British Standard

“BRITISH STANDARD

BS 5212-3: 1990

Cold applied joint sealant systems for concrete pavements —

Part 3: Methods of test

UDC 625.848.083:620.1

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Road Engineering Standards Policy Committee (RDB/-) to Technical Committee RDB/10, upon which the following bodies were represented:

Association of Consulting Scientists
British Adhesives and Sealants Association
British Airports Authority
British Tar Industry Association
County Surveyors' Society
Department of the Environment (Property Services Agency)
Department of Transport
Department of Transport (Transport and Road Research Laboratory)
Institution of Civil Engineers
Institution of Highways and Transportation
Coopted members

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Contents

Foreword

This Part of BS 5212 has been prepared under the direction of the Road Engineering Standards Policy Committee. BS 5212:1975 has been revised in three Parts, namely:

— *Part 1: Specification for joint sealants;*

— *Part 2: Code of practice for the application and use of joint sealants;*

— *Part 3: Methods of test.*

BS 5212-1, BS 5212-2 and BS 5212-3 supersede BS 5212:1975 which is withdrawn.

The tests have been, as far as possible, related to practical conditions, and for this reason concrete test blocks are specified for the extension test rather than mortar blocks. Because of the many variables and the limited data available on the effects of adhesion of using different aggregates, a single coarse aggregate is specified for the blocks.

Exposure to excessive heat (e.g. jet blast) can have deleterious effects on all sealants but knowledge of this effect is very limited. Because of this the test method included in this standard is indicative of a minimum performance level only.

Hot applied joint sealants are specified in BS 2499.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately experienced people.

This British Standard calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Information on precision and traceability is given in Appendix B.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 16, 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.

1 Scope

This Part of BS 5212 describes methods of test for cold applied joint sealants for use in joints in roads, airfields and other exposed concrete pavements.

NOTE 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 5212, the definitions given in BS 5212-1 apply.

3 Determination of minimum application life

3.1 Principle

The ability of cold hand applied sealants to flow is determined after the mixed sample has been stored for a period at least as long as the minimum application life.

3.2 Sealant components

The test shall be carried out on base and curing components supplied in closed containers capable of being stored at 23 ± 2 °C.

3.3 Apparatus

3.3.1 *A laboratory balance,* capable of weighing up to 400 g of sample to an accuracy of 0.1 g.

3.3.2 *An environment,* capable of maintaining the samples and apparatus at 23 ± 2 °C and 50 ± 5 % r.h.

3.3.3 *A flat bladed mixing spatula*

3.3.4 *A mixing vessel,* such as a cylindrical container approximately 75 mm in diameter and 70 mm in height.

3.4 Conditioning

Store supplies of base component and curing component (approximately 250 mL total) in closed containers, together with the mixing spatula and mixing vessel at 23 ± 2 °C for at least 16 h.

3.5 Mixing of hand applied sealant

Weigh out appropriate quantities of base component and curing component in a ratio by mass specified by the manufacturer to an accuracy of 1 % into the mixing vessel to give a batch volume of approximately 250 mL of material, and mix the two components for 10 min using the spatula. Ensure that the final mix is completely homogeneous and take particular care during the process to avoid or eliminate all air bubbles.

3.6 Procedure

3.6.1 Store the mixed sample uncovered at 23 ± 2 °C and 50 ± 5 % r.h.

3.6.2 Not less than 0.5 h after completion of mixing determine the ability to flow of the sealant in accordance with the method described in **5.3**, but with the test carried out at a temperature of 23 ± 2 °C.

3.7 Expression of results

Record whether the application life is greater than 0.5 h.

3.8 Test report

A test report shall be completed in accordance with clause **12**.

4 Determination of tack-free condition

4.1 Principle

The tack-free condition of a prepared sample is determined using polyethylene film.

4.2 Sealant components

The test shall be carried out on base and curing components supplied in closed containers capable of being stored at 23 ± 2 °C.

4.3 Apparatus

4.3.1 *A laboratory balance,* capable of weighing up to 400 g of sample to an accuracy of 0.1 g.

4.3.2 *An environment,* capable of maintaining the samples and apparatus at 23 ± 2 °C and 50 ± 5 % r.h.

4.3.3 *A flat bladed mixing spatula*

4.3.4 *A mixing vessel,* such as a cylindrical container approximately 75 mm in diameter and 70 mm in height.

4.3.5 *A metal or polyethylene frame,* measuring internally 125 ± 1 mm × 38 ± 1 mm × 6 ± 0.5 mm.

4.3.6 *A metal base plate,* measuring 150 mm × 75 mm × 1 ± 0.5 mm thick.

4.3.7 *Polyethylene film,* measuring 150 mm × 25 mm × 100 ± 10 μm thick.

4.3.8 *A metal plate,* measuring approximately 40 mm × 30 mm and weighing 30.5 ± 0.5 g.

4.4 Conditioning

Store supplies of base component and curing component (approximately 100 mL total) in closed containers for at least 16 h at 23 ± 2 °C.

4.5 Mixing

4.5.1 *Mixing of hand applied sealant*

Weigh out appropriate quantities of base component and curing component in a ratio by mass specified by the manufacturer to an accuracy of 1 % into the mixing vessel and mix the two components for 10 min using the spatula. Ensure that the final mix is completely homogeneous and take particular care during the process to avoid or eliminate all air bubbles.

4.5.2 *Mixing of machine applied sealant*

Prepare a sample from conditioned base and curing components in accordance with and in the equipment specified in the manufacturer's instructions.

4.6 Procedure

4.6.1 Pour or extrude the mixed sealant into the frame mounted on its base plate, and strike off level with a spatula.

4.6.2 Transfer the assembly into the controlled environment at 23 ± 2 °C and leave it there for 3 ± 0.1 h if a machine applied sealant or for 16 ± 0.1 h if a hand applied sealant.

4.6.3 At the end of this time place the polyethylene film on the upper surface of the specimen and immediately cover it with the metal plate.

4.6.4 Remove the metal plate after 30 ± 3 s, then peel off the polyethylene film uniformly and progressively at right angles to the surface of the sealant within 3 s.

4.7 Expression of results

Examine the polyethylene film for signs of adhesion of the sealant and report accordingly.

NOTE Staining or similar markings on the polyethylene film are not relevant.

Report the tack-free time of the sealant.

4.8 Test report

A test report shall be completed in accordance with clause **12**.

5 Determination of rheological properties

5.1 Principle

The flow characteristics of cold applied sealant are determined using moulds in the flat and inclined positions.

5.2 Sealant component

The test shall be carried out on base and curing components supplied in closed containers capable of being stored at 5 ± 2 °C.

5.3 Determination of ability to flow using a horizontal mould at 5 °C

5.3.1 *Apparatus*

5.3.1.1 *A laboratory balance,* capable of weighing up to 400 g of sample to an accuracy of 0.1 g.

5.3.1.2 *An environment,* capable of maintaining the samples and apparatus at 5 ± 2 °C.

5.3.1.3 *A flat bladed mixing spatula*

5.3.1.4 *A mixing vessel,* such as a cylindrical container approximately 75 mm in diameter and 70 mm in height.

5.3.1.5 *A mould,* consisting of a channel having both ends closed and inside dimensions of 20 ± 0.2 mm × 25 ± 1 mm deep × 300 ± 1 mm long. The channel shall be made of not less than 3 mm thick aluminium, steel or plastics. Means for positioning the base of the mould in a horizontal plane, using a spirit level, are also required.

5.3.1.6 *A penetrometer,* complying with BS 2000-49 and fitted with a blunt needle or rounded rod, to be used for measuring differences in depth below a given datum.

NOTE Other means of measuring this difference in depth are acceptable as long as they are of equal accuracy.

5.3.2 *Conditioning*

5.3.2.1 Clean the mould with a detergent solution, followed by a suitable non-residue solvent.

5.3.2.2 Condition the mould positioned in the horizontal plane, mixing vessel, spatula, and supplies of base and curing components (approximately 250 mL total) in closed containers in the enclosure at 5 ± 2 °C for at least 16 h.

5.3.3 *Mixing and application of hand and machine[1)] applied sealants*

Prepare a mix of sealant as described in **4.5** and immediately pour the sealant into the mould in one continuous pour within 30 s along the axis of the mould at a height not less than 70 mm and not greater than 100 mm. Allow the material to flow freely to within 5 mm of the top of the mould.

Transfer the mould immediately after filling, without vibration, to the refrigerated environment at 5 ± 2 °C and position it in a horizontal plane.

5.3.4 *Procedure*

5.3.4.1 After curing the specimen for 48 h at 5 ± 2 °C transfer the mould to the platform of the levelled penetrometer.

5.3.4.2 Set the probe at a convenient height above the sealant in the channel and set the dial to zero.

[1)] Since machines usually preheat the sealant, machine applied grades should be mixed by hand for this test procedure.

5.3.4.3 Measure the depth of the sealant surface below the zero datum midway between the sides of the channel to an accuracy of ± 0.2 mm at the centre point of the mould and at points 25, 50, 75, 100 and 125 mm on either side of the centre point.

5.3.4.4 Subtract the highest reading from the lowest reading and record this difference.

5.3.5 ***Expression of results***

Express the result to the nearest 0.5 mm.

5.3.6 ***Test report***

A test report shall be completed in accordance with clause **12**.

5.4 Determination of resistance to flow using a mould inclined at 2.5 % slope at 23 ± 2 °C

5.4.1 ***Apparatus***

5.4.1.1 *A laboratory balance,* capable of weighing up to 400 g of sample to an accuracy of 0.1 g.

5.4.1.2 *An environment,* capable of maintaining the samples and apparatus at 23 ± 2 °C.

5.4.1.3 *A flat bladed mixing spatula*

5.4.1.4 *A mixing vessel,* such as a cylindrical container approximately 75 mm in diameter and 70 mm in height.

5.4.1.5 *A mould,* consisting of a channel as described in **5.3.1.5** but with inside dimensions of 20 ± 0.2 mm wide × 20 ± 0.2 mm deep × 300 ± 1 mm long. Means for positioning the mould so that the longitudinal axis of the channel is at a slope of 2.5 ± 0.25 % to the horizontal, and the transverse axis is horizontal, are also required.

5.4.1.6 *A penetrometer,* as specified in **5.3.1.6**.

5.4.2 ***Conditioning***

5.4.2.1 Clean the mould as described in **5.3.2.1**.

5.4.2.2 Condition the mould, mixing vessel, spatula, and supplies of base and curing component (approximately 250 mL total) in closed containers at 23 ± 2 °C for at least 16 h.

5.4.3 ***Mixing and application***

5.4.3.1 *Mixing and application of hand applied sealants*

Mix the sealants as described in **4.5.1**.

Position the mould conditioned to 23 ± 2 °C horizontally on any suitable surface.

Apply the mixed material to the mould as described in **5.3.3**, but in this case overfill the mould and strike off the surplus material level to the mould edges using a spatula or knife.

5.4.3.2 *Mixing and application of machine applied sealants*

Mix the sealant as described in **4.5.2**. Position the mould, conditioned to 23 ± 2 °C, horizontally on a suitable surface. Overfill the mould using a single pass of the nozzle at a speed which will not envelop the nozzle in the mould with sealant.

5.4.4 ***Procedure***

5.4.4.1 Within 60 s after filling, and with a minimum of vibration, reposition the mould in the environment at 23 ± 2 °C at the 2.5 % slope.

5.4.4.2 Leave to cure for 24 h at 23 ± 2 °C and 50 ± 5 % r.h.

5.4.5 ***Measurement***

5.4.5.1 Measure as described in **5.3.4** the depth below an arbitrary datum at two points 20 mm from either end of the mould, each measurement midway between the channel sides.

5.4.5.2 Record the difference between these two measurements.

5.4.6 ***Expression of results***

Express the result to the nearest 0.5 mm.

5.4.7 ***Test report***

A test report shall be completed in accordance with clause **12**.

6 Determination of resistance to plastic flow

6.1 Principle

The resistance to plastic flow of the cured sealant is determined using a mould inclined at an angle of 75° at 60 ± 2.5 °C.

6.2 Sealant components

The test shall be carried out on base and curing components supplied in closed containers capable of being stored at 23 ± 2 °C.

6.3 Apparatus

6.3.1 *A laboratory balance,* capable of weighing up to 400 g of sample to an accuracy of 0.1 g.

6.3.2 *An environment,* capable of maintaining the sample and apparatus at 23 ± 2 °C.

6.3.3 *An oven,* complying with BS 2648 capable of maintaining the apparatus at 60 ± 2 °C.

6.3.4 *A flat bladed mixing spatula*

6.3.5 *A mixing vessel,* such as a cylindrical container approximately 75 mm in diameter and 70 mm in height.

6.3.6 *A thin bladed knife*

6.3.7 *A metal or polyethylene frame,* with internal dimensions 40 ± 1 mm wide × 60 ± 1 mm long × 3 ± 0.1 mm deep.

6.3.8 *An aluminium plate,* not less than 60 mm wide × 80 mm long × 1.5 mm thick.

6.4 Conditioning

6.4.1 Store supplies of base component and curing component (approximately 250 mL total) in closed containers, together with mixing spatula and mixing vessel, metal plate and frame previously cleaned as described in **5.3.2.1** at 23 ± 2 °C for at least 16 h.

6.5 Mixing

6.5.1 ***Mixing of hand applied sealants***

Mix the sealant as described in **4.5.1**.

6.5.2 ***Mixing of machine applied sealant***

Mix the sealant as described in **4.5.2**.

6.6 Procedure

6.6.1 Place the metal or polyethylene frame on the aluminium plate and fill the frame with an excess of material.

6.6.2 Immediately trim the specimen flush with the face of the frame with a knife or spatula.

6.6.3 After 24 h curing at 23 ± 2 °C separate the sealant with a thin knife blade from the inside of the frame.

6.6.4 Remove the frame and mark the existing profile of the sealant on the metal plate. Place the metal plate containing the sample, mounted so that the longitudinal axis of the specimen is at an angle of 75 ± 2° with the horizontal and the transverse axis is horizontal, in an environment maintained at 60 ± 2.5 °C for 5 h ± 3 min.

6.7 Measurement

Measure to the nearest 0.5 mm the maximum change in the length of the specimen or movement of the lower transverse edge of the specimen after completion of the 5 h test.

6.8 Expression of results

Express the results to the nearest 0.5 mm.

6.9 Test report

A test report shall be completed in accordance with clause **12**.

7 Determination of penetration and recovery

7.1 Principle

The penetration and recovery of cold applied sealant are determined using a ball penetration tool.

7.2 Sealant components

The test shall be carried out on base and curing components supplied in closed containers capable of being stored at 23 ± 2 °C.

7.3 Apparatus

7.3.1 *A laboratory balance,* capable of weighing up to 400 g of sample to an accuracy of 0.1 g.

7.3.2 *An environment,* capable of maintaining the samples and apparatus at 23 ± 2 °C and 50 ± 5 % r.h.

7.3.3 *A flat bladed mixing spatula*

7.3.4 *A mixing vessel,* such as a cylindrical container approximately 75 mm in diameter and 70 mm in height.

7.3.5 *Two metal containers,* approximately 55 mm diameter and 35 mm deep.

7.3.6 *A penetrometer,* complying with BS 2000-49, in which the ball penetration tool shown in Figure 1 has been substituted for the needle.

7.4 Conditioning

Store supplies of base and curing component (approximately 250 mL total) in closed containers, together with mixing spatula and mixing vessel at 23 ± 2 °C for at least 16 h.

7.5 Mixing

7.5.1 ***Mixing of hand applied sealant***

Mix the sealant as described in **4.5.1**.

7.5.2 ***Mixing of machine applied sealant***

Mix the sealant as described in **4.5.2**.

7.6 Procedure

7.6.1 ***Preparation of the test specimens***

Clean the two metal containers as described in **5.3.2.1**. Extrude the mixed sealant into the two containers from the bottom up or pour it in as applicable. Overfill the containers and immediately strike off the excess with the spatula.

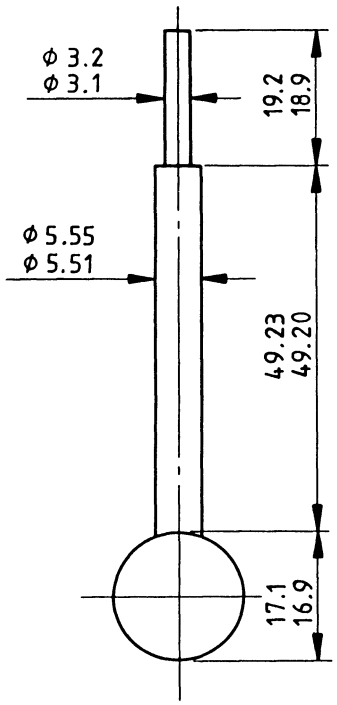
7.6.2 ***Curing of test specimens***

Cure hand applied sealants for 7 days and machine applied sealants for 48 h at 23 ± 2 °C and 50 ± 5 % r.h.

7.6.3 ***Determination of penetration at 23 ± 2 °C***

NOTE The surface of the specimen may be lightly dusted with talc with the excess immediately removed by blowing, or the ball of the penetration tool may be lightly coated with glycerine.

7.6.3.1 Position a light so that initial contact of the ball with the surface of the specimen can be observed readily.



All dimensions are in millimetres.

Material: Steel
Total mass of tool and standard penetrometer plunger 75 ± 0.1 g.

Figure 1 — Ball penetration tool

7.6.3.2 Place the ball of the penetration tool in contact with the surface of the specimen and set the indicating dial at zero.

7.6.3.3 Release the clutch for a period of 5 ± 0.1 s, thus allowing the ball to penetrate the specimen. Record the reading in millimetres to ± 0.1 mm as the initial ball penetration (*P*).

7.6.3.4 Without returning the dial pointer to zero, release the clutch and press the ball penetration tool down an additional 5 mm (i.e. to a reading of *P* + 5 mm) at a uniform rate in 10 s.

7.6.3.5 Re-engage the clutch thereby holding the ball in this position for a further 5 s and during this time push up the upper shaft of the penetrometer until the dial reads zero.

7.6.3.6 Release the clutch and with the ball still supported by the specimen, allow the specimen to recover for 20 s, and then re-engage the clutch.

7.6.3.7 Push down the upper shaft of the penetrometer until it is in contact with the plunger and measure and record in millimetres to ± 0.1 mm the final penetration (*F*).

7.6.3.8 Carry out the procedure at three points equally spaced and not less than 10 mm from each other and from the container rim.

7.7 Calculation and expression of results

Calculate the percentage recovery *R* from the equation:

$$R = (P + 5 - F) \times \frac{100}{5}$$

where:

P is the initial ball penetration (in mm);

F is the final penetration (in mm).

Record the recovery as the average of the three determinations and express it to the nearest 1 %.

Record the initial ball penetration, *P*, and the final penetration, *F*, to the nearest 0.1 mm.

7.8 Test report

A test report shall be completed in accordance with clause **12**.

8 Determination of adhesion and cohesion in tension and compression

8.1 Principle

The adhesive and cohesive properties of cold applied sealants when subjected to alternate cycles of tension and compression are assessed and the forces involved are measured.

8.2 Sealant components

The test shall be carried out on base and curing components supplied in closed containers capable of being stored at 23 ± 2 °C.

8.3 Apparatus

8.3.1 *A laboratory balance,* capable of weighing up to 400 g of sample to an accuracy of 0.1 g.

8.3.2 *An environment,* capable of maintaining the samples and apparatus at 23 ± 2 °C.

8.3.3 *Extension apparatus,* such that the specimens can be inserted into holding clamps conveniently and without disturbing the specimens before, during or after removal. The performance of the test machine shall not be significantly affected by the number of specimens or the failure of one or more specimens.

NOTE The apparatus specified is capable of testing more than one specimen at a time. Other apparatus may be used to test specimens singly provided that the apparatus requirements are complied with.

The extension apparatus shall:

a) be motor driven through positive drives without slip or significant backlash so that cycles of extension and compression are carried out steadily and automatically

b) be capable of moving the blocks smoothly and linearly, so that their alignment is maintained at all times and the specimens are not subjected to torsion, bending, shock or significant vibration;

c) be capable of exerting on each specimen an appropriate tensile force and of extending the specimen uniformly under the specified conditions of – 20 °C to 50 ± 0.25 mm at a rate of 6 ± 0.25 mm/h;

d) be capable of exerting on each specimen an appropriate compressive force and of compressing each specimen uniformly under the specified conditions of + 15 °C to 12.5 ± 0.25 mm at a rate of 6 ± 0.25 mm/h;

e) be capable of measuring with an accuracy of ± 1 N up to 100 N and with an accuracy of ± 1 % thereafter the maximum tensile force applied to each specimen.

8.3.4 *A flat bladed mixing spatula*

8.3.5 *A mixing vessel,* such as a cylindrical container approximately 75 mm in diameter and 70 mm in height.

8.3.6 *Concrete substrate test blocks,* prepared in accordance with Appendix A.

8.3.7 *Two spacers,* each measuring 18.7 ± 0.1 mm × 25 ± 0.1 mm × 50 ± 0.5 mm, of metal or other material with non-adherent and non-reactive surfaces.

8.3.8 *A cooling chamber,* capable of reducing the temperature of a full complement of specimens to – 20 °C in not more than 4 h and then holding the specimens at – 20 ± 1 °C for at least 36 h.

8.3.9 *A maximum/minimum temperature indicator,* capable of measuring temperatures in the range – 20 °C to + 15 °C to an accuracy of ± 1 °C.

NOTE An electronic device of equal sensitivity may be used.

8.4 Preparation of sealant specimens

8.4.1 *Priming the test blocks at 23 ± 2 °C*

Apply the primer to the sawn test faces of the concrete blocks in accordance with the manufacturer's instructions. Otherwise using a clean, stiff brush, brush the primer on well and then brush off the excess. In every case use clean equipment taking care to avoid contamination with surface active agents, grease, etc. and ensure that the primer gives a continuous coating all over the face and extends 3 mm over all edges.

8.4.2 *Drying the test blocks*

Treat the primed blocks in accordance with the manufacturer's instructions; otherwise, store in a dust-free atmosphere at room temperature until dry. Do not place the primed blocks in an enclosed space which would hinder the drying of the primer.

8.4.3 *Assembly*

Prepare the sealant assemblies based on concrete substrate and spacers as shown in Figure 2.

8.4.4 *Conditioning*

Store supplies of base and curing component (approximately 150 mL total), in closed containers, together with mixing spatula and mixing vessel at 23 ± 2 °C for at least 16 h.

8.4.5 *Mixing of hand applied sealant*

Mix the sealant as described in **4.5.1**.

8.4.6 *Mixing of machine applied sealant*

Mix the sealant as described in **4.5.2**.

8.4.7 *Pouring*

Allow the assembly to stand at 23 ± 2 °C for 0.5 h after which pour the mixed sealant, in one operation, into the space between the blocks in sufficient quantity to fill the joint completely.

8.4.8 *Curing*

Cure the assembly for 7 days at 23 ± 2 °C and 50 ± 5 % relative humidity. After 7 days remove the spacers.

8.4.9 *Water immersion*

Immerse the specimen in water at 23 ± 2 °C for 7 days without distortion, after which allow to dry in air for 1 h with the 50 mm joint dimension vertical [see Figure 2(b)].

8.5 Procedure

8.5.1 Only the specimens, clamps, etc. shall be subjected to low temperature; motors, drives, etc. shall be situated outside the cold chamber.

8.5.2 Fit the maximum/minimum temperature indicator with its bulb or sensor as nearly as practicable at the point where the temperature fluctuation is known to be greatest or, failing such information, in the centre of the horizontal plane through the top of the highest specimen.

8.5.3 Measure the depth of each sample [*d* in Figure 2(a)] to the nearest 0.1 mm. Reject all samples outside the range 11.5 mm to 13.5 mm.

8.5.4 Subject the specimens to three cycles of compression at 15 ± 1 °C and extension at – 20 ± 1 °C in accordance with Table 1.

8.5.5 Record the maximum tensile forces at the extension stage of each of the three cycles and scale these to represent the forces appropriate to a sample of 12.5 mm depth.

NOTE The compression forces generated need not be recorded.

8.5.6 At the end of the compression and extension cycles, immediately examine the specimen for failure in adhesion and cohesion.

NOTE Typical failures are illustrated in Figure 3.

Table 1 — Compression and extension cycles

Elapsed time		Motion[a]	Temperature
Start of test	h *0*	*Test pieces in position*	°C *Laboratory temperature*
	4		condition to + 15
	2	compression to 12.5 mm	+ 15
	8	hold	+ 15
	2	return to neutral (25 mm)	+ 15
	4		condition to – 20
	2	extension to 37.5 mm	– 20
	8	hold	– 20
	2	extension to 50 mm	– 20
	8	hold	– 20
End of first cycle (44)	4	return to neutral (25 mm)	– 20
	8		condition to + 15
	2	compression to 12.5 mm	+ 15
	8	hold	+ 15
	2	return to neutral	+ 15
	4		condition to – 20
	2	extension to 37.5 mm	– 20
	8	hold	– 20
	2	extension to 50 mm	– 20
	8	hold	– 20
End of second cycle (48)	4	return to neutral (25 mm)	– 20
	8		condition to + 15
	2	compression to 12.5 mm	+ 15
	8	hold	+ 15
	2	return to neutral (25 mm)	+ 15
	4		condition to – 20
	2	extension to 37.5 mm	– 20
	8	hold	– 20
	2	extension to 50 mm	– 20
	8	hold	– 20
End of third cycle (48) End of test (140)	4	return to neutral (25 mm)	– 20

[a] Controlled at a rate of 6 ± 0.25 mm/h. The compression and extension times will vary about the values shown due to this tolerance.

Determine the area of each type of failure in square millimetres.

NOTE The specimens should not be examined during the test if the examination is likely to affect the results.

8.5.7 Carry out the test on three specimens of the sealant.

8.6 Expression of results

Express the adjusted tensile forces to the nearest 1 N as shown in Table 2.

Express extent of adhesion and cohesion failure of each sample after three cycles to the nearest 1 mm^2 as shown in Table 3.

For adhesion failure, collate the sum of the areas on the face of both concrete blocks from which the sealant has separated.

For cohesion failure, collate the sum of the superficial areas of any ruptures on the face of the sealant.

8.7 Test report

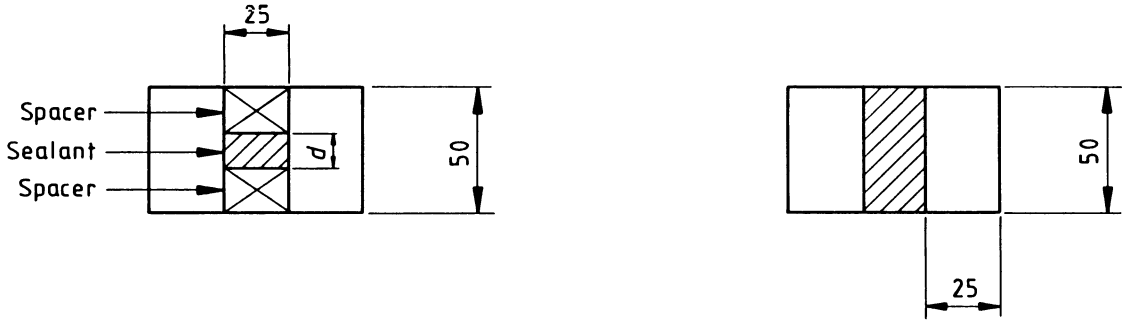
A test report shall be completed in accordance with clause **12**.

Table 2 — Example table showing maximum adjusted tensile forces (in N) recorded in the determination of adhesion and cohesion in tension and compression

Specimen	Cycle		
	1	2	3
1			
2			
3			
Mean			

Table 3 — Example table showing extent of adhesion and cohesion failure

Specimen	Total adhesion failure	Total cohesion failure	Total failure
	mm^2	mm^2	mm^2
1			
2			
3			



(a) Plan

(b) Elevation (spacer omitted)

All dimensions are in millimetres.

Figure 2 — Sealant assemblies

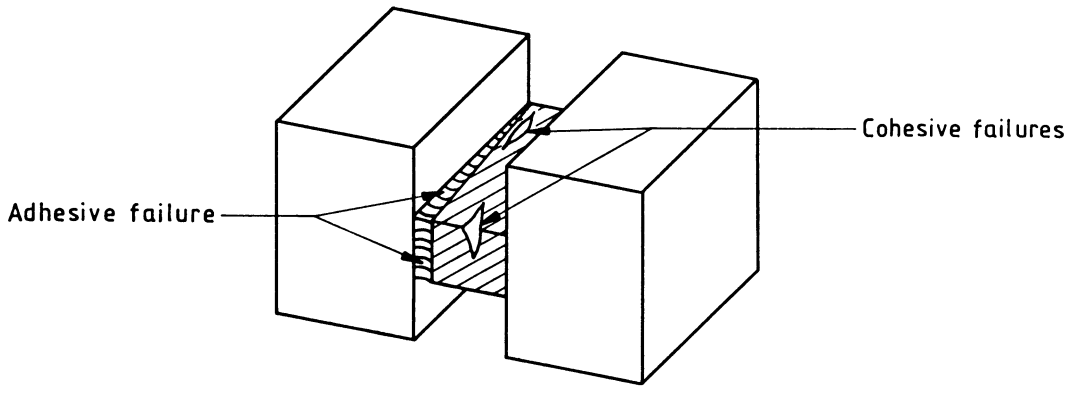


Figure 3 — Typical failures

9 Determination of resistance to heat ageing

9.1 Principle

The resistance to heat ageing of cold applied sealants are evaluated with regard to mass loss, changes in penetration and recovery, and changes in tensile forces and in adhesion and cohesion after heat ageing periods of 14 days and 28 days at 70 ± 2.5 °C.

9.2 Sealant components

This test shall be carried out on base and curing components supplied in closed containers capable of being stored at 23 ± 2 °C.

9.3 Determination of mass loss

9.3.1 *Apparatus*

9.3.1.1 *A laboratory balance,* capable of weighing up to 400 g of sample to an accuracy of 0.01 g.

9.3.1.2 *An unvented oven,* complying with BS 2648 and capable of maintaining the sealant at 70 ± 2.5 °C.

9.3.1.3 *An environment,* capable of maintaining the apparatus at 23 ± 2 °C and 50 ± 5 % r.h.

9.3.1.4 *A flat bladed mixing spatula*

9.3.1.5 *A mixing vessel,* such as a cylindrical container approximately 75 mm in diameter and 70 mm in height.

9.3.1.6 *A thin bladed knife*

9.3.1.7 *Two brass or polyethylene frames,* with internal dimensions of 125 ± 1 mm × 38 ± 1 mm × 6 ± 0.5 mm.

9.3.1.8 *Two aluminium plates,* 150 mm × 75 mm × 1 ± 0.5 mm thick.

9.3.2 *Conditioning and mixing*

9.3.2.1 Prepare two sealant specimens by conditioning and mixing material as described in **4.4** and **4.5.1** or **4.5.2** as appropriate.

9.3.2.2 Clean the frames and plates as described in **5.3.2.1**.

9.3.3 *Procedure*

9.3.3.1 Determine the mass of the aluminium plates.

9.3.3.2 Centre the brass or polyethylene frame on the aluminium plate and fill with the mixed compound and then strike off flat with a spatula. Prepare two such specimens and cure for 7 days at 23 ± 2 °C and 50 ± 5 % r.h.

9.3.3.3 At the end of this time remove the frame by trimming round the inside edge of the frame with a thin knife blade.

9.3.3.4 Determine the mass of the aluminium plate plus the compound to the nearest 0.01 g. Deduct the mass of the aluminium plate to give the original mass of the compound.

9.3.3.5 Place the plate and compound in the oven at 70 ± 2.5 °C for a further 14 days. Following this remove the specimen from the oven and allow to cool for 2 h at 23 ± 2 °C and 50 ± 5 % r.h. and redetermine the mass.

9.3.3.6 Deduct the mass of the aluminium plate to give the final mass.

9.3.4 *Calculation and expression of results*

Record the loss in mass and express it as a percentage (L) of the original mass from the equation:

$$L = \frac{M_o - M_F}{M_o} \times 100$$

where

M_o is the original mass (in g);

M_F is the final mass (in g).

Calculate the average percentage mass loss from the two specimens.

9.3.5 *Test report*

A test report shall be completed in accordance with clause **12**.

9.4 Determination of penetration and recovery

9.4.1 *Preparation and conditioning*

Prepare specimens of sealant as described in **7.2** to **7.6.1** and cure as described in **7.6.2**. Then condition the specimen in an oven at 70 ± 2.5 °C for a further 14 days, followed by conditioning in air for 2 h at room temperature.

9.4.2 *Procedure*

Test the specimens for penetration and recovery as described in **7.6.3**, and record the average of three determinations as the recovery after heat ageing as specified in **7.7**. Record the initial ball penetration and final penetration to the nearest 0.1 mm as specified in **7.7**.

9.4.3 *Reporting*

A test report shall be completed in accordance with clause **12**.

9.5 Determination of changes in forces and changes in adhesion and cohesion on extension and compression

9.5.1 *Heat ageing for 14 days*

9.5.1.1 *Preparation and conditioning*

Prepare test specimens in accordance with clause **8** except that, after curing in accordance with **8.4.8**, condition the specimens as follows.

Place the specimens in an oven at 70 ± 2.5 °C for 14 days, then allow the specimens to stand in air in the laboratory for 2 h and then place the specimens in a water bath at 23 ± 2 °C for 7 days.

9.5.1.2 *Procedure*

Carry out the test as described in clause **8** but consider only one cycle of compression and extension. Record the forces measured at maximum extension to the nearest 1 N for each of three samples. Examine specimens for failure in adhesion and cohesion.

9.5.2 *Heat ageing for 28 days*

9.5.2.1 *Preparation and conditioning*

Prepare further test specimens as described in **9.5.1.1** but after curing the specimens in accordance with **8.4.8** condition the specimens as follows.

Place the specimens in an oven at 70 ± 2.5 °C for 28 days, then allow the specimens to stand in air in the laboratory for 2 h and then place the specimens in water at 23 ± 2 °C for 7 days.

9.5.2.2 *Procedure*

Carry out the tests as described in clause **8**, i.e. for three full cycles. Record the forces measured at maximum extension to the nearest 1 N for each of three samples for each cycle. Examine specimens for failure in adhesion and cohesion.

9.5.3 *Expression of results*

Express the results as described in clause **8** showing maximum tensile forces and extent of adhesion and cohesion failure for:

a) one cycle after 14 days heat ageing at 70 ± 2.5 °C;

b) three cycles after 28 days heat ageing at 70 ± 2.5 °C.

In addition express the average change in maximum force on extension after 14 days heat ageing at 70 ± 2.5 °C compared with the average maximum force on extension of initial non-heat aged specimens to the nearest 1 N, i.e. for the first cycle.

Also express as a percentage to the nearest 1 % the average change in maximum force on extension after 28 days heat ageing compared with the average maximum force on extension measured after 14 days heat ageing at 70 ± 2.5 °C, i.e. for the first cycle only.

9.5.4 *Test report*

A test report shall be completed in accordance with clause **12**.

10 Determination of fuel immersion characteristics

10.1 Principle

The fuel immersion characteristics of cold applied sealants are determined, in order to verify that the properties of fuel resistant type materials do not deteriorate to an unacceptable degree as the result of contact with spilt fuel oil.

NOTE The reference test fuel will give results which indicate the probable behaviour of a material coming into contact with the usual petroleum fuel, but provision is made for the test to be carried out with a different fluid if the reference fuel is not representative of a particular type of spillage.

CAUTION. Attention is drawn to the Health and Safety at Work etc. Act 1974, and the need to ensure that this test is carried out under suitable environmental conditions to provide adequate protection to personnel against the risk of fire, inhalation of smoke and/or toxic products of combustion.

10.2 Sealant components

The test shall be carried out on base and curing components supplied in closed containers capable of being stored in an oven at 23 ± 2 °C.

10.3 Fuel

The reference fuel shall be a mixture of 70 % by volume general purpose reagent 2,2,4-trimethylpentane (iso-octane) having the properties given below, with 30 % industrial grade toluene.

Properties of iso-octane:

assay	99.5
density at 20 °C (in g/mL)	0.690 to 0.693
refractive index, n_D	1.390 to 1.392

10.4 Apparatus for fuel immersion tests

10.4.1 *A laboratory balance,* capable of weighing up to 400 g of sample to an accuracy of 0.01 g.

10.4.2 *An environment,* capable of maintaining prepared specimens and fuel immersion containers at 23 ± 2 °C.

10.4.3 *A flat bladed mixing spatula*

10.4.4 *A mixing vessel,* such as a cylindrical container approximately 75 mm in diameter and 70 mm in height.

10.4.5 *A large container,* made of 2 mm metal sheet of internal dimensions 460 mm × 310 mm × 150 mm deep with a close-fitting lid which can be sealed with adhesive tape.

10.4.6 *Two small containers,* made of 1 mm metal sheet of internal dimensions 150 mm × 150 mm × 150 mm deep with a closely-fitting lid which can be sealed with adhesive tape.

10.4.7 *Two inert aluminium or glass panels,* 50 mm × 50 mm × 6 mm depth.

10.4.8 *A fan,* 300 mm diameter complying with BS 5060.

10.4.9 *Apparatus,* as specified in clause **8**.

10.5 Determination of change in mass after fuel immersion

10.5.1 *Procedure*

10.5.1.1 Weigh the individual aluminium or glass test pieces to the nearest 0.01 g.

10.5.1.2 After conditioning and mixing the sealant as described in **4.4** and **4.5.1** or **4.5.2** prepare two sealant specimens as described in clause **8** but using the aluminium or glass substrate panels.

NOTE An appropriate primer may be required.

10.5.1.3 Cure for a period of 7 days at 23 ± 2 °C.

10.5.1.4 Weigh the prepared assemblies to the nearest 0.01 g.

10.5.1.5 Place the sealant assemblies into one of the two containers specified in **10.4.6**, with the longest axes of the assemblies parallel to the base of the container. Pour reference fuel slowly and carefully, without splashing, into the container until a depth of at least 13 mm of the sealant specimen is immersed, i.e. until one substrate test piece is totally immersed.

10.5.1.6 Place the lid on the container and seal with adhesive tape.

10.5.1.7 Place the container in the enclosure maintained at 23 ± 2 °C for 48 ± 1 h.

10.5.1.8 Remove the specimens from the fuel and dry the specimens by means of the fan specified in **10.4.8** in a stream of air having a velocity of 120 ± 30 mm/min for 1 h at normal temperature. During the drying procedure place the sealant specimen in such a manner that its longest axis is perpendicular to the air stream and so that the surface of the sealant is facing the air stream. After 30 min of drying turn the specimen through 180° so that its opposite surface is facing the air stream, and complete the drying procedure.

10.5.1.9 Reweigh the assemblies to the nearest 0.01g.

10.5.1.10 Deduct the mass of the aluminium or glass panels to give the final mass.

10.5.2 *Calculation and expression of results*

Record the loss in mass and express it as a percentage (L) of the original mass from the equation:

$$L = \frac{M_o - M_F}{M_o} \times 100$$

where

M_o is the original mass (in g);

M_F is the final mass (in g).

Calculate the average percentage mass loss from the two specimens.

10.5.3 *Test report*

A test report shall be completed in accordance with clause **12**.

10.6 Determination of penetration and recovery after fuel immersion

10.6.1 *Procedure*

10.6.1.1 Prepare two specimens of sealant as described in **7.6** and cure as described in **7.6.2**.

10.6.1.2 Place the specimens in one of the containers specified in **10.4.6** and pour in reference fuel to a depth of 100 mm.

10.6.1.3 Place the lid on the container and seal with adhesive tape.

10.6.1.4 Place the container in the environment and maintain at 23 ± 2 °C for 48 ± 1 h.

10.6.1.5 Remove the specimens from the fuel and dry the specimens in a stream of air having a velocity of 120 ± 30 m/min for 1 h at room temperature with the container standing vertically.

10.6.1.6 Test the specimens for penetration as specified in **7.6.3** and record the average of three determinations as the penetration and recovery after immersion in fuel as specified in **7.7**.

10.6.2 ***Test report***

A test report shall be completed in accordance with clause **12**.

10.7 Determination of forces and adhesion and cohesion in tension and compression after fuel immersion

10.7.1 ***Procedure***

10.7.1.1 Prepare sealant assemblies using concrete substrate blocks as specified in clause **8**.

10.7.1.2 Allow the assemblies to cure for 7 days at 23 ± 2 °C and 50 ± 5 % r.h.

Immersion in water is not required.

10.7.1.3 Place the sealant assemblies into one of the two containers specified in **10.4.6** with the longest axes of the assemblies parallel to the base of the container. Pour reference fuel slowly and carefully, without splashing, into the container until a depth of at least 13 mm of the sealant specimen is immersed, i.e. until one substrate test piece is totally immersed.

10.7.1.4 Place the lid on the container and seal with adhesive tape.

10.7.1.5 Place the container in the enclosure maintained at 23 ± 2 °C for 48 ± 1 h.

10.7.1.6 Remove the specimens from the fuel and dry by means of the fan specified in **10.4.8** in a stream of air having a velocity of 120 ± 30 m/min for 1 h at rom temperature. During the drying procedure place the sealant specimen in such a manner that its longest axis is perpendicular to the air stream and so that the surface of the sealant is facing the air stream. After 30 min of drying turn the specimen through 180° so that its opposite surface is facing the air stream, and complete the drying procedure.

10.7.1.7 Immediately after drying subject the sealant assemblies to three cycles of extension and compression as specified in clause **8**.

10.7.1.8 Record the maximum tensile forces on extension as specified in **8.5.5**.

10.7.1.9 After three cycles of extension and compression examine the specimens as specified in **8.5.6**.

10.7.2 ***Expression of results***

Express the results as specified in **8.6**.

10.7.3 ***Test report***

A test report shall be completed in accordance with clause **12**.

11 Determination of flame resistant properties

11.1 Principle

The resistance to flame of cold applied sealants is determined.

NOTE The test is indicative of a minimum performance level. Compliance will not necessarily ensure that resistance of the sealant will be adequate under all conditions of surface; consultation between user and manufacturer is recommended.

CAUTION. Attention is drawn to the Health and Safety at Work etc. Act 1974, and the need to ensure that this test is carried out under suitable environmental conditions to provide adequate protection to personnel against the risk of fire, inhalation of smoke and/or toxic products of combustion.

11.2 Apparatus

11.2.1 *A high temperature laboratory burner,* rated to supply up to 3 000 W.[2)] At operating capacity such a burner shall be capable of burning 211 g of propane/h[3)].

11.2.2 *An open ended cylinder,* of light gauge metal with diameter of 127 mm and a height of 305 mm to be used as a draught shield.

11.2.3 *A steel specimen support,* made from two 150 mm long rods and two 50 mm long rods, all of 3 mm nominal diameter, to form a support with a rectangular centre opening of 40 mm × 50 mm as shown in Figure 4.

11.2.4 *A temperature measuring device,* capable of measuring temperatures of up to 300 °C with an accuracy of ± 5 °C.

11.3 Test specimen

One of the specimens of sealant passing the test for adhesion and cohesion in tension and compression described in clause **8** shall be used.

11.4 Procedure

11.4.1 Assemble the apparatus using a tripod as a support for the cylindrical draught shield (see Figure 4).

11.4.2 Centre the burner under the draught shield with the top in the same plane as the bottom of the draught shield.

11.4.3 Centre the specimen support on the top of the draught shield with the thermometer in a horizontal position laid on it with the sensor at the centre.

11.4.4 Regulate the burner to produce a thermometer reading of 260 ± 10 °C for 120 ± 1 s.

[2)] 1 W = 3.4 Btu/h.
[3)] Burners are available commercially. For information contact Enquiry Section, BSI Linford Wood, Milton Keynes MK14 6LE.

11.4.5 Substitute the specimen for the thermometer so that the sealant, its 25 mm × 50 mm faces horizontal, is directly in the centre of the opening of the support.

11.4.6 Leave in position 120 ± 1 s and observe the specimen for signs if ignition, hardening, flow or separation.

11.4.7 At the end of the 120 s remove the burner and allow the specimen to cool to room temperature.

11.4.8 When cooled, examine the sealant sample for signs of flow, cracking, flaking, hardening, ignition and any other effects caused by the flame.

11.5 Expression of results

Describe the effects produced by flame treatment.

11.6 Test report

A Test report shall be completed in accordance with clause **12**.

12 Test report

The test report shall affirm that the test was carried in accordance with this part of BS 5212. The report shall say 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:

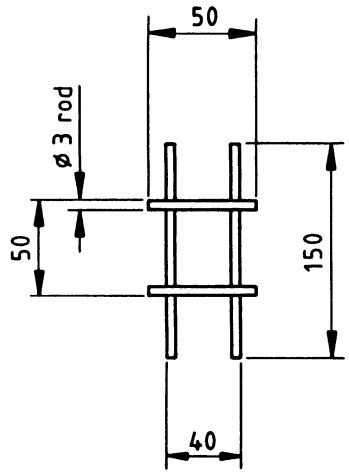
a) name of sample and related primers if used;

b) source of sample and relevant primers;

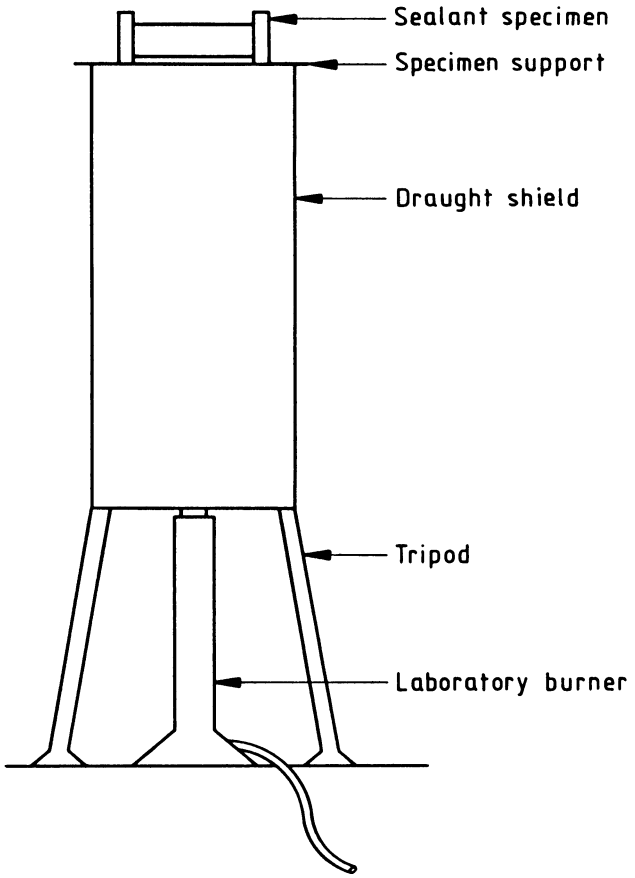
c) bath number and date of manufacture where appropriate or expiry date of sample and related primers;

d) the particular clauses to which the material has been tested, i.e. the requirements specified in BS 5212-1 and the methods of test described in BS 5212-3;

e) the results of each test.



(a) plan of specimen support



(b) general arrangement

All rods are of 3 mm diameter

All dimensions are in millimetres and are nominal

Figure 4 — Specimen support for flame resistance test

Appendix A Preparation of concrete test blocks

NOTE This appendix describes in detail the manufacture and conditioning of concrete test blocks. The requirements of this Part of BS 5212 will also be satisfied if concrete test blocks of different dimensions and configurations are tested, provided that:

a) the composition of the concrete and the manufacture and conditioning of the blocks are as specified, the test faces are sawn and the water absorption of the finished test block is 5 ± 0.5 % as specified;

b) the dimensions of the test section of sealant after pouring are, as specified, 50 ± 0.5 mm × 25 ± 0.25 mm × 12.5 ± 1 mm.

By agreement between supplier and purchaser other test blocks (e.g. blocks of cement mortar, epoxy-mortar, or steel) may be substituted, but the test results will not necessarily be strictly comparable with those obtained when using the test blocks described even when the other conditions of the test remain the same. The new criteria should be agreed between the interested parties and reported in the test report (see clause **12**).

A.1 Apparatus for making concrete test blocks

A.1.1 *Metal moulds,* of steel or cast iron stout enough to resist distortion and of internal dimensions 50 ± 0.15 mm square × 50 ± 0.15 mm long.

A.1.2 *A trowel*

A.1.3 *A vibrating table,* or a hand tamping bar.

A.1.4 *A cabinet,* capable of maintaining a temperature of 20 ± 2 °C and a relative humidity greater than 90 %.

A.1.5 *Test sieves,* complying with BS 410.

A.2 Materials for concrete

A.2.1 *Coarse aggregate,* composed of crushed quartzite rock containing not more than 5 % of carbonates, complying with BS 882 and having a water absorption of less than 1.5 % when tested in accordance with BS 812-2. Determine the carbonate content specified using the method in BS 12 for fine aggregate.

Coarse aggregate shall pass a 20 mm test sieve and be substantially retained on a 5 mm test sieve; the amount passing a 75 μm test sieve, determined by wet sieving in accordance with BS 812-103, shall not exceed 0.5 % by mass of the total coarse aggregate.

A.2.2 *Fine aggregate,* composed of a natural siliceous sand complying with the following:

a) carbonate content shall be not more than 5 %;

b) particle size shall comply with clause **5** of BS 882:1983, grading M except that the amount passing a 75 μm test sieve determined by wet sieving in accordance with BS 812 shall not exceed 2 % of the total fine aggregate;

c) water absorption shall be less than 1.5 % when tested in accordance with BS 812-2.

A.2.3 *Ordinary portland cement,* complying with BS 12.

A.3 Procedure

A.3.1 *Drying*

Dry the aggregate in accordance with BS 812-2. If not used immediately after it has cooled, store the aggregate in an airtight container.

A.3.2 *Proportioning*

Use the following proportions of cement, total aggregate and water:

cement	1 part by mass
total aggregate	6 parts by mass
water	0.6 parts by mass

Fine aggregate shall constitute between 35 % and 45 % by mass of the total aggregate, the exact percentage being determined by an initial trial with a batch of sufficient size to obtain a slump and workability as below.

Adjust the grading and proportion of the coarse and fine aggregates by experiment until a true slump of between 15 mm and 50 mm determined in accordance with BS 1881-102 is obtained with concrete which an experienced operator considers reasonably workable.

A.3.3 *Mixing*

Mix the concrete either by machine, or, if not more than three specimens are required from the batch, by hand.

If mixed by machine, put the aggregate and cement in the mixer first followed by the water, and mix the whole for 3 min.

If mixed by hand, first mix the cement and aggregate on a non-porous surface for 1 min or until the mixture is uniform; then add the water and mix the whole for 3 min with two trowels.

A.3.4 *Casting*

Cast the blocks within 30 min of mixing the concrete.

Transfer the concrete to the mould in two approximately equal quantities placed in layers and compact each layer by vibration on a suitable vibrating table in such a manner that full compaction is obtained without the occurrence of segregation or excessive laitance. Alternatively, compact the layers fully by hand tamping. Smooth the top of the concrete with a trowel.

A.3.5 ***Storage***

Immediately after casting, put the blocks in their moulds in an atmosphere of at least 90 % r.h. at a temperature of 20 ± 2 °C. After 24 h remove the blocks from the moulds, and submerge the blocks in water at a temperature of 20 ± 2 °C for at least 27 days. When required for use, remove them from the tank, and wipe clean of mould oil using a cloth moistened with a small amount of suitable solvent, e.g. 1.1.1 trichloroethane.

A.3.6 ***Cutting***

Cut the blocks at any time after they have reached an age of 14 days, and then immediately resubmerge them in water for the balance of the 27 days or longer, until required for testing.

Cut the blocks vertically into two parts each of dimensions 50 ± 0.15 mm × 50 ± 0.15 mm × 24 ± 1 mm in length by means of an impregnated diamond concrete saw. Discard any block that becomes damaged by ravelling of the edge during sawing. Before resubmerging, wash the concrete in a suitable solvent (e.g. 1.1.1 trichloroethane) to remove oil and similar adherent matter.

A.3.7 ***Conditioning of test blocks***

Prepare the test blocks as follows so that the residual moisture content of each block, expressed as a percentage of the mass of the concrete when dried at a temperature of 105 °C for 48 h, is 5 ± 0.5 %.

Take the sawn test blocks, at least 28 days old, from the water, and dry in an oven at 105 ± 5 °C for 48 h. Then place in a desiccator over anhydrous calcium chloride to cool for 4 h and determine and record the mass. Then store in air in the laboratory at room temperature and humidity.

When required for use, submerge the test blocks in water maintained at 20 ± 2 °C for 24 h. Then remove from the water and wipe their surfaces dry with a clean, absorbent cloth or filter paper. Allow the blocks to stand for 1 ± 0.25 h in the laboratory at 23 ± 2 °C and at 50 ± 5 % r.h. with the cut faces in a vertical plane. Determine the mass of the blocks and calculate their moisture contents.

Reject the blocks which have moisture contents outside the prescribed limits of 5 ± 0.5 %.

A.4 Re-use of concrete test blocks

Use the test blocks only once.

Appendix B Precision and traceability

B.1 Precision

Estimates of the repeatability and reproducibility of the test methods in this Part of BS 5212 and of the variability due to sampling are not yet available but will be included by amendment when known.

B.2 Traceability

The calibration of the test apparatus specified in this Part of BS 5212 to verify compliance with requirements should be traceable to the National Physical Laboratory[4)] either directly or indirectly through a hierarchical chain according to the accuracy demanded by the test. Systems used should comply with BS 5781.

[4)] National Physical Laboratory, Teddington, Middlesex TW11 0LW.

Publications referred to

BS 12, *Specification for ordinary and rapid-hardening Portland cement.*
BS 410, *Specification for test sieves.*
BS 812, *Testing aggregates.*
BS 812-2, *Methods for determination of physical properties.*
BS 812-103, *Methods for determination of particle size distribution.*
BS 882, *Specification for aggregates from natural sources for concrete.*
BS 1881, *Testing concrete.*
BS 1881-102, *Method for determination of slump.*
BS 2000, *Methods of test for petroleum and its products.*
BS 2000-49, *Penetration of bituminous materials.*
BS 2499, *Specification for hot applied joint sealants for concrete pavements*[5)].
BS 2648, *Performance requirements for electrically- heated laboratory drying ovens.*
BS 5060, *Specification for performance and construction of circulating fans and electric regulators.*
BS 5212, *Cold applied joint sealant systems for concrete pavements.*
BS 5212-1, *Specification for joint sealants.*
BS 5212-2, *Code of practice for the application and use of joint sealants*[5)].
BS 5781, *Measurement and calibration systems.*

[5)] Referred to in the foreword only.

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