British Standard

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Testing aggregates —

Part 117: Method for determination of water-soluble chloride salts

UDC [625.07 + 691.22]:[620.1 + 543.721:543.217.1:546.131]

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Cement Gypsum, Aggregates and Quarry Products Standards Committee (CAB/-) to Technical Committee CAB/2, upon which the following bodies were represented:

Aggregate Concrete Block Association
Association of Consulting Engineers
Association of Consulting Scientists
Association of Lightweight Aggregate Manufacturers
Brick Development Association
British Aggregate Construction Materials Industries
British Ceramic Research Ltd.
British Civil Engineering Test Equipment Manufacturers' Association
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Foreword

This Part of BS 812 has been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee, and is a revision of BS 812-4:1976, which is withdrawn. In the revision of BS 812-2:1975 and BS 812-3:1975 each test, or collection of related tests, is being revised separately and is being issued as a separate Part or Section of BS 812.

BS 812-4:1976 although entitled "Methods for determination of chemical properties" contained only one test and it is this test for the determination of water-soluble chloride salts present in aggregates which has been revised and included in this Part of BS 812. Few changes have been made to the test.

It is intended that other British Standards should call up BS 812 test methods as the basis of compliance. Nevertheless, it is *not* intended that aggregates should be subjected regularly to all the listed tests. Specifications in other standards should call up only relevant test methods.

Advice on the use of simpler qualitative tests is given, for example, when they can be used for a preliminary sorting of aggregates to see whether more precise and expensive testing is justified.

Reference should be made to BS 812-101 for general guidance on testing aggregates, precision of test methods and variance arising from sampling errors.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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1 Scope

This Part of BS 812 describes the method for determination of the water-soluble chloride salt content of aggregate.

NOTE 1 In appendix A a qualitative test is described and appendix B describes a more rapid method of test than the test described in the main text. It is strongly recommended that these tests are used as preliminary checks before resorting to the test described in the main text which may be needed for compliance with a specification. These rapid tests can also be used regularly for quality control.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 812 the definitions given in BS 812-101 and Part BS 812-102 apply.

3 Principle

An aggregate sample is extracted with its own mass of distilled or demineralized water to remove chloride ions. The method of analysis of the extract is based on that of Volhard where an excess of silver nitrate solution is added to the chloride solution and the unreacted portion is back-titrated with a standardized solution of thiocyanate, using ammonium iron (III) sulphate solution as an indicator. The chlorides are expressed in terms of, and reported as, the chloride ion content of the aggregate sample.

4 Sampling

The sample to be used for the test (the laboratory sample) shall be taken in accordance with procedures described in clause **5** of BS 812-102:1984.

Ensure that the sample is representative of the moisture content as well as the solids, by preventing loss of moisture except through evaporation, throughout the sampling procedure and at any subsequent stage up to the point of test.

NOTE This is necessary because where the aggregate to be tested carries surface water the chlorides will normally be dissolved in both this and the absorbed water and hence the chloride content will be affected by migration of water through the bulk materials.

5 Apparatus

5.1 *Apparatus for preparation of test portion and extraction of the chloride* (see clause **8** and **9.1**)

5.1.1 *Well ventilated oven*, capable of being controlled to maintain a temperature of 105 ± 5 °C.

5.1.2 *Balance*, capable of weighing up to 5 kg accurate to 5 g. The balance shall be regularly calibrated as specified in BS 5781-1.

5.1.3 *Test sieve*, 20 mm square hole perforated plate complying with BS 410.

5.1.4 *Pestle and mortar*, or suitable mechanical crusher.

NOTE This is not required for aggregates all passing the 20 mm sieve.

5.1.5 *Two plastics or metal bottles*, wide-mouthed, screw-capped. The bottles shall be 5 L capacity when testing coarse aggregate or 2 L when testing fine aggregates.

5.1.6 *Two filter funnels*, of approximately 100 mm diameter with medium grade[1] filter papers of a diameter appropriate to the size of the funnel.

5.1.7 *Beakers.*

5.2 *Apparatus for the determination of the chloride content of the extracts* (see **9.2**)

5.2.1 *Pipette*, 100 mL size, grade B in accordance with BS 1797.

5.2.2 *Stoppered conical flasks*, 250 mL capacity.

5.2.3 *Graduated measuring cylinder*, capacity 10 mL, grade B in accordance with BS 1797.

5.2.4 *Wash bottle*, containing distilled water or water of equivalent quality.

5.2.5 *Two burettes*, 50 mL size, grade B in accordance with BS 1797.

5.3 *Additional apparatus for standardization of the thiocyanate solution* (see clause **7**)

5.3.1 *Pipette*, 25 mL size, grade B in accordance with BS 1797.

5.4 *Apparatus for the preparation of reagents* (see clause **6**)

5.4.1 *Balance*, capable of weighing up to 100 g accurate to 0.001 g. The balance shall be regularly calibrated as specified in BS 5781-1.

5.4.2 *Two volumetric flasks*, capacity 1 000 mL, grade B in accordance with BS 1797.

5.4.3 *Amber-coloured glass reagent bottle.*

5.4.4 *Plain glass reagent bottles.*

5.4.5 *Graduated measuring cylinder*, capacity 500 mL, grade B in accordance with BS 1797.

5.4.6 *Fume cupboard.*

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[1] Whatman No. 40 is suitable.

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6 Reagents

6.1 *General*

Reagents of recognized analytical quality and only distilled water or water of equivalent quality shall be used.

NOTE Where accurately standardized solutions are required it may be more convenient to obtain them already standardized to be used in accordance with the manufacturer's instructions. However the thiocyanate reagent should be regularly standardized in accordance with **7.5**.

6.2 *Reagents*

6.2.1 *Silver nitrate solution* (c ($AgNO_3$) = 0.100 mol/L), prepared by drying about 20 g of silver nitrate at a temperature of 105 ± 5 °C for 1 h to 2 h, allowing to cool and then weighing 16.987 g of the dried silver nitrate, dissolving in distilled water and diluting to 1 000 mL in a volumetric flask (**5.4.2**). Store the solution in the amber-coloured glass reagent bottle (**5.4.3**) and protect from prolonged exposure to sunlight.

6.2.2 *Thiocyanate solution (*c (NH_4SCN) or c ($KSCN$) = approximately 0.1 mol/L), prepared by dissolving 10.5 g of potassium thiocyanate or 8.5 g of ammonium thiocyanate in distilled water and diluting to 1 000 mL in a volumetric flask.

6.2.3 *Nitric acid (*c (HNO_3) = approximately 6 mol/L), prepared by diluting 100 mL of nitric acid (70 % HNO3, 1.42 g/mL) with distilled water to 250 mL, boiling the diluted acid in a fume cupboard (**5.4.6**) until it is colourless and cooling before storage.

6.2.4 *3,5,5-trimethylhexan-1-ol.*

6.2.5 *Ammonium iron (III) sulphate indicator solution,* prepared by adding 60 g of water to 50 g of ammonium iron (III) sulphate, warming to dissolve, and adding 10 mL nitric acid (**6.2.3**). Allow the solution to cool and store in a glass bottle (**5.4.4**).

7 Standardization of the thiocyanate solution

7.1 Place 25 mL of silver nitrate solution (**6.2.1**) into a flask (**5.2.2**) and add 5 mL of nitric acid (**6.2.3**) and 1 mL of ammonium iron (III) sulphate indicator solution (**6.2.5**).

7.2 Add the thiocyanate solution (**6.2.2**) from a burette (**5.2.5**) until the first permanent colour change occurs, that is from white opalescence to pale brown.

7.3 Note the volume of thiocyanate solution added.

7.4 Calculate the concentration of the thiocyanate solution T, (in mol/L), from the following equation:

$$T = \frac{2.5}{V_1}$$

where

V_1 is the volume of thiocyanate added (in mL).

7.5 Standardize the solution at weekly intervals or before use if the tests are carried out infrequently.

8 Preparation of test portion

8.1 Dry the laboratory sample at a temperature of 105 ± 5 °C to remove surface water so that the sample is free flowing.

8.2 Reduce the laboratory sample by the procedures described in clause **6** of BS 812-102:1984 to an amount not less than the mass given in Table 1 appropriate to the nominal size of aggregate.

Table 1 — Minimum mass of preliminary sub-sample

Nominal maximum size of aggregate	Minimum mass of sub-sample
mm	kg
63	50
50	35
40	15
28 or less	5

8.3 Sieve the sub-sample through a 20 mm sieve (**5.1.3**) and crush any oversize to pass the sieve avoiding excessive grinding. Combine, mix thoroughly and by suitable sampling techniques produce two test portions each of about 2 kg mass for coarse aggregate or two test portions each of about 500 g mass for fine aggregate. Dry the test portions by heating at a temperature of 105 ± 5 °C to achieve a dry mass which is constant to within 0.1 %.

9 Procedure

9.1 Preparation of extracts

9.1.1 For coarse aggregates use the two wide-mouth plastics or metal bottles of 5 L capacity and for fine aggregates use the two bottles of 2 L capacity (**5.1.5**). Weigh each bottle and record its mass to the nearest 5 g.

9.1.2 Transfer the test portion obtained as described in **8.3** to the bottles, weigh bottles and contents and record their mass to the nearest 5 g. Calculate the mass of aggregate in each bottle by difference.

9.1.3 Add to each bottle a mass of distilled or demineralized water equal to the mass of the test portion. Fasten the water-tight bottle closures and mix the contents by occasional shaking or rolling for a minimum of 24 h.

NOTE 1 Continuous mechanical agitation or rolling equipment, which may give a more efficient extraction, can be used.

NOTE 2 With some types of aggregates, e.g. from hot desert countries. the total chloride content may not be extracted in 24 h of soaking in water. For these, an alternative method for determining the total chloride content using a nitric acid extract is given in appendix C.

9.1.4 Filter the extracts through dry, medium grade filter papers (**5.1.6**) until at least 100 mL of clear or slightly opalescent filtrates have been collected in clean dry beakers (**5.1.7**).

9.2 Determination of the chloride content of the extracts

9.2.1 Take 100 mL of the filtered extract by means of the pipette (**5.2.1**) and transfer to the flask (**5.2.2**).

9.2.2 Add 5 mL of nitric acid to the flask followed by silver nitrate solution from a burette (**5.2.5**) until all the chloride has been precipitated and then add excess.

Sufficient silver nitrate is required to ensure a titre of a minimum of 3 mL of thiocyanate solution (see **9.2.6**).

NOTE When aggregates containing sulphide (e.g. slags) are being analysed, boil the solution for 3 min to 5 min in a fume cupboard after adding the nitric acid but before adding silver nitrate. A white precipitate of sulphur may form, but it is not necessary to filter this off. Cool and add the silver nitrate solution (**6.2.1**).

9.2.3 Note the total volume (V_2) of silver nitrate solution added.

9.2.4 Add 2 mL of 3,5,5-trimethylhexan-1-ol (**6.2.4**), stopper, and shake the flask vigorously to coagulate the precipitate.

9.2.5 Carefully loosen the stopper, avoiding loss of solution and rinse the stopper with distilled water, collecting the washings in the solution.

9.2.6 Add 5 mL of the ammonium iron (III) sulphate indicator solution followed by the standardized thiocyanate solution from a burette until the first permanent colour change occurs, that is from white opalescence to pale brown and the solution has the same depth of colour as was used for the standardization described in clause **7**.

9.2.7 Note the volume (V_3) of thiocyanate solution added.

9.2.8 Repeat the procedure with the extract from the second test portion.

10 Calculation and expression of results

10.1 Calculate the concentration of chloride ions, C, present in the extracts from test portions with a water: aggregate ratio of 1 : 1, as a percentage by mass of dry aggregate from the equation:

$$C = 0.003546\ (V_2 - 10TV_3)$$

where

V_2 is the volume of silver nitrate solution added (in mL);

V_3 is the volume of standardized thiocyanate solution added (in mL);

T is the concentration of the standardized thiocyanate solution (in mol/L).

10.2 Report the average of the two determinations of the chloride ion content to the nearest 0.01 % and the individual test results to more significant figures when specially requested. If the individual results differ by more than 0.1 % for values of the average chloride ion content up to 0.15 % repeat the test starting with new test portions.

For values of the average chloride ion content above 0.15 % repeat the test if the difference between individual results is above 0.2 %.

11 Precision

11.1 A precision experiment was carried out on five aggregates by 10 laboratories. Details of the experiment and the precision data are given in appendix D.

11.2 Uses of precision data are described in clause **5** of BS 812-101:1984.

12 Test report

The test report shall affirm that the water-soluble chloride content was determined in accordance with this Part of BS 812 and state whether or not a certificate of sampling is available. If available, a copy of the certificate of sampling shall be provided. The test report shall include the following information:

a) sample identification;

b) the water-soluble chloride ion content, expressed as a percentage by mass of the dry aggregate.

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Appendix A Qualitative test for the presence of chloride ions

A.1 Apparatus and reagents

A.1.1 *Plastics bucket,* capacity 10 L.

A.1.2 *Beaker or plastics drinking cup.*

A.1.3 *Silver nitrate solution* (*c* ($AgNO_3$) = 0.1 mol/L), as described in **6.2.1**.

A.1.4 *Nitric acid*(*c* (HNO_3) = approximately 6 mol/L), as described in **6.2.3**.

A.1.5 *Filter paper*, medium grade[2)].

A.2 Procedure

A.2.1 Place approximately 5 kg coarse aggregate or 1 kg fine aggregate in the bucket (**A.1.1**) and add an equivalent mass of distilled or deionized water. Agitate the contents intermittently for 4 h, allow to settle and then pour some of the supernatant solution into the beaker or plastics drinking cup (**A.1.2**).

A.2.2 Filter, if necessary, through the filter paper (**A.1.5**) until about 25 mL of clear solution has been collected. Acidify with the nitric acid (**A.1.4**), add about five drops of the silver nitrate solution (**A.1.3**) and allow to stand for 10 min.

NOTE If an aqueous extract for sulphate content obtained by the method described in clause **5** of BS 812-118:1988 is available the procedure described in **A.2.1** may be omitted and 25 mL of the extract may be tested for the presence of chlorides as described in **A.2.2**.

A.3 Results

If no turbidity is apparent after 10 min the chloride ion content of the aggregate is negligible.

Appendix B Field tests for determination of chloride ions

B.1 Apparatus and reagents

B.1.1 *Plastics bucket*, capacity 10 L.

B.1.2 *Water*, preferably free from chloride ions. If this is not available, it is necessary to measure the chloride content of the water by making a determination of the water alone by the procedure described in **9.2**.

B.1.3 *Beakers or plastics drinking cups*, of any preferred volume. 100 mL to 250 mL is the recommended range.

B.1.4 *Filter paper*, medium grade[2)].

B.1.5 *Balance*, capable of weighing up to 10 kg accurate to 50 g.

B.1.6 *Chloride test kit or strips.*

NOTE Two commercial materials which have been found to be suitable are:

a) Quantab test strips. Type 1175. (Miles Laboratories, Stoke Poges, Bucks); or

b) Hach tester, Chloride 7-P. (Camlab Ltd, Cambridge.)

B.2 Procedure

B.2.1 *Extraction of chloride*

Weigh 2 kg of fine aggregate or 4 kg of coarse or mixed aggregate directly into a clean pre-weighed bucket. Weigh 2 kg of water into the bucket. Stir the materials in the bucket intermittently for at least 15 min for fine aggregate or 10 h for coarse or mixed aggregate.

NOTE 1 One hour extraction can be used for the coarse or mixed aggregate provided the relationship between chloride extracted at 1 h and 10 h is known and can be allowed for.

NOTE 2 These shorter extraction times may result in lower chloride contents than the standard test.

When the required extraction time is complete, allow the aggregate to settle and remove some of the supernatant extraction liquid into a beaker or cup.

B.2.2 *Measurement of chloride in the extract*

B.2.2.1 *Using the Quantab test strip*. Fold a filter paper (**B.1.4**) into a cone and place it apex down in the test liquid. Place a test strip in the clear filtered solution appearing in the bottom of the filter paper cone. Follow the manufacturer's instructions at all times. When the operation of the strip is complete read off the scale the height of the white column. Refer this reading to the calibration chart supplied with the test strip, ensuring that the chart bears the same reference number as the bottle of the test strips, and record the concentration of chloride as mg Cl^-/L.

B.2.2.2 *Using the Hach tester*. Following the manufacturers' instructions, fill the plastics measuring tube with the test liquid and pour the contents into the mixing bottle. If the test liquid is very turbid, it may be helpful to filter some of the liquid before filling the measuring tube.

Pour the contents of one of the indicator "pillows" into the mixing bottle, when the solution will turn yellow. Add the silver nitrate from the dropping bottle, drop by drop, swirling the solution after each drop until the colour changes to reddish-brown. Record the number of drops required to cause this change in colour. Calculate the concentration of chloride in the test liquid, as mg Cl^-/L, by multiplying the number of drops by 30.

NOTE The test kit instructs the user to multiply the number of drops by 50 to give the concentration as mg NaCl/L.

[2)] Whatman No. 40 has been found suitable.

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B.2.3 *Calculation*

B.2.3.1 *Correction.* If necessary, correct the determined value for the test liquid by subtracting the concentration of chloride (mg Cl^-/L) in the water alone, to give the required corrected value for the concentration of chloride (mg Cl^-/L) in extract.

B.2.3.2 *Coarse or mixed aggregate* (i.e. 4 kg sample taken)

$$\%\ \text{Cl ion (as received basis)} = \frac{\text{mg Cl}^-\text{/L in extract}}{20\ 000}$$

B.2.3.3 *Fine aggregate* (i.e. 2 kg sample taken)

$$\%\ \text{Cl ion (as received basis)} = \frac{\text{mg Cl}^-\text{/L in extract}}{10\ 000}$$

NOTE If the moisture content of the aggregate is known, the results can be corrected to a dry mass basis by multiplying by a correction factor which assumes that the moisture in the aggregate dilutes the extract. If the moisture content is M, as a percentage by mass of the aggregate, then the correction factors are:

a) $\frac{100 + 2M}{100 - M}$ for coarse aggregate; and

b) $\frac{100 + M}{100 - M}$ for fine aggregate

Appendix C Test method for determination of chloride content of aggregates using a nitric acid extract, for aggregate containing chloride not extracted by water

C.1 Introduction

C.1.1 The test for water-soluble chlorides described in this Part of BS 812 is suitable for aggregates where the chloride content derives directly from contact with, or immersion in, saline water, e.g. typical UK sea-dredged aggregates. With some aggregates, e.g. from some desert areas, testing a nitric acid extract of the finely ground aggregate may show significantly higher levels of chloride than the water extraction method described in this Part of BS 812.

C.1.2 This may cause difficulties reconciling the results from aggregate testing with the results obtained from analysing concrete containing the aggregate by the method described in BS 1881-6[3]. In such cases it is recommended that the following procedure using nitric acid to determine the chloride content is used.

C.2 Apparatus and reagents

C.2.1 *Test sieves*, 20 mm, 5 mm, 1 mm and 150 µm complying with BS 410.

C.2.2 *Balance*, capable of weighing up to 100 g accurate to 0.001 g. The balance shall be regularly calibrated as specified in BS 5781-1.

C.2.3 *Beaker*, capacity 500 mL.

C.2.4 *Filter funnel*, of approximately 100 mm diameter with coarse filter papers[4] of a diameter appropriate to the size of the funnel.

C.2.5 *Stoppered conical flask*, capacity 250 mL.

C.2.6 *Burette*, 50 mL size in accordance with BS 1797.

C.2.7 *Reagents*, as described in clause **6**.

C.3 Method

Grind the aggregate sample to provide a test portion all passing a 150 µm sieve, by the procedure described in **6.3** of BS 812-118:1988.

Weigh 5 ± 0.005 g of this test sample, place into a 500 mL beaker, disperse with 50 mL distilled water and add 15 mL of nitric acid. Heat to near boiling and keep warm for 10 min to 15 min. Filter through a coarse filter paper [5] and wash with hot water collecting the filtrate and washings in a conical flask. Cool and add silver nitrate solution from a burette until all the chloride has been precipitated and then add excess (see **9.2.2**). Continue as described in **9.2.3** to **9.2.7**.

C.4 Calculation and expression of results

C.4.1 The chloride content of the aggregate C, as a percentage by mass of dry aggregate, is given by:

$$C = 0.07092\ (V_2 - 10TV_3)$$

where V_2, V_3 and T have the same meanings as described in **10.1**.

C.4.2 Express the results as in **10.2**.

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[3] BS 1881-6: 1971 is under revision and will be replaced by BS 1881-124.

[4] Whatman No. 541 has been found to be suitable.

[5] Whatman No. 541 has been found to be suitable.

Appendix D Details of experiment for determining precision of test for water-soluble chloride content of aggregates

D.1 The precision data given in Table 2 were determined from an experiment conducted in 1984/5 involving 10 laboratories. The experiment was designed, and the data analysed following the principles set out in BS 5497-1:1979.

D.2 The materials used were approximately 200 kg lots. With each material 20 laboratory samples of 5 kg to 10 kg were prepared and two sent to each laboratory. The laboratories divided each sample into four test portions: one was used for the chloride determination described in this Part of BS 812, one for the water-soluble sulphate determination and two for the total sulphate determination described in BS 812-118.

Table 2 — Precision data, water-soluble chloride determination

Aggregate	n	$\bar{X}$	r_1	R_1	R_2	$\sqrt{V_{r_1}}$	$\sqrt{V_L}$	$\sqrt{V_S}$
14 mm light grey limestone (D)	8	0.0005	0.0005	0.0013	0.0015	0.00018	0.00043	0.00025
28 mm colliery shale (C)	8	0.0025	0.0009	0.0013	0.0016	0.00031	0.00034	0.00035
14 mm sea-dredged gravel and sand (B)	10	0.033	0.003	0.007	0.009	0.0012	0.0023	0.0019
5 mm medium grey limestone crushed sand/shell mix (E)	10	0.046	0.003	0.010	0.011	0.0011	0.0034	0.0020
14 mm blastfurnace slag (A)	7	0.058	0.002	0.084	0.086	0.0006	0.030	0.006

NOTE n is the number of laboratories whose results were included in the calculation of the precision data. Definitions of $\bar{x}$, r_1, R_1, R_2, V_{r_1}, V_L and V_S are given in **5.2** of BS 812-101:1984.

Table 3 — Results excluded from calculation of precision data in Table 2

Laboratory	Aggregate	Laboratory average	Between-sample range	Between-test-portion range	
				Laboratory sample 1	Laboratory sample 2
L1	C	Outlier			
L1	D	Outlier			
L3	C			Outlier	
L3	D			Outlier	
L7	A			Outlier	Outlier
L9	A		Excluded (spoiled samples)		
L10	A			Outlier	
L10	B				Outlier

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D.3 The tests for outliers given in BS 5497-1:1979 were applied to the data. A summary of the results shown to be outliers by these tests is given in Table 3.

D.4 Because of the small quantities of the aggregates obtained for this experiment, the estimates of V_s measure only that variability which arises when dividing 100 kg to 200 kg of material into 5 kg to 10 kg laboratory samples. Likewise, the contribution of sample reduction variability to the estimates of V_{r1} consists only of the variability which arises when dividing 5 kg to 10 kg laboratory samples into two test portions. In practice one might expect V_s and perhaps V_{r1} to be larger than found in this experiment.

D.5 The materials used were those also used for the precision experiment in BS 812-118 (sulphate test) and did not give as wide a range of chloride content as can be found in practice. Additional work is necessary to find the precision.

D.6 The precision data from Table 2 for four of the materials (limestone, shale, gravel and sand) fit the following relationships:

$$r_1 = 0.0007 + 0.060\ \bar{x}$$

$$R_1 = 0.0010 + 0.191\ \bar{x}$$

$$R_2 = 0.0013 + 0.224\ \bar{x}$$

These may be used to interpolate values of r_1, R_1 and R_2 for levels of chloride ion ($\bar{x}$ %) between those which appear in Table 2. The blastfurnace slag gave higher values of R_1 and R_2 than those predicted by the relationships. This is attributed to the presence of sulphides. This difficulty is overcome by following the procedure described in the note to **9.2.2**.

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Publications referred to

BS 410, *Specification for test sieves.*

BS 812, Testing aggregates.

BS 812-2, *Methods for determination of physical properties*[6].

BS 812-3, *Methods for determination of mechanical properties*[6].

BS 812-101, *Guide to sampling and testing aggregates.*

BS 812-102, *Methods of sampling.*

BS 812-118, *Methods for determination of sulphate content.*

BS 1797, *Tables for use in the calibration of volumetric glassware.*

BS 1881, *Testing concrete.*

BS 1881-6, *Analysis of hardened concrete*[7].

BS 5497, *Precision of test methods.*

BS 5497-1, *Guide for the determination of repeatability and reproducibility for a standard test method by interlaboratory tests.*

BS 5781, *Measurement and calibration systems.*

BS 5781-1, *Specification for system requirements.*

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[6] Referred to in the foreword only. Under revision.

[7] Under revision. To be replaced by BS 1881-124.

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