INTERNATIONAL STANDARD

ISO 22965-2

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Concrete —

Part 2: Specification of constituent materials, production of concrete and compliance of concrete

Béton —

Partie 2: Spécification des matériaux constituants, de la production du béton et de la conformité du béton

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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 22965-2 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 22965 consists of the following parts, under the general title *Concrete*:

— *Part 1: Methods of specifying and guidance for the specifier*

— *Part 2: Specification of constituent materials, production of concrete and compliance of concrete*

Introduction

This International Standard is intended for nations that have no national concrete standard and it sets out a framework of principles for nations revising their national standards. To be operable, this International Standard needs a national annex or a reference to the national complementary provisions. This International Standard can also be applied on specific projects where a project specification supplements the standards in lieu of a national annex applicable at the place of use.

This International Standard is applied under various climatic and geographical conditions, various levels of protection and under different established regional traditions and experience. Consequently, this International Standard includes classes for concrete with different properties to cover the most frequent and normal situations. For certain uses of concrete, additional or deviating rules can be necessary. The national provisions, preferably given in a national annex to this International Standard, or the project specification can specify any additional or deviating requirements.

During the development of this International Standard, consideration was given to detailing a performance-related approach to the specification of durability. It was concluded that such an approach is not yet sufficiently developed to be detailed in an International Standard. ISO/TC 71/SC 3 recognizes that some ISO member bodies have developed local tests and criteria for performance-based specifications. This International Standard does not exclude the continuation and development of such practices valid in the place of use of the concrete as an alternative to the prescriptive approach. It is necessary that these requirements be specified in the national annex or national complementary provisions. The Model Code for Service Limit Design (MC-SLD), which was published by *fib* in 2006, is a promising basis for implementation as future International Standards from ISO/TC 71; see ISO 22965-1:2007, Annex B.

This International Standard incorporates rules for the use of constituent materials that are covered by International Standards. For materials for which International Standards have not yet been published, the standards cited in the national annex (often the regional or national standards) apply; see 5.1. In particular, documents in current use for by-products of industrial processes, recycled materials, etc. are based on local experience. Until international specifications for these materials are available, this International Standard does not provide rules for their use, but instead refers to the national annex.

This International Standard defines the two parties involved in the ordering and the supply of concrete, which are hereinafter referred to as specifier and supplier. In practice, there can be several parties specifying requirements at various stages of the design and construction process, e.g. the client, the designer, the quantity surveyor, the constructor and the concreting subconstructor. Each is expected to pass the specified requirements, together with any additional requirements, to the next party in the chain until they reach the supplier. In the terms of this International Standard, this final compilation of requirements is known as the "concrete specification". In some cases, the specifier and the supplier is the same party (e.g. a constructor doing design, production and execution). In the case of ready-mixed concrete, the purchaser is the specifier.

This part of ISO 22965 also gives rules for the exchange of information between the parties. Contractual matters are not addressed.

This International Standard is intended for use with ISO 22965-1 and with the future ISO 22966, currently under development, which will give the requirements associated with the level of quality specified and the methods to be employed for the execution of concrete structures.

Concrete —

Part 2: Specification of constituent materials, production of concrete and compliance of concrete

1 Scope

This part of ISO 22965 applies to concrete for structures cast *in situ*, pre-cast structures and structural pre-cast products for buildings and civil engineering structures. The concrete can be mixed on site, ready-mixed concrete or produced in a plant for pre-cast concrete products.

This part of ISO 22965 applies to concrete compacted to retain no appreciable amount of entrapped air other than entrained air and to normal-weight, heavy-weight and light-weight concrete.

Other International Standards for specific products, e.g. pre-cast products, or for processes within the field of the scope of this standard can require or permit deviations from this part of ISO 22965.

This part of ISO 22965 specifies the properties of constituent materials, the production of concrete and the compliance system of concrete.

This part of ISO 22965 does not apply to

— concrete with a maximum aggregate size equal to or less than 4 mm or 5 mm (mortar),

— aerated concrete,

— foamed concrete,

— concrete with an open structure (“no-fine aggregate” concrete),

— concrete with a density less than 800 kg/m^3,

— refractory concrete.

This part of ISO 22965 does not cover health and safety requirements for the protection of workers during production and delivery of concrete.

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 680, *Cement — Test methods — Chemical analysis*

ISO 1770, *Solid-stem general purpose thermometers*

ISO 1920-1, *Testing of concrete — Part 1: Sampling of fresh concrete*

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 concrete — Part 5: Properties of hardened concrete other than strength*

ISO 9297, *Water quality — Determination of chloride — Silver nitrate titration with chromate indicator (Mohr's method)*

ISO 22965-1:2007, *Concrete — Part 1: Methods of specifying and guidance for the specifier*

ASTM C 173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

3 Terms and definitions

For the purposes of this part of ISO 22965, the terms and definitions given in ISO 22965-1 and the following apply.

3.1
agitating equipment
equipment generally mounted on a self-propelled chassis and capable of maintaining fresh concrete in a homogeneous state during transport

3.2
all-in aggregate
aggregate comprising a mixture of coarse and fine aggregates

3.3
concrete family
group of concrete compositions for which a reliable relationship between relevant properties is established and documented

3.4
cubic metre of concrete
quantity of fresh concrete which, when compacted, occupies a volume of one cubic metre

3.5
high-strength concrete
concrete with a compressive strength class higher than B50 in the cases of normal-weight or heavy-weight concrete and LB50 in the case of light-weight concrete

NOTE Other limits may be set in the national annex.

3.6
initial test
test or tests before the production starts to check how a new concrete or concrete family shall be composed in order to meet all the specified requirements in the fresh and hardened states

3.7
non-agitating equipment
equipment used for transporting concrete without agitation in the sense of 3.1, e.g. dump truck or transport hopper

3.8
production day
⟨for strength testing⟩
day in which 20 m^3 or more of concrete has been produced or, on days when less than 20 m^3 of concrete has been produced, the day on which a cumulative 20 m^3 of these concretes has been produced

NOTE The sequence is restarted on a new day for each occasion when a production day is counted. Limits other than 20 m^3 may be set in the national annex

3.9
production week
period of seven consecutive days comprising at least five production days or the period taken to complete five production days, whichever is the longer period

3.10
truck mixer
concrete mixer mounted on a self-propelled chassis capable of mixing and delivering a homogeneous concrete

3.11
project specification
project-specific document describing the requirements applicable for the particular project, giving all information and requirements necessary for the execution of the works, including documents, drawings, etc.

NOTE The concrete specification drawn up by the specifier (see ISO 22965-1) should include all relevant requirements for the concrete as given in the project specification.

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviations given in ISO 22965-1 and the following apply.

$f_{\mathrm{ck,cyl}}$ characteristic compressive strength of concrete determined by testing cylinders, expressed in newtons per square millimetre

$f_{\mathrm{c,cyl}}$ compressive strength of concrete determined by testing cylinders, expressed in newtons per square millimetre

$f_{\mathrm{ck,cube}}$ characteristic compressive strength of concrete determined by testing cubes, expressed in newtons per square millimetre

$f_{\mathrm{c,cube}}$ compressive strength of concrete determined by testing cubes, expressed in newtons per square millimetre

f_{cm} mean compressive strength of concrete, expressed in newtons per square millimetre

f_{tsm} mean tensile splitting strength of concrete, expressed in newtons per square millimetre

f_{tsk} characteristic tensile splitting strength of concrete, expressed in newtons per square millimetre

σ estimate for the standard deviation of a population

s_n standard deviation of n consecutive test results

$R_{\mathrm{w/c}}$ water/cement ratio

$R_{\mathrm{w/(c,}k\mathrm{a)}}$ ratio of water to the sum of the cement plus k times the addition, designated as the “effective cementitious material”

5 Requirements for constituent materials

5.1 General

For the use of constituent materials that are covered by International Standards, requirements contained in the International Standards apply. For materials for which there are not yet International Standards, the standards cited in the national annex (often regional or national standards) apply.

Constituent materials shall not contain harmful ingredients in such quantities as can be detrimental to the strength, consistence, setting time and durability of the concrete, or cause corrosion of the reinforcement, and shall be suitable for the intended use in concrete.

Constituent materials that conform to the relevant International Standards cited in this part of ISO 22965 shall be deemed to meet the requirement that they do not contain harmful ingredients in such quantities as can be detrimental to the durability of the concrete or cause corrosion of the reinforcement provided that the concrete conforms to any specified limits placed on it, e.g. maximum chloride content.

Only constituent materials with established suitability for the specified application shall be used in concrete conforming to this part of ISO 22965.

NOTE 1 Where general suitability is established for a constituent material, this does not indicate suitability in every situation and for every concrete composition.

NOTE 2 This part of ISO 22965 lists constituent materials conforming to International Standards that have general suitability. The national annex extends these lists of constituent materials with approved general suitability.

Where types and classes of constituent materials are not detailed in the specification, the producer shall select constituent materials for the specified requirements only.

5.2 Cements

General suitability is established in the national annex for cements conforming to a standard listed in the same annex.

NOTE The following types of cement have characteristics specified in regional and national standards:

— portland cements;

— portland composite cements;

— blast-furnace-slag cements;

— pozzolanic cements;

— composite cements.

Cements can be specified in grades based on the 28-day strength in mortar (e.g. 32,5 MPa, 42,5 MPa and 52,5 MPa), and as normal hardening, rapidly hardening or slowly hardening cements.

5.3 Additions

5.3.1 General suitability is established in the national annex for type I additions of the following types:

— filler aggregate conforming to a standard listed in the same annex;

— pigments conforming to a standard listed in the same annex.

5.3.2 General suitability is established in the national annex for type II additions of the following types:

— fly ash conforming to a standard listed in the same annex;

— silica fume conforming to a standard listed in the same annex;

— ground-granulated blast-furnace slag (GGBS) conforming to a standard listed in the national annex.

5.4 Aggregates

General suitability is established in the national annex for aggregates conforming to a standard listed in the same annex.

The maximum aggregate size shall not be greater than the value specified.

NOTE 1 See the national annex for the test method. Most test methods permit a small proportion of over-sized particles.

Light-weight aggregates shall conform to the following requirements.

a) The acid-soluble sulfate content shall be not more than 0,1 % by mass (see the national annex for the test method);

b) For furnace-bottom ash or clinker, the loss-on-ignition shall be not more than 10 % by mass (see the national annex for the test method).

Where freezing- and thawing-resistant, light-weight aggregates are specified, the producer shall hold data demonstrating that the chosen light-weight aggregates produce concrete with adequate freezing and thawing resistance.

NOTE 2 Freezing and thawing resistance is deemed to be adequate if the aggregates have a successful track record of use for at least 10 years in similar or worse environments with concrete of the quality specified or lower than the quality specified. An alternative method for determining freezing and thawing resistance is by relative freezing and thawing testing of concrete in water or a salt solution, as appropriate. Where this latter method is to be used, it is necessary that the test method and compliance criteria be specified in the national annex.

5.4.1 All-in aggregate

All-in aggregate shall be used only in concrete with compressive strength classes $\leqslant$ B12.

5.4.2 Recovered aggregate

Aggregate recovered from wash water or fresh concrete may be used as aggregate for concrete.

Unless otherwise permitted by the national annex, undivided recovered aggregate shall not be added in quantities greater than 5 % of the total aggregate. Where the quantities of the recovered aggregates are greater than 5 % of the total aggregate, they shall be of the same type as the primary aggregate and shall be divided into separate coarse and fine fractions and shall conform to the aggregate specification.

5.5 Mixing water

General suitability is established in the national annex for mixing water conforming to a standard listed in the same annex.

Recycled water from concrete production shall be used in accordance with the conditions specified for its use in a mixing-water standard of established suitability or in accordance with the provisions given in the national annex.

5.6 Admixtures

General suitability is established in the national annex for admixtures conforming to a standard listed in the same annex.

The total amount of admixtures, if any, should not exceed the maximum dosage recommended by the admixture producer.

Admixtures used in quantities less than 2 g/kg of cement shall be dispersed in part of the mixing water unless otherwise specified in the national annex.

At higher levels of use, the producer may select the method of dispersal.

If the total quantity of liquid admixtures exceeds 3,0 l/m^3 of concrete, its water content shall be taken into account when calculating the water/cement ratio, unless otherwise specified in the national annex.

Where more than one admixture is used, the compatibility of the admixtures shall be checked in the initial tests.

6 Requirements for concrete

6.1 Requirements for composition of concrete

6.1.1 General

The concrete composition and the constituent materials shall be chosen to satisfy the requirements specified for fresh and hardened concrete, including consistence, density, strength, durability and protection of embedded steel against corrosion, taking into account the production process and, if informed, the intended method of execution of the concrete works. Requirements for the use of additions shall be given in the national annex.

Where not detailed in the specification, the producer shall select types and classes of constituent materials from those with established suitability for the specified environmental conditions.

The concrete should be designed so as to minimize segregation and bleeding of the fresh concrete.

6.1.2 Resistance to alkali-aggregate reaction

Deleterious alkali-aggregate reaction shall be avoided using procedures specified in the national annex or the project specification.

6.1.3 Use of additions

The quantities of type I and type II additions used in concrete shall be covered by the initial tests.

The influence of high quantities of additions on properties other than strength should be taken into account.

For designed concrete, the use of additions shall conform to the requirements specified in the national annex or the project specification.

Type II additions conforming to 5.3 may be taken into account when calculating the cement content and the water/cement ratio in accordance with the k-value concept and as permitted by the national annex.

NOTE Informative guidance on the k-value concept is given in Annex F. Other concepts, other k values, other cements, other additions (including type I) or combinations of additions can be given in the national annex.

6.1.4 Chloride content

The chloride content of the concrete shall not exceed the value specified in the national annex or the project specification.

Calcium chloride and chloride-based admixtures shall not be added to concrete containing steel reinforcement, pre-stressing steel reinforcement or other embedded metal.

The method for determining the chloride content of constituent materials is specified in Table 1.

Table 1 — Method for determining the chloride content of constituent materials

Constituent	Method reference
Cement, fly ash, ground-granulated blast-furnace slag (GGBS), limestone fines, pulverized fuel ash (PFA), metakaolin	See national annex
Aggregate	See national annex
Admixture	See national annex
Water [a]	ISO 9297
[a] Testing is not required if the water is from a potable supply.	

For the determination of the chloride content of the concrete, the sum of the contributions from the constituent materials shall be determined using one of, or a combination of, the following methods:

— calculation based on the maximum chloride content of the constituent either permitted in the standard for the constituent or declared by the producer of each constituent material;

— calculation based on the chloride content of the constituent materials calculated monthly from the sum of the means of the last 25 determinations of chloride content plus 1,64 times the calculated standard deviation for each constituent material.

NOTE The latter method is particularly applicable to sea-dredged aggregates and for those cases where there is no declared or standard maximum value.

For the determination of the chloride content of the concrete, the measurement of freshly mixed trial mixtures by means of methods defined in the national annex may be applied.

6.2 Requirements for fresh concrete

6.2.1 Consistence

When measured in accordance with Table 2, the consistence of the concrete at the time of use or, in the case of ready-mixed concrete, at the time of delivery, shall be within the limits given in 9.3.

Where a slump class has been specified, the slump shall be measured to the highest point. Where a target slump has been specified, the slump shall be measured to the highest point except where otherwise specified in the national annex.

Table 2 — Method for measuring consistence

Method	Conforming to
Slump	ISO 1920-2
Slump flow	ISO 1920-2
Flow	ISO 1920-2
Other	To be specified

If concrete is delivered in a truck mixer or agitating equipment, the consistence may be measured using a spot sample obtained from the initial discharge. The spot sample shall be taken after a discharge of approximately 0,1 m^3 in accordance with ISO 1920-1.