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Ready mixed concrete — Specification

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 624 was prepared by Technical Committee RSB/TC 9, Civil engineering and building materials.

In the preparation of this standard, reference was made to the following standard:

- 1) ASTM C94/C94M – 24b Standard Specification for Ready-Mixed Concrete

The assistance derived from the above source is hereby acknowledged with thanks.

Committee membership

The following organizations were represented on the Technical Committee on *Civil engineering and building materials* (RSB/TC 9) in the preparation of this standard.

ASTRIK International

CAMOSAG Ltd

Cleaner Production and Climate Innovation Centre (CPCIC)

Consulting Engineering Group (CEG Ltd)

HOSHAN LTD

Independent Experts

NPD Ltd

Rwanda Housing Authority (RHA)

Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)

Rwanda Transport development Agency (RTDA)

University of Rwanda – College of Science and Technology (UR-CST)

Rwanda Standards Board (RSB) – Secretariat

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Ready mixed concrete — Specification

1 Scope

This Draft Rwanda Standard specifies requirements, sampling and test methods for ready-mixed concrete as defined in 3.2. Requirements for quality of ready-mixed concrete are either as stated in this specification or as ordered by the purchaser. When the purchaser's requirements, as stated in the order, differ from those in this specification, the purchaser's requirements govern.

This standard is applicable to the production of the ready-mixed concrete and the purchase of the ready-mixed concrete.

It does not cover the placement, consolidation, curing or protection of the concrete after delivery to the purchaser.

NOTE This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health and environmental practices and determine the applicability of regulatory limitations prior to use.

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.

ASTM C125, *Terminology Relating to Concrete and Concrete Aggregates*

ASTM C231/C231M, *Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method*

RS ASTM C494/C494M, *Specification for Chemical Admixtures for Concrete*

ASTM C1064/C1064M, *Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete*

C1798/C1798M, *Specification for Returned Fresh Concrete for Use in a New Batch of Ready-Mixed Concrete*

ASTM C39/C39M, *Test Method for Compressive Strength of Cylindrical Concrete Specimens*

ASTM C138/C138M, *Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete*

RS EAS 18-1, *Cements — Part 1: Composition, specification and conformity criteria for common cements*

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

RS 373: 2018, *Aggregates for concrete — Specification*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in ASTM C125 and the following apply.

3.1

central-mixed

ready-mixed concrete mixed completely in a stationary mixer

3.2

concrete, ready-mixed

concrete manufactured and delivered to a purchaser in a fresh state

3.3

shrink-mixed concrete

ready-mixed concrete partially mixed in a stationary mixer with mixing completed in a truck mixer

3.4

truck-mixed concrete

ready-mixed concrete completely mixed in a truck mixer

3.5

target batch water

quantity of water to be added to the batch through the water measuring system after compensating for the quantity of ice, if used, surface moisture on the aggregates and water in the admixtures, when applicable, and by subtracting a quantity of water that is anticipated to be added at the job site or in transit to adjust slump or slump flow of the concrete batch

4 Basis of purchase

4.1 The basis of purchase shall be a cubic meter of fresh concrete as discharged from the transportation unit.

4.2 The volume of fresh concrete in a given batch shall be determined from the total mass of the batch divided by the density of the concrete. The total mass of the batch shall be determined as the net mass of the concrete in the batch as delivered, including the total mixing water as defined in 9.4.

4.3 The yield shall be determined as the average of at least three measurements, one from each of three different transportation units.

NOTE It should be understood that the volume of hardened concrete may be, or appear to be, less than expected due to waste and spillage, over-excavation, spreading forms, some loss of entrained air, or settlement of wet mixtures, none of which is the responsibility of the producer.

5 Materials

5.1 In the absence of designated applicable material specifications, the following material specifications shall be used:

5.1 Cementitious materials

5.2.1 Hydraulic cement, shall conform to RS EAS 18-1 and its conformity evaluation shall be conducted in accordance with RS EAS 18-2.

5.2.2 Supplementary cementitious materials, coal ash or natural pozzolans shall conform to RS 425. Slag cement, silica fume, ground-glass pozzolan and blended supplementary cementitious materials shall conform to approved the standard.

5.3 Aggregates, normal weight aggregates shall conform to RS 373. Lightweight aggregates and heavyweight aggregates shall conform to the approved Standard.

5.4 Ground calcium carbonate and aggregate mineral filler, ground calcium carbonate and aggregate mineral filler shall conform to the approved Standard.

5.5 Water, mixing water shall conform to the requirements of RS ISO 12439.

5.6 Admixtures, shall conform to RS ISO 19596.

NOTE In any given instance, the required dosage of air-entraining, accelerating, retarding, water-reducing, and high-range water-reducing admixtures may vary. Therefore, a range of dosages should be allowed, which will permit obtaining the desired effect.

NOTE Interchanging kinds, characteristics, types, classes, or grades of the materials permitted in ready-mixed concrete may produce concrete of different properties.

5.7 Returned fresh concrete, when permitted by the purchaser, shall conform to ASTM C1798/C1798M.

NOTE ASTM C1798/C1798M provides requirements for using, measuring, and reporting returned fresh concrete. These requirements are in addition to those stated herein. The purchaser may further clarify which concrete within an order, such as specific mixtures or applications, may incorporate returned fresh concrete.

6 Ordering information

6.1 In the absence of designated applicable general specifications, the purchaser's order shall include the following:

6.1.1 Designated size, or sizes, of course aggregate,

6.1.2 Slump, or slumps, desired at the point of discharge from the transportation unit (see Clause 7 for acceptable tolerances).

6.1.3 Slump flow, or flows, desired at the point of discharge from the transportation unit (see Clause 7 for acceptable tolerances).

6.1.4 Total air content at the point of discharge from the transportation unit for concrete that will be exposed to cycles of freezing and thawing or anticipated exposure of the concrete (see Clause 8 for sampling for air content tests and tolerances).

6.1.5 Which of Options A, B, or C shall be used as a basis for determining the proportions of the concrete to produce the required quality.

6.1.6 When lightweight concrete is specified, the equilibrium density,

NOTE The density of fresh concrete is the only measurable density of lightweight concrete at the time of delivery. The density of fresh concrete is always higher than the equilibrium or oven-dry density.

Therefore, for acceptance of lightweight concrete based on density at the point of discharge from the transportation unit, a relationship between the equilibrium density and density of fresh concrete needs to be established.

6.1.7 When high-density or heavyweight concrete is specified, the density of fresh concrete, and,

NOTE High-density or heavyweight concrete typically contains aggregate with a relative density of 3.3 or greater. This concrete is used for radiation shielding or other applications where higher density is required by design. For acceptance of density at point of discharge from the transportation unit, a relationship between the fresh density and the density of hardened concrete required by design should be established.

Table 1 — Total air content for Air entrained concrete exposed to cycles of freezing and thawing

Exposure condition (see footnote)	Total air content %							
	Nominal maximum sizes of aggregates mm (in.)							
	9.5 [3/8]	12.5 [1/2]	19.0 [3/4]	25.0 [1]	37.5 [1 1/2]	50.0 [2]	75.0 [3]	
Moderate	6.0	5.5	5.0	4.5	4.5	4.0	3.5	
Severe	7.5	7.0	6.0	6.0	5.5	5.0	4.5	

NOTE Table 1 provides total air contents for concrete that vary by exposure condition and aggregate size. Total air contents less than those shown in Table 1 may be specified or used for concrete that is not subject to freezing and thawing. This may be done to improve workability and cohesiveness, reduce the rate of bleeding, reduce the water content for a given consistency, or achieve required lightweight concrete density. Specified total air contents higher than those shown in Table 1 may reduce strength without any further improvement of durability. Exposure conditions for freezing and thawing environments in Table 1 correspond to the following:

Moderate exposure — Concrete exposed to freeze-thaw cycles but not in contact with the ground or with limited exposure to water, limiting the ability to cause saturation of a portion of the concrete prior to freezing. The concrete shall not receive de-icing salts or other aggressive chemicals.

Examples include exterior beams, columns, walls, girders, footings below the frost line, or elevated slabs where application of de-icing salt is not anticipated.

Severe exposure — Concrete exposed to freeze-thaw cycles while in contact with the ground or with frequent exposure to water, potentially causing saturation of a portion of the concrete prior to freezing. The concrete may receive de-icing chemicals or other aggressive chemicals. Examples include pavements, bridge decks, curbs, gutters, sidewalks, canal linings, or exterior water tanks or sumps.

6.1.8 If desired, any of the optional requirements of Table 2 in Specification C1602/C1602M.

6.1.9 Purchaser shall state any drum revolution limit as to when the concrete discharge must begin. If no drum revolution limit is stated by purchaser, the producer shall determine and communicate the limit to the purchaser prior to delivery.

6.1.10 Purchaser shall state a time limit from the start of mixing defined in 12.3 or 12.5 to when the concrete discharge must be completed. If no time limit is stated by purchaser, the producer shall establish and communicate the limit to the purchaser prior to delivery. The time limit to complete discharge shall be stated on the delivery ticket.

NOTE This specification previously included a 1 1/2 h time limit to end of discharge since its original publication in 1935. There are many options available to the producer to provide the required quality of concrete with end of discharge limits beyond 1 1/2 h or less than 1 1/2 h. The purchaser should consult with the producer for available options to establish a time limit to end of discharge prior to or at the time concrete is ordered. Selection of a time limit to end of discharge should consider ambient conditions, types of cementitious materials and admixtures used, placement procedures, and projected transportation time between the batch plant and the point of delivery.

6.2 If a project specification applies, the order shall include applicable requirements for the concrete to be produced in compliance with the specification.

6.3 If the type, kind, or class of cementitious materials in 5.2.1 and 5.2.2 are not designated by the purchaser, it is permitted to use cementitious materials in concrete mixtures that will satisfy the concrete properties and other requirements of the purchaser as ordered.

6.4 Option A

6.4.1 When the purchaser requires the producer to assume full responsibility for the selection of the proportions for the concrete mixture, the purchaser shall also specify the following:

6.4.1.1 Requirements for compressive strength as determined on samples taken from the transportation unit at the point of discharge in accordance with Clause 17 and specimens made, cured, and tested in accordance with Clause 18.

6.4.1.2 The purchaser shall specify the requirements in terms of the compressive strength of standard specimens cured under standard laboratory conditions for moist curing (see Clause 18).

6.4.1.3 Unless otherwise specified the age at test shall be 28 days.

NOTE The purchaser, in selecting requirements for which he assumes responsibility should give consideration to requirements for workability, placeability, durability, surface texture, and density, in addition to those for structural design. The purchaser is referred to Standard

6.4.2 At the request of the purchaser, the producer shall, prior to the actual delivery of the concrete, furnish a statement to the purchaser, giving the dry masses of cement and saturated surface-dry-masses of fine and coarse aggregate and quantities, type, and name of admixtures (if any) and of water per cubic yard or cubic meter of concrete that will be used in the production of each class of concrete ordered by the purchaser.

6.4.3 The producer shall also furnish evidence satisfactory to the purchaser that the materials to be used and proportions selected will produce concrete of the quality specified.

6.5 Option B

6.5.1 When the purchaser assumes responsibility for the proportioning of the concrete mixture, he shall also specify the following:

6.5.1.1 Cement content in kilograms per cubic meter [pounds per cubic yard] of concrete,

6.5.1.2 Maximum allowable water content in litres per cubic metre (gallons per cubic yard) of concrete, including surface moisture on the aggregates, but excluding water of absorption, and

6.5.1.3 If admixtures are required, the type, name, and dosage to be used. The cement content shall not be reduced when admixtures are used under this option without the written approval of the purchaser.

6.5.2 At the request of the purchaser, the producer shall, prior to the actual delivery of the concrete, furnish a statement to the purchaser giving the sources, densities, and sieve analyses of the aggregates and the dry masses of cement and saturated-surface-dry masses of fine and coarse aggregate and quantities, type and name of admixture (if any) and of water per cubic yard or cubic meter of concrete that will be used in the production of each class of concrete ordered by the purchaser.

6.6 Option C

6.6.1 When the purchaser requires the producer to assume responsibility for the selection of the proportions for the concrete mixture with the minimum allowable cement content specified, the purchaser shall also specify the following:

6.6.1.1 Requirements for compressive strength as determined on samples taken from the transportation unit at the point of discharge in accordance with Clause 17 and specimens made, cured, and tested in accordance with Clause 18.

The purchaser shall specify the requirements for strength in terms of tests of standard specimens cured under standard laboratory conditions for moist curing (see Clause 18). Unless otherwise specified the age at test shall be 28 days.

6.6.1.2 Minimum cement content in kilograms per cubic meter (pounds per cubic yard) of concrete.

6.6.1.3 If admixtures are required, the type, name, and dosage to be used. The cement content shall not be reduced when admixtures are used.

NOTE Option C can be distinctive and useful only if the designated minimum cement content is at about the same level that would ordinarily be required for the strength, aggregate size, and slump or slump flow specified. At the same time, it must be an amount that will be sufficient to ensure durability under expected service conditions, as well as satisfactory surface texture and density, in the event specified strength is attained with it.

6.6.2 At the request of the purchaser, the producer shall, prior to the actual delivery of the concrete, furnish a statement to the purchaser, giving the dry masses of cement and saturated surface-dry masses of fine and

coarse aggregate and quantities, type, and name of admixture (if any) and of water per cubic yard or cubic meter of concrete that will be used in the production of each class of concrete ordered by the purchaser.

6.6.3 The producer shall also furnish evidence satisfactory to the purchaser that the materials to be used and proportions selected will produce concrete of the quality specified. Whatever strengths are attained the quantity of cement used shall not be less than the minimum specified.

6.7 The proportions arrived at by Options A, B, or C for each class of concrete shall be available at the batch plant and be assigned a designation to facilitate identification of each concrete mixture delivered to the project. This is the designation required in 14.1.7 and supplies information on concrete proportions when they are not given separately on each delivery ticket as outlined in 14.2.

6.8 The purchaser shall ensure that the producer is provided copies of all reports of tests performed on concrete samples taken to determine compliance with specification requirements. Reports shall be provided on a timely basis.

6.9 The producer shall obtain the purchaser's permission to incorporate returned fresh concrete.

7 Slump or slump flow

7.1 Unless other tolerances are indicated by the purchaser, the following shall apply.

7.1.1 When slump is stated as a "maximum" or "not to exceed" requirement:

Tolerances for "Maximum" or "Not to Exceed" Slumps

- a) For Slump of 75 mm the tolerance is +0 and -40 mm
- b) For Slump of more than 75 mm the tolerance is +0 and -65 mm

7.1.1.1 The maximum or not to exceed slump provision shall be used only if a job site water addition is permitted by the specification in accordance with 12.7.

7.1.2 When slump is stated as a target or nominal slump:

Tolerances for target or nominal slumps

- a) For slump of 50 mm, the tolerance less ± 15 mm.
- c) For slump of more than 50 mm to 100 mm, the tolerance ± 25 mm.
- d) For slump of more than 100 mm, the tolerance is ± 40 mm.

7.1.3 When the purchaser states a slump flow requirement for self-consolidating concrete:

Tolerances for slump flow

- a) For slump flow less than or equal to 550 mm, the Tolerance ± 40 mm.
- b) For slump more than 550 mm, the tolerance is ± 65 mm.

7.1.4 The tolerances for slump or slump flow apply to the values stated in the order when adjustments in accordance with 12.7 and 12.8 are permitted.

7.2 Concrete shall be available within the permissible range of slump or slump flow for a period of 30 min starting either on arrival at the job site or after the initial slump adjustment permitted in 12.7, whichever is later. The first and last $1/4$ m³ [$1/4$ yd³] discharged are exempt from this requirement. If the user is unprepared for discharge of the concrete from the vehicle, the producer shall not be responsible for the limitation of minimum slump or slump flow after 30 min have elapsed starting either on arrival of the vehicle at the prescribed destination or at the requested delivery time, whichever is later.

8 Air-entrained concrete

8.1 Unless otherwise specified, for air-entrained concrete the total air contents in Table 1 shall apply based on the exposure condition stated in the purchase order. It is permitted to reduce the total air content values in Table 1 by one percentage point for concretes with a specified compressive strength greater than or equal to 35 MPa (5 000 psi). Total air content that differs from the values in Table 1 is permitted for concrete not exposed to cycles of freezing and thawing.

8.2 The air content of air-entrained concrete when sampled from the transportation unit at the point of discharge shall be within a tolerance of ± 1.5 of the specified value.

8.3 When a preliminary sample taken within the time limits of 12.7 and prior to discharge for placement shows an air content below the specified level by more than the allowable tolerance in accordance with 8.2, the producer may use additional air entraining admixture to achieve the desired air content level, followed by a minimum of 30 revolutions at mixing speed, so long as the revolution limit of 6.1.9 is not exceeded.

9 Measuring materials

9.1 Except as otherwise specifically permitted, cementitious materials shall be measured by mass. When supplementary cementitious materials are used in the concrete mixtures, the cumulative mass is permitted to be measured with hydraulic cement, but in a batch hopper and on a scale which is separate and distinct from those used for other materials except for ground calcium carbonate and aggregate mineral filler. The mass of the hydraulic cement shall be measured before supplementary cementitious materials. When the quantity of cementitious material exceeds 30 % of the full capacity of the scale, the measured quantity of the hydraulic cement shall be within ± 1 % of the required mass, and the cumulative measured quantity of hydraulic cement plus supplementary cementitious materials shall also be within ± 1 % of the required cumulative mass at each intermediate weighing. For smaller concrete batches to a minimum of 1 m³, the measured quantity of the hydraulic cement and the measured cumulative quantity of hydraulic cement plus supplementary cementitious materials used shall be not less than the required amount nor more than 4 % in excess. When the purchaser requires alternate methods of measuring cementitious materials, measurement methods and reporting shall be stated in the order.

9.2 Aggregate shall be measured by mass. The quantity of aggregate weighed shall be the required dry mass plus the total moisture content (absorbed and surface) of the aggregate.

9.2.1 For individual weigh batchers, the quantity of aggregate weighed shall be within 62 % of the required mass; except if the required quantity of aggregate is less than 15 % of scale capacity, the quantity of aggregate weighed shall be within 60.3 % of scale capacity.

9.2.2 For cumulative weigh batchers, if the required quantity of aggregate is equal to or greater than 30 % of the scale capacity, the quantity of aggregate weighed shall be within 61 % of the required mass at each successive weighing. If the required quantity of aggregate is less than 30 % of the scale capacity, the quantity of aggregate weighed shall be within 60.3 % of scale capacity at each successive weighing.

NOTE The batching accuracy limit of 0.3 % of scale capacity establishes a reasonable minimum weighing tolerance that is independent of the quantity of material being weighed.

9.3 Except as otherwise specifically permitted, ground calcium carbonate and aggregate mineral filler shall be measured by mass and on the same scale as the cementitious materials.

9.3.1 The masses of ground calcium carbonate and aggregate mineral filler shall be measured after the cementitious materials.

9.3.2 Each cumulative measured quantity of cementitious materials with ground calcium carbonate, aggregate mineral filler, or both shall be within the cumulative mass tolerances in 9.1. When the purchaser requires alternate methods of measuring ground calcium carbonate and aggregate mineral filler, measurement methods and reporting shall be stated in the order.

NOTE Ground calcium carbonate and aggregate mineral filler are not considered part of the cementitious materials.

9.4 Mixing water shall consist of batch water (water weighed or metered at the plant), ice, free moisture on the aggregates, wash water retained in the mixer before batching, water added at the job site in accordance with 12.7 or by an automated truck mixer system in accordance with 12.8, and water introduced from admixtures if the quantity added increases the water-cementitious materials ratio by more than 0.01. The batch water shall be measured by mass or volume to an accuracy of 61.5 % of the target batch water. Ice shall be measured by mass. In the case of truck mixers, any wash water retained in the drum for use in the next batch of concrete shall be measured; if this proves impractical or impossible the wash water shall be discharged before loading the next batch of concrete. Quantity of mixing water shall be accurate to within 63 % of the amount established by the designed mixture proportions.

NOTE Mixing water is the total amount of water in a batch less the water absorbed by the aggregates. Mixing water is used to calculate the water-cementitious materials ratio (w/cm).

9.5 Chemical admixtures in powdered form shall be measured by mass. Liquid chemical admixtures shall be matched by mass or volume. Admixtures measured by either mass or volume shall be batched with an accuracy of 63 % of the total amount required or plus or minus the amount or dosage required for 50 kg of hydraulic cement, whichever is greater.

NOTE Admixture dispensers of the mechanical type capable of adjustment for variation of dosage, and of simple calibration, are recommended.

10 Batching plant

10.1 Bins with adequate separate compartments shall be provided in the batching plant for fine and for each required size of coarse aggregate. Each bin compartment shall be designed and operated so as to discharge

efficiently and freely, with minimum segregation, into the weighing hopper. Means of control shall be provided so that, as the quantity desired in the weighing hopper is approached, the material shall be shutoff with precision. Weighing hoppers shall be constructed so as to eliminate accumulations of tare materials and to discharge fully.

10.2 Indicating devices shall be in full view and near enough to be read accurately by the operator while charging the hopper. The operator shall have convenient access to all controls.

10.3 Scales shall be considered accurate if their accuracy is verified through the normally used capacity in accordance with Table 2 and load indicated relative to applied test load is within 60.15 % of the total capacity of the scale or 0.4 % of the net applied load, whichever is greater. The minimum quantity and sequence of applied test loads used to verify material scales shall conform to Table 2 and its notes.

10.4 All exposed fulcrums, clevises, and similar working parts of scales shall be kept clean. Beam scales shall be equipped with a balance indicator sensitive enough to show movement when a weight equal to 0.1 % of the nominal capacity of the scale is placed in the batch hopper. Pointer travel shall be a minimum of 5 % of the net-rated capacity of the largest weigh beam for underweight and 4 % for over-weight.

10.5 The device for the measurement of the added water shall be capable of delivering to the batch the quantity required within the accuracy required in 9.4. The device shall be so arranged that the measurements will not be affected by variable pressures in the water supply line. Measuring tanks shall be equipped with outside taps and valves to provide for checking their calibration unless other means are provided for readily and accurately determining the amount of water in the tank.

NOTE The scale accuracy limitations of the National Ready Mixed Concrete Association Plant Certification meet the requirements of this specification.

11 Mixers and agitators

11.1 Mixers include stationary mixers or truck mixers. Agitators include truck mixers or truck agitators.

11.1.1 Stationary mixers shall be equipped with a metal plate or plates on which are plainly marked the mixing speed of the drum or paddles, and the maximum capacity in terms of the volume of mixed concrete. If used for the complete mixing of concrete, stationary mixers shall be equipped with an acceptable timing device that will not permit the batch to be discharged until the specified mixing time has elapsed.

11.1.2 Each truck mixer or agitator shall have attached thereto in a prominent place a metal plate or plates on which are plainly marked the gross volume of the drum, the capacity of the drum or container in terms of the volume of mixed concrete, and the minimum and maximum mixing speeds of rotation of the drum, blades, or paddles. If the concrete is truck mixed as described in 12.5, or shrink mixed as described in 12.4, the volume of mixed concrete shall not exceed 63 % of the total volume of the drum or container. If the concrete is central mixed as described in 12.3, the volume of concrete in the truck mixer or agitator shall not exceed 80 % of the total volume of the drum or container. Truck mixers and agitators shall be equipped with means to readily verify the number of revolutions of the drum, blades, or paddles.

Table 1 — Total air content for Air entrained concrete exposed to cycles of freezing and thawing

Device Capacity	Minimum (in terms of device capacity)		Minimum Loads for Verification of Scale Accuracy
	Field Standard Weights	Test Loads ^B	

0 kg to 2 000 kg [0 lb to 4 000 lb]	100 %	100 %	Field standard weights or test load to used capacity, if greater than minimum specified.
2001 kg to 20 000 kg [4 001 lb to 40 000 lb] Greater of 10 % or 500 kg [1 000 lb]			Strain-load tests E are permitted to be used above test load minimums. During initial verification, a scale shall be tested to full capacity.

^A If the configuration and set up of the scale system prevents access or application of adequate field standard weights or if an unsafe condition is created by the verification process then the use of the scale above the verified position shall be discontinued until corrective measures have been completed.

^B The term “test load” means the sum of the combination of field standard weights and any other applied load used in the conduct of a test using substitution test methods.

Substitution Test—In the substitution test procedure, material or objects are substituted for field standard weights, or a combination of field standard weights and previously quantified material or objects, using the scale under test as a comparator. Additional test weights or other known test loads may be added to the known test load to verify the accuracy of higher weight ranges on the scale.

^D The scale shall be tested from zero to at least 10 % of scale capacity using field standard weights, and then to at least 50 % of scale capacity using a series of substitution load tests that utilize field standard weights equaling at least 10 % of scale capacity.

^E A strain-load test shall be conducted to verify the accuracy from 50 % of scale capacity to the used capacity of the scale. At least one load test shall be performed in each quarter of scale capacity. Strain-Load Test—In the strain-load test procedure, an unknown quantity of material or objects are used to establish a reference load or tare to which field standard weights or substitution test loads are added.

11.2 Stationary and truck mixers shall be capable of producing uniformly mixed concrete within the specified time in 12.3 or the specified number of revolutions in 12.5. The capability to produce and discharge uniformly mixed concrete shall be determined in accordance with Annex A1, if required.

NOTE The sequence or method of charging the mixer will have an important effect on the uniformity of the concrete.

11.3 The agitator shall be capable of maintaining the mixed concrete in a uniformly mixed condition. The capability to maintain and discharge uniformly mixed concrete shall be determined in accordance with Annex A1, if required.

11.4 Slump tests of individual samples can be used to provide a quick check of the probable degree of uniformity. Sampling and testing shall be in accordance with Annex A. If the difference in slump exceeds the limits in Annex A, the mixer or agitator shall not be used unless the condition is corrected, except as provided in 11.5.

11.5 Use of the equipment not conforming to 11.2 is permitted if operated with a longer mixing time, a smaller load, or a more efficient charging sequence. If required, the uniformity of concrete shall be evaluated in accordance with Annex

11.6 Mixers and agitators shall be examined or their mass determined as frequently as necessary to detect changes in condition due to accumulations of hardened concrete or mortar and examined to detect wear of blades. If these conditions are considered extensive enough to affect the mixer performance, Annex A1 establishes the basis to determine whether correction of deficiencies is required or if the correction of the deficiencies is adequate.

12 Mixing and delivery

12.1 General

12.1.1 Ready-mixed concrete shall be mixed and delivered to the point designated by the purchaser by means of one of the following combinations of operations:

- a) central-mixed concrete;
- b) shrink-mixed concrete; and
- c) truck-mixed concrete.

12.1.2 Mixers and agitators shall be operated within the limits of capacity and speed of rotation designated by the manufacturer of the equipment.

12.2 Central-mixed concrete

12.2.1 Concrete that is mixed completely in a stationary mixer and transported to the point of delivery either in a truck agitator, or a truck mixer operating at agitating speed, or in non-agitating equipment approved by the purchaser and meeting the requirements of Clause 13, shall conform to the following: The mixing time shall be counted from the time all the solid materials are in the drum. The batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregate and the target batch water shall be in the drum by the end of the first one-fourth of the specified mixing time, or in accordance with the central concrete mixer manufacturer's recommended charging sequence.

12.2.2 If no mixer performance tests are made, the acceptable mixing time for mixers having capacities of 0.76 m³ or less shall be not less than 1 min. For mixers of greater capacity, this minimum shall be increased 15 s for each cubic meter [cubic yard] or fraction thereof of additional capacity.

NOTE Stationary mixers of similar design bearing a Performance Rating plate of the Concrete Plant Manufacturers Bureau have been tested for their ability to produce uniformly mixed concrete in accordance with Annex A1 for low slump (<50 mm) and normal slump (100 mm to 50 mm) concrete in a mixing time between 30 s and 90 s.

12.2.2 If mixer performance tests have been made in accordance with Annex A1, the acceptable mixing time is permitted to be reduced to the time equal to or greater than that used in the qualification testing. If the mixing time is so reduced the maximum time of mixing shall not exceed this reduced time by more than 60 s for air-entrained concrete. Mixer performance tests shall be repeated whenever the appearance of the concrete or a comparison of coarse aggregate content of separate samples as described in Annex A1 indicates that adequate mixing has not been accomplished.

12.3 Shrink-Mixed Concrete

Concrete that is first partially mixed in a stationary mixer, and then mixed completely in a truck mixer, shall conform to the following: The time of partial mixing shall be the minimum time required to intermingle the ingredients. After transfer to a truck mixer the amount of mixing at the designated mixing speed shall be that necessary to meet the requirements for uniformity of concrete as indicated in Annex A1. Additional turning of the mixer, if any, shall be at a designated agitating speed.

12.4 Truck-mixed concrete

Concrete that is completely mixed in a truck mixer for 70 to 100 revolutions at the mixing speed designated by the truck mixer manufacturer shall produce uniformly mixed concrete as defined in Annex A1. The start of mixing shall be when all the materials have been loaded in the mixer. If requirements for uniformity of concrete indicated in Annex A1 are not met with 100 revolutions of mixing that mixer shall not be used until the condition is corrected, except as provided in 11.5. If satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of blades are permitted to be regarded as satisfactory. Additional revolutions of the mixer beyond the number found to produce the required uniformity of concrete shall be at a designated agitating speed.

NOTE Truck mixers of similar design bearing a Performance Rating plate of the Truck Mixer Manufacturers Bureau have been tested for their ability to produce uniformly mixed concrete in accordance with Annex A.

12.5 Mixing and delivery of mixed concrete

12.5.1 When a truck mixer or truck agitator is used for transporting concrete that has been completely mixed in a stationary mixer, any turning during transportation shall be at the speed designated by the manufacturer of the equipment as agitating speed.

12.5.2 For concrete delivered in truck mixers, no water from the truck water system or elsewhere shall be added after the initial introduction of water during batching, except as permitted in 12.8, and if on arrival at the job site the slump or slump flow needs to be increased to comply with the requirement stated in the purchase order. Unless otherwise stated, obtain the required slump or slump flow within the tolerances stated in 7.1.1, 7.1.2, or 7.1.3 with the addition of water, or water reducing admixture, or both. The maximum quantity of water or water-reducing admixture that can be added at the job site shall be determined by the producer and shall not exceed the maximum water content for the batch as established by the designed mixture proportions. Adjusting the concrete mixture with water or water-reducing admixture shall be done before discharge of concrete, except when obtaining a preliminary sample in accordance with 17.6. Additional water shall be injected into the mixer under pressure and direction of flow to allow for proper distribution within the mixer. After the additions, the drum shall be turned at least 30 revolutions at mixing speed. The quantity of water or water-reducing admixture added shall be recorded.

12.5.3 For truck mixers with automated water or water reducing admixture measurement and slump or slump flow monitoring equipment defined in 12.8.1 and if permitted by the purchaser, water, or water-reducing admixture, or both, may be added during transportation to the job site. Such additional water shall be injected into the mixer under such pressure and direction of flow to allow for proper distribution within the mixer. The water content of the batch shall not exceed that established by the designed mixture proportions. If water or water-reducing admixture is added, the mixer shall be turned at least 30 drum revolutions at mixing speed. Said mixing shall take place after the last water or water-reducing admixture addition but before the start of discharge. The acceptance or rejection of concrete based on slump or slump flow shall be in accordance with Clause 17.

12.5.4 The automated slump or slump flow monitoring equipment shall be capable of obtaining one or more physical measurements on the truck mixer related to concrete slump or slump flow and providing an indication of slump or slump flow based on pre-established correlations. The slump or slump flow measurement equipment shall report in terms of slump or slump flow. The device for the measurement of water shall be accurate to 63 % of the amount added with said device. The device for the measurement of water-reducing admixture shall be accurate to the greater of 63 % of the amount added or 630 mL. Upon request by the purchaser, the producer shall submit data no older than 6 months substantiating the accuracy of the devices used for the measurement of water or water-reducing admixture. The equipment shall have controls to prevent discharge of water at pre-set limits to avoid exceeding the maximum water content for the batch as established by the designed mixture proportions.

12.5.5 Discharge of the concrete shall be completed within time limit as established in 6.1.10. This limitation may be waived by the purchaser if the concrete is of such slump or slump flow after the specified time limit has been reached that it can be placed, without the addition of water, to the batch.

12.5.6 If a drum revolution limit (6.1.9) for start of discharge or time limit (6.1.10) for the completion of discharge is specified by the purchaser, these limits shall govern.

NOTE Depending on the project requirements, technology is available to the producer to alter fresh concrete properties such as setting time, slump or slump flow, air content, and alter delivery and discharge times, or both. Discharge limitations should consider ambient conditions, placement procedures, and distance or projected transportation time between the batch plant and the point of delivery.

12.5.7 Concrete delivered in cold weather shall have the applicable minimum temperature indicated in the following table. (The purchaser shall inform the producer as to the type of construction for which the concrete is intended.)

Table 3 — Minimum concrete temperature as placed

Section size mm	Temperature °C
300	13
300 to 900	10
900 to 1800	7
1800	5

The maximum temperature of concrete produced with heated aggregates, heated water, or both, shall at no time during its production or transportation exceed 32 °C [90 °F]

12.5.8 The producer shall deliver the ready-mixed concrete during hot weather at concrete temperatures as stated by the purchaser.

NOTE Owners may have different temperature limits. Concrete for mass concrete members may have temperature limits specified or stated in the thermal control plan. The temperature limit should be communicated to the producer.

13 Use of non-agitating equipment

13.1 If the use of non-agitating transportation equipment is approved by the purchaser, the concrete shall be manufactured in a central mix plant. The following limitations shall apply:

13.2 Bodies of nonagitating equipment shall be smooth, watertight, metal containers equipped with gates that will permit control of the discharge of the concrete. Covers shall be provided for protection from the weather if required by the purchaser.

13.3 The concrete shall be delivered to the site of the work with a satisfactory degree of uniformity. Satisfactory degree of uniformity is defined in Annex A.

13.4 Slump tests of individual samples obtained and tested in accordance with Annex A1 can be used for a quick check of the probable degree of uniformity. If these slumps differ by more than the limits in Table A1.1, the nonagitating equipment shall not be used unless the conditions are corrected as provided in 13.5.

13.5 If the requirements of Annex A1 are not met when the nonagitating equipment is operated for the maximum time of haul, and with the concrete mixed the minimum time, the equipment shall only be used when operated using shorter hauls, or longer mixing times, or combinations thereof that will result in the requirements of Annex A1 being met.

14 Delivery ticket information

14.1 General

14.1.1 The producer of the concrete shall furnish to the purchaser with each batch of concrete before unloading at the site, a delivery ticket containing information concerning said concrete as follows:

- a) Name of ready-mixed concrete producer and batch plant, or batch plant number,
- b) Serial number of ticket,
- c) Date,
- d) Truck number,
- e) Name of purchaser,
- f) Specific designation of job (name and location),
- g) Specific class or designation of the concrete in conformance with that employed in job specifications,
- h) Amount of concrete in cubic yards (or cubic meters),
- i) Time loaded or of first mixing of cement and aggregates, and
- j) Amount of water added at the request of the purchaser or the purchaser's designated representative and their initials.
- k) Type and quantity of admixture or other adjustments made to the batch after batching.
- l) For trucks equipped with automated water or water-reducing admixture measurement and slump or slump flow monitoring equipment as defined in 12.8.1, the total amount of water or water-reducing admixture added by said equipment.
- m) Revolution limit to begin discharge as established in accordance with 6.1.9.
- n) Time limit to complete discharge as established in accordance with 6.1.10.

14.2 Additional information

14.2.1 For the purposes of certification purposes as designated by the purchaser and required by the job specifications, the following additional information shall be provided when requested:

- a) Reading of revolution counter at the first addition of water,
- b) Type, brand, and amount of cement,
- c) Class, brand, and amount of coal ash, or raw or calcined natural pozzolans,
- d) Grade, brand, and amount of slag cement,
- e) Type, brand, and amount of silica fume,
- f) Type, brand, and amount of ground calcium carbonate or aggregate mineral filler,
- g) Type, brand, and amount of blended supplementary cementitious materials,
- h) Type, brand, and amount of ground-glass pozzolan,
- i) Type, brand, and amount of admixtures,
- j) Type, brand, and amount of fiber reinforcement,
- k) Source and amount of each metered or weighed water,
- l) Information necessary to calculate the mixing water, as listed in 9.4,
- m) Maximum size of aggregate,
- n) Mass (amount) of fine and coarse aggregate,
- o) Ingredients certified as being previously approved, and
- p) Signature or initials of producer's representative.

15 Plant inspection

15.1 The producer shall afford the inspector all reasonable access, without charge, for making necessary checks of the production facilities and for securing necessary samples to determine if the concrete is being produced in accordance with this specification. All tests and inspection shall be so conducted as not to interfere unnecessarily with the batching and delivery of concrete

16 Test methods and reporting

16.1 Test ready-mixed concrete in accordance with the following methods:

16.1.1 Making and Curing Concrete Test Specimens in the Field shall be performed in accordance with the RS ISO 1920-3.

16.1.2 The strength of hardened concrete shall be tested in accordance with RS ISO 1920-4.

16.1.3 Properties of hardened concrete other than strength including density and depth of water penetration of hardened concrete shall be measure in accordance with RS ISO 1920-5.

16.1.4 The properties of fresh concrete including consistence (slump test, Vebe test, degree of compactability, flow-table test for high-fluidity concrete, and the slump-flow test), fresh density, air content shall be performed in accordance to RS ISO 1920-2.

16.1.8 The temperature of fleshly mixed concrete shall be tested in accordance with ASTM C1064/C1064M.

16.2 The acceptance tests shall be performed by the competent laboratory.

16.3 Testing agency reports of concrete test results used to determine compliance with this specification shall include a statement that all tests performed by the testing agency or its agents were in accordance with the applicable test methods or shall note all known deviations from the prescribed procedures. The reports shall also list any part of the test methods not performed by the testing agency.

17 Sampling and testing fresh concrete

17.1 The contractor shall afford the inspector all reasonable access and assistance, without charge, for the procurement of samples of fresh concrete at time of placement to determine conformance of it to this specification.

17.2 Tests of concrete required to determine compliance with this specification shall be made by a qualified technician.

17.3 Samples of concrete shall be obtained in accordance with RS ISO 1920-1, except when taken to determine uniformity of slump within any one batch or load of concrete (11.4, 13.4, and Annex A1).

17.4 Slump or slump flow, air-content, density, and tem- perature tests shall be made at the time of discharge at the option of the inspector as often as is necessary for control checks. In addition, these tests shall be made when specified and always when each set of strength specimens are made.

17.5 Strength tests as well as slump or slump flow, temperature, density, and air content tests shall generally be made with a frequency of not less than one test for each 115 m³. Each test shall be made from a separate batch. On each day concrete is delivered, at least one strength test shall be made for each class of concrete.

17.6 If preliminary checks of slump, slump flow, or air content are made, a single sample shall be taken after the discharge of not less than 1/4 m³. All other requirements of RS ISO 1920-1 shall be retained. If the

preliminary measurement of slump (12.7) or air content (8.3) falls outside the specified limits, address as indicated in 17.6.1 or 17.6.2 as appropriate.

17.6.1 If the measured slump or slump flow, or air content, or both is greater than the specified upper limit, a check test shall be made immediately on a new test sample. In the event the check test fails, the concrete shall be considered to have failed the requirements of the specification.

17.6.2 If the measured slump or slump flow, or air content, or both is less than the lower limit, permit adjustments in accordance with 12.7 or 8.3 or both, as appropriate, and obtain a new sample. If the sample of the adjusted concrete fails, a check test shall be made immediately on a new sample of the adjusted concrete. In the event the check test fails, the concrete shall be considered to have failed the requirements of the specification.

18 Strength

18.1 When strength is used as a basis for acceptance of concrete, the sample of concrete shall be taken in accordance with Clause 17 and standard specimens shall be made in accordance with RS ISO 1920-3. The specimens shall be cured under standard moisture and temperature conditions in accordance with Practice RS ISO 1920-3. The specimens shall be tested for compressive strength in accordance with ASTM C39/C39M.

18.2 For a strength test, at least two standard test specimens shall be made from a composite sample secured as required in Clause 17. A test shall be the average of the strengths of the specimens tested at the age specified in 6.4.1.1 or 6.6.1.1. If a specimen shows definite evidence other than low strength, of improper sampling, molding, handling, curing, or testing, it shall be discarded and the strength of the remaining cylinder shall then be considered the test result.

NOTE Additional tests may be made at other ages to obtain information for determining form removal time or when a structure may be put in service. Specimens for such tests are cured according to RS ISO 1920-3.

18.4 The representative of the purchaser shall ascertain and record the delivery-ticket number for the concrete and the exact location in the work at which each load represented by a strength test is deposited.

18.5 To conform to the requirements of this specification, strength tests representing each class of concrete must meet the following two requirements:

18.5.1 The average of any three consecutive strength tests shall be equal to, or greater than, the specified strength, $f'c$, and

18.5.2 When the specified strength is 35 MPa or less, no individual strength test (average of two cylinder tests) shall be more than 3.5 MPa below the specified strength, $f'c$.

NOTE Due to variations in materials, operations, and testing, the average strength necessary to meet these requirements will be substantially higher than the specified strength. The amount higher depends upon the standard deviation of the test results and the accuracy with which that value can be estimated from prior data.

18.5.3 When the specified strength is greater than 35 MPa, no individual strength test (average of two cylinder tests) shall be less than $0.90 f'c$.

19 Failure to meet strength requirements

19.1 In the event that concrete tested in accordance with the requirements of Clause 18 fails to meet the strength requirements of this specification, the producer of the ready-mixed concrete and the purchaser shall confer to determine whether agreement can be reached as to what adjustment or adjustments, if any, shall be made to the mixture proportions, production process, or testing procedures.

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Annex A (informative)

Concrete uniformity requirements

A.1.1 Significance and use

A1.1.1 This annex provides procedures to evaluate the ability of stationary and truck mixers to produce uniformly mixed concrete. The procedures described herein can also be used to determine the required minimum mixing revolutions in truck mixers for shrink-mixed concrete and for evaluating the uniformity of concrete mixtures delivered in nonagitating equipment.

A1.1.2 The sequence and method of charging mixers has a significant effect on the ability to produce uniformly mixed concrete. The procedures in this annex can also be used to evaluate the effect of batching sequence for charging or loading mixers of acceptable condition.

A1.1.3 It is not the intent that this complete evaluation be performed on mixers at an established frequency. For equipment in operation, a visual inspection of the condition of the mixer for blade wear and hardened concrete build up can be conducted as an alternative. If one mixer of a specific design has been evaluated by procedures in this annex, it can be assumed that mixers of essentially the same design and of different sizes will also produce uniformly mixed concrete. A selected portion of this evaluation, such as comparison of slump or coarse aggregate content, can also be performed as a quick indication of the uniformity of concrete mixtures.

A1.2 Concrete mixture, load size and mixing

A1.2.1 Unless the intent is to evaluate special project situations or concrete mixtures, the concrete mixture used for this evaluation should be typical of that produced in the production facility. Recommended mixture characteristics include the following:

A1.2.1.1 Cementitious materials content of 300 kg/m³ to 350 kg/m³ [500 lb/yd³ to 600 lb/yd³],

A1.2.1.2 Coarse aggregate size 19mm and 25mm Sieve No. 4.

A1.2.1.3 Fine aggregate fineness modulus 2.5 to 3.0,

A1.2.1.4 Target slump of 100 mm to 150 mm [4 in. to 6 in.] or for paving operations at 25 mm to 50 mm [1 in. to 2 in.], and A1.2.1.5 Air content of 4 % to 6 %.

A1.2.2 The load size used for this evaluation shall be within -20 % and +10 % of the rated mixing capacity of the mixer.

A1.2.3 Use a batching sequence of concrete materials that has been used previously with success or in accordance with the recommendation of the mixer manufacturer. Use alternative procedures if the purpose is to evaluate the effect of batching sequence.

A1.2.4 For stationary mixers, mix concrete at the mixing speed and minimum duration recommended by the mixer manufacturer. The start of mixing time shall be from the time all solid materials are in the mixer. Mixing

time is taken as the earlier of when the mixer is stopped or when the first material is discharged. Use a suitable timing device, accurate to 1 s, to measure and record the time duration of mixing.

A1.2.5 For truck mixers, mix concrete at a mixing speed exceeding 12 r/min or at the speed recommended by the truck mixer manufacturer. Complete mixing using between 70 and 100 revolutions of the drum at mixing speed. To determine the mixer drum revolutions, the start of mixing shall be when all the materials have been loaded in the mixer. Record the number of revolutions at mixing speed.

A1.3 Sampling

A1.3.1 Separate samples, each consisting of approximately 0.1 m³ [2 ft³] shall be taken after discharge of approximately 15 % and 85 % of the load (Note A1.2). These samples shall be obtained within an elapsed time of not more than 15 min. The samples shall be secured in accordance with RS ISO 1920-1, but shall be kept separate to represent specific points in the batch rather than combined to form a composite sample.

Sufficient personnel must be available to perform the required tests promptly. Segregation during sampling and handling must be avoided. Each sample shall be covered to prevent moisture loss or contamination. Remix the minimum necessary before performing the tests.

A1.3.2 Sampling From Stationary Mixers—Samples of concrete shall be obtained immediately after mixing duration is completed, in accordance with one of the following procedures:

A1.3.2.1 Alternative Procedure 1—The mixer shall be stopped, and the required samples removed by any suitable means from the mixer at approximately equal distances from the front and back of the drum, or A1.3.2.2 Alternative Procedure 2—As the mixer is being emptied, individual samples shall be taken after discharge of approximately 15 % and 85 % of the load. The method of sampling shall provide samples that are obtained from widely separated portions, but not from the very ends of the batch (Note A1.2).

A1.3.3 Sampling From Truck Mixers—The concrete shall be discharged at the normal operating rate for the mixer being tested, with care being exercised not to obstruct or retard the discharge. For the duration between obtaining samples, the mixer shall be turned in the mixing direction at agitating speed.

Obtain samples by intercepting the full discharge stream from the chute without stopping and starting the discharge during the collection of the sample.

A1.3.4 Sampling From Nonagitating Equipment—Obtain the two samples from approximately 15 % and 85 % of the discharge from the nonagitating equipment in accordance with RS ISO 1920-1. Mix the portions obtained from each location into uniformly mixed samples.

NOTE A1.2—No samples should be taken before 10 % or after 90 % of the batch has been discharged. Due to the difficulty of determining the actual quantity of concrete discharged, the intent is to provide samples that are representative of widely separated portions, but not the beginning and end of the load.

A1.4 Slump

A1.4.1 Perform the slump test on each sample in accordance with approved Test Method. Start the slump test within 5 min after the sample was obtained.

A1.5 Density (Unit Weight) and Yield

A1.5.1 Determine the density of each sample in accordance with Test Method C138/C138M. Use the measure for measurement of air content by Test Method C231/C231M unless the concrete contains a larger nominal maximum size coarse aggregate than is appropriate for this measure

A1.5.2 Calculate the density (unit weight) of each sample as follows:

$$D = \frac{M}{V}$$

where

D = measured density (unit weight), kg/m³ [lb/ft³],

M = net mass of concrete in the measure, kg [lb], and

V = volume of the measure, m³ [ft³].

A1.5.3 From the average density (unit weight) of the two samples, calculate the yield of the batch in accordance with Test Method C138/C138M.

A1.6 Air Content

A1.6.1 Measure the air content of each sample in accordance with Test Method C231/C231M. Use relevant approved Test Method if the concrete is made with lightweight aggregate or if the coarse aggregate in the concrete has an aggregate correction factor larger than 0.5 %.

A1.7 Air-Free Density (Unit Weight)

A1.7.1 Calculate the air-free density (unit weight) of each sample as follows:

$$\text{air-free density} = \frac{D}{100 - A} \times 100$$

where

D = measured density, kg/m³ [lb/ft³];

A = measured air content on that sample, %.

A1.8 Coarse aggregate content

A1.8.1 Use the concrete in the measure used to measure density (unit weight) to determine the coarse aggregate content. If a separate portion of the sample is used, the concrete sample shall be at least 15 kg [35 lb]. Place the concrete in an adequately sized container and determine the net mass of the fresh concrete.

A1.8.2 Wash each sample over a 4.75 mm (No. 4) sieve sufficiently to remove the cement and most of the fine aggregate. Determine the mass of the wet coarse aggregate, store in a plastic bag, and transport it to a laboratory facility.

Dry the coarse aggregate in an oven at 230 °C [110 °F] for 16 h ± 2 h. Sieve the coarse aggregate over a 4.75 mm (No. 4) sieve to remove any fine aggregate particles. Determine the mass of dry coarse aggregate in each sample.

A1.8.3 Express the mass of dry coarse aggregate as a percentage of the mass of the original concrete sample:

$$\text{coarse aggregate content, \%} = \frac{c}{M} \times 100$$

where

c = mass of dry coarse aggregate, kg [lb];

M = net mass of same fresh concrete sample, kg [lb].

A1.9 Compressive strength

A1.9.1 Make at least three 150 mm × 300 mm [6 in. × 12 in.] or 100 mm × 200 mm [4 in. × 8 in.] cylinders from each concrete sample. Cure the specimens in accordance with RS ISO 1920-3, except that the cylinders shall be immersed in water immediately after molding with the temperature maintained between the required temperature limits for initial curing of RS ISO 1920-3 for the first 24 h. Transport the cylinders to the laboratory facilities after 24 h and cure in accordance with RS ISO 1920-3.

A1.9.2 Test the cylinders in accordance with Test Method C39/C39M at an age of seven days. If the strength of an individual cylinder differs from the average strength of either sample by more than 9.5 %, this value can be disregarded for determining the average strength for the sample.

A1.9.3 Average the strength of the cylinders from each sample and express that value as a percentage of the average of all cylinders made from that batch. Calculate the difference in strength between each sample as a percentage of the overall average.

A1.10 Report

A1.10.1 Report the following information:

A1.10.1.1 Purpose of the evaluation.

A1.10.1.2 Type and description of mixer and rated mixing capacity.

A1.10.1.3 Concrete mixture proportions, batch quantities, density (unit weight), and yield of the batch.

A1.10.1.4 Mixing duration for stationary mixers or number of revolutions at mixing speed for truck mixers.

A1.10.1.5 Slump of each sample and the difference between samples, mm [in.].

TABLE A1.1 Requirements for Uniformity of Concrete

Test	Maximum Permissible Difference
Air-free density (unit weight), kg/m ³ [lb/ft ³]	16 [1.0]
Air content, %	1.0
Slump, mm [in.]:	
If average slump is less than 100 mm [4 in.]	25 [1.0]
If average slump is 100 mm to 150 mm [4 in. to 6 in.]	40 [1.5]
Coarse aggregate content, %	6.0
Average compressive strength at 7 days for each sample, ^A %	7.5 ^A

^AApproval of the mixer shall be tentative, pending results of the 7 day compressive strength tests.

A1.10.1.6 Air content of each sample and the difference between samples, %.

A1.10.1.7 Air-free density (unit weight) of each sample and the difference between samples, kg/m³ [lb/ft³].

A1.10.1.8 Coarse aggregate content of each sample and the difference between samples, %.

A1.10.1.9 Average strength in MPa [psi] and percent of overall average for each sample and the percent difference between samples.

A1.11 Requirements for uniformity of concrete

A1.11.1 The maximum permitted difference for each property obtained from the two different samples of the same batch are as provided in Table A1.1. Test results conforming to the limits of all five properties listed in Table A1.1 shall indicate uniform concrete within the limits of this specification.

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