

Mechanical tests for post-tensioning systems

The European Standard EN 13391:2004 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN 13391:2004. It supersedes BS 4447:1973 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee B/525, Building and civil engineering structures, to Subcommittee B/525/2, Structural use of concrete, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Additional information

Attention is drawn also to ETAG 013 (June 2002), *Guideline for European Technical Approval of post-tensioning kits for prestressing of structures (these are commonly called Post-Tensioning Systems)*, available from EOTA, Kunstlaan 40 Avenue des Arts, B-1040 Brussels (see <http://www.eota.be>).

Cross-references

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English version

Mechanical tests for post-tensioning systems

Essais mécaniques concernant les procédés de
précontrainte par post-tension

Mechanische Prüfungen für Spannverfahren mit
nachträglichem Verbund

This European Standard was approved by CEN on 3 November 2003.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 13391:2004) has been prepared by Technical Committee CEN/TC 250 "Structural Eurocodes", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2004, and conflicting national standards shall be withdrawn at the latest by August 2004.

This European Standard was prepared by Working Group 1 of CEN/TC 250/SC 2 "Design of concrete structures". The standard supplements ENV 1992-1-1, ENV 1992-2 and the "European Technical Approval Guideline of post-tensioning kits for prestressing of structures (these are commonly called Post-Tensioning Systems)", ETAG 013.

Annex A is informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies the test procedures for the anchorages and couplings of post-tensioning systems. This standard is to be used in conjunction with the relevant European Standards ENV 1992-1-1 and ENV 1992-2 and others for pertaining to prestressed concrete structures.

The test results should be used for the acquisition of the Technical Approval of the specified post-tensioning system.

For unbonded tendons additional tests and requirements are needed and these are not covered in the present scope of this standard.

2 Normative references

Not applicable.

3 Terms, definitions and symbols

For the purposes of this European Standard, the following terms, definitions and symbols apply.

3.1 Definitions

3.1.1

Anchorage

mechanical device, usually consisting of several components designed to reliably and safely retain the force in the stressed tendon and to transmit it to the concrete. Anchorages can be either of the two types specified below:

$\frac{3}{4}$ Stressing anchorage: an anchorage located at the end of a tendon which can be used for stressing. It is exposed until grouting has been carried out and the anchorage sealed.

$\frac{3}{4}$ Fixed anchorage: an anchorage which is not used for tendon stressing.

3.1.2

Anchorage zone

local zone in the structure through which the prestressing force is transferred to the structure via the anchorage

3.1.3

Bursting reinforcement

reinforcement in the anchorage zone to resist transverse tensile forces due to the introduction of prestressing force into the structure

3.1.4

Coupling

device to join tendons

3.1.5

Duct (sheathing)

enclosure in which the prestressing steel is placed and which temporarily or permanently allows relative movement between the prestressing steel and surrounding concrete. The remaining void within the duct can

be subsequently filled with cementitious grout or other suitable material to protect the prestressing steel against corrosion

3.1.6

Prestressing

controlled generation of permanent forces and deformations in a structural concrete member to counteract the stresses arising from dead and live loads and/or due to shrinkage etc.

3.1.7

Post-tensioning system

arrangement of tendon and anchorages to carry out post-tensioning

3.1.8

Tendon

one or a number of prestressing steel elements e.g. wire, strand, bar, etc. Tendons can be either:

- ¾ Bonded: following stressing the tendon is grouted, thereby creating bond between the prestressing steel, grout, duct and concrete; or
- ¾ Unbonded: bond between tendon and concrete is prevented with the tensile force of the stressed tendon being permanently transferred to the concrete by the anchorages and deviators only

3.1.9

Tendon-anchorage assembly

connection between tendon and anchorage

Symbols

A_{pk}	characteristic cross-sectional area of the tendon
A_{pm}	actual mean cross-sectional area of the tendon
F_{pk}	characteristic ultimate resisting force of prestressing steel of tendon; $F_{pk} = A_{pk} f_{pk}$
F_{pm}	calculated ultimate resisting force of prestressing steel of tendon; $F_{pm} = A_{pm} f_{pm}$
F_{Tu}	measured ultimate force of tendon-anchorage assembly
F_u	measured ultimate force in load transfer test
max F	upper force in the dynamic load test with tendon-anchorage assembly
min F	lower force in the dynamic load test with tendon-anchorage assembly
F	force range in the dynamic load test; $F = \max F - \min F$
f_{ck}	characteristic compressive strength of concrete at 28 days
$f_{ck,o}$	minimum characteristic compressive strength of concrete at which full prestressing is planned on site
$f_{cm,e}$	mean compressive strength of concrete of specimen at final test to failure in the load transfer test
$f_{cm,o}$	mean compressive strength of concrete at which full prestressing is planned on site
f_{pk}	characteristic tensile strength of prestressing steel

f_{pm}	actual mean tensile strength of prestressing steel used for test (mean of the result of minimum three tests)
t	time
w	crack width measured in the load transfer test
ϵ_{Tu}	elongation of prestressing steel on free length of tendon at ultimate force F_{Tu}

4 Tests and requirements for post-tensioning anchorages

4.1 General

4.1.1 Purpose

It is the purpose of the test procedures to standardize the required mechanical tests for post-tensioning systems. The stipulated requirements pertain to the described tests. Figures are given in annex A.

4.1.2 Specification of system

Prior to testing, the principal details of the prestressing system shall be made known as far as they relate to the tests, e.g. by the technical report or specification of system.

4.1.3 Laboratory, testing facility

Generally, the tests shall be performed by an independent and notified laboratory. However, facilities provided by the applicant may be used, if the tests are executed under the surveillance and responsibility of such a laboratory.

4.1.4 Materials and components for the tests

All tests should be performed with the type and grade of prestressing steel and with the anchorage components as intended for application. If the anchorage to be used requires mechanical treatment of the prestressing steel, the effects of such treatment should be considered and justified.

The geometrical and mechanical properties of anchorage components as well as the tolerance range of dimensions shall be made known.

For the load transfer test the grade of concrete for the application of the post-tensioning system shall be as defined in the specifications. The grade of concrete is specified by its characteristic compressive concrete strength at 28 days, f_{ck} , this being determined in accordance with relevant standards. The minimum concrete compressive strength at which full prestress can be applied on site shall be specified. It can be defined either as the mean compressive strength $f_{cm,o}$ or as the minimum characteristic compressive strength, $f_{ck,o}$ of the concrete of the anchorage zone. These values are assumed to be related to each other by:

$$f_{ck,o} = f_{cm,o} - 8 \text{ MPa.}$$

(The properties of the concrete for the specimens are given in 4.2.3.2 and 4.2.3.3)

4.1.5 Types of test

The tests are performed according to the method of anchoring the prestressing steel. A distinction is made between: