



**International  
Standard**

**ISO 22477-6**

**Geotechnical investigation and  
testing — Testing of geotechnical  
structures —**

**Part 6:  
Load testing of soil nails and rock  
bolts**

*Reconnaissance et essais géotechniques – Essais de structures  
géotechniques —*

*Partie 6: Essai de chargement des clous et des boulons*

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# Sample Document

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ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

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## Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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This document was prepared by Technical Committee ISO/TC 182, *Geotechnics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 341, *Geotechnical Investigation and Testing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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](http://www.iso.org/members.html).

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# Geotechnical investigation and testing — Testing of geotechnical structures —

## Part 6: Load testing of soil nails and rock bolts

### 1 Scope

This document establishes the specifications for the execution of tension tests to be carried out on soil nails and rock bolts.

NOTE 1 Soil nails and rock bolts are referred to as elements in the scope of this document.

NOTE 2 This document covers but is not limited to grouted soil nails and rock bolts.

NOTE 3 This document does not provide specification for the number of tests, the type of test, the Test Method, the value of the proof load and the limiting criteria. These aspects reside in EN 1997-3 and its national annex or in similar standards.

This document provides specifications for three types of tension tests: investigation tests, suitability tests and acceptance tests.

Two methods of testing are recognised by this document. Test Method A involves step-loaded maintained load tension tests. Test Method B involves constant displacement rate tension tests.

This document provides specifications for the experimental devices, the measurement apparatus, the test procedures, the definition and the presentation of the test results and the content of records, aiming at:

a) measuring the pull-out resistance of a soil nail or a rock bolt;

NOTE 4 A loading test performed using this document provides the pulled-out resistance along the bonded length, that will possibly differ from the pull-out resistance considered in design.

b) checking that a soil nail or rock bolt behaves as designed.

### 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 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

EN 1990 (series), *Eurocode: Basis of structural and geotechnical design*

EN 1992-1-1, *Eurocode 2: Design of concrete structures*

EN 1993-5, *Eurocode 3: Design of steel structures*

EN 1997 (series), *Eurocode 7: Geotechnical design*

### 3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in the EN 1990 series and the EN 1997 series and the following terms 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 Terms, definitions

##### 3.1.1

##### **applied load**

$P$

tension load applied to the tendon head during the test

##### 3.1.2

##### **proof load**

$P_p$

maximum load to which a test element is subjected in a particular load test

##### 3.1.3

##### **measured pull-out resistance**

$R_{t,m}$

measured value of the pull-out resistance at the element-ground interface

##### 3.1.4

##### **tendon**

soil nail or rock bolt reinforcing element

Note 1 to entry: Steel, fibreglass, etc.

##### 3.1.5

##### **test element**

element on which a test is performed

##### 3.1.6

##### **sacrificial element**

test element installed in the same way as production elements, but not forming part of the completed reinforced ground structure

##### 3.1.7

##### **production element**

test element which forms part of the completed reinforced ground structure

##### 3.1.8

##### **investigation test**

load test to establish the geotechnical ultimate load resistance of a soil nail or rock bolt at the interface between the element and the ground and to determine the behaviour of the element in the working load range

##### 3.1.9

##### **suitability test**

load test to confirm that a particular soil nail or rock bolt design will be adequate in particular ground conditions

##### 3.1.10

##### **acceptance test**

load test to confirm that an individual soil nail or rock bolt conforms with its acceptance criteria

### 3.2 Symbols

|                     |  |
|---------------------|--|
| $A_t$               | minimum cross section of the tendon, including the connecting parts            |
| $E_t$               | elastic modulus of the tendon material   |
| $L_b$               | bonded length of the test element  |
| $L_{db}$            | debonded length of the test element  |
| $L_e$               | external length of the tendon  |
| $P$                 | applied load   |
| $P_a$               | datum load   |
| $P_c$               | critical creep load  |
| $P'_c$              | intermediate parameter to derive the critical creep load $P_c$                 |
| $P_p$               | proof load   |
| $R_{t,m}$           | measured pull-out resistance   |
| $f_{tk} (= f_{uk})$ | tensile strength   |
| $f_{t0,2k}$         | yield strength at 0,2 % strain   |
| $s$                 | axial displacement of tendon head  |
| $s_1$               | axial displacement of tendon head at time $t_1$ , for creep rate determination |
| $s_2$               | axial displacement of tendon head at time $t_2$ , for creep rate determination |
| $t$                 | time   |
| $t_{min}$           | minimum load step duration for Test Method A                                   |
| $t_1$               | time at the beginning of the interval used for creep rate determination        |
| $t_2$               | time at the end of the interval used for creep rate determination              |
| $\alpha$            | creep rate (defined in <a href="#">Annex A</a> )                               |
| $\alpha_A$          | limiting criterion for creep rate for Test Method A                            |

## 4 Equipment

### 4.1 Test set-up

The equipment comprises (non-exhaustive list) of one jack, used as a loading device, displacement and load monitoring devices, a reaction system, associated locking nuts, tendon extension.

An example of test set-up is given in [Figure 1](#).

The test set-up shall take into account the aim of the test, the ground conditions and the expected displacement of the test element.

Where the facing system or the load test reaction system can influence the test result, then the test element should be de-bonded over the zone of influence.