

Products and systems for the protection and repair of concrete structures — Test methods — Determination of stiffening time

The European Standard EN 13294:2002 has the status of a
British Standard

ICS 91.080.40

National foreword

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Products and systems for the protection and repair of concrete structures - Test methods - Determination of stiffening time

Produits et systèmes de protection et de réparation des structures en béton - Méthodes d'essai - Temps de raidissement

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Bestimmung der Verarbeitbarkeitszeit

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Contents

	page
Foreword.....	3
1 Scope	4
2 Normative references	4
3 Principle.....	4
4 Apparatus	5
5 Procedure	5
5.1 General.....	5
5.2 Preparation of mortar or concrete	5
5.3 Separation of mortar and filling of containers.....	6
5.4 Storage conditions	6
5.5 Times of determination of resistance to penetration.....	6
5.6 Resistance to penetration.....	6
6 Expression of the test results	6
7 Test report	6

Foreword

This document EN 13294:2002 has been prepared by Technical Committee CEN/TC 104 "Concrete and related products", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by December 2002.

It has been prepared by sub-committee 8 "Products and systems for the protection and repair of concrete structures", the secretariat of which is held by AFNOR.

This European Standard is one of a series dealing with products and systems for the protection and repair of concrete structures. It describes a method of test determining the stiffening time of grout, mortar or concrete repair products and systems, making allowance for the presence of coarse aggregate.

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

1 Scope

This European Standard specifies a method for determining the stiffening time of repair products and systems specified in prEN 1504-3¹ comprising hydraulic based mortar and concrete (CC), including those modified by the addition of polymers (PCC).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 196-1, *Methods of testing cement - Part 1: Determination of strength.*

EN 480-2, *Admixtures for concrete, mortar and grout - Test methods - Part 2: Determination of setting time.*

EN 933-1, *Tests for geometric properties of aggregates - Part 1: Determination of particle size distribution – Sieving method.*

EN 1015-7, *Methods of test for mortar for masonry - Part 7: Determination of air content of fresh mortar.*

EN 1766, *Products and systems for the protection and repair of concrete structures - Test methods - Reference concretes for testing.*

prEN 1504-3, *Products and systems for the protection and repair of concrete structures - Part 3: Structural and non-structural repair.*

3 Principle

The method shall be based on EN 480-2. A sample of freshly-mixed repair product is placed into a container set on a weigh balance. Periodically, a penetration rod is pressed into the mortar to a defined depth and the penetration resistance calculated from the mass reading on the scale. As the mortar stiffens due to hydration of the cementitious components, the resistance to penetration will increase and by recording the penetration resistance with time, the stiffening time can be determined.

The stiffening time is the period from completion of mixing of the grout, mortar or concrete until a resistance to penetration of 0,5 N/mm² (initial) and 3,5 N/mm² (final) is achieved.

For mixes of a repair product with a particle size in excess of 5 mm, the wet mix is first sieved to separate and collect the mortar component, on which the test is performed.

¹ Under preparation.

4 Apparatus

The following apparatus is required.

- 4.1 Full tolerance 5 mm perforated plate test sieve** complying with the requirements of EN 933-1.
- 4.2 Self-indicating platform scale** preferably with a tare device, reading to at least 15 kg with graduations not greater than 100 g.
- 4.3 Containers** rigid, watertight, non-absorptive, non-oiled and at least 75 mm in diameter and 50 mm to 100 mm deep. Sufficient containers are needed to provide an area of surface large enough for the required number of penetrations of the rod.

NOTE It can be found advantageous to use disposable containers.

- 4.4 Stop-clock** with divisions in seconds.
- 4.5 Brass rod** 65 mm long and $(6,175 \pm 0,025)$ mm in diameter, with one end ground flat perpendicular to the axis of the rod. At $(25 \pm 0,25)$ mm from this end the diameter shall be turned down to $(4,5 \pm 0,5)$ mm for the remaining 40 mm.
- 4.6 Brass washer** approximately 5 mm internal diameter and 20 mm in external diameter, slipped over the narrow end of the brass rod to rest on the shoulder formed by the change in diameter of the rod.
- 4.7 Clamp and stand** such that the brass rod is held vertically by the narrow end with the washer well clear of the clamp. The clamp shall be mounted in a stand, such as a lever-type drill-stand, that enables the rod to be lowered vertically in a controlled and steady manner over a distance of at least 40 mm (Figure 1).
- The stand shall be firmly fixed to a bench so that the lower end of the brass rod, in its raised position, is about 6 mm above the rim of the container when this is placed on the platform scale.
- 4.8 Standard laboratory climate** of (21 ± 2) °C and (60 ± 10) % RH.
- 4.9 Mortar mixer** in accordance with EN 196-1.
- 4.10 Mortar and concrete mixer** forced action pan mixer.

5 Procedure

5.1 General

The determination of stiffening time is carried out in the standard laboratory climate (4.8). All materials and test equipment shall be conditioned in the standard laboratory climate for 24 h prior to proceeding with the test.

NOTE In addition, the stiffening time for the repair product or system can be determined at other temperatures for special applications.

5.2 Preparation of mortar or concrete

For concrete mixes which contain coarse aggregates, preparation shall be in accordance with EN 1766, using a concrete mixer (4.10), or as otherwise instructed by the manufacturer.

For mortar mixes, unless stated otherwise by the manufacturer, use the mortar mixer (4.9), set to a low speed. For both PCC and cementitious (CC) mortar, add the water or gauging liquid to the bowl and then add all the dry ingredients, mixing for a total period of two minutes. Where manufacturer's instructions preclude use of part bags of material, a mortar mixer (4.10) or other method recommended by the manufacturer shall be used.

NOTE It has been found that certain types of repair mortar can foam excessively under the action of the mixer specified in EN 196-1. An alternative is to use a concrete mixer (4.10).

Where required, the air content of the freshly mixed concrete or mortar shall be determined according to EN 1015-7, pressure method.

5.3 Separation of mortar and filling of containers

For concrete mixes which contain aggregate in excess of 5 mm, separate the mortar matrix from the aggregate by sieving the concrete through the 5 mm test sieve (4.1) and onto a non-absorptive surface. Remix the mortar thus obtained using a hand trowel before proceeding.

Fill the containers (4.3) to within 10 mm of the top in ten increments, tapping the container on the bench four times after each addition. Complete the filling within 15 min of the completion of mixing.

NOTE For certain stiff products or systems, which have zero flow slump when measured in accordance with EN 13395-1 this compaction method will be unsuitable and tamped compaction or other method advised by the manufacturer will be required.

5.4 Storage conditions

Cover the filled containers to prevent the evaporation of water. Record whether any bleed or segregation occurs during the test period but do not remove the bleed water that may collect.

5.5 Times of determination of resistance to penetration

Determine the resistance to penetration at hourly intervals up to a resistance of 1 N/mm² and thereafter at half-hourly intervals until a resistance of 4 N/mm² is reached.

5.6 Resistance to penetration

At the appropriate times place the container on the platform scale and remove the cover. Position the container so that the mortar surface beneath the brass rod is at least 20 mm from the rim of the container or from the position of any previous penetration. Adjust the scale-tare device or record the mass of the filled container. Slowly lower the brass rod into the mortar until the brass washer just touches the surface; at this moment note the scale reading, in kilograms, and correct if necessary, for the mass of the filled container.

6 Expression of the test results

Calculate the resistance to penetration in newtons per square millimetre, at various test times, by dividing the recorded reading in kilograms by three.

NOTE This simple calculation is made possible by using a brass rod with an end area of 30 mm², and by assuming that the reading in kilograms is equivalent to a force of 10 N, which is sufficiently accurate for the purpose of this test.

Estimate the times to each resistance to penetration of 0,5 N/mm² (initial) and 3,5 N/mm² (final) by linear interpolation between the results immediately above and below these values. Report the results to the nearest 15 min.

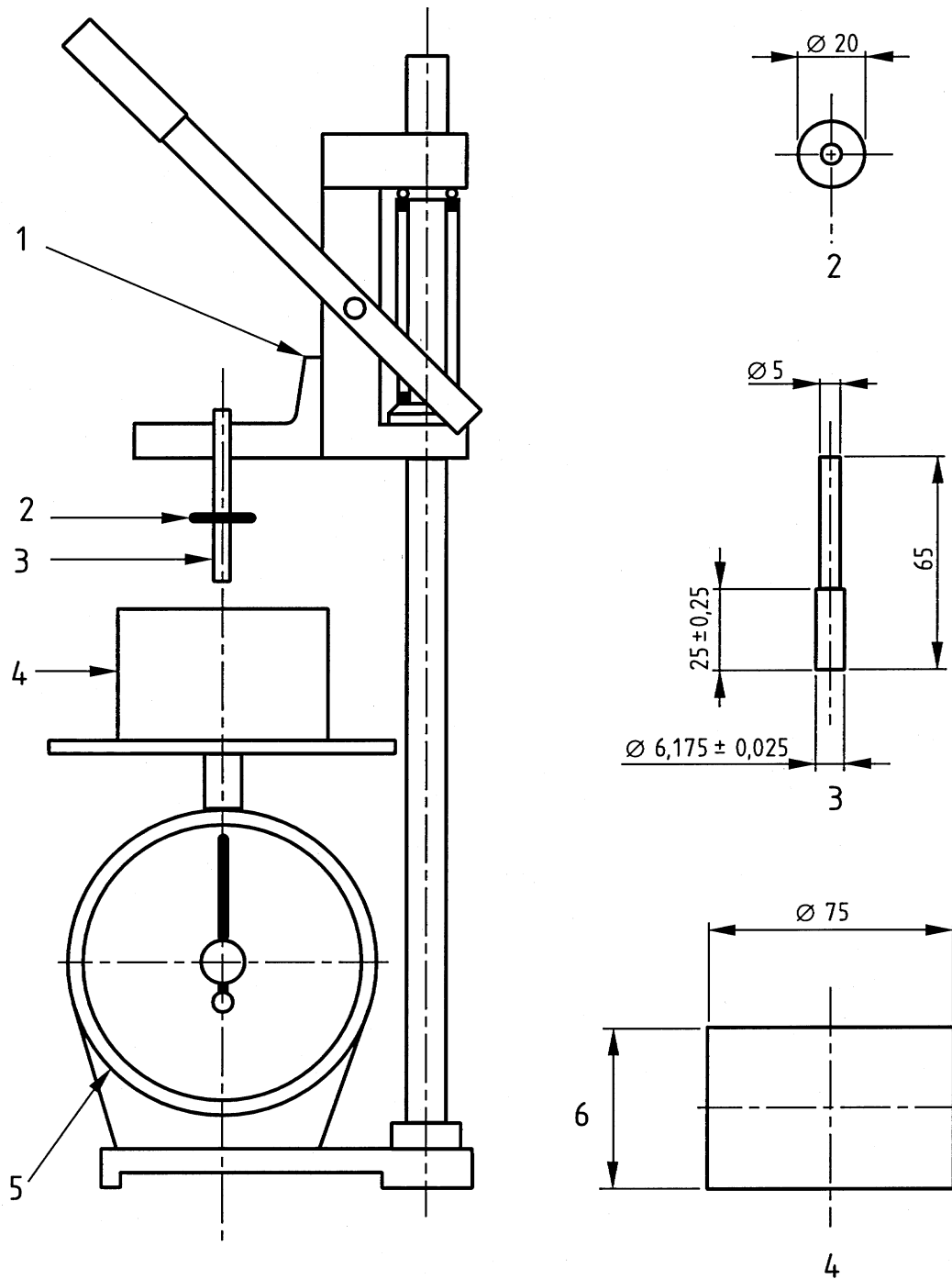
7 Test report

The test report shall contain the following information :

- a) a reference to the test method standard ;
- b) name and address of the test laboratory ;
- c) identification number and date of the test ;

- d) name and address of the manufacturer or supplier of the product ;
- e) name and identification marks or batch number of the product,
- f) date of supply of the product ;
- g) date of preparation of the test specimens and any deviation from the prescribed method of preparation, including date of manufacture of the test samples and the maximum aggregate size ;
- h) conditions of storage of prepared specimens prior to test ;
- i) date of test and details of the test equipment used, including the make, type and capacity and the calibration details or the identification number of the apparatus ;
- j) the test results, including the period of delay between completion of mixing and testing, evidence of segregation and bleeding and the time to achieve the initial and final penetration resistance ;
- k) precision data ;
- l) date of test report and signature.

Dimensions in millimetres



Key

- 1 Drill stand (lever type)
- 2 Washer
- 3 Penetration rod
- 4 Mould (or container)
- 5 Scale (preferably with a tare device) reading to at least 15 kg by graduations not greater than 100 g
- 6 50 to 100

Figure 1 - Apparatus for the determination of stiffening time

Bibliography

EN 1015-9, *Methods of test for mortar for masonry - Part 9: Determination of workable life and correction time of fresh mortar.*

EN 1504-1, *Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 1: Definitions.*

prEN 13395-1, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of Workability - Part 1: Test for flow of thixotropic mortars.*

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