

Annex A (normative)

Recycled aggregate L for concrete

A.1 General

This Annex specifies the recycled aggregate L for concrete manufactured by treatment such as crushing concrete waste¹⁾ generated by demolishing structures or the like.

Moreover the original concrete shall include the product manufactured by crushing hardening concrete of returned ready mixed concrete. However the product which added water when it was fresh or crushed into gravel within a few days after discharged by carrier shall be excluded²⁾.

Note¹⁾ : The concrete waste includes hardening return concrete of concrete products or ready-mixed concrete.

²⁾ : Due to the product which is not enough hardened shall not be applied.

A.2 Classification, division and designation

A.2.1 Classification

The classification of recycled aggregate L shall be in accordance with Table A.1.

Class	Symbol	Remarks
Recycled coarse aggregate L	RLG	Coarse aggregate manufactured by treatment such as crushing the original concrete
Recycled fine aggregate L	RLS	Fine aggregate manufactured by treatment such as crushing the original concrete

A.2.2 Division according to grain size

The division according to the grain size for recycled aggregate L shall be in accordance with Table A.2.

Division	Grain size range	Symbol
	mm	
Recycled coarse aggregate L 4005 a)	40 to 5	RLG4005
Recycled coarse aggregate L 2505	25 to 5	RLG2505
Recycled coarse aggregate L 2005	20 to 5	RLG2005
Recycled coarse aggregate L 4020 a)	40 to 20	RLG4020
Recycled fine aggregate L	5 max.	RLS

Note a) The recycled aggregate shall be restricted to be manufactured by original concrete using aggregates which maximum size is 40 mm or over.

A.2.3 Division according to alkali-silica reactivity

The division according to the alkali-silica reactivity for recycled aggregate L shall be in accordance with Table A.3.

Division	Remarks
A	The recycled aggregate judged as "harmless" in alkali-silica reactivity in accordance with A.4.5.
B	Other recycled aggregate than those judged as "harmless" in alkali-silica reactivity in accordance with A.4.5.

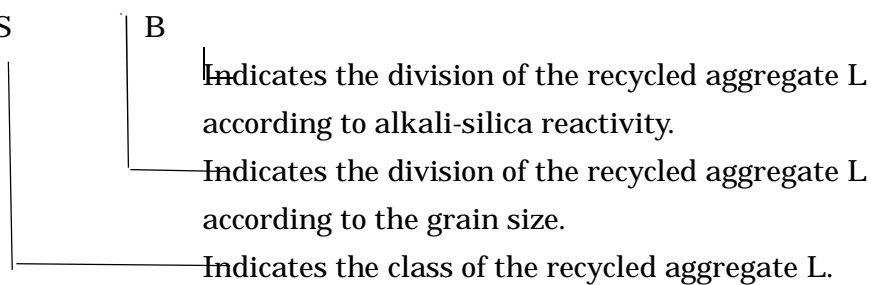
A.2.4 Designation

The designation of recycled aggregate L shall be as follows.

Example RLG 2005 B

RLS

B



A.3 Quality

A.3.1 Amount of impurities

The recycled aggregate L shall not contain harmful amount of impurities that may have an adverse effect on the quality of concrete. The amount of impurities shown in Table A.4 shall be tested in accordance with A.5.2 and shall conform to the requirement given in Table A.4.

Classification	Contents of impurities	Upper limit a)
		%
A	Tiles, bricks, pottery and asphalt concrete lumps	2.0
B	Glass pieces	0.5
C	Gypsum and gypsum board pieces	0.1
D	Other inorganic board pieces than C	0.5
E	Plastics pieces	0.5
F	Wooden pieces, bamboo pieces, cloth pieces, paper scraps and asphalt lumps	0.1
G	Metal pieces	1.0
	Total amount of impurities (total amount of impurities of A to G)	3.0
Notes a)	The upper limit is the value, expressed in mass ratio, of amount of impurity of each classification relative to the total amount of impurities.	

A.3.2 Physical properties

The water absorption and content of materials finer than 75 μm sieve of recycled aggregate L shall be tested in accordance with A.5.3 and A.5.4 conform to the requirements in Table A.5. When using JIS A 1801 instead of A.5.4 for daily quality management, the sand equivalent value shall be 60 % or over.

The absolute dry density of recycled aggregate L shall be tested in accordance with A.5.3 and reported by the test result certificate.

Test items		Recycled coarse	Recycled fine
		aggregate	aggregate
Percentage of water absorption	%	7.0 max.	13.0 max.
Content of material finer than 75 μm seive	%	3.0 max.	10.0 max.

A.3.3 Alkali-silica reactivity

A.3.3.1 Alkali-silica reactivity of recycled coarse aggregate L

When being in compliance with all of the following requirements, the alkali-silica reactivity of recycled coarse aggregate L is judged as harmless.

- All the original coarse and fine aggregates shall be identified. "Identification of original aggregate" is given in Annex A of JIS A 5021.
- All the original coarse and fine aggregates or recycled coarse aggregate L shall be judged as harmless by the alkali-silica reactivity test given in A.5.5. Alkali-silica reactivity test shall be carried out for every original aggregate specified by a).

A.3.3.2 Alkali-silica reactivity of recycled fine aggregate L

When being in compliance with all of the following requirements, the alkali-silica reactivity of recycled fine aggregate L is judged as harmless.

- a) All the original coarse and fine aggregates shall be identified. "Identification of original aggregate" is given in Annex A of JIS A 5021.
- b) All the original coarse and fine aggregates or recycled fine aggregate L shall be judged as harmless by the alkali-silica reactivity test given in A.5.5. Alkali-silica reactivity test shall be carried out for every original aggregate specified by a).

A.3.4 Grain size

When using either recycled coarse aggregate L or recycled fine aggregate L independently, the grain size shall be tested in accordance with A.5.6 and be satisfied the any of the grain size of the recycled coarse aggregate L4005, L2505, L2005 or the recycled fine aggregate shown in Table A.6. The specified range in Table A.6 is applicable to those retained on the sieve of nominal size 75 μm .

The manufacturer may consult with the purchaser to change the range of the mass fraction of those which pass the sieve for each division according to the grain size.

When mixing the recycled coarse aggregate L with the coarse aggregate conform to Annex A of JIS A 5308³⁾ or with the recycled coarse aggregate M conform to Annex A of JIS A 5022, or mixing the recycled coarse aggregate L4020 with L2005, the grain size of the mixed recycled coarse aggregate L shall be satisfied one of the designation given in recycled coarse aggregate L4005, L2505 or L2005.

When mixing the recycled fine aggregate L with the fine aggregate conform to Annex A of JIS A 5308³⁾ or the recycled fine aggregate M conform to Annex A of JIS A 5022, the grain size of the mixed recycled fine aggregate L shall be satisfied the designation given in recycled fine aggregate L.

Note ³⁾ : The artificial lightweight aggregate shall be excluded among the aggregate conform to Annex A of JIS A 5308.

Table A.6 Grain size												
Division	Mass fraction of those passing through sieve %											
	Nominal sieve size a) mm											
	50	40	25	20	15	10	5	2.5	1.2	0.6	0.3	0.15
Recycled coarse aggregate L4005	100	95 to 100		35 to 70		10 to 30	0 to 5					
Recycled coarse aggregate L2505		100	95 to 100		30 to 70		0 to 10	0 to 5				
Recycled coarse aggregate L2005			100	90 to 100		20 to 55	0 to 10	0 to 5				
Recycled coarse aggregate L4020	100	90 to 100	20 to 55	0 to 15		0 to 5						
Recycled fine aggregate						100	85 to 100	65 to 100	45 to 90	25 to 65	10 to 35	2 to 15

Note a) The nominal sieve sizes in the table correspond to the nominal sieve apertures specified in JIS Z 8801-1, namely, 53mm, 37.5 mm, 26.5 mm, 19 mm, 16 mm, 9.5 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 μm , 300 μm , and 150 μm , respectively.

A.3.5 Chloride content

The chloride content in recycled aggregate L shall be provided by agreement with the related parties of delivery as necessary. If specified, the chloride content⁴⁾ in recycled aggregate L shall not exceed 0.04 % when tested in accordance with A.5.7. However, this maximum limit may be applied at 0.1 % if approved by the purchaser.

Note⁴⁾ Indicated as a value converted to NaCl.

A.4 Manufacture

A.4.1 Storage of original concrete

The original concrete shall be stored exactly classified in such a way as to prevent impurity incorporation and mixture with other materials.

A.4.2 Manufacture recycled aggregate L

The manufacture of recycled aggregate L shall be as follows.

- The original concrete showing evident signs of abnormalities that can be attributed to the aggregate, such as alkali-silica reactivity, shall not be used.
- The original concrete containing a lot of chloride shall not be used.
- The original concrete containing a number of impurities shall not be used.
- The original concrete not fully hardened shall not be used.
- The original concrete that is chemically contaminated shall not be used.
- The light-weight aggregate concrete shall not be used for the original concrete.
- Sea water shall not be used for cleaning water.

- h) When any other products than the recycled aggregate L are manufactured at the same manufacturing facility, the recycled aggregate L shall be handled in such a way as to prevent impurity incorporation. The recycled aggregate L with contamination shall not be handled as the recycled aggregate L.
- i) The recycled aggregate L of division A in alkali-silica reactivity shall be handled so as not to be mixed with the recycled aggregate L of division B during storage of the original concrete and at each stage of manufacture, storage and shipment of the recycled aggregate L.

A.4.3 Storage of recycled aggregate L

The recycled aggregate L shall be stored appropriately by division as to prevent segregation and mixture with other materials according to classification, division of grain size and alkali-silica reactivity.

A.5 Test method

A.5.1 Sampling of specimen

The specimen to be taken shall be a representative part of the recycled aggregate L and shall be reduced in accordance with JIS A 1158.

A.5.2 Test of amount of impurities

The test shall be in accordance with Annex B of JIS A 5021.

A.5.3 Test of density in oven-dry condition and percentage of water absorption

The test shall be performed in accordance with JIS A 1109⁵⁾ or JIS A 1110. The density in oven-dry condition and percentage of water absorption shall be the mean value of the results in three times tests. For the recycled fine aggregate with a lot of materials finer than 75 μm , the judgement for the state of surface dry saturated with water might be difficult. In that case the washed recycled fine aggregate L in accordance with Clause 5 (Test method) of JIS A 1103 may be used as a specimen, however the notice shall be indicated in the remarks of the test result certificate.

Notes⁵⁾ The amount of specimen may be 450g.

A.5.4 Test of content of materials finer than 75 μm sieve

The test shall be performed in accordance with JIS A 1103.

A.5.5 Test of alkali-silica reactivity

The test shall be performed in accordance with JIS A 1145, JIS A 1146 or Annex D of JIS A 5021.

A.5.5.1 In test performed according to JIS A 1145

- a) The cement paste adhered to the original aggregate or recycled aggregate L shall be removed by dissolving with hydrochloric acid or the like and then washing with water prior to testing.
- b) The judgement shall be made based on the average of the determined values of the

measurement items. In the range where the amount of dissolved silica (Sc) is 10mmol/L or over and the amount of alkali concentration decrease (Rc) is under 700mmol/L, the aggregate shall be judged as “harmless” if the amount of dissolved silica (Sc) is less than the amount of alkali concentration decrease (Rc) and shall be judged as “not harmless” if the amount of dissolved silica (Sc) is equal to or greater than the amount of alkali concentration decrease (Rc). When the amount of dissolved silica (Sc) is under 10mmol/L and the amount of alkali concentration decrease (Rc) is under 700mmol/L, the aggregate shall be judged as “harmless”. When the amount of alkali concentration decrease (Rc) is 700mmol/L or over, judgement shall not be made on that aggregate.

A.5.5.2 In test performed according to JIS A 1146

- a) The cement paste adhered to the original aggregate or recycled aggregate L shall be remained for testing.
- b) When the average expansion coefficient of three specimens after 26 weeks of material age is under 0.100 %, the aggregate shall be judged as “harmless” and when it is 0.100 % or greater, it shall be judged as “not harmless”. When the aggregate shows expansion of 0.050 % or greater at the material age of 13 weeks, it shall be judged as “not harmless” at that point, and measurement at the material age of 26 weeks may be omitted.

A.5.5.3 In test performed according to Annex D of JIS A 5021

- a) The cement paste adhered to the original aggregate or recycled aggregate L shall be remained for testing.
- b) When the water absorption of recycled aggregate L is high and the mixing of mortar or the preparation of specimen is difficult, the preparation of test specimen may be supplied for the test in the surface dried state or in similar condition⁶⁾.
- c) When the specimen is in the oven-dry condition or in the air-dried condition, the water may be added into mixing of mortar for producing the surface dry condition of recycled aggregate L.
- d) The mix proportion number and mix proportion of mortar shall be according to either the following methods.
 - 1) For measurement of ultrasonic propagation velocity or dynamic modulus of elasticity, the mix proportion number of mortar shall be one and the constitution ratio of fine aggregate shall be in accordance with the constitution condition 1 indicated in Table A.7. The mix proportion of mortar shall be in accordance with a) 2) of D.5.1 of JIS A 5021
 - 2) For measurement of change of length, the mix proportion number of mortar shall be four, with the constitution ratio of fine aggregate changed. The test shall be carried out with constitution condition 1 in Table A.7, and depending on the result, additional tests shall be carried out with the constitution conditions 2 to 4 as necessary. The mix proportion of mortar shall be in accordance with a)2) of D.5.1 of JIS A 5021.

Table A.7		Constitution ratio and mass of fine aggregate (standard sand, test specimen)			
Constitution condition of fine aggregate	Constitution ratio of fine aggregate (mass ratio)		Mass of fine aggregate		
	Standard sand	Test specimen	Standard sand	Test specimen	Total
1	25	75	300	900	1,200
2	0	100	0	1,200	1,200
3	50	50	600	600	1,200
4	75	25	900	300	1,200

e) The judgement shall be as follows.

- 1) For measurement of ultrasonic propagation velocity or dynamic modulus of elasticity, the judgement shall be made on the rate of ultrasonic propagation velocity or the coefficient of relative dynamic modulus of elasticity which is the mean value of test results of three specimens of fine aggregate constitution condition 1 rounded off to an integer. When the conditions which the rate of ultrasonic propagation velocity is not less than 95 % and the coefficient of relative dynamic modulus of elasticity is not less than 85 % are satisfied, judgement shall be “harmless” and when not satisfied, judgement shall be “not harmless”.
- 2) For measurement of change rate of length, when the test results of three specimens of fine aggregate constitution condition 1 rounded off to two decimal places, is 0.07 % or less, judgement shall be “harmless” and when the value is exceeding 0.07 %, judgement shall be “not harmless”. However, when the change rate of length is exceeding 0.07 % but less than 0.10 %, additional tests shall be carried out with fine aggregate constitution conditions 2 to 4 indicated in Table A.7, and if all the results of the fine aggregate constitution conditions 1 to 4 turn out to be under 0.10 %, judgement shall be “harmless”.

Note ⁶⁾ The similar condition of surface dried state means the conditions of which removing most of surface water of specimen in infiltrating state by means of a centrifugal machine or the like or adding the water into testing specimens in oven-dry condition which amount is as same as the water absorption in the recycled aggregate L before crushing.

A.5.6 Grain size test

The test shall be performed in accordance with JIS A 1102.

A.5.7 Test of chloride content

The chloride content test shall be either the followings.

- a) In accordance with 5.5 of JIS A 5002. Therefore the analysis of chloride content in sample solution shall be in accordance with clause 4 of JIS A 1144.

The quantity of the specimen shall be 1,000 g and four times of the test result value shall be the chloride content.

- b) In accordance with JIS A 1154.

A.6 Inspection

A.6.1 Inspection method

- a) For inspection, the lot size shall be determined for each class by agreement between the manufacturer and the purchaser, the specimen shall be taken in accordance with a reasonable sampling plan, the test shall be carried out as specified in A.5 and those which conform to the requirements in A.3 are accepted.
- b) When the division of alkali-silica reactivity is “A”, the maximum value of a lot shall be the less amount of either 1,500 t or the amount that can be manufactured in two weeks.
- c) The alkali-silica reactivity of all kinds of original aggregates or recycled aggregate L shall be confirmed by the test given in A.5.5. The maximum value of a lot in alkali-silica reactivity test or a target for the test may be changed as shown in following 1) to 3) depending on the condition.
 - 1) For the recycled aggregate L which has been judged as harmless in three times consecutive alkali-silica reactivity test, the maximum value of the lot for alkali-silica reactivity test after that may be the amount that can be manufactured in one month.
 - 2) The recycled aggregate L of which judged as harmless in alkali-silica reactivity in all kinds of original coarse aggregates and original fine aggregates according to the test result certificate, the maximum value of the lot for alkali-silica reactivity test may be the amount which can be manufactured in three months.
 - 3) When the alkali-silica reactivity test given in A.5.5 is performed for all kinds of original coarse aggregate and original fine aggregates sampled by original concrete, and judged as harmless, the alkali-silica reactivity test for recycled aggregate L may be omitted.

A.6.2 Preservation of inspection data

The manufacturer shall store the records of the test results obtained in the inspection for a specified period.

A.7 Marking

The marking shall be as follows.

When using the aggregate conform to Annex A of JIS A 5308³⁾ or the aggregate conform to Annex A of JIS A 5022 mixed with the recycled aggregate L, the test result certificate shall be used as same format given in the JIS.

- a) In the invoice of recycled aggregate L, the following information shall be given.

- 1) Class and division (according to the designation in A.2.4)
 - 2) Name of manufacturer, name of manufacturing factory and its address
 - 3) Time of manufacture and date of shipment
 - 4) Mass or volume
 - 5) Name of the company and factory of consignee
- b) Address where the original concrete was produced, if the original aggregate can be identified and if necessary.

A.8 Report

The manufacturer shall present the test result certificate if requested by the purchaser. The standard format of the test result certificate shall be shown in Table A.8 and Table A.9.