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## Maintenance and repair of concrete structures —

### Part 4: Execution of repairs

~~Élément introductif — Élément central — Entretien et réparation des structures en béton —~~

Partie 4: ~~Titre de la partie~~ Exécution des réparations

ISO/FDIS 16311-4

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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.

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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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 16311-4:2014) which has been technically revised.

The main changes are as follows:

- the title has **been** changed due to clarification of the definition of the term;
- some relevant reference standards have been clarified;
- some editorial corrections have been made.

A list of all parts in the ISO 16311 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](http://www.iso.org/members.html).



## Introduction

This document defines and specifies site application of products and systems and quality control of repairs. The execution of maintenance and repair of concrete structures is an important and integral part of the complex process of repair, and this document specifies how it is carried out. This document incorporates rules for the use of maintenance and repair materials and systems. Maintenance and repair methods applying traditional concrete construction work are listed in this document. Maintenance and repair methods applying electrochemical methods, e.g. cathodic protection, ~~realkalisation~~re-alkalisation of carbonated concrete, and chloride extraction, are listed in this document.

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# Maintenance and repair of concrete structures —

## Part 4: Execution of repairs ~~and prevention~~

### 1 Scope

This document provides requirements for substrate condition before and during application, including structural stability, storage of materials, the preparation, and application of products and systems for repair of concrete structures, including quality control and qualifications of personnel, maintenance, health and safety, and the environment.

### 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 1920-2, *Testing of concrete — Part 2: Properties of fresh concrete*

ISO 1920-3, *Testing of concrete — Part 3: Making and curing test specimens*

ISO 1920-4, *Testing of concrete — Part 4: Strength of hardened concrete*

ISO 1920-5, *Testing of concrete — Part 5: Properties of hardened concrete other than strength*

ISO 1920-6, *Testing of concrete — Part 6: Sampling, preparing and testing of concrete cores*

ISO 1920-7, *Testing of concrete — Part 7: Non-destructive tests on hardened concrete*

ISO 2394, *General principles on reliability for structures*

ISO 2409, *Paints and varnishes — Cross-cut test*

ISO 2808:2019, *Paints and varnishes — Determination of film thickness*

ISO 3274, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments*

~~ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*~~

ISO 4624, *Paints and varnishes — Pull-off test for adhesion*

ISO 4628-1, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 1: General introduction and designation system*

ISO 4628-~~2~~**2**, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part-~~2~~**2**: Assessment of degree of blistering*

ISO 4628-~~3~~**3**, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part-~~3~~**3**: Assessment of degree of rusting*

ISO 4628-~~4~~**4**, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part-~~4~~**4**: Assessment of degree of cracking*

ISO 4628-~~5~~**5**, *Paints and varnishes — Evaluation of quantity and size of defects, and of intensity of uniform changes in appearance — Part-~~5~~**5**: Assessment of degree of flaking*

ISO 4628-~~6~~**6**, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part-~~6~~**6**: Assessment of degree of chalking by tape method*

~~ISO 4677-1, Atmospheres for conditioning and testing — Determination of relative humidity — Part 1: Aspirated psychrometer method~~

~~ISO 4677-2, Atmospheres for conditioning and testing — Determination of relative humidity — Part 2: Whirling psychrometer method~~

~~ISO 5091 (all parts), Structural intervention of existing concrete structures using cementitious materials — Part 1: General principles~~

ISO 6935-~~2~~**2**, *Steel for the reinforcement of concrete — Part-~~2~~**2**: Ribbed bars*

ISO 8501-~~1~~**1**, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part-~~1~~**1**: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

ISO 8502-~~2~~**2**, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part-~~2~~**2**: Laboratory determination of chloride on cleaned surfaces*

ISO 8502-~~3~~**3**, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part-~~3~~**3**: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)*

ISO 8502-~~4~~**4**, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part-~~4~~**4**: Guidance on the estimation of the probability of condensation prior to paint application*

ISO 13822, *Bases for design of structures — Assessment of existing structures*

ISO 14654, Epoxy-coated steel for the reinforcement of concrete

ISO 14657, Zinc-coated steel for the reinforcement of concrete

ISO 16311-~~1~~**1**, *Maintenance and repair of concrete structures — Part-~~1~~**1**: General principles*

ISO 16311-~~2~~**2**, *Maintenance and repair of concrete structures — Part 2: Assessment of existing concrete structures*

ISO 16311-3:2014, *Maintenance and repair of concrete structures* — Part 3: Design of repairs and prevention

ISO 19338, *Performance and assessment requirements for design standards on structural concrete*

ISO 21920-3, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 3: Specification operators*

ISO 22965-1, *Concrete — Part 1: Methods of specifying and guidance for the specifier*

ISO 22965-2, *Concrete — Part 2: Specification of constituent materials, production of concrete and compliance of concrete*

ISO 22966, *Execution of concrete structures*

~~ISO 5091-1, *Structural intervention of existing concrete structures using cementitious materials*~~

~~ISO 14654, *Epoxy coated steel for the reinforcement of concrete*~~

~~ISO 14657, *Zinc coated steel for the reinforcement of concrete*~~

## 5.3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16311-1, ISO 2394, ISO 13822, and ISO 19338 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 bond

adhesion of the applied product or system to the substrate

Note 1 to entry: The bond requirements for a given repair can range from negligible to firmly adherent.

### 3.2 cement grout

mixture of cement, water, and, in some cases, admixtures

### 3.3 cementitious repair products and systems

hydraulic or polymer hydraulic mortars, concretes and grouts

### 3.4 dew point

temperature at which water vapour condenses

### 3.6.5 mortars concrete

hydraulic, polymer hydraulic, and polymer mortar and concrete

**3.96**

**pre-formed hole**

hole or slot formed or cut in concrete into which reinforcement or other fixing is to be anchored

**3.107**

**quality plan**

programme to ensure that the activities of a process are undertaken to comply with the intended design

**3.128**

**sprayed mortar or concrete**

mortar or concrete applied under pressure through a nozzle delivered through pipes

**3.139**

**wet on wet**

application of a cementitious mortar or concrete onto the surface of a similar material which has set but not hardened

**64 Structural stability during execution of repairs**

Safety and stability before, during and after repair shall be maintained in accordance with ISO 16311-3.

Any period required for gain of strength of the repair products and systems shall be a part of the duration of the repair.

**75 General requirements**

Consideration shall be given to the chemical, electrochemical and physical condition of the substrate and any contaminants, the ability of the structure to accept loading, movement and vibration during repair, ambient conditions and the characteristics of the materials contained in the structure and those of repair products and systems.

The following requirements shall be met. [ISO/FDIS 16311-4](#)

- The achievement of the required condition of the substrate regarding cleanliness, roughness, cracking, tensile and compressive strength, chloride or other contaminant and their penetration, depth of carbonation, moisture content, temperature, and degree of corrosion of reinforcement.
- The achievement of the compatibility of the original concrete and reinforcement with repair products and systems and compatibility between any different products and systems, including avoiding the risk of creating conditions which can cause corrosion.
- The achievement of the specified properties of products and systems when applied and in their hardened condition regarding the fulfilment of their purpose for repair of the structure.
- The achievement of the required storage and application conditions regarding ambient temperature, humidity and dew point, wind force and precipitation, and any temporary protection which is needed.

**86 Methods of repair**

The remedies and methods of repair, given in ISO 16311-3:2014, Table 1, are described below, excluding those methods specified in standards valid in the place of use.

The preparation of substrate, application of products and systems, quality control, and maintenance for each method shall comply with [Clauses 7, 8, 9 and 10](#). [Clauses 7, 8, 9 and 10](#).