



**International
Standard**

ISO 12439

Mixing water for concrete

Eau de gâchage pour béton

**Second edition
2025-03**

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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).

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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.

This document 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*.

This second edition cancels and replaces the first edition (ISO 12439:2010), which has been technically revised.

The main changes are as follows:

- addition of some new normative references;
- addition of the definition of water types;
- inclusion of requirements regarding radioactive testing ([subclause 4.3.4](#)).

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

The quality of the mixing water for production of concrete can influence the setting time, the strength development of concrete and the protection of the reinforcement against corrosion.

When assessing the suitability of water of unknown quality for the production of concrete, both the composition of the water and the application of the concrete being produced must be considered.

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Mixing water for concrete

1 Scope

This document specifies requirements for the treatment of water that is suitable for making concrete in accordance with ISO 22965 (all parts) and describes methods for assessing its suitability.

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

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

ISO 23696-1, *Water quality — Determination of nitrate in water using small-scale sealed tubes — Part 1: Dimethylphenol colour reaction*

ISO 6878, *Water quality — Determination of phosphorus — Ammonium molybdate spectrometric method*

ISO 13163, *Water quality — Lead-210 — Test method using liquid scintillation counting*

ISO 29581-1, *Cement — Test methods — Part 1: Analysis by wet chemistry*

ISO 9597, *Cement — Test methods — Determination of setting time and soundness*

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

ISO 10523, *Water quality — Determination of pH*

3 Terms and definitions

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

potable water

water intended for human consumption

Note 1 to entry: This water is generally considered as suitable for use in concrete. The water shall not be further tested, if already tested and certified by concerned authorities. Otherwise, the water shall be tested and shall conform to the requirements specified in [4.3](#).

3.2

natural surface water

water which flows over, or rests on, the surface of a land mass

Note 1 to entry: This water can be suitable for use in concrete but shall be tested to determine whether it is suitable for use in concrete.

3.3

sewage water

wastewater conveyed in underground pipes

Note 1 to entry: This water is not suitable for use in concrete.

3.4

combined water

mixture of water recovered from processes in the concrete industry and water of some other origin.

Note 1 to entry: This water can be suitable for use in concrete but shall be tested to determine whether it is suitable for use in concrete.

4 Requirements

4.1 General

Water for use in concrete shall conform to [4.2](#), [4.3.1](#), [4.3.2](#) and [4.3.3](#). The water shall conform to either the chemical requirements in [4.3.4](#), or the requirements for setting time and compressive strength in [4.4](#).

NOTE When waters are mixed (see [3.4](#)), the requirements apply to the combined water.

4.2 Preliminary assessment

The water shall be examined in accordance with the test procedures stated in [Table 1](#). Water not in accordance with one or more of the requirements in [Table 1](#) may be used only if it can be shown to be suitable for use in concrete in accordance with [4.4](#).

Table 1 — Requirements and test procedures for preliminary assessment of mixing water

Number	Parameter	Requirement	Test procedure
1	Oils and fats	Not more than visible traces.	6.1.1
2	Detergents	Foam shall disappear within 2 min except for small residues.	6.1.1
3	Colour	Water not from sources classified as potable: the colour shall be assessed qualitatively as pale yellow or paler.	6.1.1
4	Suspended matter	Water from sources classified as potable.	A.4.4
		Water from other sources: max. 4 ml of sediment.	6.1.1
5	Odour	Water from sources classified as potable: no smell, except the odour allowed for potable water and a slight smell of cement; where blast-furnace slag is present in the water, a slight smell of hydrogen sulfide.	6.1.1
		Water from other sources: no smell, except the odour allowed for potable water; no smell of hydrogen sulfide after addition of hydrochloric acid.	
6	pH value	pH ≥5	6.1.1
7	Humic matter	The colour shall be assessed qualitatively as yellowish brown or paler after addition of NaOH.	6.1.2

4.3 Chemical properties

4.3.1 Chlorides

The chloride content of the water, tested in accordance with 6.1.3 and expressed as Cl^- , shall not exceed the levels given in Table 2, unless it can be shown that the chloride content of the concrete does not exceed the maximum value permitted for the total chloride content specified in ISO 22965-2.

ISO 22965-2 recommends that limits for the total chloride content in concrete be given in a national annex to ISO 22965-2. The values may be different depending on the end use. It can be necessary to amend the recommended values in Table 2 to fit with the limits for the total chloride content.

Table 2 — Maximum recommended values for the chloride content of mixing water

End use	Chloride concentration max. mg/l	Test procedure
Pre-stressed concrete or grout	500	6.1.3
Concrete with reinforcement or embedded metal	1 000	
Concrete without reinforcement or embedded metal	4 500	

4.3.2 Sulfates

The sulfate content of the water, tested in accordance with 6.1.3 and expressed as SO_4^{2-} shall not exceed 2 000 mg/l.

4.3.3 Alkali

If it is expected to use alkali-reactive aggregates in the concrete and the exposure conditions of the concrete can promote deleterious alkali-related reactions to occur, the water shall be tested for its alkali content in accordance with 6.1.3. The equivalent sodium oxide content of the water shall not exceed 1 500 mg/l, unless it can be shown that the alkali content of the concrete does not exceed the maximum value recommended. If these limits are exceeded, the water may be used only if it can be shown that actions have been taken to prevent deleterious alkali-silica reactions.

NOTE Guidance can be found in technical literature, such as CEN CR 1901.

4.3.4 Harmful contamination

In the first instance, qualitative tests for sugars, phosphates, nitrates, lead and zinc may be carried out. If the qualitative tests show a positive result, tests for setting time and compressive strength shall be performed or chemical analysis shall be chosen.

If chemical analysis is chosen, the water shall conform to the limits given in Table 3.

When specified, the radioactivity of the water may be tested. See additional information in Annex D.

Table 3 — Requirements for harmful substances

Substance	Maximum concentration mg/l	Test procedure
Sugars	100	6.1.3
Phosphates; expressed as P_2O_5	100	
Nitrates; expressed as NO_3^-	500	
Lead; expressed as Pb^{2+}	100	
Zinc; expressed as Zn^{2+}	100	

4.4 Setting time and strength

When tested in accordance with 6.1.4, the initial setting time obtained on paste samples made with the water shall be not less than 1 h and not differ by more than 25 % from the initial setting time obtained on specimens made with distilled or de-ionized water. The final setting time shall not exceed 10 h and not differ by more than 25 % from the final setting time obtained on specimens made with distilled or de-ionized water. Potable water may be used, provided it has been demonstrated that it gives results similar to those obtained with distilled or de-ionized water.

The mean compressive strength at 7 days and 28 days of the concrete or mortar specimens prepared with the water shall be at least 90 % of the mean compressive strength of corresponding specimens prepared with distilled or de-ionized water.

5 Sampling

A sample of water of not less than 5 l shall be taken. The sample shall be correctly identified. It shall be representative of the water being used, with due regard being given to the possible effects of seasonal fluctuations.

Natural surface water shall be collected from the centre of the water area and below 100 mm from the water surface. The water from underground sources shall be collected after the pipeline is flushed with water, or be directly collected in containers, and shall not be collected from the groundwater accumulated on the surface. Water recovered from processed in the concrete industry shall be collected from the tank below 100 mm from the water surface after sedimentation.

The sample of combined water should be taken from its final combined form. If it is impractical, it is acceptable to sample, proportion and combine the individual sources of water to produce a test sample that is representative of the combined water.

The sample shall be stored in a clean and sealed container. The container shall be rinsed out with water from the source prior to filling to capacity with the water sample. The water shall be tested within two weeks of sampling.

6 Testing

6.1 Test methods

6.1.1 Preliminary assessment

A small subsample shall be assessed as soon as possible after sampling for density, oil and fats, detergents, colour, suspended matter, odour and humic matter.

Bring any material that has settled back into suspension by shaking the sample. Measure the density using the pycnometer method, hydrometer method or digital densimeter method. Pour 80 ml of the sample into a 100 ml measuring cylinder. Seal with a suitable stopper and shake the cylinder vigorously for 30 s. Smell the sample for any odours other than those of clean water. If in doubt about the odour, test the water for its odour level. The odour level of the water shall be lower than the maximum level accepted for potable water. Observe the surface for foam. Set the cylinder in a place free from vibration and allow to stand for 30 min. After 2 min, check the sample for the continuing presence of foam and signs of any oils or fats. After 30 min have elapsed, observe the apparent volume of the settled solids and the colour of the water. Measure the pH using indicator paper or a pH meter in accordance with ISO 10523. Then, add 0,5 ml hydrochloric acid, mix and then smell or test for the presence of hydrogen sulfide.

NOTE 1 Regional standards can apply when measuring the density using the pycnometer method, hydrometer method or digital densimeter method.

NOTE 2 When testing, national regulations for potable water can apply.

6.1.2 Humic matter

Put 5 ml of the sample into a test tube. Bring it to a temperature between 15 °C and 25 °C by allowing it to stand indoors. Add 5 ml of 3 % sodium hydroxide solution, shake and leave for 1 h. Observe the colour.

6.1.3 Chemical tests

The following test methods describe the reference procedures for the mentioned chemical tests. If other methods are used, it shall show that they give results equivalent to those given by the reference methods. In case of a dispute, only the following reference procedures shall be used:

- chlorides in accordance with ISO 29581-1;
 - sulfates in accordance with ISO 29581-1;
 - alkali in accordance with ISO 29581-1;
 - sugars
- NOTE Regional standards can apply.
- phosphates in accordance with ISO 6878;
 - nitrates in accordance with ISO 23696-1;
 - lead in accordance with ISO 13163;
 - zinc
- NOTE Regional standards can apply.
- radionuclide in accordance with ISO 22017.

6.1.4 Setting time and strength

The following test methods shall be applied:

- setting time of paste shall be in accordance with ISO 9597;
- NOTE Regional standards can apply.
- strength of mortar prisms shall be in accordance with ISO 679;
- NOTE Regional standards can apply.
- making concrete specimens shall be in accordance with ISO 1920-3;
- NOTE Regional standards can apply.
- testing concrete specimens shall be in accordance with ISO 1920-4.
- NOTE Regional standards can apply.

Methods given in EN 196-1 and EN 196-3 may be used as an alternative.

For strength testing, three mortar or concrete specimens made using the water under investigation shall be tested. The test results shall be compared with the results of tests on similar specimens made using distilled or de-ionized water.

6.2 Frequency for testing

The following frequencies for testing water shall apply.

- Potable water: no testing is required.
- Water recovered from processes in the concrete industry (as defined in [A.2.1](#)): test in accordance with [Annex A](#).
- Water from underground sources, natural surface water and industrial waste water: test before first use and monthly thereafter until such time that a clear insight into the fluctuation of the water composition has been established. Thereafter, a lower frequency may be adopted.
- Sea water and brackish water: test before first use; thereafter once per year and whenever necessary.

6.3 Conformity evaluation

The requirements given in this document are expressed as absolute values. For conformity, the mixing water shall be in accordance with the requirements given in [Clause 4](#).

7 Test report

The test report shall contain the following information:

- a) description of the type and source of the water;
- b) place of sampling;
- c) time and date of sampling;
- d) name of laboratory and of the person responsible for the test;
- e) date of testing;
- f) test results and the comparison with the requirements of this document.

Annex A

(normative)

Requirements for the use of water recovered from processes in the concrete industry

A.1 General

This annex applies to water recovered from processes in the concrete industry, used alone or combined with other water as mixing water.

A.2 Description of the water

A.2.1 Water recovered from processes in the concrete industry

A.2.1.1 Water recovered from processes in the concrete industry is comprised of:

- water that was part of any surplus concrete which is fresh concrete, left over after placing or discharged from concrete mixers during cleaning at the concrete plant. Surplus concrete also includes any fresh concrete that is recovered during cleaning of concrete trucks and pumps. Surplus mortar may be treated in the same way as surplus concrete;
- water used to clean the inside of stationary mixers, mixing drums of truck mixers or agitators and concrete pumps;
- process water from sawing, grinding and water blasting of hardened concrete;
- water extracted from fresh concrete during concrete production.

A.2.1.2 The water may be taken from:

- basins provided with suitable equipment that distributes the solid matter evenly throughout the water;
- sedimentation basins or similar installations, provided the water is left in the basin for a sufficient amount of time to allow the solids to settle properly.

NOTE Water recovered from processes in the concrete industry contains varying concentrations of very fine particles, the size of which is generally less than 0,25 mm.

A.2.2 Combined water

Combined water is a mixture of water recovered from processes in the concrete industry and water of some other origin.

A.3 Limitations on the use of water recovered from processes in the concrete industry

Water recovered from processes in the concrete industry or combined water may be used as mixing water for concrete with or without reinforcement or embedded metal and also for pre-stressed concrete, provided the following requirements are met.

- a) The additional mass of solid material in the concrete resulting from the use of water recovered from processes in the concrete industry shall be less than 1 % mass fraction of the total mass of aggregates present in the concrete.
- b) The possible influence of the use of this water shall be taken into account if there are special requirements for the concrete being produced, e.g. architectural concrete, pre-stressed concrete, air-entrained concrete, concrete exposed to aggressive environments, etc.
- c) The amount of recovered water shall be spread as evenly as possible over a day's production.

For some production processes, a greater quantity of solid material may be used, provided satisfactory performance in concrete can be demonstrated.

A.4 Requirements

A.4.1 General

All water recovered from processes in the concrete industry or combined water used in concrete shall conform to the requirements specified in [Clause 4](#) and the requirements given in [A.4.2](#) to [A.4.4](#).

The age of water for the test batch that is being qualified for use shall be as close as possible to the actual age of water used during actual production. The age of water represents the period of time that the water from concrete production operations contained cement fines.

A.4.2 Special requirements for setting time

Extended set control admixtures are permitted for use in the tested water to maintain conformance to the requirement of setting time, and the effectiveness and dosage of the extended set control admixtures should be specified. No other setting controlling admixtures are permitted.

A.4.3 Storage

Water in storage shall be adequately protected against contamination. The containers used for water in storage should be free from contamination. The containers should be rinsed three times with the water to be collected before filling, and they should be sealed for later use.

A.4.4 Uniformity

A suitable means of ensuring uniform distribution of the solid material in recovered water with a density greater than 1,01 kg/l shall be provided.

Water with a density less than or equal to 1,01 kg/l may be assumed to contain negligible amounts of solid material.

A.4.5 Mass of solid material present in the recovered water

The mass of solid material present in the recovered water shall be estimated from [Table A.1](#), on the basis of its density. The solid material and the water shall be taken into account in the design of the concrete.

If other densities are measured, the concentration, c_{fl} , expressed in kilograms per litre, of solid material present in the water may be recalculated according to [Formula \(A.1\)](#):

$$c_{fl} = \left(\frac{1 - \rho_w}{1 - \rho_f} \right) \times \rho_f \quad (\text{A.1})$$

where

ρ_w is the density of the water, expressed in kilograms per litre;

ρ_f is the particle density of the solid material, expressed in kilograms per litre.

Table A.1 — Solid material in water^a

Density of the water kg/l	Concentration of solid material kg/l	Volume of mixing water l
1,02	0,038	0,982
1,03	0,057	0,973
1,04	0,076	0,964
1,05	0,095	0,955
1,06	0,115	0,945
1,07	0,134	0,936
1,08	0,153	0,927
1,09	0,172	0,918
1,10	0,191	0,909
1,11	0,210	0,900
1,12	0,229	0,891
1,13	0,248	0,882
1,14	0,267	0,873
1,15	0,286	0,864

^a A particle density of 2,1 kg/l was used in calculating the values in this table.

A.5 Inspection

A.5.1 Density

The density of the water recovered from processes in the concrete industry or combined water shall be determined on homogenized samples taken from the basin containing the water.

During the concrete production, the density of this water shall be determined at least daily at the time at which the highest density is most likely to occur, unless other procedures to monitor the density are stated in the producer's quality manual.

If the automatic devices are used, the concrete producer's quality manual shall describe the method of use and their calibration.

A.5.2 Suitability

The suitability of the water recovered from processes in the concrete industry or combined water shall be determined in accordance with [Clause 4](#)

Annex B

(informative)

Testing scheme for mixing water for concrete

The testing scheme in Table B.1 is intended to suggest a practical way of testing water samples. The requirements specified in this document take precedence.

Table B.1 — Testing scheme for mixing water for concrete

Action			Types of water	Note
Accept water.	← yes	1	Potable water (3.1)	
Reject water.	← yes	2	Sewage water (3.3)	
See Annex A.	← yes	3	Water recovered from processes in the concrete industry or combined water (3.4)	
Go to box 6.	← yes	4	— Water from underground sources; — Natural surface water and industrial waste water (3.2)	See also Clause 4.
Use only for concrete without re-inforcement or embedded metal.	← yes	5	Sea water or brackish water	

			Preliminary assessment	
		6	Oils and fats: visible traces	For boxes 6 to 12, see also Table 1.
Go to box 28 or reject water.	← yes	6.1	Density (Water recovered from processes in the concrete industry or combined water)	Note: The solid material should be taken into account in the design of concrete
Go to box 28 or reject water.	← yes	7	Detergents: stable foam	
Go to box 28 or reject water.	← yes	8	Colour: darker than pale yellow	
Go to box 28 or reject water.	← yes	9	Suspended matter: > 4 ml	NOTE Suspended matter is any solid matter that is suspended in the water, in the form of solid particles.
Go to box 28 or reject water.	← yes	10	Odour: strong smell other than the odour of potable water	If slag is present, see Table 1, line 5.
Go to box 28 or reject water.	← yes	11	Acids: pH < 5	
Go to box 28 or reject water.	← yes	12	Humic matter: colour darker than yellowish brown	

			Test of chemical properties; see 4.3	
				Filter sample through a 0,45 µm membrane filter and use filtrate for the tests.
Accept water.	← yes	13	Dissolved matter < 100 mg/l	NOTE Dissolved matter is any solid matter that is dissolved in the water in a liquid phase.
Reject water unless the maximum chloride level permitted in concrete is not exceeded.	← yes	14	Chloride content exceeds levels given in Table 2.	The water may be used if it is shown that the chloride content of the concrete does not exceed the maximum values for the specified class in accordance with ISO 22965-2.
Reject water.	← yes	15	Sulfate content > 2 000 mg/l	
Accept water unless alkali-reactive aggregates are expected to be used in the concrete.	← yes	16	The equivalent sodium oxide content of the water exceeds 1 500 mg/l.	If this limit is exceeded it is expected to use alkali-reactive aggregates, and the water may be used only if it can be shown that actions have been taken to prevent deleterious alkali-silica reactions. See, for example, CEN CR 1901 for guidance.
Accept water.	← yes	17	Dissolved matter: NaCl ≤ 100 mg/l	The amount of NaCl is calculated by assuming that the measured amount of Cl in the water is present as NaCl.
Accept water.	← yes	18	Dissolved matter: NaCl + Na ₂ SO ₄ ≤ 100 mg/l	The amount of Na ₂ SO ₄ is calculated by assuming that sulfate is present as its sodium salt.
Accept water.	← yes	19	Dissolved matter: NaCl + Na ₂ SO ₄ + Na ₂ CO ₃ ≤ 100 mg/l	The amount of Na ₂ CO ₃ is calculated by assuming that carbonates are present as its sodium salt.

			Harmful contamination	
Go to box 28	← a)	Either a) determine the influence on setting time and strength; or b) perform qualitative chemical analyses.		b) → Go to box 20
		20	Qualitative tests of — sugars — phosphates — nitrates — lead — zinc	
Accept water.	← yes	21	Qualitative tests are negative.	
Go to box 28		Either a) determine the influence on setting time and strength; or b) perform qualitative chemical analyses.		b) → Go to box 20
Reject water.		22	Sugars > 100 mg/l	
Reject water.		23	Phosphates (expressed as P ₂ O ₅) > 100 mg/l	
Reject water.		24	Nitrates (expressed as NO ₃ ⁻) > 500 mg/l	
Reject water.		25	Lead (expressed as Pb ²⁺) > 100 mg/l	