TECHNICAL SPECIFICATION

**ISO/TS 16774-1**

First edition
2017-05

# Test methods for repair materials for water-leakage cracks in underground concrete structures —

## Part 1: Test method for thermal stability



*Méthodes d'essai pour matériaux de réparation pour fissures dues à l'eau dans les structures en béton —*
*Partie 1: Méthode d'essai de la stabilité thermique*



Reference number
ISO/TS 16774-1:2017(E)



ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

 

# Contents

Page

# 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 voluntary nature of standards, 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



This document was prepared by ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 7, *Maintenance and repair of concrete structures.*



A list of parts in the ISO 16774 series, published under the general title *Test methods for repair materials for water-leakage cracks in concrete structures*, can be found on the ISO website.

# Introduction

ISO/TR 16475 outlines six basic properties and the required performance levels of water-leakage repair materials, and ISO/TS 16774-1 through ISO/TS 16774-6 provide test methods designed to evaluate the respective properties of these repair materials.

These test methods are intended to serve as references for nations that have not yet developed a test method on the six proposed required performance properties of water leakage repair materials. If other forms of test methods that are simpler, more accurate or more organized are available, such methods are recommended for use instead.

Many of the dependent variables outlined in the ISO 16774 series of reference test methods are subject to change in accordance with the environmental conditions (temperature; chemical substance and concentration; relative humidity; width of movement activity; water pressure or water flow velocity, etc.) outlined in the standards and testing parameters used in respective countries.

In ISO/TS 16774-1, ISO/TS 16774-5 and ISO/TS 16774-6, for the purpose of objectively comparing the performance of injected repair materials, artificial cracks of same volume were used to control the usage of repair materials for each testing cycle and enable repetition of the same test methods under the same conditions.

# Test methods for repair materials for water-leakage cracks in underground concrete structures —

# Part 1:
# Test method for thermal stability

## 1 Scope

This document specifies a laboratory test method for evaluating the thermal stress resistance of water-leakage crack repair materials through permeability testing.

The repair material injected into a test specimen with an artificial crack is thermally stressed under the applied temperature conditions outlined in different national testing parameters that reflect different environmental conditions. As such, the results are only intended to provide a comparative performance evaluation of the waterproofing repair materials between different products of the same type of repair material.

This document outlines general guidelines and procedures for the test method. Specific variables that control the quantifiable parameters of the testing are filled in using relevant national standardizations and/or testing parameters.



NOTE 1 This test method classifies and categorizes materials that are tested into families of similar properties for the purpose of making relative comparisons with the data results.



NOTE 2 Each individual repair material can be further tested in an actual construction site application for a complete assessment.

## 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/TR 16475, *Guidelines for repair of water-leakage cracks in concrete structures*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 16475 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**
**repair material**
<water-leakage cracks>material used for preventing the escape of water at cracks in concrete

EXAMPLE Injection type grouts, such as synthetic rubberized asphalt, mastic, urethane, poly-urea, etc.

Note 1 to entry: In this document, target ingredients are limited to injection materials outlined in ISO/TR 16475.

## 4 Principle

Resistance to physical change, loss, or disintegration due to thermal stress is one of the fundamental properties that water leakage repair materials should possess. Repair material property changes due to high or low temperature conditions, can potentially cause the repair material's performance to deteriorate. To evaluate the leakage crack repair material's **thermal stability** performance, this test method uses two separate procedures: 1) a thermal stress test method and 2) a permeability test method.

The test specimen with an artificial crack is injected with repair material, and the specimen goes through thermal stress testing for a specified number of cycles, between hot and cold temperature conditions. Test specimens with the repair materials are placed in temperature chambers where the temperature is repeatedly changed from maximum to minimum temperature conditions for a period of time (time and temperature variables are subject to change in accordance to different national test parameters). To evaluate whether the repair material loses its waterproofing property due to thermal stressing, the specimen goes through water permeability testing for the last stage of the test method.

## 5 Apparatus

**5.1 Temperature chamber**, which should be able to handle temperature precision values of 2 °C ranging from (−20 ± 2) °C to (60 ± 2) °C and maintain a constant temperature in the interior of the chamber apparatus. Apparatus should also be equipped with a compartment dryer and freezers with temperature precision of ± 2 °C. The chamber should also be able to automatically alternate between high and low temperature conditions.



NOTE Temperature condition values are subject to change in accordance with different national testing parameters and requirements.

**5.2 Air compressor**, which should be able to handle minimum air pressure value of 0,1 N/mm$^2$ to 0,3 N/mm$^2$.



**5.3 Permeability test chamber**, which should be able to handle minimum water pressure value of 0,1 N/mm$^2$ to 0,3 N/mm$^2$ (output method).

NOTE Conditions outlined in 5.2 and 5.3 are subject to change in accordance with different national testing parameters and requirements.

## 6 Preparation of the test specimen and artificial crack conditions

1) Two separate concrete or mortar substrate parts should be cured to form a water-leakage crack test specimen. The parts consist of upper and bottom parts, and they should be flat and cylindrical in shape and made using concrete or mortar.

   NOTE The mix proportion is (water: cement: fine aggregate = 1: 2: 6, mass ratio). The curing period for the mortar or concrete substrate parts is approximately 72 hours, but subject to change in accordance to different national testing parameters and requirements.

2) The bottom substrate is drilled with evenly spaced holes (Ø2,5 mm) near the centre of the substrate. The pinholes shall be drilled all the way through from one surface of the substrate part to the other.

   NOTE The purpose of these pinholes is to check for signs of leakage during repair material injection and during permeability testing.

3) Spacers are placed on one surface of the bottom substrate part without covering the pinholes, and the upper substrate part is placed on top of the spacers. The substrate parts, now having formed the test specimen with the artificial crack, are held together with tape, silicone sealants or other applicable materials along the exterior side. The spacer height represents the width of the crack and can vary depending on the different national testing parameters and requirements.

NOTE Any material can be used to hold the two substrate parts together with a crack space in between, but they should leave an inlet in one side for material injection.

4) The injection space should be flushed out with water before injecting the repair material to remove any debris as well as to verify that the interior mortar surface is sufficiently wet for repair material injection. After making sure the substrate parts are held together tightly, place the test specimen under water for a specified amount of time. After taking the specimen out of the water, inject the repair material into the specimen.

   The injection method varies according to different national testing parameters and requirements. If manufacturer's instructions are available, this method is recommended instead. If debris and other substances are present they should be removed prior to material application.

NOTE For detailed and clearer explanation, refer to Annex A.

# 7 Procedure

## 7.1 Thermal stress test

1) Once the test specimen have been injected with the repair materials and taken out of the water after the specified duration, place the test specimens in the temperature chamber.

2) Run the thermal stress testing.

   NOTE Thermal stress testing will consist of alternating the interior temperature of the testing chamber between low and high temperature for a set number of cycles within a set period of time. Temperature range, duration, and number of cycles are subject to change in accordance to different national testing parameters and requirements.



3) Take the test specimen out of the temperature chamber and record its conditions. Proceed to the permeability test.



   NOTE Record sample conditions at different intervals of cycles during thermal cycling for changes on for mass change and visual descriptions of failure like cracking, disintegration, erosion, etc. if such data is required.

## 7.2 Permeability test

1) Place the specimen in the permeability test chamber.

   NOTE The procedure outlined will follow the steps required for the output method of this permeability test. Other methods, if applicable, can be used for this step.

2) Fill the chamber with water. Connect the air compressor valves to the air compression chamber.

3) Run the permeability test.

   NOTE Water/air pressure values are subject to change in accordance with different national test parameter requirements.

4) Observe and record to see if there is leakage or not with the test specimen.

   Photos of the specimen and equipment conditions shall be taken at every stage possible during each and every test procedure for recording and information purposes.

NOTE For detailed and clearer explanation, refer to Annex A.

# 8 Presentation of results

The continually induced physical stress of the test cycles can affect the repair material's performance level. This test method evaluates the physical properties of the repair materials under the prescribed conditions of permeability testing through a qualitative evaluation of whether the repair material can maintain adequate waterproofing properties. These results can be used in the future as a data base for a guideline on selecting appropriate repair materials with the required properties of adhesion on leakage crack surfaces of underground concrete structures.

# 9 Test report

## 9.1 Information on the repair material of the test target

### 9.1.1 General

The test report should record the following information on the repair material of the test target:

1) Producer (name, address, phone number).

2) Production date, time, place of the repair material.

3) Type, storage method and authentication of the repair material.

4) Manufacturer's product instructions and relevant repair material guidelines.

5) Data on the chemical composition of repair material as indicated in manufacturer's data sheet.



### 9.1.2 Other information



The following information is recorded on demand, if required:

1) Project of the test target.

2) Application areas of the test specimen.

3) Result of some eco-toxicological performance tests to account for the release of hazardous substances and the subsequent effects on health and safety.

## 9.2 Information on the test

The test report should record the following information on the test:

1) Test manager.

2) Name/purpose of the test.

3) Ambient condition of the laboratory (temperature, relative humidity, safety conditions etc.).

4) Production time and place of the specimens.

5) Shape and size of the specimens, and the number of replicates of the specimens for repeat test.

6) Identification of the specimens (Lot No. etc.).

7) Curing and storage conditions.

8) Information on the test repair material (name, producer, validity etc.).

9) Test data (production, measurement, test period etc.).

10) Type of facilities, equipment, tools.

11) Status of test equipment, tools.

12) Test results.

13) Details on other test programmes and procedures.