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Grout for prestressing tendons —

Part 2: Grouting procedures

Coulis pour câbles de précontrainte —

Partie 2: Modes opératoires de gobetage

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 14824-2 was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 3, *Concrete production and execution of concrete structures*.

ISO 14824 consists of the following parts, under the general title *Grout for prestressing tendons:*

— *Part 1: Basic requirements*

— *Part 2: Grouting procedures*

— *Part 3: Test methods*

Introduction

In post-tensioned prestressed concrete construction, the grouting of tendons is an important operation. The intention of this part of ISO 14824 is to provide a specification for grouting, compliance with which will satisfy the requirements in ISO 22966.

The main function of grouting is to:

— protect the prestressing steel against corrosion;

— provide a bond between the prestressing steel and the ducts where required for the design of the structure;

— allow the transfer of compressive stresses in the structure in a direction transverse to the internal tendons;

— fill all voids where water may accumulate and cause frost damage.

The testing regimes anticipated by this part of ISO 14824 include three levels:

(1) initial type and audit testing in accordance with ISO 14824-1;

(2) suitability testing for confirmation of the selected grout for a specific project in accordance with this part of ISO 14824;

(3) inspection during the production of grout on a specific project in accordance with this part of ISO 14824.

The test methods for each of the regimes are given in ISO 14824-3.

In some countries requirements exist for independent third-party certification of grout and grouting procedures which should be set out in national requirements to supplement ISO 22966.

Where the suitability of high viscosity grouts has been proven by full scale trials, any amendments or alternatives to the procedures in this part of ISO 14824 need to be incorporated in the execution specification (see 4.1). This also applies to certain special structures or tendon configurations which require grouts with enhanced performance.

Grout for prestressing tendons —

Part 2:
Grouting procedures

1 Scope

This part of ISO 14824 gives the procedures to be used for grouting of tendons in post-tensioned prestressed concrete. It is applicable to all types of structures, including bridges and buildings.

This part of ISO 14824 also covers suitability testing and inspection testing for grouts and their component materials used on a project.

2 Normative references

The following referenced documents are indispensable for the application 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 14824-1, *Grout for prestressing tendons — Part 1: Basic requirements*

ISO 14824-3, *Grout for prestressing tendons — Part 3: Test methods*

ISO 22966, *Execution of concrete structures*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
grout
homogeneous mixture of cement and water, which may contain admixtures and additions

3.2
grouting
injection of grout into ducts in a continuous operation

3.3
tendon
assembly of prestressing steel and sheath with anchorages and all necessary auxiliary components to permit grouting, either placed internally or externally to the concrete structure

3.4
specialist contractor
contractor or construction enterprise which carries out grouting of tendons

4 Documentation

4.1 Execution specification

Before starting any part of the grouting works, the execution specification relevant to that part of the works shall be complete and available.

The following items shall be included in the execution specification:

— reference to this part of ISO 14824;

— reference to other relevant International or national standards;

— reference to international or national approvals for the post-tensioning kit;

— reference to other relevant national regulations and standards;

— information and requirements for the particular project prepared to supplement and qualify the requirements of the above listed documents;

— drawings and other technical documents needed for the execution.

In addition, where relevant, procedures shall be established for:

— making alterations to previously agreed requirements;

— distribution, the filing and recording of technical documents used for the works.

4.2 Quality plan

If a quality control procedure for grouting works is required by the execution specification, it shall be available at the site.

4.3 Execution documentation

The specialist contractor shall keep available on site written method statements covering materials, equipment, grouting procedures and inspection all adapted to the extent and complexity of the project. Provisions for the case of unusually low or high temperatures or delayed grouting, if likely to occur during the project duration, shall be specified.

The specialist contractor shall have shop drawings showing the position and details of the inlets and outlets, and the details of the sealing of the tendon anchorages.

The specialist contractor shall keep available on site documented records of:

— materials and grout used;

— initial type testing according to ISO 14824-1;

— suitability testing according to this part of ISO 14824;

— results of the project specific grouting tests, if specified.

The specialist contractor shall keep documented records of the conformity of the materials, equipment, grout, grouting operations, and inspection with this standard and the execution specification according to Table 2, Table 3 and Table 4. These records shall be kept for the duration required by national provisions.

Any eventual corrective actions taken shall also be recorded.

If special documentation beyond the requirements of this part of ISO 14824 is required for grouting works, the type and extent of the documentation shall be stated in the execution specification.

5 Materials

The individual materials and the grout to be used shall comply with ISO 14824-1.

6 Grout assessment

6.1 Suitability testing

The suitability of the grout shall be assessed for each project sufficiently in advance of grouting operations, to enable any necessary adjustments to be made in the use of the materials, equipment or personnel. The extent of suitability testing and number of tests shall be in accordance with Table 1.

Table 1 — Extent of suitability testing[a]

Test in accordance with ISO 14824-3 [b]	Suitability testing	Number of tests
Sieve	Yes	1 test
Fluidity	Yes	1 test immediately after mixing 2 tests 30 min after mixing
Inclined tube	Only required if not already subject to initial type testing with the same type of mixer intended to be used on the project	1 test if required
Wick-induced bleed [c]	Yes	3 tests
Volume change [c]	Yes	3 tests
Compressive strength [d]	Yes	3 tests
Density	Yes	1 test

[a] Suitability testing may be waived for structures in Inspection Class 2 subject to there being satisfactory evidence from previous similar projects of full compliance of the grout with the requirements of ISO 14824-1 and documented testing during production in accordance with ISO 14824-1.

[b] Other test methods may be used if the correlation or safe relationship between the results of these test methods and the reference methods in ISO 14824-3 have been established.

[c] Tests for bleeding and volume change are performed on the same sample.

[d] The number of compressive tests may be reduced to one where there is documented evidence from previous projects of full compliance of the grout with the requirements of ISO 14824-1.

The grout assessment shall consist of the preparation of the grout using the materials, equipment and personnel proposed for the project, and testing in accordance with ISO 14824-3. The preparation of the grout shall be carried out under the conditions expected on site for the project. The assessed grout properties shall comply with ISO 14824-1. The range of acceptable temperatures specified for the particular grout shall be compatible with the expected conditions of the project.

6.2 Project specific grouting tests

If required by the execution specification, project specific grouting tests on tendons in representative forms of the project shall be performed. Such tests should be planned and carried out well in advance of the site operations.

NOTE Such project specific grouting tests can be advisable, e.g. when tendon geometry and details are specified on the project for which no prior experience for successful grouting is available. Experience has shown that full-scale tests of grout and grouting procedures can be valuable to prove adequacy.

7 Equipment

7.1 General

Grouting equipment shall consist of a mixer and a pump with all the necessary connection hoses, valves, measuring devices for water, cement, admixtures and additions, and testing equipment as required to perform the grouting of the project.

The grouting equipment shall be such that the ducts can be filled without interruption and at the anticipated speed.

Grouting equipment shall include a storage reservoir if required for continuous filling of the tendons on the project. Such storage reservoirs shall have an agitator to keep the grout moving continually before it is pumped into the ducts.

The grouting equipment shall be compatible with the post-tensioning kit provided for the project.

7.2 Mixer

The mixing equipment shall be capable of producing grout, which possesses an even distribution of cement, and an even dispersal of admixtures, additions, if any, and water. The mixed grout shall contain no cement lumps as confirmed with the sieve test of ISO 14824-3. The mixed grout shall comply with the requirements of ISO 14824-1.

7.3 Pump

The pump shall be capable of providing a continuous flow of grout and maintaining the anticipated pressure for grouting. It shall be equipped with a pressure gauge and means to prevent unsafe pressure during grouting.

The pump shall be constructed in such a way as to prevent introduction of air, oil or other foreign substances into the grout.

NOTE 1 Limiting the grout pressure serves to: (a) prevent blow-outs of hoses, inlets and outlets; (b) prevent damage to the concrete structure; (c) protect the equipment and valves from damage; (d) protect the operators.

NOTE 2 The use of a pump with a variable output gives the advantage that it can be adapted to the requirements of ducts of different diameters.

7.4 Hoses

The diameter and rated pressure capacity of the grout hoses shall be compatible with the pump output, the assumed maximum pressure and the length needed.

7.5 Inlet connections

The connections of the grout hoses to the inlets of the ducts shall be leak tight. Narrow openings in hose connectors or inlet connections through which the grout must pass, should be avoided. A pressure gauge should be mounted at the grout inlet if the hose length is greater than 30 m.

NOTE 1 Narrow openings cause resulting pressure build-up which can increase the risk of bleeding and in turn can lead to blockage.

NOTE 2 In the event of sudden and abnormal pressure increase, an additional pressure gauge located at the grout inlet will indicate whether the reason for the pressure build-up lies within the tendon ducts or in the grout hoses.

7.6 Stand-by and emergency equipment

If required, stand-by and emergency equipment shall be provided in the execution specification.

8 Grouting procedures

8.1 Inlets, outlets and tendon anchorages

Tendon anchorages or tendon anchorage recesses shall be sealed with a temporary or permanent cover which is compatible with the post-tensioning kit and which can be removed after grouting for inspection of the quality of grouting.

Inlets and outlets shall be provided in general, at both tendon ends and at those points of the tendons where air and water may accumulate.

All inlets and outlets shall be suitably marked to identify the tendon, and their location along the tendon. Drainage outlets should be provided at all low points if freezing temperatures are to be expected before grouting is carried out. These drainage outlets should be left open until shortly before grouting starts.

NOTE Likely points of the tendons where air and water can accumulate are: anchorages, couplers, at high points and in the slope of the duct beyond these.

8.2 Precautions before grouting

During the time before grouting the tendons shall be adequately sealed against an ingress of water.

Ducts in precast segmental construction shall be verified to be sufficiently leak tight to avoid grout migration into adjacent ducts.

Ducts shall be confirmed to be free of debris, water and blockages that could prevent or harm grouting operations as provided in the method statement of the specialist contractor or as required in the execution specification. This may be done by blowing dry air through the tendon ducts. Verification by flushing of water through the tendon ducts shall be prohibited, in general. Any requirements for air pressure tests of ducts should be given in national requirements for the project specification.

Precautions shall be taken for temporary protection of the prestressing steel and post-tensioning kit anchorages if the construction periods recommended in ISO 22966 are likely to be exceeded.

Ducts should be grouted as soon as possible after it is verified that the tensioning of the prestressing steel has been successful. If the delay between inserting the prestressing steel and grouting the ducts is likely to permit corrosion of the prestressing steel, consideration should be given to the use of protective soluble oils on the prestressing steel or circulation of dry air in the ducts. It shall be verified that the use of protective soluble oils will not have an adverse effect upon the prestressing steel or the properties of the grout, and that the bond properties of the prestressing steel with protective soluble oils are acceptable for the design of the structure.

NOTE 1 Ducts in precast segmental construction can be checked for sufficient leak tightness with compressed air. Any leakage of concern can be repaired before grouting.

NOTE 2 For certain types of tendons with filling ratios larger than 0,45, e.g. bar tendons, it can still be considered necessary to flush the tendons with water before grouting.

8.3 Temperature at grouting

Records shall be kept of the maximum and minimum ambient temperatures and the temperature of the structure adjacent to the tendons to be grouted.

No grout shall be placed if the temperature of the structure adjacent to the tendon is, or is likely to become during the 48hrs after grouting, below 5 °C or the minimum temperature declared by the manufacturer, for which he has confirmed compliance of the grout with ISO 14824-1, unless the structure adjacent to the tendons is heated so as to maintain the temperature of the placed grout above 5 °C, or 2 °C above the temperature specified by the manufacturer, for at least 48 h.