Technical Specification

ISO/TS 16774-5

Second edition
2024-08

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

Part 5: Test method for watertightness

Méthodes d'essai pour matériaux de réparation pour fissures dues à l'eau dans les structures en béton —

Partie 5: Méthode d'essai de l'étanchéité à l'eau

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Contents

Page

Foreword

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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 document 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).

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

This second edition cancels and replaces the first edition (ISO/TS 16774-5:2017), which has been technically revised.

The main changes are as follows:

— in 6.1 a), a recommendation regarding the specification of the fine aggregate, as well as the necessary reference to the relevant standard, has been added;

— in 6.1 d), the text has been revised to provide clearer context.

A list of all parts in the ISO 16774 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is linked to ISO/TR 16475. ISO/TR 16475 outlines six basic properties and the required performance levels of water-leakage repair materials; The ISO/TS 16774 series proposes sample testing methods for evaluating the respective properties of the repair materials.

The test methods in this document are intended to serve as reference for nations that have not yet developed a test method for the six required performance properties of water-leakage repair materials. Many of the dependent variables outlined in the reference test methods of this document are subject to change in accordance with the environmental conditions (temperature and humidity, chemical solution and concentration, width of movement activity, water pressure or water flow velocity, etc.) outlined in the standards used in respective countries.

In this document, ISO/TS 16774-1 and ISO/TS 16774-6, for the purpose of objectively comparing the performance of injected repair materials, artificial cracks of same width, height, and volume are used to control the usage of repair materials for each testing cycle and enable repetition of the same test methods under the same conditions. In this document, target ingredients are limited to injection materials outlined in ISO/TR 16475.

These permeability test procedures follow applied conditions outlined in different national testing parameters and requirements. 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 with the same environmental conditions.

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.

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

Part 5:
Test method for watertightness

1 Scope

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

This document outlines general principles and procedures for the test method. This document does not specify specific variables that control the quantifiable parameters of the testing.

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, *General practices for the 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 terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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.

4 Principle

Impermeability to water pressure is one of the fundamental properties of water-leakage repair materials. Property changes in the repair material due to applied hydro-static pressure can influence the repair material's performance and lead to waterproofing failure. The test method in this document evaluates the watertightness properties of repair materials injected into a test specimen with an artificial crack through a permeability test (i.e. checking for leakage with a specified amount of water pressure), thereby assessing the material's performance with a qualitative method.

5 Apparatus

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

5.2 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 5.1 and 5.2 are subject to change in accordance with different national testing parameters and requirements.

6 Preparation

6.1 Test specimen and artificial crack conditions

a) 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.

The mix proportion is (water : cement : fine aggregate = 1 : 2 : 6, mass ratio). The fine aggregate used should be specified. A different standard specification can apply.

NOTE 1 The curing period for the mortar or concrete substrate parts is approximately 72 h, but can change according to different national testing parameters and requirements.

b) The bottom substrate is drilled with evenly spaced holes (Ø 2,5 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 2 The purpose of these pinholes is to check for signs of leakage during repair material injection and during permeability testing.

c) 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.

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

d) The specimen surface should be cleaned before injecting the repair material to remove any debris. After placing the test specimen under clean water, ensure the substrate surface is sufficiently wet for repair material injection for a specified amount of time. Inject the repair material into the specimen.

The injection method varies according to different national testing parameters and requirements. The manufacturer's instructions should be followed if available. Debris and other substances, if present, should be removed prior to material application.

NOTE 3 For detailed explanation refer to Annex A.

6.2 Ambient conditions

Keep the test room at temperature (22 ± 2) °C and humidity at (55 ± 5) % (standard drying conditions of a drying shrinkage state conditions outlined in ISO 1920-8) during the experiment unless specifically required otherwise.

NOTE Temperature values are subject to change according to different national standards. For example, warmer countries have ranges that can reach up to (27 ± 2) °C and colder countries can reach (16 ± 3) °C, etc. The same applies to humidity conditions.

7 Procedure

a) Place the specimen in the permeability test chamber.

NOTE 1 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.

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

c) Run the permeability test.

NOTE 2 Water and air pressure values are subject to change in accordance with different national test parameters and requirements.

d) Observe and record to see if there is leakage from the test specimen.

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

NOTE 3 For detailed explanation refer to Annex A.

8 Presentation of results

The results of the repair material evaluation are based on a qualitative assessment of whether the tested material fails its waterproofing performance and leaks under a water pressure value outlined in the applied national test parameters and requirements. These results can be used in the future as a data base for a guideline on selecting appropriate repair materials with the required watertightness properties in 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:

a) producer (e.g. name, address and phone number);

b) production date, time and place of the repair material;

c) type, storage method and authentication of the repair material;

d) manufacturer's product instructions and relevant repair material guidelines;

e) 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:

a) project of the test target;

b) application areas of the test specimen;

c) 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 shall record the following information on the test:

a) a reference to this document (including its year of publication);

b) the sample;

c) the test manager;

d) the name and purpose of the test;

e) ambient conditions of the lab (temperature, relative humidity, safety conditions, etc.);

f) production time and place of the specimens;

g) shape and size of the specimens, and the number of replicates of the specimens for repeat test;

h) identification of the specimens (lot no., etc.);

i) curing and storage conditions;

j) information on the test repair material (name, producer, validity, etc.);

k) test data (production, measurement, test period, etc.);

l) type of facilities, equipment and tools;

m) status of test equipment and tools;

n) test results prepared in accordance with Clause 8;

o) any deviations from the procedure;

p) any unusual features observed;

q) the date of the test;

r) details on other test programmes and procedures.

Annex A
(informative)

Example test method

A.1 Principle

This example test method evaluates the watertightness performance of a repair material injected into a test specimen with an artificial crack. The test specimen undergoes permeability testing where the repair material will be placed under a hydrostatic water pressure of approximately 0,3 N/mm^2 for one hour to determine the permeability properties of the tested repair material.

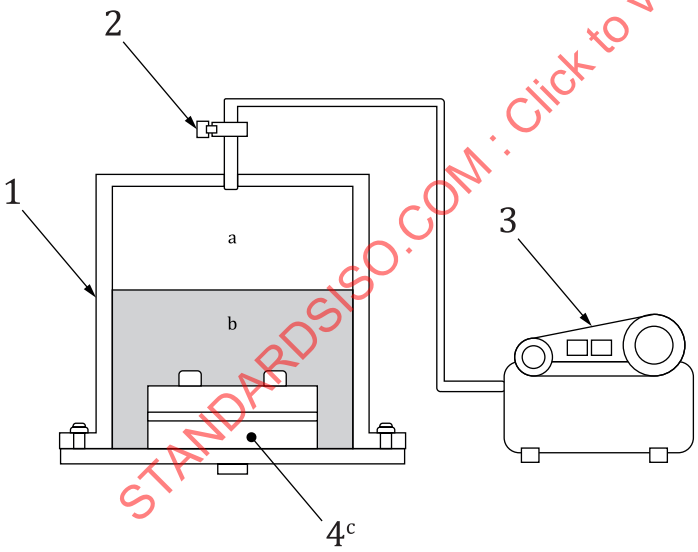
This example test method employs test parameters and environmental conditions outlined in the test standards used in the Republic of Korea. This test method requires the use of fabricated and simulated artificial cracks as illustrated with the specimen used in this example.

A.2 Apparatus

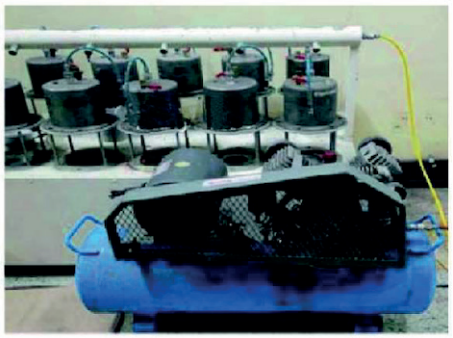
A.2.1 Air compressor, which should be able to handle minimum air pressure value of 0,1 N/mm^2 to 0,3 N/mm^2.

A.2.2 Permeability test chamber, which should be able to handle a minimum water pressure value of 0,1 N/mm^2 to 0,3 N/mm^2 (output method).

NOTE Refer to Figure A.1 a) and b).



a) Permeability test chamber (output)



b) Compressor and water pressure chamber

Key

1	watertightness chamber	a	Pressure: 0,3 N/mm^2.
2	pressure regulator	b	Water: 1 L.
3	air compressor	c	See Figure A.2.
4	test specimen		

Figure A.1 — Apparatus for example test method

A.2.3 Test specimen.

NOTE Refer to Figures A.2 a) and b) and A.3.

A.2.3.1 Fixing bolt, for connecting test specimen to universal testing machine (UTM) (⌀ 6 mm).

A.2.3.2 Upper substrate part, (acrylic, ⌀ 100 mm × 30 mm).

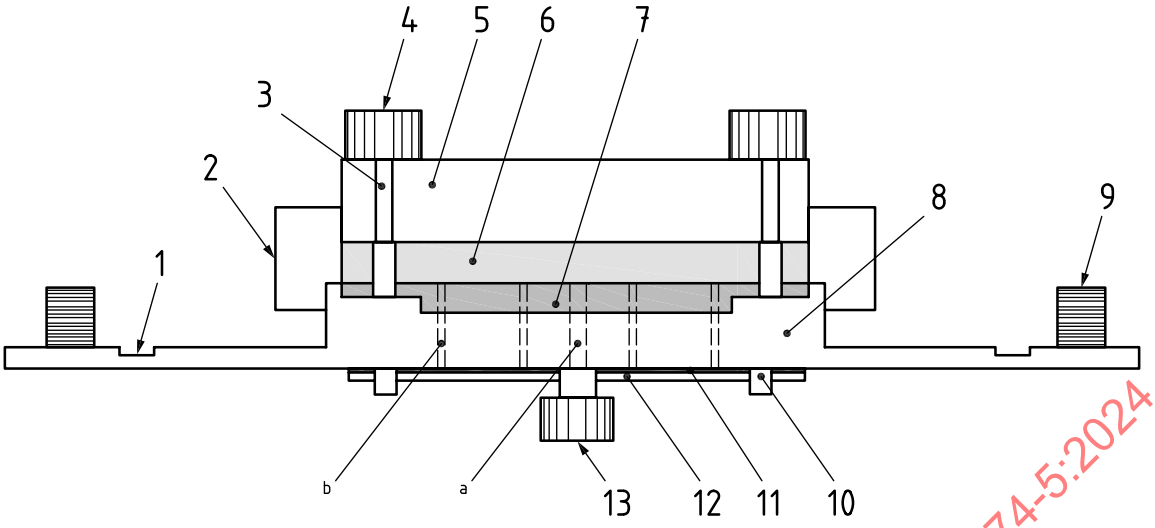
A.2.3.3 Repair material, see 3.1.

A.2.3.4 Concrete or mortar substrate part, (water: cement: fine aggregate = 1: 2: 6, mass ratio). Height of the concrete or mortar mould is 15 mm.

A.2.3.5 Steel plate, for setting the concrete or mortar substrate in place (STS 304, ⌀ 220 mm × 5 mm).

A.2.3.6 Non-woven fabric, for filtering repair material particulates when testing cementitious grout material (synthetic fibre, ⌀ 100 mm, 180 g/m^2).

A.2.3.7 Acrylic plate, for setting the non-woven fabric in place (acrylic, ⌀ 100 mm × 5 mm).



a) Test specimen

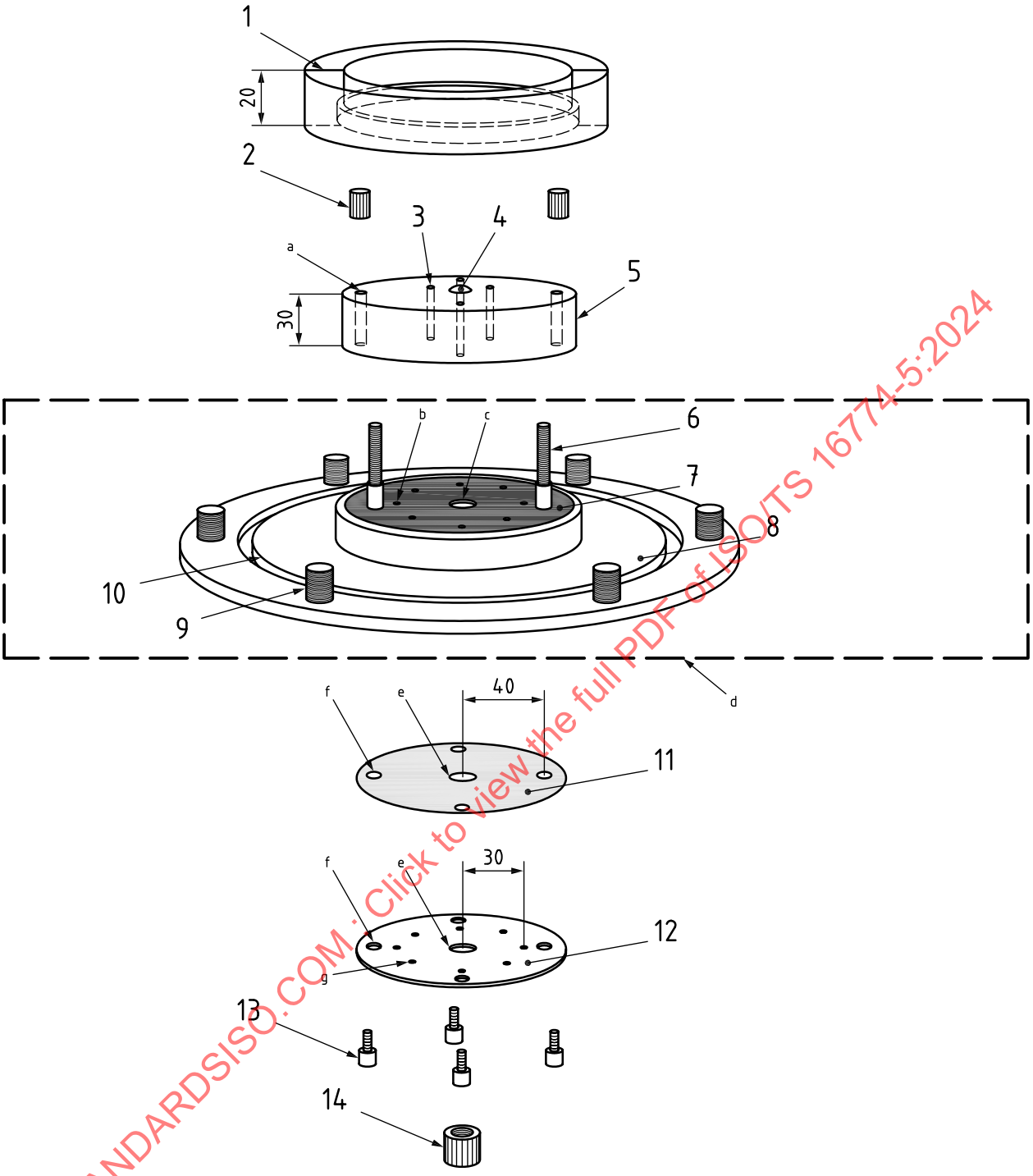
b) Example of test specimen

Key

1	O-ring (width 5 mm)	9	bolt for fixing with chamber (Ø 10 mm)
2	acrylic band for seal	10	bolt for fixing acrylic plate (Ø 6 mm)
3	bolt for connecting upper substrate	11	non-woven fabric for filtering repair material
4	fixing nut for connecting mortar substrate (Ø 6 mm)	12	acrylic plate for fixing non-woven fabric
5	upper substrate (acrylic, Ø 100 mm × 30 mm)	13	inlet cover for injecting (Ø 12 mm)
6	repair material	a	Injection hole (Ø 10 mm).
7	mortar substrate	b	Leakage hole (Ø 2,5 mm).
8	steel plate for fixing mortar substrate (Ø 220 mm × 5 mm)		

Figure A.2 — Diagram of the test specimen

Dimensions in millimetres



Key

1 acrylic band for seal
2 fixing nut for fixing mortar substrate (Ø 6 mm)
3 injection hole (Ø 10 mm)
4 level instrument
5 upper substrate (acrylic)
6 bolt for connecting upper substrate
7 mortar substrate
8 steel plate for fixing mortar substrate
12 acrylic plate for fixing non-woven fabric
13 bolts for fixing acrylic plate (Ø 6 mm)
14 inlet bar for injection (Ø 12 mm)
a Hole for connecting bolt (Ø 8 mm).
b Leakage hole (Ø 2,5 mm).
c Injection hole (Ø 10 mm).
d See Figure A.4.
e Injection hole (Ø 20 mm).

9 bolt for fixing with chamber (Ø 10 mm)
10 O-ring (width: 5 mm)
11 non-woven fabric for filtering repair material
f Hole for fixing (Ø 7 mm).
g Leakage hole (Ø 2,5 mm).

Figure A.3 — Basic parts planar of test specimen

A.2.4 Other apparatus.

A.2.4.1 Injector, suitable for the application of the tested repair material into the concrete specimen.

A.2.4.2 Water container.

A.2.4.3 Masking tape, silicone sealant or additional sealing materials.

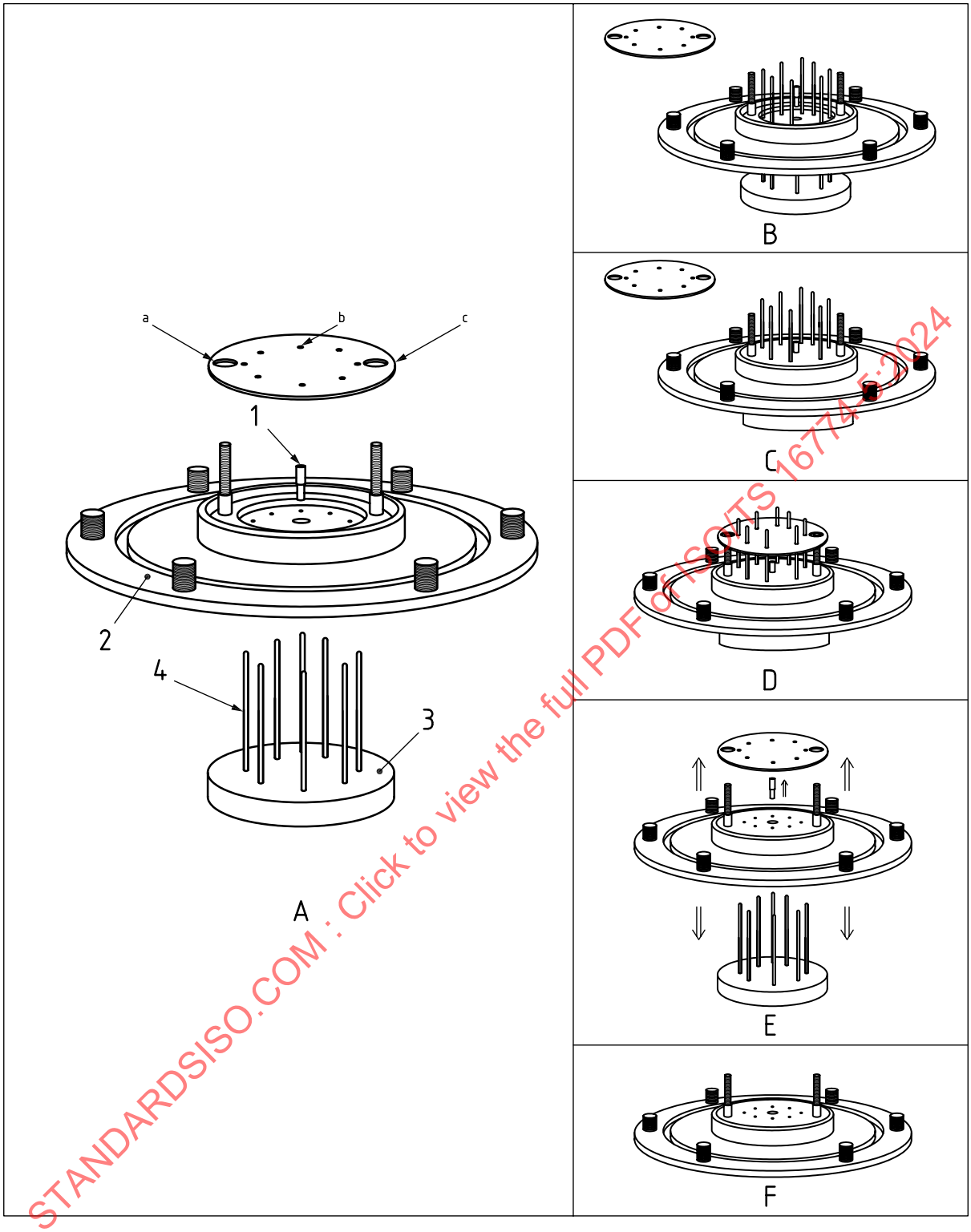
A.3 Preparation

A.3.1 Test specimen assembly part 1

a) Insert the inlet bar and the pin plate on the steel plate. Next, pour the mortar (the mortar substrate part in the mould inside the steel plate (see steps 1, 2 and 3 in Figure A.4).

b) Cure the mortar substrate part for 72 h at (20 ± 3) °C and > 65 % RH, then remove the hole plate, pin plate and inlet bar (see step 4 in Figure A.4).

c) Place the entire specimen at rest for more than 168 h at (20 ± 3) °C and > 65 % RH (see step 5 in Figure A.4).



Key

1 inlet bar
2 steel plate
3 pin plate
4 pins for leakage hole (Ø 2,4 mm × 100 mm)
A diagram of mortar substrate
B step 1
C step 2

a Hole for connecting bolt (Ø 10 mm).
b Hole for fixing pins (Ø 2,5 mm).
c Hole plate.

D step 3
E step 4
F step 5

Figure A.4 — Test specimen assembly part 1

A.3.2 Test specimen assembly part 2

a) Attach the non-woven fabric for filtering repair material particulates on the bottom of the steel plate and fix it in place with the acrylic plate (see steps 1, 2 and 3 in Figure A.5).

b) Place the upper acrylic substrate part on the bolts so that it lies horizontally over the steel plate, parallel to the placement of the mortar substrate part (see step 4 in Figure A.5).

c) Place the acrylic band around the two substrate parts to cover the space openings on the side to prevent leakage during repair material injection. Apply silicone sealing if needed to close off the seams of the acrylic band for reinforced sealing (see step 5 in Figure A.5).