



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS A 5308 : 2019

Ready-mixed concrete

ICS 91.100.30

Reference number : JIS A 5308 : 2019 (E)

Date of Establishment: 1953-11-07

Date of Revision: 2019-03-20

Date of Public Notice in Official Gazette: 2019-03-20

Investigated by: Japanese Industrial Standards Committee
Standards Board for ISO area
Technical Committee on Civil Engineering

JIS A 5308:2019, First English edition published in 2019-10

Translated and published by: Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2019

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Type, classification and designation of products	3
4.1 Type and classification	3
4.2 Designation of products	4
5 Quality	6
5.1 Quality requirement	6
5.2 Strength	6
5.3 Slump	6
5.4 Slump flow	6
5.5 Air content	7
5.6 Chloride content	7
6 Volume	7
7 Mix proportion	7
8 Materials	8
8.1 Cement	8
8.2 Aggregates	8
8.3 Water	8
8.4 Admixtures	8
9 Manufacturing methods	9
9.1 Manufacturing equipment	9
9.2 Batching of constituent materials	11
9.3 Mixing of concrete	12
9.4 Transportation of concrete	12
9.5 Handling of recovered aggregate	13
9.6 Handling of mortar adhering to drum inner wall of truck agitator	14
9.7 Quality control	14
10 Test methods	14
10.1 Sampling method	14
10.2 Strength	14
10.3 Slump	15
10.4 Slump flow	15
10.5 Air content	15

10.6	Chloride content	15
10.7	Volume	16
11	Inspection	16
11.1	Inspection items	16
11.2	Strength	16
11.3	Slump/slump flow, and air content	16
11.4	Chloride content	17
11.5	Specified requirements	17
12	Report	17
12.1	Mix design report and basic information on ready-mixed concrete	17
12.2	Delivery ticket for ready-mixed concrete	17
Annex A (normative)	Aggregates for ready-mixed concrete	26
Annex B (normative)	Restraining measures for alkali-silica reaction	33
Annex C (normative)	Water for mixing of ready-mixed concrete	36
Annex D (normative)	Stabilizer used for adhering mortar and sludge water	47
Annex E (normative)	Lightweight formwork	51
Annex F (normative)	Method for use of mortar adhering to truck agitator drum	57
Annex G (normative)	Method for use of stabilized sludge water	61
Annex H (informative)	Comparison table between previous and current editions of this Standard on technically significant revisions	65

Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law.

Consequently **JIS A 5308:2014** is replaced with this Standard.

However, **JIS A 5308:2014** may be applied in the **JIS** mark certification based on the relevant provisions of Article 19 Clause 1, etc. of the Industrial Standardization Law until September 19, 2019.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

Blank

Ready-mixed concrete

Introduction

This Japanese Industrial Standard was established in 1953 and has gone through 13 revisions including this one. The last revision was made in 2014, and this revision is intended to reflect the recent advances in technology and environmental considerations.

No corresponding International Standard has been established at this point. The comparison table between previous and current editions of this Standard on technically significant revisions is given in Annex H.

1 Scope

This Standard specifies the requirements for the ready-mixed concrete (hereafter referred to as ready-mixed concrete) delivered to the point of discharge. However, this Standard does not specify transportation, placing and curing of the concrete after delivery.

2 Normative references

The standards given in Table 13 contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) shall be applied.

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS A 0203**, and the following apply.

3.1

chloride content

chloride ion content brought about from material at the time of manufacture of ready-mixed concrete, expressed in kilogrammes per cubic meter of concrete (kg/m^3)

3.2

total alkali content

sum total of quantity of sodium ion and potassium ion brought about from material at the time of manufacture of ready-mixed concrete, which is converted into equivalent sodium oxide in molarity, expressed in kilogrammes per cubic meter of concrete (kg/m^3)

3.3

recycled water

generic term for sludge water and supernatant water obtained by treating the wastewater generated in washing of each of the fresh mortar adhering to and the fresh concrete remaining in the transport vehicle and the mixer, hopper, etc. of the plant, and of the returned concrete (hereafter referred to as concrete washing wastewater) among the wastewater generated in washing operations in ready-mixed concrete plants

3.4

sludge water

suspension water recovered from the concrete washing wastewater by removing the coarse aggregates and fine aggregates, including stabilized sludge water specified in **3.11**

3.5

supernatant water

water obtained by removing the sludge solids from sludge water by precipitation or other means

Water from stabilized sludge water is not included; however, it may be included in supernatant water when a control method¹⁾ is developed, in which the components of stabilizer specified in **3.9** are taken as indices, and when it is confirmed to conform to the requirements given in Table C.2

Note ¹⁾ An example of the control method is ion chromatography.

3.6

sludge

substance produced from sludge water through concentration and loss of fluidity

3.7

sludge solids

sludge dried at 105 °C to 110 °C

3.8

sludge solids content

the ratio in percentage of the mass of sludge solids to the quantity of cement per unit volume of concrete in the mix proportion of ready-mixed concrete

3.9

stabilizer

an agent which restrains and stabilizes the progress of the hydration reaction of cement included in both adhering mortar and sludge water for the purpose of reuse

3.10

adhering mortar

fresh mortar adhering to the drum wall, blades, etc., of a truck agitator which has discharged the entire volume of concrete

3.11

stabilized sludge water

suspension water recovered from the concrete washing wastewater to which predetermined quantity of stabilizer is added, by removing the coarse aggregates and fine aggregates

4 Type, classification and designation of products

4.1 Type and classification

The types of ready-mixed concrete covered in this Standard are normal-weight concrete, lightweight concrete, concrete for pavement and high-strength concrete. Each type of concrete is classified according to the maximum coarse aggregate size, slump/slump flow, and nominal strength; the applicable combinations of these are indicated with ○ marks in Table 1.

The nominal strength of high-strength concrete may be an integer between ○ marks given in Table 1 or an integer over 45 to and excluding 50.

Table 1 Type and classification of ready-mixed concrete

Type of concrete	Maximum coarse aggregate size mm	Slump/slump flow ^{a)} cm	Nominal strength													
			18	21	24	27	30	33	36	40	42	45	50	55	60	Flexure 4.5
Normal-weight concrete	20, 25	8, 10, 12, 15, 18	○	○	○	○	○	○	○	○	○	○	—	—	—	—
		21	—	○	○	○	○	○	○	○	○	○	—	—	—	—
		45	—	—	—	○	○	○	○	○	○	○	—	—	—	—
		50	—	—	—	—	—	○	○	○	○	○	—	—	—	—
		55	—	—	—	—	—	—	○	○	○	○	—	—	—	—
		60	—	—	—	—	—	—	—	○	○	○	—	—	—	—
	40	5, 8, 10, 12, 15	○	○	○	○	○	—	—	—	—	—	—	—	—	—
Lightweight concrete	15	8, 12, 15, 18, 21	○	○	○	○	○	○	○	○	—	—	—	—	—	—
Concrete for pavement	20, 25, 40	2.5, 6.5	—	—	—	—	—	—	—	—	—	—	—	—	—	○
High-strength concrete	20, 25	12, 15, 18, 21	—	—	—	—	—	—	—	—	—	—	○	—	—	—
		45, 50, 55, 60	—	—	—	—	—	—	—	—	—	—	—	○	○	○
Note ^{a)} These are the values at the point of discharge, and 45 cm, 50 cm, 55 cm and 60 cm are the slump flow values.																

In purchasing ready-mixed concrete, the purchaser shall specify the items of **a)** to **d)** upon agreement with the producer. The purchaser may, where necessary, specify the items of **e)** to **q)** upon agreement with the producer. The items of **a)** to **h)** shall be specified within the range given in this Standard.

- a) Type of cement
- b) Type of aggregate
- c) Maximum coarse aggregate size
- d) Restraining measures for alkali-silica reaction
- e) Classification by alkali-silica reactivity of aggregate
- f) Class of water, when nominal strength exceeds 36

- g) Type and use amount of admixture
- h) Upper limit value of chloride content, when other values than those specified in **5.6** are applied
- i) Material age that guarantees nominal strength
- j) Air content, when other values than those given in Table 6 are applied
- k) Bulk density of lightweight concrete, where applicable
- l) Highest or lowest temperature of concrete
- m) Upper limit of target value of water-cement ratio ²⁾
- n) Upper limit of target value of water quantity per unit volume of concrete ³⁾
- o) Lower or upper limit of target value of cement quantity per unit volume of concrete ⁴⁾
- p) In the case of plasticized concrete, the amount of slump increased as compared to that of the ready-mixed concrete before superplasticization [In the case where the purchaser specifies the method for restraining the total alkali content in concrete for item **d**), the purchaser shall inform the producer of the content (kg/m³) of alkali to be mixed through the use of superplasticizer.]
- q) Other requirements

Notes ²⁾ The target value of water-cement ratio set in the mix design

³⁾ The target value of water quantity per unit volume of concrete, set in the mix design

⁴⁾ The target value of cement quantity per unit volume of concrete, set in the mix design

4.2 Designation of products

The ready-mixed concrete shall be designated by the symbol for type of concrete, nominal strength, slump/slump flow, maximum coarse aggregate size, and symbol for type of cement.

Symbols used for designation of ready-mixed concrete are given in Tables 2 and 3.

Example: Normal weight 21 12 20 N

- Symbol for type of concrete
- Nominal strength
- Slump (cm)
- Maximum coarse aggregate size (mm)
- Symbol for type of cement

Example: High strength 50 60 20 L

- Symbol for type of concrete
- Nominal strength
- Slump flow (cm)
- Maximum coarse aggregate size (mm)
- Symbol for type of cement

Table 2 Symbols for type of concrete and aggregates used

Type of concrete	Symbol	Coarse aggregate	Fine aggregate
Normal-weight concrete	Normal weight	Crushed stone, various slag coarse aggregates, Class H recycled coarse aggregate, gravel	Crushed sand, various slag fine aggregates, Class H recycled fine aggregate, sand
Lightweight concrete	Lightweight Class 1	Artificial lightweight coarse aggregate	Crushed sand, blast-furnace slag fine aggregate, sand
	Lightweight Class 2		Artificial lightweight fine aggregate, artificial lightweight fine aggregate partially mixed with crushed sand, blast-furnace slag fine aggregate, and sand
Concrete for pavement	Pavement	Crushed stone, various slag coarse aggregates, Class H recycled coarse aggregate, gravel	Crushed sand, various slag fine aggregates, Class H recycled fine aggregate, sand
High-strength concrete	High strength	Crushed stone, gravel	Crushed sand, various slag fine aggregates, sand

Table 3 Symbol for type of cement

Type	Symbol
Ordinary portland cement	N
Ordinary portland cement (low alkali type)	NL
High-early-strength portland cement	H
High-early-strength portland cement (low alkali type)	HL
Ultra-high-early-strength portland cement	UH
Ultra-high-early-strength portland cement (low alkali type)	UHL
Moderate-heat portland cement	M
Moderate-heat portland cement (low alkali type)	ML
Low-heat portland cement	L
Low-heat portland cement (low alkali type)	LL
Sulfate-resistant portland cement	SR
Sulfate-resistant portland cement (low alkali type)	SRL
Portland blast-furnace slag cement Class A	BA
Portland blast-furnace slag cement Class B	BB
Portland blast-furnace slag cement Class C	BC
Portland pozzolan cement Class A	SA
Portland pozzolan cement Class B	SB
Portland pozzolan cement Class C	SC
Portland fly-ash cement Class A	FA
Portland fly-ash cement Class B	FB
Portland fly-ash cement Class C	FC
Ordinary ecocement	E

5 Quality

5.1 Quality requirement

The strength, slump/slump flow, air content and chloride content of the ready-mixed concrete shall satisfy the conditions specified in **5.2** to **5.6** at the point of discharge.

5.2 Strength

The strength of the ready-mixed concrete, when tested in accordance with **10.2**, shall satisfy the following requirements. Material age of the specimen for the strength test shall be 28 days unless otherwise specified in **4.1 i)** or the material age specified by the purchaser, if any.

- a) The result of one test shall be 85 % or over of the nominal strength value ⁵⁾ specified by the purchaser.
- b) The mean value of the results of three tests shall not be less than the nominal strength value ⁵⁾ specified by the purchaser.

Note ⁵⁾ The value, expressed in N/mm², is obtained by putting a decimal point on the nominal strength value and a zero in the first decimal place. However, flexure of nominal strength 4.5 shall be expressed by 4.50 N/mm².

5.3 Slump

The value of slump specified by the purchaser shall be within the range given in Table 4.

Table 4 Tolerances on slump at the point of discharge

Unit: cm

Slump	Tolerance on slump
2.5	± 1
5 and 6.5	± 1.5
8 or over up to and incl. 18	± 2.5
21	± 1.5 ^{a)}
Note ^{a)} The tolerance shall be ± 2 when the concrete has a nominal strength of 27 or over and the air-entraining and high-range water-reducing admixture is used.	

5.4 Slump flow

The value of slump flow specified by the purchaser shall be within the range given in Table 5.

Any segregation shall not occur.

Table 5 Tolerances on slump flow at the point of discharge

Unit: cm

Slump flow	Tolerance on slump flow
45, 50 and 55	± 7.5
60	± 10

5.5 Air content

Air content and its tolerances shall be as given in Table 6.

Even when the air content is specified in **4.1 j)**, the tolerance on air content shall be ± 1.5 %.

Table 6 Air content and its tolerances at the point of discharge

Unit: %

Type of concrete	Air content	Tolerance on air content
Normal-weight concrete	4.5	± 1.5
Lightweight concrete	5.0	
Concrete for pavement	4.5	
High-strength concrete	4.5	

5.6 Chloride content

The chloride content in the ready-mixed concrete shall not be more than 0.30 kg/m^3 as chloride ion (Cl^-) content. If the upper limit of chloride content is specified in **4.1 h)**, the specified value shall be applied. Further, this upper limit may be increased up to 0.60 kg/m^3 when approved by the purchaser.

6 Volume

The volume of the ready-mixed concrete shall not fall short of the volume entered in the delivery ticket at the point of discharge.

7 Mix proportion

The mix proportion of the ready-mixed concrete shall be as follows.

- The mix proportion of the ready-mixed concrete shall be determined by the producer so as to satisfy the requirements specified by the purchaser in Clause 4 and the quality requirements specified in Clause 5, and to pass the inspection specified in Clause 11.

The producer shall also specify the mix proportion of concrete assessed by slump flow so that segregation does not occur.

- The producer shall submit the mix design report of ready-mixed concrete given in Table 10 in **12.1** to the purchaser prior to delivery of the concrete.

- c) The producer, as requested by the purchaser, shall submit information which can be used as a basis for planning concrete mix proportions, calculating the chloride content of the ready-mixed concrete and formulating the restraining measures for alkali-silica reaction.

8 Materials

8.1 Cement

The cement used shall conform to one of the following standards.

- a) **JIS R 5210**
- b) **JIS R 5211**
- c) **JIS R 5212**
- d) **JIS R 5213**
- e) Ordinary ecocement in **JIS R 5214**; however, ordinary ecocement is not applicable to high-strength concrete.

8.2 Aggregates

The aggregates used shall conform to Annex A. Class H recycled aggregate shall be applied to normal-weight concrete and concrete for pavement. Any slag coarse aggregates shall not be applied to high-strength concrete.

When crushed stone, crushed sand, electric arc furnace oxidizing slag aggregate, gravel and sand specified in Annex A are used, one of the restraining measures for alkali-silica reaction specified in **B.3**, **B.4** and **B.5** shall be selected and applied. When ferronickel slag aggregate is used, the restraining measures for alkali-silica reaction according to **JIS A 5011-2**, Annex D shall apply. When copper slag fine aggregate is used, the restraining measures for alkali-silica reaction against Class A aggregates given in Table A.1 shall apply. When Class H recycled aggregate is used, those specified in **B.4** or **B.5** shall apply.

8.3 Water

The water used shall conform to Annex C. Sludge water shall not be applied to high-strength concrete.

8.4 Admixtures

The admixtures shall be as follows.

- a) Fly ash, expansive additive, chemical admixture, corrosion inhibitor, ground granulated blast-furnace slag and silica fume, when used, shall conform to the following standards, respectively.
 - 1) **JIS A 6201**
 - 2) **JIS A 6202**
 - 3) **JIS A 6204**
 - 4) **JIS A 6205**

5) **JIS A 6206**

6) **JIS A 6207**

- b) The crushed stone powder conforming to **JIS A 5041** may be used as an admixture. In this case, the aggregate used shall be of Class A given in Table A.1.
- c) Other admixtures than those given in **a)** and **b)**, when used, shall be confirmed not to adversely affect the concrete or steel material and confirmed to satisfy the specified quality and safety requirements. Of such admixtures, the one specified by the purchaser shall be used upon agreement with the producer.

9 Manufacturing methods

9.1 Manufacturing equipment

9.1.1 Silos for material storage

The silos for material storage shall be as follows.

- a) The silos for storing cement shall be classified by producer and type of cement and capable of preventing the cement from weathering.
- b) The silos for storing aggregates shall be located within the distance which allows daily management of the facilities, compartmented according to the types and classes, and capable of preventing segregation of large and small particles. The floor of the silos shall be constructed of concrete, provided with draining functions and capable of preventing ingress of foreign matters. Furthermore, the silos shall be capable of storing aggregates in volume corresponding to at least the maximum shipment volume of the ready-mixed concrete for one day.
- c) In the case of storing artificial lightweight aggregate, the silos shall be provided with means of sprinkling water over the aggregates.
- d) The silos for storing aggregates used for manufacturing high-strength concrete shall be provided with roofs.
- e) The silos for aggregates and the facility for transporting the aggregates from the silos to the batching plant shall be capable of supplying uniform aggregates.
- f) The silos for admixtures shall be compartmented according to the types and classes, and shall be such that admixture materials stored do not deteriorate.

9.1.2 Batching plant

The batching plant shall be as follows.

- a) The plant shall generally be provided with separate bins for respective principal materials.
- b) The weighing equipment used shall have an accuracy which allows the weighing of the materials within the tolerances specified in **9.2.2** and shall have an indicator capable of displaying the measured value with the above-mentioned accuracy.
- c) All the indicators shall be located at places visible to the operators, and the weighing equipment shall be easily controllable by the operators.

- d) The weighing equipment shall be capable of successively measuring the materials used for concrete of different mix proportions.
- e) The weighing equipment shall be provided with a device which can easily correct the measured values for surface moisture of aggregates. In the case of coarse aggregate, the correction may be made by calculation.

9.1.3 Mixer

The mixer shall be as follows.

- a) The mixer shall be of the stationary type conforming to **JIS A 8603-2** or to the requirements given in Tables 7 and 8.

If the rated capacity of the mixer conforms to none of them, conformity to the requirements given in Table 8 shall be ensured.

Table 7 Types of mixer and rated capacity

Type		Rated capacity (nominal capacity) m ³
Gravity type mixer	Tilting drum	0.5, 0.75, 1.0, 1.5, 2.0, 2.5, 3.0
Revolving-paddle mixer	Horizontal single shaft	
	Horizontal double shaft	
	Pan	

Table 8 Performance requirements for mixer

Items			Concrete volume	
			Rated capacity (nominal capacity)	Half the rated capacity (nominal capacity)
Required uniformity (mixing performance)	Deviation of mortar weight in concrete (difference in bulk density of mortar)		0.8 % max.	0.8 % max.
	Deviation of coarse aggregate weight in concrete (difference in coarse aggregate quantity per unit volume of concrete)		5 % max.	5 % max.
	Deviation (difference from the mean value)	Compressive strength	7.5 % max.	—
		Air content	10 % max.	—
		Slump	15 % max.	—
Restarting performance			When the mixer is stopped after completion of mixing of test concrete, it shall restart without difficulty in 5 min after it was stopped.	
Discharging performance			The mixer shall be capable of discharging all the aggregates without causing segregation, within 25 s for the tilting drum mixers and pan mixers, and within 15 s for the horizontal single shaft mixers and horizontal double shaft mixers.	
NOTE	The test concrete used shall be that with the maximum coarse aggregate size of 20 mm or 25 mm, slump of 8 cm ± 3 cm, air content of 4.5 % ± 1.5 %, and strength corresponding to nominal strength 24.			

- b) The mixer, when mixing the concrete of a specified slump/slump flow of the volume specified in **9.3 b)**, shall be capable of mixing the materials thoroughly and discharging them in homogeneous state.
- c) When the concrete of a specified volume is mixed for a specified time and the results of the tests performed in accordance with **JIS A 1119** do not exceed the following values, the mixer used shall be considered to have demonstrated the capability of mixing the concrete uniformly.

Difference in bulk density of mortar contained in concrete 0.8 %

Difference in coarse aggregate quantity per unit volume of concrete 5 %

9.1.4 Transportation vehicle

The transportation vehicle of the ready-mixed concrete shall be as follows.

- a) The truck agitator used shall deliver the following performance features.
 - 1) The truck agitator shall be capable of maintaining the mixed concrete sufficiently homogeneous, and of discharging it readily and completely without causing segregation of materials.
 - 2) When the slump test is carried out on two samples taken from the whole section at about 1/4 and 3/4 of concrete flow discharged from the truck agitator, the difference of slump between the two samples shall be within 3 cm. In this case, the concrete to be taken shall be 8 cm to 18 cm in slump.
- b) The dump truck can be used only for transporting concrete for pavement having a slump of 2.5 cm. The bed of the dump truck shall be flat, smooth and water-proof and shall have a waterproof cover for protection from rain and wind.

9.2 Batching of constituent materials

9.2.1 Batching method

The batching method shall be as follows.

- a) The cement, aggregates, water and admixtures shall be batched separately with different weighing equipment.

The mixing water may be batched cumulatively with the chemical admixtures which have been batched in advance.
- b) The cement, aggregates and admixtures shall be batched by mass. With the approval by the purchaser, the admixtures may be batched by counting the number of bags, except those in the quantity less than one bag.
- c) The mixing water and chemical admixtures shall be batched by mass or by volume.

9.2.2 Tolerances for batching

The tolerances for batching shall be as follows.

- a) The batching tolerances for the cement, aggregates, water and admixtures shall be as given in Table 9.

Table 9 Tolerances for batching of constituent materials

Unit: %

Material	Tolerance on batched value of one batching result
Cement	± 1
Aggregate	± 3
Water	± 1
Admixture	± 2 ^{a)}
Chemical admixture	± 3
Note ^{a)} For ground granulated blast-furnace slag, the tolerance shall be ± 1 %.	

- b) Calculations of difference in batched values shall be made according to the following formula, and the results rounded off to the nearest whole number.

$$m_0 = \frac{m_2 - m_1}{m_1} \times 100$$

where, m_0 : difference in batched values (%)
 m_1 : target batched value of one batching result
 m_2 : measured value

9.3 Mixing of concrete

The mixing of concrete shall be as follows.

- a) The constituent materials shall be mixed uniformly in a mixer conforming to **9.1.3** in a plant.
- b) Mixing quantity and mixing time of the concrete shall be determined by performing the test as specified in **JIS A 1119** and referring to **9.1.3 c)**.

9.4 Transportation of concrete

The transportation of the ready-mixed concrete shall be as follows.

- a) The ready-mixed concrete shall be transported by the transport vehicle specified in **9.1.4**.
- b) The transport time ⁶⁾ of ready-mixed concrete shall be the time required for the ready-mixed concrete to be transported by a transport vehicle to the point of discharge, and shall be within 1.5 h after the producer started the mixing. However, upon agreement with the purchaser, the limit of the transport time may be changed. In this case, the changed transport time limit shall be indicated in the Remarks to Table 10 of **12.1**.
- c) Where the concrete is transported by a dump truck, the transport time shall be within 1 h after the start of mixing.

Note ⁶⁾ The transport time can be obtained from the time difference between the departure and arrival time of delivery indicated in the delivery ticket shown in Table 11 of **12.2**.

9.5 Handling of recovered aggregate

The handling of recovered aggregate (hereafter referred to as recovered aggregate) shall be as follows.

- a) The recovered aggregate used shall be obtained by washing returned concrete or fresh concrete adhering to and remaining in the transport vehicle and in the mixer, hopper, etc. of the plant with fresh water or recycled water, and by separating it into coarse aggregate and fine aggregate.
- b) Of the ready-mixed concrete having been shipped, concrete which has been brought back to the ready-mixed concrete plant as follows is considered as returned concrete: concrete having become unnecessary for the purchaser's reasons; concrete not satisfying quality requirements specified by the purchaser; concrete remaining after discharge; or concrete adhering to the drum of the transport vehicle.
- c) Aggregates recovered from the normal-weight concrete, concrete for pavement and high-strength concrete shall be used as recovered aggregates. The content of aggregate particles finer than 75 μm sieve when tested in accordance with **JIS A 1103** shall not exceed that in the unused aggregate (hereafter referred to as new aggregate).
- d) The aggregate recovered from fresh concrete containing the following aggregates shall not be used: normal-weight aggregate of which the grading is significantly different from that of new aggregate; aggregate of which the density is significantly different from that of new aggregate, e.g. lightweight aggregate and heavyweight aggregate; and recycled aggregate.
- e) The recovered aggregate shall not be used for lightweight concrete or high-strength concrete.
- f) The use amount of recovered aggregate shall be expressed as a substitution rate which is a mass fraction of the use amount of the recovered aggregate to the total use amount of the new aggregate of both coarse and fine aggregates and the recovered aggregate.
- g) The addition ⁷⁾ of recovered aggregate to new aggregate shall be controlled at specified intervals ⁸⁾ and recorded so that the upper limit of the target substitution rates of recovered aggregate for both coarse and fine aggregates do not exceed 5 %. "Method A" shall be entered in the column of use method of recovered aggregate in Table 10, and "not more than 5 %" shall be entered in the column of recovered aggregate substitution rate in Table 11.

Note ⁷⁾ Recovered aggregate is to be added to new aggregate at a fixed ratio so that a substitution rate does not exceed 5 %. The recovered aggregate is added to new aggregate either by drawing a fixed amount of recovered aggregate from a hopper onto the new aggregate being transported on a belt conveyor or by adding a fixed amount of recovered aggregate with a shovel or other tools to every input of new aggregate into the hopper through which new aggregate is transported to the silo using a belt conveyor.

Note ⁸⁾ The control period of recovered aggregate is one day.

Where the shipment volume of concrete per day is less than 100 m³, the number of days required for the shipment volume to reach approximately 100 m³ is considered as one control period.

- h) In the case where the recovered aggregate used is stored, transported and batched with exclusive use facilities, the upper limit of the target substitution rate of recovered aggregate for both coarse and fine aggregates may be 20 %. In this case, the batched value of the recovered aggregate shall be controlled and recorded for every batch.

The recovered aggregate may be batched cumulatively with other new aggregate. "Method B" shall be entered in the column of use method of recovered aggregate in Table 10, and the recovered aggregate substitution rate obtained from the aggregate quantity per unit volume of concrete which depends on the type of mix proportion being used shall be entered in the column of recovered aggregate substitution rate in Table 11.

9.6 Handling of mortar adhering to drum inner wall of truck agitator

Handling of mortar adhering to drum inner wall of truck agitator shall be as follows.

- a) In the case of normal-weight concrete, after the entire volume of mixed concrete in the truck agitator has been discharged, the fresh mortar adhering to the inner wall of drum, blades, etc. of the truck agitator may be reused by mixing with the stabilizer specified in Annex D.
- b) The adhering mortar of normal-weight concrete shall be reused in accordance with Annex F, and the times when the concrete is mixed and when the adhering mortar is turned into slurry form shall be recorded.
- c) For lightweight concrete, concrete for pavement and high-strength concrete, the adhering mortar shall not be reused as described in a) and b).

9.7 Quality control

The producer shall conduct necessary quality control for guaranteeing the quality of the ready-mixed concrete specified in Clause 5. Furthermore, if requested by the purchaser, the producer shall submit the results of the quality control tests.

10 Test methods

10.1 Sampling method

The sampling method shall be as specified in JIS A 1115.

10.2 Strength

10.2.1 Compressive strength

The compressive strength test shall be performed in accordance with JIS A 1108, JIS A 1132 and Annex E. For the specimen prepared using a mould with a verified accuracy, the nominal dimension may be used for the diameter. Furthermore, the measurement of each item given in 4.5 of JIS A 1132 may be omitted.

If the unbonded capping specified in Annex A of **JIS A 1108** is applied, it may be applied to both end faces of the specimen.

The end faces of high-strength concrete shall be finished in accordance with **4.4.2** of **JIS A 1132**. The prepared specimen shall be stored at the ordinary temperature during the time up to demoulding⁹⁾.

After the demoulding, the specimen shall be cured in water at $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

Note ⁹⁾ The specimen should be prepared in the ordinary temperature environment. When this is difficult, the specimen should be moved to the ordinary temperature environment immediately after preparation. While the specimen is stored, it should be ensured that the moisture evaporation is kept to a minimum.

10.2.2 Flexural strength

The flexural strength test shall be performed in accordance with **JIS A 1106** and **JIS A 1132**. For the specimen prepared using a mould with a verified accuracy, the nominal dimensions may be used for the width and height. Furthermore, the measurement of each item given in **5.4** of **JIS A 1132** may be omitted.

The prepared specimen shall be stored at the ordinary temperature during the time up to demoulding⁹⁾.

After the demoulding, the specimen shall be cured in water at $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

10.3 Slump

The slump test shall be performed in accordance with **JIS A 1101**.

10.4 Slump flow

The slump flow test shall be performed in accordance with **JIS A 1150**.

After the slump flow test, the specimen shall be examined visually for the occurrence of segregation.

10.5 Air content

The air content test shall be performed in accordance with any of **JIS A 1128**, **JIS A 1118** or **JIS A 1116**.

10.6 Chloride content

The test of chloride content shall be performed as follows.

- a) The test of chloride ion concentration in water contained in fresh concrete shall be carried out in accordance with **JIS A 1144**. For this test, a chloride content measuring instrument with a verified accuracy may be alternatively used.
- b) The chloride content shall be determined as the product of the chloride ion concentration in water contained in fresh concrete and the water quantity per unit volume of concrete used in the mix proportion.

The water quantity per unit volume of concrete used for determining the chloride content shall be the value given in the mix design report of ready-mixed concrete given in Table 10.

- c) When ordinary ecocement specified in Clause 8 is used, the value obtained by multiplying the product of the chloride ion concentration in ordinary ecocement and the cement quantity per unit volume of concrete used in the mix proportion by the chloride ion residual ratio shall be added to the value obtained in b).
- d) When Class H recycled aggregate specified in Clause 8 is used, the value obtained by multiplying the product of the chloride quantity in Class H recycled aggregate and the quantity of Class H recycled aggregate used in the mix proportion by 1/4 shall be added to the value obtained in b).

10.7 Volume

The volume of the ready-mixed concrete shall be obtained by dividing the total loaded mass of one transport vehicle by the bulk density of fresh concrete. The total loaded mass of one transport vehicle shall be calculated either by obtaining the total sum of mass of all the materials loaded or by using the difference in mass of the transport vehicle before and after discharge. The bulk density of the fresh concrete shall be determined by the method specified in **JIS A 1116**.

If the exact volume of the vessel for the test specified in **JIS A 1128** is known, the vessel may be used.

11 Inspection

11.1 Inspection items

The inspection of ready-mixed concrete shall be made on the strength, slump/slump flow, air content and chloride content.

11.2 Strength

The test of strength shall be performed in accordance with **10.2**, and products found to be in conformance with **5.2** shall be accepted.

The test shall be normally conducted once per 150 m³ for normal-weight concrete, lightweight concrete and concrete for pavement, and once per 100 m³ for high-strength concrete.

Moreover, when, for three times of test, the relation between the water-cement ratio and the strength is the same and the nominal strength is the same, even if slump/slump flow is different, the concrete sampled may be deemed to be of the same lot.

The result of one test shall be expressed by the mean test value of three specimens which have been prepared from a sample taken from one arbitrary transport vehicle.

11.3 Slump/slump flow, and air content

The test of slump/slump flow and air content shall be performed, as required, by the methods specified in **10.3** or **10.4**, and **10.5**, and products found to be in conformance with the requirements given in **5.3** or **5.4**, and **5.5**, respectively, shall be accepted. When either of the slump/slump flow or air content test result, or both of these test results is/are found to be non-conforming, one retest is permitted, in which case a new sample shall be prepared in accordance with **10.1**. In the retest, the same test method(s) shall be employed and the same requirement(s) shall be met.

11.4 Chloride content

The test of chloride content shall be performed in accordance with **10.6**, and products found to be in conformance with **5.6** shall be accepted.

The inspection on the chloride content may be made at the time of shipment from the plant because the specified conditions at the point of discharge can be satisfied at the time of shipment from the plant.

11.5 Specified requirements

For the requirements in Clause **4** which have been specified by the purchaser, the inspection shall be performed by the method agreed upon between the purchaser and the producer.

12 Report

12.1 Mix design report and basic information on ready-mixed concrete

The producer shall, prior to the delivery, submit the mix design report of ready-mixed concrete to the purchaser as shown in Clause **7 b)**. The standard format of the mix design report of ready-mixed concrete is shown in Table 10. Furthermore, upon request by the purchaser, the producer shall submit information used as a basis for e.g. planning concrete mix proportions as shown in Clause **7 c)**.

In the case of using sludge water, if requested by the purchaser, the producer shall submit the control record of sludge water specified in **C.6.3**.

12.2 Delivery ticket for ready-mixed concrete

The producer shall provide the purchaser with a delivery ticket for the ready-mixed concrete for each delivery and for each transport vehicle. The standard format of a delivery ticket is shown in Table 11.

The producer, upon request by the purchaser, shall also provide the purchaser with a batching record¹⁰⁾ for each batch and the quantities of materials per unit volume of concrete¹¹⁾ calculated by using the batching record above, after delivery of ready-mixed concrete. Where the concrete from one transport vehicle is mixed in multiple batches, the producer shall indicate the quantities of materials per unit volume of concrete calculated by averaging the batched values of all the batches. The batching record shall be kept for a predetermined period of time.

The quantities of materials per unit volume of concrete expressed as the average per transport vehicle which has been obtained from the batching record shall not deviate from the specified value by more than the tolerance given in Table 9. The quantities of fine aggregate and coarse aggregate per unit volume of concrete shall be obtained by totalling and then averaging the batched results of the two.

If the producer uses recycled materials given in Table 12, the Mobius loop specified in **JIS Q 14021** may be indicated in the delivery ticket given in Table 11, along with the symbol for the type of material used and its content, as shown in Figure 1.

If this is the case, the producer shall keep the control data, test data, etc. in the form of documents that validate matters indicated above and shall submit the documents to the purchaser if so requested.

- Notes ¹⁰⁾ The record of batched results of materials used in mixing of the concrete. The batching record can be either the manually recorded values read out from the weighing equipment or the automatically recorded values.
- ¹¹⁾ The quantities of materials per unit volume of concrete can be calculated from the batched results by running a calculation programme on the computer to which batched results are input manually or running an automatic calculation programme built in the weighing equipment.

Table 10 Mix design report of ready-mixed concrete

Mix design report of ready-mixed concrete										No.
Name of purchaser					Date					
Name of producer and plant										
Name of person in charge of mix proportion planning										
Name of work										
Location										
Appointed time of delivery										
Applicable period of this mix proportion ^{a)}										
Placing point of concrete										
Designing conditions of mix proportion										
Designation	Symbol for type of concrete	Nominal strength		Slump/slump flow		Maximum coarse aggregate size		Symbol for type of cement		
				cm		mm				
Specified requirements (Compulsory)	Type of cement	Given in the "Designation" column		Maximum coarse aggregate size		Given in the "Designation" column				
	Type of aggregate	Given in the "Materials used" column		Restraining measures for alkali-silica reaction ^{b)}						
Specified requirements (Optional)	Classification by alkali-silica reactivity of aggregate	Given in the "Materials used" column		Bulk density of lightweight concrete				kg/m ³		
	Class of water	Given in the "Materials used" column		Temperature of concrete				Highest/lowest temperature °C		
	Type and use amount of admixtures	Given in the "Materials used" and "Mix proportion table" columns		Upper limit of target value of water-cement ratio				%		
	Chloride content	kg/m ³ max.		Upper limit of target value of water quantity per unit volume of concrete				kg/m ³		
	Material age guaranteeing nominal strength	days		Lower or upper limit of target value of cement quantity per unit volume of concrete				kg/m ³		
	Air content	%		Amount of slump increased after superplasticization				cm		
Materials used ^{c)}										
Cement		Name of producer				Density g/cm ³		Na ₂ O _{eq} ^{d)} %		
Admixture		Name of product		Type		Density g/cm ³		Na ₂ O _{eq} ^{e)} %		
Aggregate	No.	Type	Production region and product name	Classification by alkali-silica reactivity ^{f)}		Range of particle size ^{g)}	Fineness modulus or solid content ^{h)}	Density g/cm ³		Range of content of aggregate particles finer than 75 µm % ⁱ⁾
				Class	Test methods			Absolute dry condition	Surface dry condition	
Fine aggregate	①									
	②									
	③									
Coarse aggregate	①									
	②									
	③									
Chemical admixture ①		Name of product		Type				Na ₂ O _{eq} ^{j)} %		
Chemical admixture ②										
Chloride content of fine aggregate ^{k)}				%		Class of water ^{l)}		Target sludge solids content ^{m)}		%
Use method of recovered aggregate ⁿ⁾				Fine aggregate		Coarse aggregate		Use of stabilized sludge water: Y/N		