objective of this test is a comparative evaluation of locking elements under defined test conditions.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16047, *Fasteners — Torque/clamp force testing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16047 and the following apply.

3.1
clamp force
F
axial tension acting on the bolt shank or compression acting on the clamped member

[SOURCE: ISO 16047:2005, 3.1; modified — without restriction “during tightening”]

3.2
ultimate clamp force
F_u
theoretical maximum clamp force under combined stress condition potentially induced before bolt/nut failure

[SOURCE: ISO 16047:2005, 3.3, modified]

3.3
initial clamp force
F_M
clamp force after tightening of test specimen before test

3.4
relative clamp force loss
Y

$$Y = \left(1 - \frac{F}{F_M}\right) * 100\,\%$$

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3.5
number of load cycles
N
number of transverse movements of the glider plate of the apparatus

3.6
pitch diameter
D_2
d_2
diameter of the pitch cylinder or pitch cone

[SOURCE: ISO 5408:2009, 5.9, modified — without reference, without note]

3.7
minor diameter
D_1
d_1
d_3
diameter of an imaginary cylindrical or conical surface tangent to the roots of an external thread and/or to the crests of an internal thread

[SOURCE: ISO 5408:2009, 5.3, modified — without references, without notes]

3.8
tightening torque
T
overall torque applied on nut or bolt head in tightening

[SOURCE: ISO 16047:2005, 3.4, modified — without substitutes]

3.9
self-locking torque
prevailing torque
torque to be applied to the nut or bolt to maintain its movement of rotation in relation to the associated part, the assembly being under no axial load, and the nut-locking system being completely engaged with the bolt (two pitches minimum protrusion, including the end chamfer)

[SOURCE: ISO 5858:1999, 3.15]

3.10
transverse displacement
t_s
transverse movement of the glider plate in both directions from fastener centre line

Note 1 to entry: It is expressed in millimetres.

4 Test principle

The fasteners under test are tightened in a vibration testing machine to achieve a defined clamp force, F_M, and then subjected to dynamic transverse loading. No additional axial operating force is applied to the fasteners.

The change in clamp force during the vibration test is measured.

The test terminates after a specified number of load cycles or upon fracture of the bolt, stabilization of residual clamp force, or upon complete loss of clamp force.

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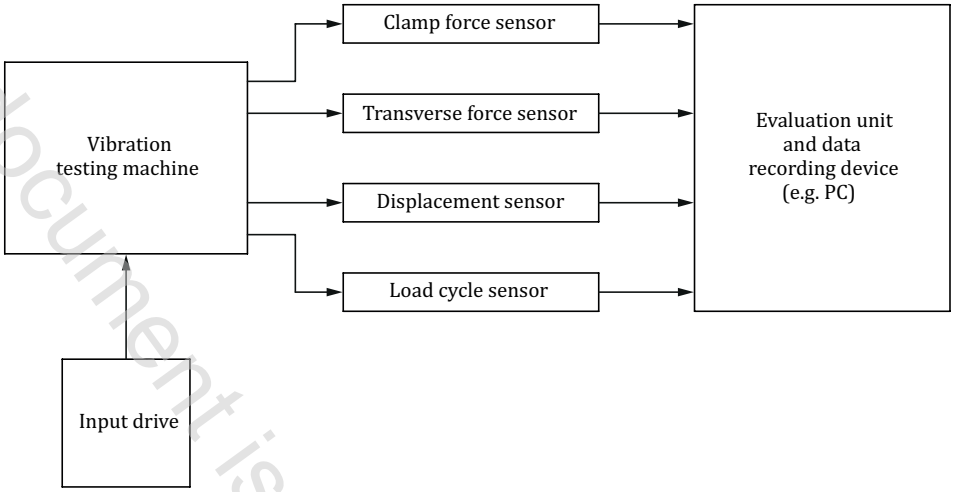
5 Apparatus

5.1 Schematic overview of components

See Figure 1.



NOTE Transverse force sensor is optional.

Figure 1 — Schematic overview of components

5.2 Test machine description

The machine (see Figure 2 for an example of a vibration testing machine) essentially consists of e.g. a motor drive or a hydraulic drive generating a transverse displacement in the test fixture.

The test fixture consists of a stationary base and a floating glider plate which acts as clamped members in the bolted joint in which the fastener to be tested is installed. The glider plate contains a rotationally immobilized washer (test washer). The stationary base accommodates a clamp force-sensor for measuring the clamp force between the glider plate and the stationary base. In the force-sensor, a test insert is used that it is locked to prevent it from rotating. The relative movement between the stationary base and the glider plate is measured with a displacement sensor.

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