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

**Part 10:
Testing of piles: rapid load testing**

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

Partie 10: Essai des pieux: essai de charge rapide

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Reference number
ISO 22477-10:2016(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

ISO 22477-10 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 182, *Geotechnics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 22477 series, published under the general title *Geotechnical investigation and testing — Testing of geotechnical structures*, can be found on the ISO website.

Introduction

This part of ISO 22477 outlines how a rapid load pile test is defined and specifies the equipment and testing procedures required. Informative, non-prescriptive guidance is included on the analysis of rapid load pile test results required to determine mobilised or ultimate compressive resistance of a pile.

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Geotechnical investigation and testing — Testing of geotechnical structures —

Part 10: Testing of piles: rapid load testing

1 Scope

This part of ISO 22477 establishes the specifications for the execution of rapid load pile tests in which a single pile is subject to an axial load in compression to measure its load-displacement behaviour under rapid loading and to allow an assessment of its measured compressive resistance ($R_{c,m}$) and corresponding load-displacement behaviour.

This part of ISO 22477 is applicable to piles loaded axially in compression.

All pile types mentioned in EN 1536, EN 12699 and EN 14199 are covered by this part of ISO 22477.

The tests in this part of ISO 22477 are limited to rapid load pile tests only.

NOTE 1 This part of ISO 22477 can be used in conjunction with EN 1997-1. Numerical values of partial factors for limit states from pile load tests to be taken into account in design are provided in EN 1997-1. For design to EN 1997-1, the results from rapid load pile testing will be considered equivalent to the measured compressive resistance, $R_{c,m}$, after being subject to appropriate analysis.

NOTE 2 Guidance on analysis of the rapid load testing results to determine measured compressive resistance and corresponding load-displacement behaviour is given in [Annex A](#).

This part of ISO 22477 provides specifications for the following:

- a) investigation tests, whereby a sacrificial test pile is loaded up to ultimate limit state;
- b) control tests, whereby the pile is loaded up to a specified load in excess of the serviceability limit state.

NOTE 3 Generally, an investigation test focuses on general knowledge of a pile type; a control test focuses on one specific application of a pile.

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.

There are no normative references in this document.

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1997-1 and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

trial pile

pile installed before the commencement of the main piling works or a specific part of the works for the purpose of investigating the suitability of the chosen type of pile and for confirming its design, dimensions and bearing resistance

Note 1 to entry: The trial pile might be sacrificed to achieve ultimate limit state.

3.1.2

working pile

pile that will form part of the foundation of the structure

3.1.3

test pile

pile to which loads are applied to determine the resistance deformation characteristics of the pile and the surrounding ground

Note 1 to entry: A test pile can be a *trial pile* (3.1.1), or a *working pile* (3.1.2).

3.1.4

pile load

axial compressive load (or force) applied to the head of the pile during the test

3.1.5

rapid load

force applied to the pile in a continuously increasing and then decreasing manner of a suitable duration (typically less than 1 s) relative to the natural period of the pile which causes the pile to compress over the full length and translate approximately as a unit during the full loading period

3.1.6

maximum compressive load

maximum axial compressive load (or force) applied to the pile during the test, generally defined prior to the test

3.1.7

rapid load test

pile loading test where a pile is subjected to chosen axial *rapid load* (3.1.5) at the pile head for the analysis of its capacity

3.1.8

ultimate measured compressive resistance of a pile

corresponding state in which the pile foundation displaces significantly with negligible increase of resistance

Note 1 to entry: Where it is difficult to define an ultimate limit state from a load settlement plot showing a continuous slight increase, a settlement of the pile top equal to 10 % of the pile base diameter should be adopted as the "failure" criterion.

Note 2 to entry: The maximum compressive resistance measured during a *rapid load test* (3.1.7) is not necessarily equal to the ultimate measured compressive resistance of a pile. The measured resistance obtained from rapid load testing must be analysed to remove the effects of inertia and soil dependent behaviour before it can be considered equivalent to the ultimate measured compressive resistance as outlined in [Annex A](#).

3.1.9

design compressive static resistance of a pile

ultimate compressive static resistance of a pile that shall be determined prior to load testing to allow specification of appropriate magnitude *rapid load test* (3.1.7) cycles

3.1.10

equivalent diameter

diameter of an equivalent circle of which the area equals the area of the relevant pile section

Note 1 to entry: The equivalent diameter for a circular pile is the outer diameter of the pile, for a square pile the diameter which gives the same area as the square pile (as long as the longest side is smaller than 1,5 times the shortest side) is the equivalent diameter.

3.1.11

minimum reference separation distance

distance which separates a stationary reference point from a point that will be significantly displaced by the testing method

Note 1 to entry: Only stationary points can be used for reference of *displacement* (3.1.12) measurement devices. Displacement measuring systems can be placed on the soil outside the reference distance without isolating (displacement compensating) measures.

3.1.12

displacement

axial displacement of the pile head measured during testing

3.2 Symbols

a	pile acceleration
c_p	velocity of the stress wave in the test pile
c_s	velocity of the shear wave in the ground
D	diameter or equivalent diameter of the test pile
F_c	pile load in compression
$F_{c,max}$	maximum compressive load
g	acceleration due to gravity
L	total length of the test pile
$R_{c,m}$	measured ultimate resistance of the ground in the test, or measured geotechnical resistance of the pile
r_{ref}	minimum reference separation distance
t	time
t_f	duration of the rapid load application
t_g	duration of the falling of the mass for a falling mass equipment
w	pile displacement