BRITISH STANDARD

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+A1:2010

Selection of construction sealants — Guide

ICS 91.100.50

Committees responsible for this British Standard

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Association of Sealant Applicators
British Adhesives and Sealants Association
Consumer Policy Committee of BSI
Department of the Environment, Transport and the Regions (Building Research Establishment)
Flat Glass Manufacturers Association
Glass and Glazing Federation
Institution of Civil Engineers
Water UK

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Contents

Foreword

This revision of BS 6213 has been prepared by Technical Committee B/547. It supersedes BS 6213:1982, which is withdrawn.

BS 6213:2000+A1:2010 supersedes BS 6213:2000, which is withdrawn.

The start and finish of text introduced or altered by Amendment No. 1 is indicated in the text by tags ⟨A1⟩ ⟨A1⟩.

In this revision of BS 6213 selection tables have been removed. This reflects the change in emphasis in this revision from providing solutions to providing guidance and methodology enabling the user to determine the sealing requirement for a particular project.

The approach adopted in this guide is suitable for both new construction and resealing/renovation projects.

Guidance for sealant installation is to be found in BS 8000-16. As sealant choice will be influenced by installation conditions, relevant factors are given for consideration.

The recently introduced system of classification of sealant properties, determined using laboratory test data in accordance with ⟨A1⟩ BS EN ISO 11600 ⟨A1⟩, is referred to as a means of identifying suitable sealants which meet a number of requirements, in particular movement accommodation. ⟨A1⟩ BS EN ISO 11600 ⟨A1⟩ recognizes two sealant types: those intended for façade and general construction (type F), and those intended for glazing applications (type G). As not all characteristics of sealants are evaluated for classification, other means may need to be used to assess capability, e.g. field trials, case histories, test programmes or research reports.

Reference should also be made to BS 6093 for design of joints and jointing in building construction.

For existing structures with no design history, joint movement will need to be estimated as part of the selection process.

Certain sealant types have been designed for use as part of a system for fire prevention, sound deadening, insulated glass unit construction and installation. The specialized characteristics of these materials are not within the scope of this guide which is aimed primarily at the weather sealing water retention and exclusion applications most frequently found in general construction. Guidance on selection of sealants for horizontal joints outside the scopes of BS 2499 and BS 5212 is included, as well as guidance on the selection of sealants for many installations.

It is advisable to gain assurance that data provided for the performance characteristics of sealants is relevant to the materials that will be supplied to the project. Long-term performance data in particular may be based on an earlier generation of product and not validated on current supplies.

Use of certified products. Manufacturers of sealants are advised to consider the desirability of third-party certification/inspection/testing of product conformity with ⟨A1⟩ BS EN ISO 11600 ⟨A1⟩ to provide additional confidence that the actual product used to fulfil the specification meets the requirements.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot 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 7 and a back cover.

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1 Scope

This British Standard gives guidance on the key considerations and issues to be identified when selecting an appropriate sealant for sealing joints in buildings or general construction work.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

〈A1〉 BS 6093, *Design of joints and jointing in building construction — Guide*
BS 8449, *Building and construction sealants with movement accommodation factors greater than 25% — Methods for test for determination of adhesion/cohesion properties at variable temperatures*
BS EN ISO 11600, *Building construction — Jointing products — Classification and requirements for sealants* 〈A1〉

3 Terms and definitions

For the purposes of this British Standard the following terms and definitions apply.

3.1

single component sealant

sealant which cures by exposure to the atmosphere, and from the outside to the inside

NOTE The rate at which the cure proceeds through the bead depends primarily on the temperature and relative humidity.

3.2

multi-component sealant

sealant which cures by incorporation of a curing agent with the base component

NOTE Cure occurs at the same time throughout the sealant bead.

4 Sealant selection

4.1 General

Sufficient information for the sealant selection process can usually be obtained from knowledge of the function and design of a structure including the joints.

4.2 Service environment

The following data should be gathered prior to sealant selection:

a) for joints:
   1) locations;
   2) dimensions;
   3) nature of substrate;
   4) total movements(thermal/structural);

b) on service environments:
   1) annual ranges for:
      i) temperature;
      ii) humidity;
      iii) rainfall;
      iv) wind speed;
      v) sunshine/ultraviolet radiation;
   2) additional considerations:
      i) immersion;
      ii) chemical contact;
      iii) compatibility;
      iv) biodeterioration;
      v) abrasion;
      vi) traffic;
      vii) hydrostatic pressure;
      viii) food contact;
      ix) vermin.

4.3 Preparing a sealant specification

The data in **4.2** should be used to prepare a specification that describes acceptable sealant properties for the project and to define the following installation and service issues which are described in **4.4** and **4.5** in detail:

a) in service:
   1) movement accommodation (during cure/post cure);
   2) adhesion;
   3) visual appearance;
   4) resistance to working environment etc.;
   5) effects of weathering;

b) installation:
   1) gunnability;
   2) slump resistance;
   3) pourability — self levelling;
   4) work life;
   5) cure time;
   6) substrate.

For new building it is assumed that joint design is in accordance with the recommendations of BS 6093. At the design stage the inter-relationship between joint movement, joint width and movement capability will provide additional flexibility in the selection of a suitable sealant.

Joint movement should usually be considered in the context of straight components positioned approximately parallel to each other. Movement between those components is then considered to be uniformly distributed along the joints.

Careful consideration of the movement pattern and magnitudes is needed where joints occur in shaped components as the joint interface may be curved radially or tangentially and give rise to movements which may not be equally distributed around the joint. This effect may be further complicated by the shape of components causing movement to be predominant in one direction.

The required mechanical performance properties of the sealant should take account of the rate, frequency and direction of joint movement.

If the calculated movement is unlikely to be distributed equally, the sealant selected will need to have a performance safety factor to accommodate the maximum predicted movement in any of the joints, or alternatively the joint specification may be reassessed to provide another sealing option.

For resealing of existing structures with no design history, joint behaviour should be investigated to provide the information needed in the sealant selection process. The reasons for replacing the old sealant should be understood as they will be relevant to the future selection of a replacement sealant.

NOTE Performance properties of sealants predicted from laboratory simulation test data are dealt with in **7.2**. Such data may be supplemented by case histories and field evaluations.

4.4 Service issues

In addition to being able to accommodate the expected joint movement the sealant selected should also be able to withstand climatic conditions and any specific environmental conditions to which it is subjected.

Narrow joints should be avoided at the design stage wherever possible, because small decreases in the joint width can easily cause the sealant to be overstressed and fail.

Where a joint undergoes rapid thermal movement at the time of sealing it may be inappropriate to use a slow curing sealant.

The rate of cure of a sealant should be an important aspect of the selection process as this can influence the scheduling of subsequent operations. Sealants are more vulnerable to mechanical damage or chemical attack during the cure period whilst the service properties are developing.

The rate of cure of single component sealants tends to be slower than that of multi-component sealants. There may be a practical limit to the sealant depth for single part sealants.

Where it is known that a sealant will be subject to early exposure to service conditions such as traffic, chemical contact, or water immersion a sealant of appropriate cure rate should be selected. Alternatively, a minimum time period between application and service should be specified to avoid irreversible damage to the sealant.

As certain sealants, when cured, are more capable of resisting wet environments involving contact with water, chemicals, including fuels, and solvents or microbial activity, consideration should be given to length of exposure, temperature and concentration, which affect the choice of sealant.

Natural weathering and the presence of atmospheric pollutants can alter the visual appearance of a sealant in a joint. Any change in appearance may not be uniform in all joints in a structure. The rate of any change will be related to the severity of conditions in each joint or aspect of the structure.

4.5 Installation issues

4.5.1 *General*

The sealant selected should be compatible with the envisaged service conditions. However, consideration should be given to the conditions that will be encountered during installation.

As performance characteristics, particularly at the time of installation, may vary considerably according to the temperature and humidity prevailing, the sensitivity of products towards such variations should be considered as part of the selection process.

NOTE Practical guidance and information on sealant application is given in BS 8000-16.

4.5.2 *Joint orientation and dimensions*

The following factors relating to joints should be considered when selecting a sealant.

— The dimensions of the sealed joint may differ in width and depth according to the requirements of the selected sealant, the nature of the substrate and the service environment.

— Narrow joints give rise to practical difficulties of inspection, preparation, priming and sealant application.

— Wide joints require sealants with the appropriate application, slump and cure characteristics in order to be filled successfully, otherwise specialist application techniques will be required.

The sealant should be installed within its application life at ambient temperature to ensure that it will wet the joint substrates so it can be tooled and finished.

The position of joints in relation to other elements should be considered during design to ensure ease of access for sealing and maintenance.

Pouring grade sealants, which are usually multi-component, are used to seal horizontal joints. After mixing they may be poured directly into the joint, or applied by gun to avoid overspill. Not all pouring grade sealants are self levelling. A small amount of flow resistance is advantageous where joints have crossfalls. A small amount of light tooling is required to give a level surface.

4.5.3 *Substrate compatibility*

The performance of a sealant is dependant upon good adhesion to and compatibility with the substrate. However, consideration should be given to the following specific substrate characteristics which may exist prior to sealant installation:

a) surface treatment of substrate: anodizing, organic coatings;

b) in depth treatment of porous substrates: preservative/stain treatment of timber, water repellents in stone or the presence of excessive amounts of moisture;

c) chemically reactive substrates: alkaline materials such as cement, plaster and some stones which react with sealants that evolve acid as part of the cure process;

d) substrate staining which may occur by absorption of some components of the sealant into porous substrates, especially some stones;

e) sealant staining or discoloration which may occur from contact with other construction components within the joint: fixings, rubber/plastic spacers, polymeric or bituminous damp-proof courses;

f) substrate strength which should be sufficient to resist the stresses imposed by the sealant during movement.

The effects of specific adverse conditions such as those given in a) to f) may be reduced or overcome by careful sealant and primer selection and the specification of appropriate substrate preparation in conjunction with sealant manufacturers.

The function of a primer may be one or more of the following:

— to enhance adhesion between sealant and substrate;

— to strengthen or consolidate weak or friable materials;

— to provide a barrier film between the substrate and the sealant to prevent staining of the sealant or substrate.

NOTE A completely effective barrier coat may be difficult to achieve in practice. A change in design to remove incompatible construction components from within the joint, or the selection of an alternative sealant not susceptible to staining may be a preferred solution

Where dissimilar surfaces form the joint, the use of two different primers may be indicated. As this can give rise to practical difficulties in use, advice should be sought from the sealant manufacturer.

4.5.4 *Joint filler and back up*

As joint filler and/or back-up materials, defined in BS EN 26927, together with the sealant and primer form the sealant system the appropriate filler or back-up material for the specific service environment material should be selected for proper performance of the sealed joint.

Factors which should be considered in the selection of a joint filler or back-up material are:

a) sufficient strength to support the sealant during cure;

b) resilience and recovery appropriate to envisaged application;

c) compatibility with selected sealant primer system;

d) risk of staining or incompatibility from bitumen or wax content;

e) risk of restraining sealant during movement of the joint;

f) resistance to damage during construction or installation.

4.5.5 *Resealing*

Resealing should be considered when evidence of sealed joint failure is observed, or as part of a planned maintenance programme.

It is essential that the cause(s) of sealed joint failure are identified prior to the specification of a resealing programme. A survey should be carried out to establish:

a) the type(s) of sealant failure and pattern or distribution of failures on the structure;

b) ability of joints and sealant to accommodate the movement that has occurred;

c) substrate materials and coatings or other subsequent surface treatments;

d) the type of sealant and primer used;

e) if the sealed joints adequately resist service/environmental conditions of the structure.

The resealing specification will depend upon the result of the survey, together with other factors such as access, cleaning, time-scales and cost.

Sealant selection for reseal work should follow the same process as for new work. Additionally, consideration should be given to compatibility with original sealant, especially where total cleanliness cannot be obtained or where a complete reseal is not required.

If any doubt exists, the final specification should follow from the successful completion of a resealing trial to a typical area of the structure.

5 Sealant performance

5.1 General

The properties of sealants should be measured using the test methods in [A1] BS EN ISO 11600 [A1], which identifies sealant properties and preferred ranges of values selected as the basis for a sealant classification. Sealants having properties appropriate to a particular class may be considered as suitable for joints having particular service characteristics and sealant requirements. Sealants classified to [A1] BS EN ISO 11600 [A1] have an identification coding on their packaging.

5.2 Sealant properties

5.2.1 *Elastic/plastic*

The terms elastic/plastic can be used to classify sealants in relation to their ability to return to an original width (elastic recovery) after being stretched or compressed, or in relation to what happens to stresses over time at maintained extension (see **5.2.3**).

Elastic sealants (elastic recovery) are usually defined as such by being able to recover to a specified width and profile after a specified amount of extension. Sealants that fail to meet this condition should be classified as plastic, see [A1] BS EN ISO 11600 [A1].

Plastic sealants ([A1] BS EN ISO 11600 [A1] type P) are more suitable for joints where the movement that occurs tends to be irreversible.

Elastic sealants ([A1] BS EN ISO 11600 [A1] type E) are suitable for joints where the movement that occurs is reversible.

5.2.2 *Modulus*

5.2.2.1 *General*

High modulus ([A1] BS EN ISO 11600 [A1] type HM) sealants are stiffer than low modulus ([A1] BS EN ISO 11600 [A1] type LM) sealants. A high modulus sealant requires a higher force to extend it by a given amount than a low modulus sealant. Consequently, at any given extension or compression the stresses within the sealant bead and at the sealant/substrate interface will be higher for a high modulus sealant than for a low modulus sealant. To minimize the stresses at the sealant/substrate interface low modulus sealants are often preferred when the substrate is weak or friable.

5.2.2.2 *Temperature effects*

At high temperature modulus can decrease and the sealant can become susceptible to mechanical damage.

NOTE This applies particularly to non-curing/setting sealants.

As the temperature falls the modulus increases. At sub-zero temperatures this effect can be very marked. If sub-zero service temperatures are envisaged the suitability of a particular sealant should be checked with the manufacturer.

The temperature at which the marked increase in modulus occurs will tend to rise as the sealant ages and may impinge on the service temperature range.

5.2.3 *Stress relaxation*

The stresses generated when a sealant is extended or compressed diminishes with time if the deformation is maintained at a constant value.

NOTE The phenomenon occurs, to a greater or lesser extent, in all sealants, and can be used to advantage where a joint will move only once, e.g. settlement, as the stresses imposed on the sealant/substrate interface decrease over time.

5.3 Movement accommodation

It is imperative that the sealant that is to be used to seal a joint should be able to accommodate any movement that is expected to occur.

The minimum and maximum joint widths should be estimated in accordance with BS 6093. The movement expected is the difference between the minimum and maximum widths.

The amount and direction of movement that the sealant is required to accommodate is related to the width of the joint during its application and subsequent cure. Joints that are sealed during warm weather are narrower and the subsequent movement of the sealant bead is predominantly in extension. Conversely joints sealed during cold weather are wider and the subsequent movement of the sealant bead is predominantly in compression.

The movement accommodation factor (MAF) of the sealant that is required in order to seal the joint is calculated as follows:

$$\text{MAF} \geq \frac{\text{Movement} \times 100}{\text{Minimum joint width}}$$

When selecting a sealant, the movement classes 7.5, 12.5, 20 or 25 in accordance with [A1] BS EN ISO 11600 [A1] should be used as the MAF.

[A1] If the MAF is calculated to be greater than 25 and it is therefore not possible to specify a sealant in accordance with BS EN ISO 11600, the test procedure in BS 8449 should be used to assess movement capabilities. The amount of extension applied to the sealant should be equal to the sealant's MAF. [A1]

NOTE 1 [A1] BS EN ISO 11600 [A1] class 7.5 currently makes no distinction between plastic and elastic sealant behaviour. However, most sealants within this class are plastic in nature.

NOTE 2 [A1] BS EN ISO 11600 [A1] class 12.5 sealants are sub-divided into elastic (E) or plastic (P) types.

NOTE 3 [A1] BS EN ISO 11600 [A1] class 20 and 25 sealants are considered to be elastic. Each of these two classes is sub-divided into high and low modulus classes (HM or LM).

Low modulus sealants should be selected for joints that will be exposed to long periods of maintained extension or compression and/or where the substrate material is weak or friable.

5.4 Joint configuration

The calculation of the required MAF of a sealant is based on the requirements of butt joints. When strained in shear only, the sealant can usually be expected to perform satisfactorily at twice its stated MAF.

6 Sealant selection process

As this standard does not encompass all circumstances of the use of sealants, further advice should be sought to aid sealant selection especially in relating project data to requirements for sealant performance properties and in the approach to verifying performance claims for particular brands/types of sealants. Advice may be obtained from any of the following sources:

a) sealant manufacturers and installers' trade organizations;

b) research organizations on building construction and coating technology;

c) university departments concerned with construction issues and material properties;

d) trade and academic journals, reports and data bases;

e) independent consultants.

A flowchart outlining the sealant selection process is shown in Figure 1.

NOTE For further information refer to the organizations listed on the inside front cover of this British Standard.

7 Confirmation and validation of initial sealant selection

7.1 Background

As current test procedures, listed in A1 BS EN ISO 11600 A1, may not be suitable for assessing some uses of sealants, manufacturers may carry out additional evaluation procedures designed to assess fitness for purposes that are not yet assessed by standard test methods.

Specifiers should assure themselves that the selected sealants have sufficient durability for the designed purpose and obtain supporting evidence. Several approaches exist, which may be used as indicated in **7.2**.

7.2 Trials, simulated tests, case studies and predictive testing

Specifiers may wish to obtain evidence of where the product has been used successfully in an end-use application related to the proposed end use envisaged.

If relevant trials or simulated tests have not been conducted previously in relation to a specific end-use application, consideration should be given to undertaking specific trials so that products can be demonstrated to be fit for the claimed purpose.

Results from trials should be reported in a form agreed with the specifier.

Care should be taken to establish that formulations used in trials and test simulations are the same as those for the product under consideration. It should be noted that a brand name or product description is not sufficient for this purpose. Specifiers should enquire whether changes have been made to the formulation since the trials data were generated. If formulation changes have been made their significance may need to be reviewed.

Bibliography

BS 2499 (all parts), *Hot applied joint sealant systems for concrete pavements.*

BS 5212 (all parts), *Cold applied joint sealant systems for concrete pavements.*

〉A1〈 BS 8000-16 〉A1〈, *Workmanship on building sites — Part 16: Code of practice for sealing joints in buildings using sealants.*

〉A1〈 BS EN 26927 〉A1〈, *Building construction — Jointing products — Sealants — Vocabulary* [ISO 6927].

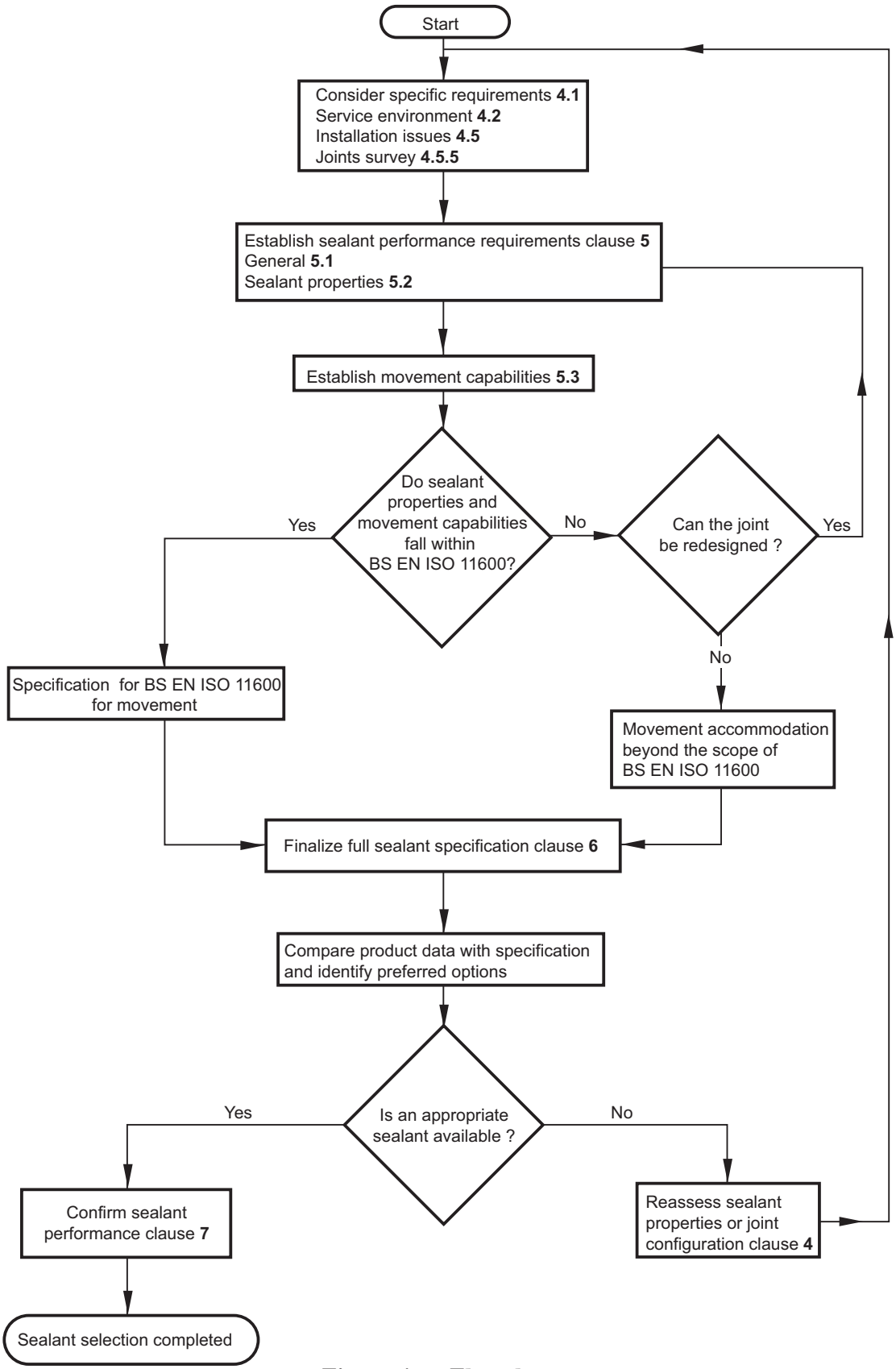

Figure 1 — Flowchart

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