International Standard

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Steel structures — Structural bolting — Test methods to determine loss of pretension from faying surface coatings

Structures en acier — Boulonnerie de construction métallique — Méthodes d'essai pour déterminer la perte de précontrainte due aux revêtements de surface

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Foreword

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This document was prepared by Technical Committee ISO/TC 167, *Steel and aluminium structures*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document has been prepared to provide provisions and guidance in the determination of the loss of pretension of bolts in the presence of coatings on the faying surface of a joint. For pretensioned bolted joints, the potential loss of pretension can be checked when the coatings applied to any of the individual coated faying surfaces are thick or consist of a creep-prone material. In this context, coatings exclude adherent mill scale, and include liquid applied coatings as well as coatings that are the result of a galvanizing or metallizing process. Examples of coatings include duplex coating and thermal spray coating. Loss of pretension due to other material, such as insulation, in the grip of a bolt is not considered in this document.

This document provides provisions and guidance on the measurement of pretension loss, considering that the suitability of the protective coatings or coating systems for use in pretensioned bolted joints depends on the extent of the possible system reserves due to the tightening procedure, the target of pretensioning, and the losses over the service life of a structure. The test methods in this document can be also applied to uncoated faying surfaces.

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Steel structures — Structural bolting — Test methods to determine loss of pretension from faying surface coatings

1 Scope

This document specifies test methods to determine loss of pretension in high-strength bolts due to the presence of coatings on the faying surface(s) of a bolted joint to be used in structural steelwork, when any of the coatings are thick enough to affect the pretension in a bolt in the short term, or can show significant deformation over time under sustained loads (creep-prone materials).

The presence within the grip of the bolt of other materials having considerably smaller stiffness than steel, such as insulation, is not included in this test method.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 17607-1, *Steel structures — Execution of structural steelwork — Part 1: General requirements and terms and definitions*

ISO 17607-6:2023, *Steel structures — Execution of structural steelwork — Part 6: Bolting*

ISO 376, *Metallic materials — Calibration of force-proving instruments used for the verification of uniaxial testing machines*

ISO 8503-1, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces*

ASTM B659, *Standard Guide for Measuring Thickness of Metallic and Inorganic Coatings*

ASTM E4, *Standard Practices for Force Calibration and Verification of Testing Machines*

SSPC-PA 2, *Procedure for Determining Conformance to Dry Coating Thickness Requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17607-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
duplex coating
combination of two layers of different materials to give higher corrosion resistance

Note 1 to entry: The layers can be two layers of electroplated metals or can be a plated metal followed by an organic layer.

[SOURCE: ISO 2080:2022, 3.2.109]

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3.2
thermal spray coating
high-temperature process by which finely divided metallic or nonmetallic materials are deposited in a molten or semi-molten condition to form a coating on a surface when cooled

[SOURCE: ISO 17945:2015, 3.12]

4 General

4.1 Principles

Steel surfaces of pretensioned bolted connections can be coated to protect them against corrosion, to change the appearance of the surfaces, or to achieve an increased slip resistance.

The suitability for use of the chosen coatings or coating systems in pretensioned bolted connections depends on the extent of the possible system reserves due to the tightening procedure used (i.e. the actual pretension level in relation to the nominal minimum pretension force) and on the pretension losses over the service life of a structure.

EXAMPLE If pretensioning is performed by the combined method (see ISO 17607-6:2023, Annex J) or turn-of-nut method (see ISO 17607-6:2023, Annex M), a system reserve of approximately 30 % (1,3 × nominal minimum pretension) can be expected.

The test method relates the loss of pretension to the thickness and characteristics of the coating. This test method does not assess the effects of the thickness and characteristics of the coating on the friction coefficient of the faying surfaces of slip-resistant connections.

For pretensioned bolted connections, the potential loss of pretension should be checked when the coatings applied to any of the faying surfaces are thicker than 100 µm or consist of a creep-prone material.

4.2 Significant variables

The applicability of the test results is limited to cases where all significant variables are consistent with the test specimens. The following variables shall be considered as significant for the test results:

a) the surface treatment of the faying surface(s);

b) the composition of the coating;

c) the treatment of each coating layer in the case of multi-layer systems;

d) the thickness of the coating, or of the coating layers in the case of multi-layer systems for each coated surface;

e) the curing procedure and parameters;

f) the minimum time interval between application of the coating and the pretensioning of the bolts in the connection;

g) the dimensions, coating characteristics, and property class of the bolt, the nut, and the washer(s);

h) the number and configuration of washers, if needed;

i) the gage and spacing of the bolts in the connection, as applicable;

j) the pretension level from initial tensioning until completion of test (see 5.4 for frequency of measurement);

k) the pretensioning sequence used, if applicable.

NOTE In some cases, the contact surface under either the head or the nut, or both, can vary, affecting the pressure intensity and distribution.

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