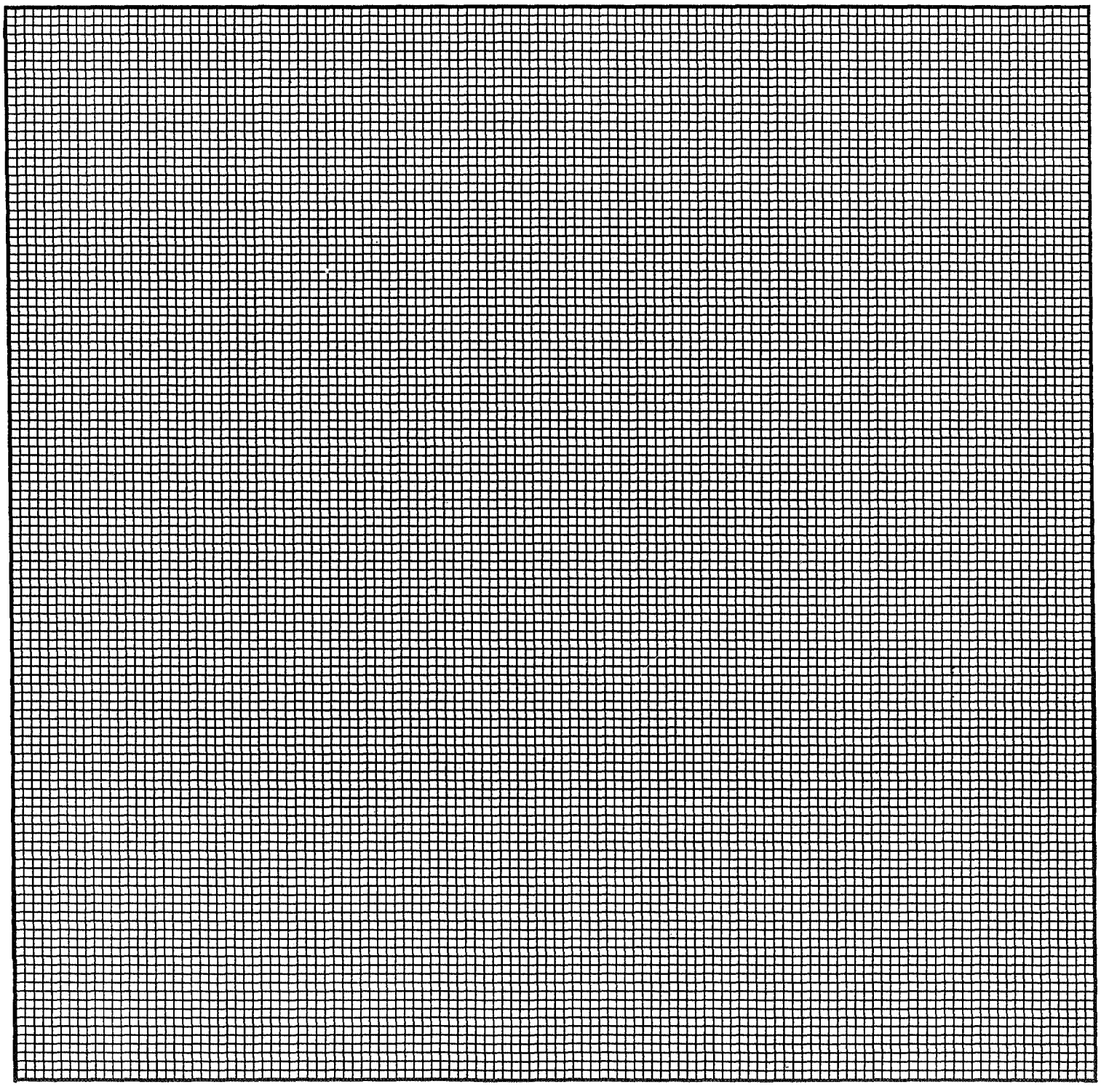
Aluminium Window Association

C1/SfB 317
(31.4) Xh4

Guidance to specifiers in the use of mastics and sealants on site

AWA 1980

# Guidance to specifiers in the use of mastics and sealants on site



# Contents



# Foreword

The successful performance of any aluminium window installation depends, in large, on sealed joints between the window and the structure. The performance of these joints depends on their design, the choice of sealants and their proper application.

The Aluminium Window Association has published Technical Report 1, 1976 which gives recommendations for terminal joints where wide building tolerances may be encountered and where correct joint design is vital. The guidance offered in this document regarding the sealing of terminal joints includes details with edge profiles suitable for these conditions.

# General

## 1.1 Scope

The recommendations offered are based on sealants and mastics currently available for sealing the perimeter of windows. Materials used in glazing are not considered in any depth, as BS Code of Practice CP 152: 1972 and Glass and Glazing Federation publications deal with this subject. The document is intended to apply to windows offered on a 'supply only' basis. For 'supply and fix' conditions the type of joint and its size, tolerances and sealant specification should be agreed between the specifier and window manufacturer.

## 1.2 Definitions

**Acrylic sealant**
An acrylic polymer based material containing a volatile solvent addition.

**Adhesion failure**
Failure of a compound by pulling away from the substrate.

**Bandage seal (Bandage joint)**
The application of sealant across a joint which is not designed to accommodate a sealant (see fig. 11)

**Bedding**
The application of mastic to fill gaps or voids.

**Bleeding**
The loss of fluids from mastics and sealants

**Bond breaker**
A release material to prevent adhesion of sealant to the back of a joint (see fig.5 and also joint backing).

**Caulk**
To fill cracks or crevices, especially around windows.

**Cohesive failure**
Failure of a sealant when placed under strain in which the sealant splits and opens.

**Compatibility**
The capability of materials to be in contact indefinitely without any adverse effects to either. Compatibility does not imply adhesion.

**Compound**
A hand grade glazing or bedding material.

**Cure**
The change of a sealant from a fluid to an elastoplastic or elastic state by a chemical reaction.

**Dynamic movement**
Continuous movement, particularly of dark coloured materials, due to rapid changes in temperature.

**Elastomer**
A material which will recover to its original dimension after stretching.

**Edge profile**
The profile of that part of a window section forming an interface or joint with building work or with coupling member.

**Fillet**
A substantially triangular sectioned pointing used to seal a non-moving right-angled joint.

**Friable surface**
A loose dusty or powdery surface.

**Joint (BS 4643)**
A position where two or more building products, components or assemblies are put together, fixed or united with or without a jointing product (e.g. sealant, etc.).

**Joint backing (back up)**
A material placed into a joint, primarily to control the depth of sealant and prevent adhesion of the sealant to the back of joint. (see figs. 1a and 1b).

**Mastic**
Hand or gun grade jointing material which should not set hard, under normal conditions, within its anticipated life.

**Pointing**
The application of mastic or sealant, usually from a gun.

**Perimeter pointing**
The application of mastic or sealant around the perimeter of a window or window assembly.

**Polysulphide**
A one ot two part sealant based on a polysulphide polymer.

**Primer**
A coating applied to improve the adhesion of sealants.

**Sealant**
A material which cures after application to form a rubber like seal. Normally sealants will accommodate more joint movement than mastics.

**Sealer**
A coating applied to prevent the absorption of oils and plasticers into porous substrates.

**Shelf life**
Maximum time a material can be stored before use.

**Shrinkage**
Decrease in volume of a material which occurs when the material loses part or all of its volatile consituents.

**Slump**
Failure of mastic or sealant in a joint to support its own weight.

**Staining**
Discolouration of porous substrate caused by absorption of oil, etc., from a material in contact with the substrate.

**Substrate**
The surface to which a primer, sealer, mastic or sealant is applied.

**Terminal joint**
The joint between window frame or assembly and adjacent building work.

**Tooling**
The operation of pressing material into a joint to remove air bubbles and make proper contact with the substrate, thus ensuring good adhesion and neat appearance.

## 2.1 Materials

Mastics and sealants encompass a variety of products and formulations which can be categorised basically as plastic, plastic/elastic or elastic.

a) Plastic materials will stretch, but not recover when the stretching force is removed.

b) Plastic/elastic materials will, if extended, stretch and partially return to their original state, but will eventually set in their extended state if retained there.

c) Elastic materials will stretch and return to the original installed dimension.

(Refer to Table 1 for general classification of materials).

**Table 1** **Classification of mastics and sealants**

| Material | Category | Use in window installation | * Max. movement capability in tension/compression | Life expectancy of material | Comments |
|---|---|---|---|---|---|
| Oil based bedding mastics | Plastic | General purpose bedding in enclosed compression joints | Negligible | 5 to 10 years | **1** Exposed surfaces require painting. Durability is dependent on volume of material and area exposed to atmosphere |
| Oil based pointing mastics | Plastic | General purpose pointing | ± 3% of joint width | 5 to 10 years | **1** Painting exposed surfaces increases life of material |
| Extruded tapes | Plastic | Compression joints | Not applicable | 10 to 15 years | **1** A vast range available with varying properties.<br>**2** Require application under compression to obtain adhesion. |
| Butyl gun grade mastics | Plastic/ Elastic | Concealed lap joints subject to little movement | ± 6% of joint width | 10 to 15 years | **1** Should not be exposed to direct weather as material is affected by UV light.<br>**2** Adequate volume must be used. |
| Acrylic sealants | Plastic/ Elastic | Perimeter pointing | ± 10% to ± 15% of joint width dependent on type | 15 to 20 years | **1** Can be hot or cold applied. Hot applied materials require special heating equipment.<br>**2** Some acrylic sealants have high adhesion quality and seldom require primers. |
| Acrylic and nitrile small joint sealants | Plastic/ Elastic | Remedial work | None | 15 to 20 years | **1** Most acrylic sealants are subject to shrinkage on solvent release. |
| Polysulphide one-part sealants | Plastic/ Elastic | Perimeter pointing | ± 10% of joint width | 15 to 20 years | **1** Priming necessary for certain aluminium finishes. Sealers for porous substrates.<br>**2** BS 5215 specifies quality standard. |
| Polysulphide two-part sealants | Plastic/ Elastic | Perimeter pointing | ± 12% of joint width | 15 to 20 years | **1** Sealers necessary for porous substrates.<br>**2** BS 4254 specifies quality standard.<br>**3** If dynamic movement is anticipated, design for ± 5% movement of joint width. |
| Polyurethane sealants (can be one-part or two-part) | Elastic | Perimeter pointing<br>Expansion joints | ± 10% of joint width for one-part.<br>± 12% of joint width for two-part | 15 to 20 years | **1** Priming usually necessary for all substrates<br>**2** Not yet in general use in UK |
| Silicone sealants (one-part) | Elastic | Perimeter pointing, expansion joints, where dynamic movement is anticipated | ± 12% of joint width (higher for recently introduced low modulus materials) | 20 years | **1** Sealer to masonry essential.<br>**2** Priming of some aluminium finishes may be necessary. |

*Percentages stated

**Fig 1a Butt Joint**

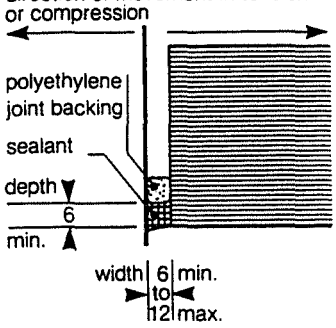



**Fig 1b. Butt Joint**

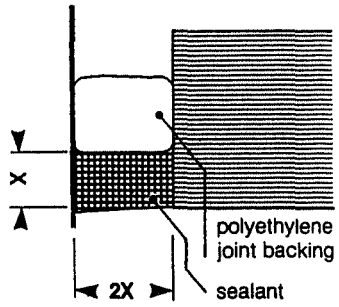



**Fig 2. Sealed Lap Joint**

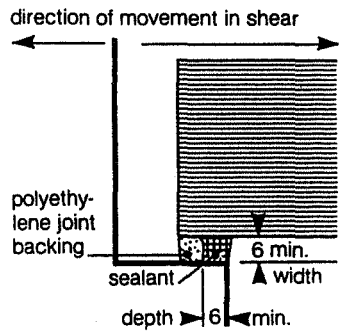



**Fig 3. Bedded Lap Joint**

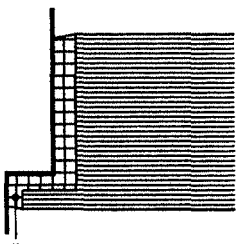
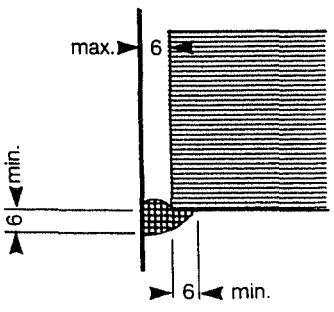



**Fig 4. Fillet Seal**




all dimensions are in millimetres

## 2.2 Joints

**Joints in window installation fall into two basic types.**

1 Butt joints
2 Lap joints

Both types can be either working joints where movement occurs, or non-working joints where movement is restricted or absent.

## 2.3 Sealing the joints

### 2.3.1 Butt joints

(Examples include the sealing of terminal joints and panel joints).

For non moving joints the minimum width and depth of sealant should be 6 mm (see fig 1a). For joints exceeding 12 mm wide the ratio of width to depth for most sealants should be in the order of 2:1 (see fig. 1b).

For moving joints the same rules apply but in addition a joint width must be adopted which will allow the sealant to perform within its movement capabilities.

### 2.3.2 Lap joints

(Examples include the sealing of rebated terminal joints, the bedding of long leg section frames to rebates and pressed aluminium profiles).

Sealed lap joints have certain advantages over butt joints. The sealant is partly protected from direct exposure to the weather and joint movement subjects the sealant to shear, a less critical stress than the tension/compression stresses in butt joints. They can, therefore, accommodate up to three times more movement.

In lap joints the depth of the joint should be at least equal to the width which should be calculated in relation to the predicted joint movement (see fig. 2).

Bedded lap joints can, in practice, be difficult to seal. The compound or sealant must be applied to the surfaces before they are brought together, and adjustments made in positioning the components can result in voids being left in the compound. After installation it is often impossible to inspect the seal for defects. It can also be difficult to perform remedial work.

Bedded lap joints are only suitable where little or no movement is expected. Minimum joint size with bedding compound should not be less than 5 mm x 25 mm. (see fig. 3).

### 2.3.3 Butt or lap joints with fillet seals

(Examples include the perimeter pointing of window frames where little movement is expected and also remedial work).

The size of the triangular fillet of sealant must be in accordance with the dimensions shown in fig. 4.

## 2.4 Joint design

Basic factors which influence the joint design and choice of material include the exposures likely to be encountered and the life expectancy of the materials and frequency of maintenance envisaged.

Joints should be designed so that the original seal is capable of being replaced or can later be reinforced by the application of pointing. When designing the joint the following points should be considered:—

1 The amount of probable movement. (see Table 2).

2 Deviations in opening and frame sizes (including those resulting from setting out and installation).

3 Provision of suitable surfaces for the adhesion of the sealant (i.e. that a proper depth of sealant can be accommodated—see 2.3.1, 2.3.2 and 2.3.3).

4 Provision of a joint backing material to prevent the sealant adhering to the back of the joint and a means of retaining the material (see 2.3.1 and 2.3.2).

5 Adherence to the sealant manufacturer's recommendations and possibly specifying the materials by name.

Thermal movement mainly dictates joint movement. Table 2 illustrates the movement of various building materials but it should be remembered that dark colours absorb more solar energy and such components will move more than those of lighter colour.

**Table 2 Thermal movement of building materials**

| Material | Change in size, mm per m for 10 deg C change in temperature | Material | Change in size, mm per m for 10 deg C change in temperature |
|---|---|---|---|
| Rigid polyethylene | 1.10—1.30 | Sand-lime brickwork | 0.17 |
| Acrylic plastics | 0.75—0.92 | Clay brickwork | 0.050—0.070 |
| Polystyrenes | 0.60—0.80 | Concrete | 0.110 |
| Vinyl plastics | 0.43—0.72 | Asbestos Cement | 0.090 |
| Phenolic plastics | 0.19—0.45 | Slate | 0.093 |
| Glass reinforced plastics | 0.15—0.50 | Quartzite | 0.090 |
| Zinc | 0.31 | Granite | 0.080—0.110 |
| Lead | 0.29 | Sandstone | 0.070—0.160 |
| Aluminium | 0.24 | Limestone | 0.025—0.090 |
| Architectural bronze | 0.20 | Marble | 0.015—0.110 |
| Copper | 0.18 | Glass | 0.088 |
| 18/10/3 stainless steel | 0.17 | Wood (also consider moisture movement) | 0.02—0.06 |
| Vitreous enamel | 0.13—0.21 | | |
| Carbon steel | 0.12 | | |
| Gypsum plaster | 0.21—0.25 | | |
| Sanded plasters | 0.14—0.17 | | |

## 2.5 Sealant characteristics and their evaluation

There are various laboratory methods for measuring and evaluating most properties and characteristics of sealants. These are incorporated in sealant specifications (e.g. BS 3712: Parts 1, 2 and 3 which are concerned with methods of test for building sealants, BS 4254: 1967 Two-part polysulphide based sealants and BS 5215: 1975 One-part, gun-grade polysulphide based sealants). It must be recognised that laboratory testing, while quite dependable as a means of comparing products or assessing quality, cannot be expected to accurately predict the in-use performance of a given sealant.

## 2.6 Installation of sealants

Weatherproofing is often one of the last operations on the building exterior, and sealants may have to correct, or compensate for, previous errors and miscalculations. Actual site conditions may not be known in advance and a pre-installation inspection is usually advisable to determine whether or not any changes from the sealant system detailed are necessary.

### 2.6.1 Surface Preparation

One of the essentials for satisfactory performance of any sealant is the quality of surface preparation. Any negligence at this preliminary stage can result in trouble later, regardless of the quality of the sealant or how carefully it is applied.

Surface contamination from dust, dirt, incompatible sealants, and moisture is a major hazard.

In addition, the following contaminations may be present on specific materials.

a On aluminium—Oil, grease films, or wax films. Remove with one of the commercial solvents, followed by wiping with a dry cloth.

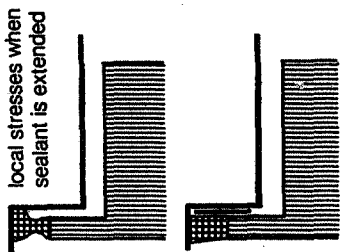
**Notes**

(i) The presence of most protective lacquers can be tolerated but the sealant manufacturer's guidance must be sought particularly in the case of moving joints.

(ii) Care should be taken in the selection of cleaning solvents and primers to avoid removal, softening or discolouration of stoved organic finishes.

b On concrete and masonry—Surface dust, residue from release coatings, polishes, lubricants, residue from reaction with cleaning acid and transparent waterproofing or preservatives. The sealant manufacturer's advice should be sought as to a suitable primer or sealer.

**Fig 5. Bond Breaker**




sealed joint without bond breaker. (unsuitable for moving joints)

sealed joints with bond breaker for moving joints.

### 2.6.2 Bond Breakers

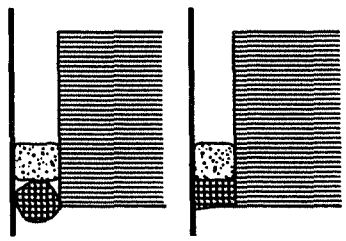
Where there is insufficient depth for joint backing (see figs 1a and 1b) a bond breaker, e.g. PVC tape, should be installed on the rear surface of moving joints to prevent sealant adhesion to the back of the joint and allow the sealant to absorb movement without creating excessive localised stresses. (see fig. 5).

### 2.6.3 Primer or Sealer

Some substrates require a primer or sealer to provide a satisfactory surface to which the mastic or sealant can adhere. The printed instructions provided by sealant manufacturers should be followed implicitly and primers or sealers supplied by one manufacturer should not be used with sealants made by another.

The appropriate primer or sealer must be used for each substrate. Before proceeding with its application, it is advisable to check for staining or deterioration of the material to which it is to be applied.

**Fig 6. Tooling**



not tooled, poor adhesion in joint

tooled good adhesion

### 2.6.4 Application of the Sealant

Two part sealants consist of base compounds and curing agents, which must be properly and thoroughly mixed prior to use. Their 'pot life' (time available for use before curing) is limited and varies with temperature. The one part sealants are ready for use as supplied.

Sealants must be applied with enough pressure and in sufficient volumes to completely fill the joint. Butt joints, in particular, should be tooled after the sealant is applied to ensure full contact with the joint faces and obtain proper adhesion (see fig. 6). Aids such as soapy water may be used to help reduce drag in the process of tooling but care must be taken to avoid contamination of other joints still to be sealed.

If solvents are used as tooling aids they should be specifically approved by the sealant manufacturer.

It is important that any mastic or sealant smeared or inadvertently dropped on adjacent surfaces is cleaned off immediately. Sealant manufacturers will advise on exceptions to this general rule.

A summary of requirements for the site application of mastics and sealants is given in the Appendix.

# 3 Practical guidance in the use of mastics and sealants for windows

Fig. 7 **Butt Joint**

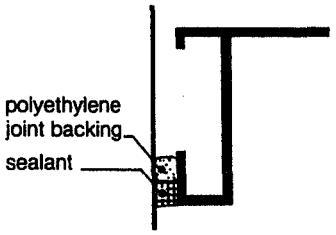



Fig. 8 **Butt Joint**

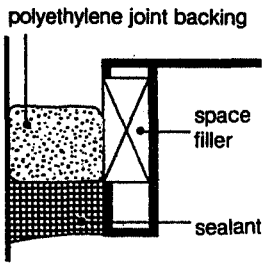



Fig 9. **Lap Joint (bedded)**

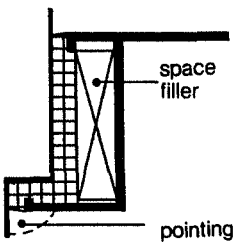
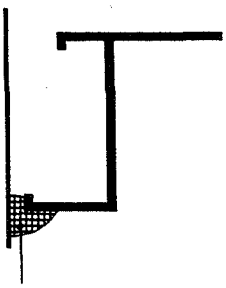



Fig 10. **Fillet Seal**




## 3.1 Terminal Joints

Traditional window designs are suitable for accurately formed openings where triangular fillet pointing or bedding is practical. In recent years difficulties have arisen when these window edge details were used in situations for which they were not designed. Terminal joint solutions for these situations are shown in the AWA Technical Report 1.

### 3.1.1 Butt Joints and Sealed Lap Joints

(see also 2.3.1 and 2.3.2)

The important factors in the design of butt joints are the dimension of the return fin in the edge detail (see fig. 7) and the sizing of the window in relation to the opening, with consideration being given to probable deviations in the opening size. (See AWA Technical Report 1). Joint backing material is essential and a space filler may be required (see fig. 8).

Joints in excess of 25 mm in width may be sealed, if aesthetically acceptable, but liaison with the sealant manufacturer is essential.

Sealed lap joints must allow for deviations in the opening size in such a way that:—

a at maximum clearance there is sufficient lap to provide a suitable area for sealant adhesion (see fig 2).

b at minimum clearance there is a sufficient width of flat external surface to the window profile, unobstructed by projections such as hinges or weatherbars, and that such projections do not restrict access with the sealant gun. (see also AWA Technical Report 1).

**Notes**

1 Deviations in the plane of the rebate will determine the depth of sealant actually used.

2 Where an opening has a combination of inside and outside rebates, e.g. inside at jamb and outside at sill, the difference in the rebate planes must be sufficient to provide for an adequate volume of sealing material, taking deviations into account.

### 3.1.2 Bedded Lap Joints

(see also 2.3.2 and Table 1)

Windows should be bedded onto rebates (see fig. 9) using an adequate volume of material. Excess compound should be tooled off immediately after bedding to prevent contamination of other surfaces. (Masting pointing may be applied to provide improved performance).

### 3.1.3 Butt or Lap Joints with Fillet Seals

(See also 2.3.3).

Fillet seals (see fig. 10) should be restricted to non-moving joints and the dimensions of the joint must be within the limits shown in figure 4.

### 3.1.4 Sealants for Terminal Joints

Under normal circumstances, suitable materials for sealing metal to masonry joints are two-part polysulphides, one-part polysulphides and acrylic sealants.

Pre-treatment of surfaces to which the sealants are to be applied is very important. Cleaning and priming of builder's work must be carried out strictly in accordance with the recommendations of the sealant manufacturer.

Cleaning and priming of the window substrate depends upon the surface finish of the windows and recommendations, based on practical laboratory controlled tests, should be obtained from the sealant manufacturer whose sealant is being used as the requirements vary from one manufacturer to another.

### 3.1.5 Performance of Terminal Joints

To ensure optimum performance and provide a satisfactory seal the following requirements should be met:—

1 The window should be recessed in the opening, having allowed for deviations in the plane of the window.

2 All lintels should have a throating or drip.

3 Rough cast or exposed aggregate finishes must have a smooth finish in the area of the window zone.

4 Joints in brickwork in the area of the window zone must be flush.

5 Mould release agents or water-proofing agents should not be applied in the window zone area.

6 Where there are applied external finishes, such as tile, mosaic or rendering, the principal seal should be between the window and the structure and not to the applied finish.

7 Sealants should not be in direct contact with bituminous materials e.g. DPCs unless this is unavoidable, because their performance will be reduced. Acrylic sealants are possibly the best but even these are susceptible to staining and a black colour may be preferred. Polysulphide sealants must not be used.

8 Particular care should be taken when sealing across the ends of coupling bars.

#### 3.1.6 Site application of Sealants

Pointing should be carried out either by specialist sealant applicator sub contractors or by window fixers who have received proper training in sealant application, preferably in conjunction with sealant manufactuers, to ensure that they are fully aware of the manufacturer's recommendations and requirements.

## 3.2 Joints in Sills and Flashings

Sleeve joints are designed so that there is space between the sleeve and the component to allow for a sufficient depth of mastic or sealant to be applied. The sleeve may be of channel or multi-channel profile. Alternatively, flat sleeves will require separators. The sleeve will usually need to be secured in a way which will allow movement to take place.

The junction between the aluminium section and builder's work must also be sealed.

Where screws are exposed, a sealant should be applied to the thread of the screws.

#### 3.2.1 Sealants for Jointing Sills and Flashing

Materials suitable for sealing these areas are polysulphides or butyl rubbers. Joint sizes are governed by the type of material to be used and the degree of movement expected.

#### 3.2.2 Movement Joints

(expansion, settlement, etc)

Where movement joints are provided in the building the architect should specify their function and the expected movement of these joints. Joints in aluminium should coincide with those in the building and be capable of similar movement.

## 3.3 Panel Joints

The jointing of panels may need special consideration as, depending on the material and colour, their thermal movement may be large and rapid. Advice should be obtained from the sealant manufacturer.

Where joints between cladding panels of any material make contact with window terminal joints, it is necessary to ensure that the sealants used in both joints are compatible.

## 3.4 Glazing on Site

Many systems of glazing are fully detailed and explained in BS.CP 152 and publications of the Glass and Glazing Federation. Reference should be made to these publications concerning the use of compounds and sealants and their expected life.

The positioning of setting and location blocks and distance pieces is described in CP 152 but there may be occasions when the window manufacturer's specification differs from the Code requirements. In these cases the glaziers on site must be given the appropriate information.

#### 3.4.1 Glazing of Panels

There is no trade association, or body, to recommend glazing methods for panels produced from materials other than glass and the panel manufacturer is often reluctant to give recommendations. The materials used in the manufacture of panels appear to be unlimited and little is known of the long-term effects of environmental conditions on some materials. To evolve a satisfactory glazing specification, details of the structural integrity of the panel must be carefully studied to establish the:—

1 degree of thermal movement

2 tolerance on thickness

3 anticipated degree of bow along the edges of the panel and force required to remove that bow

4 surface finish

With this information it should be possible to establish a glazing specification in conjunction with the sealant manufacturer.

## 3.5 Remedial Work

There can be no hard and fast rules regarding remedial work as individual job circumstances and/or frame designs may require different treatment.

The first step should be a thorough site investigation, with all parties concerned, with a view to establishing:—

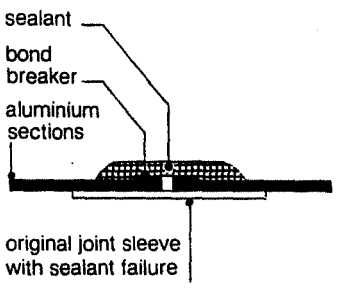
1 the source of complaint

2 responsiblity

3 the remedial treatment

It must be recognised that remedial work sometimes requires the sealant to be used in conditions for which it was not intended and the sealant manufacturer or applicator will not therefore provide any long term assurance in these cases.

**Fig 11. Bandage Joint**




### 3.5.1. Remedial bandage seal

A bandage seal may be necessary for remedial work to joints in pressed metal, sills or subframes. The best bandage seal employs a bond breaker over the actual joint with the sealant built up to a nominal 6 mm thickness and a 10 mm width of adhesion each side of bond breaker (see fig. 11).

The term is also used for a bead of gun applied sealant over a tight joint in pressed metal sections. Sealant manufactuers will seldom give assurance of sealant performances in bandage seals.

# Appendix

**Summary of requirements for the site application of mastics and sealants**
The correct site application of mastics and sealants is important to achieve a satisfactory window installation.

**Some Important Points:**

1 Check that the required perimeter clearances can be provided.

Remember, too little mastic or sealant will be unsatisfactory and too much mastic can cause problems later.

2 Mastics and sealants should not be used when the shelf life date shown on cartridges and tins has expired, nor should they be thinned down or adulterated.

3 Never attempt to apply mastics and sealants to dirty or wet masonry surrounds or window sections.

4 Use the sealers and/or primers recommended by the mastic supplier. Note the instructions on cartridges and tins or as specifically detailed for the contract.

Porous surfaces must always be sealed before applying mastics and sealants.

5 Check factory made joints for handling damage prior to positioning the frame into the surround or sub frame.

Fractured joints must be re-sealed using the correct type of sealant which may not be the same as that supplied for a normal site work.

6 When bedding with mastic make sure there are no voids left after the initial filling by tooling in before the perimeter pointing takes place.

7 Position backing materials to give the minimum joint depth.

For normal butt joints the minimum depth should be 6 mm and for wider joints not less than half the width of the joint.

8 Two part sealants must be thoroughly mixed in accordance with the manufacturer's instructions shown on the tins, using only the recommended ratio of base compound to curing agent.

9 When mastics or sealants have been applied into the joint see that the material is **tooled in to the full depth** to completely fill the joint and remove air pockets.

10 Check "through" frame fixings and seal any fixings that could allow water to penetrate behind the outer surface of the window sections.

11 Remove excess mastic or sealant.