INDUSTRY GUIDE TO THE PROFESSIONAL APPLICATION OF CONSTRUCTION SEALANTS ON SITE

With Compliments

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This Guide is divided into 9 modules:

GUIDE TO SYMBOLS

White Pages – Instructions for all sealants work

Blue Pages – Instructions for remedial work

Yellow Pages – Instructions for new build work

Red Boxes – Warning! These instructions must be followed

Green Boxes – Take note

BASA MODULE 1:

UNDERSTANDING THE JOB TO BE DONE

This module describes the procedures to be followed when first arriving at the construction site - understanding the work to be carried out and the materials to be used. Many of the procedures are common to sealing of new build and sealing for remedial purposes. However, the site conditions for new sealing and remedial sealing are often different and have specific requirements for access and safety. Remedial work is largely about bringing the original joint surfaces to a satisfactory state, ready to receive new sealant.

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THE JOB SPECIFICATION

The building designers or building owners (or their agents) draw this up, usually with expert advice from sealant manufacturers. It will detail the sealing system to be used for specific joints. The more important joints to be sealed will be inspected and measured to ensure their dimensions are within the construction tolerances and that the quality of the bonding surfaces are of an acceptable quality.

Similarly, for remedial work, the joints to be resealed and the sealant system to be used will be specified. Any concerns should be discussed prior to the commencement of work.

Re-sealing of joints is done either:

1. to replace a failed sealant, or

2. to replace the original sealant as part of a refurbishment programme.

If the original sealant failed it is important to understand why, so that the same mistake is not made again. The construction owners and or his consultant, usually in conjunction with the sealant manufacturers, will do this investigation. There are a number of reasons for a sealant to fail.

(See Module 5: Sealant Failures and Problems - page 37).

The job specification will be reviewed by the sealing sub-contractor and discussed with the sealant applicators. If there are any queries, ask the relevant site manager or sealant manufacturer.

IF THE SURFACES TO BE SEALED ARE OF NATURAL STONE, CONFIRM THAT THE PRIMER/SEALANT SYSTEM IS NOT GOING TO CAUSE STAINING. NOTE ANY SPECIAL INSTRUCTIONS RELATING TO THE JOB.

WALKING THROUGH THE JOB

THE SEALANT APPLICATOR TEAM, ACCOMPANIED BY OTHER SITE CONTRACTORS, SHALL FAMILIARISE ITSELF WITH THE SITE, ALL THE SAFETY REQUIREMENTS, INCLUDING COSSH AND RISK ASSESSMENTS AND THE JOINTS TO BE SEALED OR RESEALED. RECORD AGREED ACTIONS.

For each joint, prepare work sheets (using the recommendations on the following two pages):

Walking Through the Job - New Build

Review the sealant specification for the project and confirm:

- The type and location and size of the joint to be sealed.
- The sealant type to be used in the specific joint.
- Backing material and depth of placement in the joint.
- Does the joint require a bond breaker?
- Should masking tape be used?
- Does the joint require priming?
- Discuss how to access the joints to be sealed, especially those which are difficult to access. Procedures should be agreed, safety issues raised and put on record and resolution agreed.

Prepare a schedule for the work. If appropriate, take into consideration which elevations are best sealed in the morning, which in the afternoon.

Check the joints to be sealed for potential problems and agree how to proceed:

- Bonding substrates are those specified.
- Joints too small or too large.
- Joint surfaces needing repair.
- Joint surfaces excessively contaminated.
- Any packing materials removed.

Walking through the job - Remedial

For the surface preparation:

- The type and location of the joint to be re-sealed.
- What materials form the joint surfaces?
- Can the joint surfaces be stripped easily of old sealant?
- Is the old sealant system to be removed completely back to a fresh surface or not?
- If completely removed, what method and tools should be used?
- Can solvent be used and if so, which one?
- Will cutting or grinding be necessary? If cutting, how much and how deep?
- Is power available?
- Will the joint surfaces have to be repaired in any way? If so, what are the procedures?

For access:

- Is the site subject pedestrian or vehicular traffic? Are measures in place to control both?
- How are the joints to be re-sealed to be accessed?
- Is power available?
- Procedures should be agreed; safety issues raised and put on record.

For the resealing:

- The sealant type to be used in the specific joint.
- Backer rod and depth of placement in the joint.
- Does the joint require a bond breaker?
- Should masking tape be used?
- Does the joint require priming?
- Is the sealant joint to be flush or recessed?

CHECKING AND STORING MATERIALS TO BE USED

The sealing contractor will check the types and quantities of all the materials allocated to the sealing work to be carried out on site and compare them to those given in the job manifest.

For each joint to be sealed:

– Check against the job specification

– the name of the sealant manufacturer

– the sealant name

– type

– grade

– colour

– packaging type.

Any deviations should be recorded, reported and put right. Record the batch numbers and the sealant use-by date. If the product is out of shelf life the product must not be used and the sealant manufacturer contacted for specific advice.

If another sealant is substituted for the one specified, written confirmation of its suitability for the application should be obtained from the specifier and other interested parties. A certificate of conformity to the standard specified for the sealant should be requested.

Carry out the same checks for primer systems to be used. Record the batch number and the use-by date. If the product is out of shelf life the product must not be used and the sealant manufacturer contacted for specific advice.

PRIMER SYSTEMS ARE DESIGNED FOR A SPECIFIC SEALANT. IF THE SEALANT IS SUBSTITUTED, MAKE SURE THE PRIMERS SUPPLIED ARE STILL SUITABLE.

Check the ancillary materials against the job specification (back-up materials, tapes, cleaners).

Read material safety data sheets (MSDS) for all the materials. If there are any doubts, contact the manufacturer. Retain MSDS on file. Also note the disposal recommendations given on the MSDS and any site and local authorities requirements.

Where given, storage of all materials should be in accordance with supplier recommendations. Ensure all materials are securely stored in the dry and not exposed to excessive heat or cold. Materials labeled with the 'Flammable' or other hazard signs should be stored following site regulations and in accordance with the supplier recommendations.

GETTING STARTED

For remedial work, prepare a schedule for the joint preparation. Ensure the applicators have the tools for removing the old sealant and preparing the joint surfaces.

When the joint surfaces are ready to be sealed or resealed (and have been inspected), prepare a schedule for the sealing work. Ensure the applicators have sufficient sealant, primer(s) and ancillary materials and the tools for the job (cartridge guns, mixers, brushes, tooling aids). Input should be sought from the ASA. If appropriate, take into consideration which elevations are best sealed in the morning, which in the afternoon.

Records of the work of the work carried out should be kept in a project folder or log book and then included in the Project Manual.

APPLICATORS MUST USE SAFETY EQUIPMENT AND CLOTHING APPROPRIATE TO THE WORK BEING UNDERTAKEN AND FOR THE SPECIFIC CONDITIONS FOUND AT THE CONSTRUCTION SITE.

(See Module 6: Health and Safety and Environmental Issues - page 49).

THE WEATHER

EXTERNAL SEALING SHOULD BE CARRIED OUT ONLY IF THE WEATHER CONDITIONS ARE SUITABLE.

Tip: **KEEP A DAILY RECORD OF THE WEATHER, INCLUDING MAXIMUM AND MINIMUM AIR AND SUBSTRATE TEMPERATURES.**

– Most primers or sealants should not be applied to surfaces which are being wetted or are wet as a result of rain, snow, frost or condensation. Where a sealant manufacturer states that their products can be applied to damp wet surfaces, it is advised that the applicator checks the suitability with the sealant manufacturer before use.

– When the weather is very cold or very hot, check the sealant/primer manufacturer's guidance on recommended temperature of application.

– Remember, surfaces exposed to direct sunlight can reach much higher temperatures than the surrounding air. Applying primer or sealant to hot surfaces can lead to problems e.g. bubbling at the sealant substrate interface.

(See Module 2: Preparing the Surface - page 11).

MODULE 2:

PREPARING THE SURFACES FOR SEALING

Having completed the preliminary checks (See Module 1: New Build/Remedial. - page 3), the joints are now in a form ready for the sealing process, i.e. repairs to joint surfaces have been made, where possible undersized joints have been enlarged, any serious contamination has been removed. Proper access is in place. All materials and tools are assembled. The weather is suitable for work to start.

INITIAL PREPARATION - NEW BUILD SEALING

Whilst preparing the surface the applicator will see close up any remaining problems which might affect the sealing work. Remedial action should be taken before any sealing work is undertaken.

Prepare and clean the surfaces according to the sealant manufacturer's instructions. Surfaces to be sealed must be clean, dry (see note about damp surfaces in the Weather section on page 10), free of loose materials and free of contaminants left from the construction process.

On porous substrates allow any residual solvent to evaporate prior to sealant application.

THE DURABILITY OF THE SEALED JOINT IS ONLY AS GOOD AS THE ADHESION OF THE SEALANT (AND PRIMER) TO THE SURFACES FORMING THE JOINT. PRIMERS AND/OR SEALANTS WILL ADHERE TO SURFACES ONLY IF THOSE SURFACES ARE PROPERLY PREPARED. A VERY LARGE PROPORTION OF ALL JOINT FAILURES RESULT FROM POOR OR INADEQUATE SURFACE PREPARATION.

(See Module 4: Surface Preparation and Adhesion - page 29).

Remove laitance from new concrete using a wire brush (or suitable power tool).

IF SOLVENTS ARE USED CONSULT THE MANUFACTURERS MSDS FOR SPECIFIC INFORMATION ON USE.

On pre cast panels check with manufacturers that release agents used in the manufacture of the panels will not impair the adhesion of the sealant. Take what action is required.

Remove all loose particles and dust using a soft paint brush (or oil free compressed air).

Some very smooth surfaces may need abrading to give a good key for adhesion. Consult with the sealant manufacturer. Brush off and remove subsequent dust.

Wipe non-porous surfaces (glass, aluminium etc.) with a lint free cloth and a solvent recommended by the sealant manufacturer (Apply the solvent to the cloth, not to the surface). *N.B. Some surfaces can be attacked by solvents. Seek advice from the sealant manufacturer. In the absence of guidance, apply solvent to small test area first.*

To avoid contamination, always work in one direction only. Dry the surface using a *dry* lint free cloth, working in the same direction. Simply allowing the solvent to evaporate off the surface is insufficient.

If there is any delay between the surface cleaning and subsequent steps, it may be necessary to repeat the process, especially if it is windy and dusty or it has rained onto the surfaces.

REMEDIAL SEALING

This section describes techniques and procedures for preparing joints prior to their re-sealing with a gun applied or flowable grade cold cure sealant. Joint surfaces have to be cleaned and returned to their original clean condition as a prelude to the application of a new sealant system.

Re-sealing of joints is done either:

I) to replace a failed sealant

or

II) to replace the original sealant as part of a refurbishment programme.

DUE THE CONTAMINATION OF THE JOINT BY THE OLD SEALANT, THE PREPARATION OF THE SURFACES PRIOR TO THE APPLICATION OF THE REMEDIAL PRIMER /SEALANT SYSTEM IS AS IMPORTANT, IF NOT MORE IMPORTANT, THAN THE PREPARATION OF THE SURFACES FOR THE ORIGINAL SEALING.

The preparation of joints prior to their resealing is complicated by the presence of residues of sealant and primer from the original work. If practical, these residues must be completely removed.

If there are traces of old sealant and primer left on the surface, it may be still possible to get good adhesion, however the advice of the manufacturer of the sealant to be used in the remedial work should be taken. All parties involved must agree just how free of old sealant and primer the surfaces need to be, before applying the remedial sealant/primer system.

OPTION 1: COMPLETE REMOVAL OF OLD SEALANT/PRIMER

NON-POROUS JOINT SURFACES

Pull the bulk of the failed sealant from the joint or cut it out using a sharp blade, cutting right back to the joint surfaces, ensuring no damage is caused to sensitive surfaces (Fig 2.1). For hardened sealant it may be necessary to use a chisel. Remove old backer rod from the joint and brush out any loose debris.

Fig 2.1

Remove any residual sealant/primer on the joint surfaces using a plastic scouring pad or similar with water (Fig 2.2). For more stubborn residues, it may be necessary to use more aggressive abrasion, with a metal scouring pad or wire brush, making sure not to scratch the joint surfaces unduly. For solvent resistant substrates, the sealant can be weakened by dipping the scourer in a solvent (the sealant supplier will advise) prior to rubbing. Brush out all loose materials.

Fig 2.2

Finally, wipe the joint surfaces using a clean, lint free cloth, removing the last traces of loose material (Fig 2.3).

Fig 2.3

POROUS JOINT SURFACES

Concrete, brick, natural stone, etc.

Fig 2.4

Pull the bulk of the failed sealant from the joint or cut it out using a sharp blade, cutting right back to the joint surfaces. Remove old backer rod from the joint and brush out loose material. Using a wire brush, vigorously remove the remaining sealant / primer from the joint surfaces (Fig 2.4). Brush loose materials off the surface.

When the surface roughness and porosity of mortar, brick or natural stone make it difficult to remove the residues of the original sealing system, a fresh surface has to be exposed by cutting or grinding.

CUTTING AND GRINDING

Cutting a joint increases the joint width, which shall be taken into consideration when choosing the remedial sealant.

Mark out on the front surface(s) of the joint the width that is to be cut away (Fig 2.5). Using the appropriate power cutting tool make a vertical cut into the surface(s) (Fig 2.6). Ensure that the cut is deep enough to remove all old sealing material (contamination by old sealant could result in premature failure of the joint. The depth of the cut should be at least half the new width. (e.g. if a joint is opened up from 16mm to 24mm, the depth of the cut must be at least 12mm).. Chase out the joint, removing the contaminated face(s), using the appropriate tool (Fig 2.7). Brush loose material from the joint and off the new surface(s).

(The cutting process will produce a step between the base of the opened joint and the top of old joint. Before sealing, it may be necessary to put a bond breaker along the step).

Fig 2.5

Fig 2.6

Fig 2.7

THIS SECTION IF FOR GUIDANCE ONLY AND ALL OPERATORS OF POWER TOOLS SHALL ENSURE THAT THEY HAVE APPROPRIATE TRAINING ON THEIR USE.

OPTION 2: PARTIAL REMOVAL OF OLD SEALANT

Use a field adhesion test to confirm that the old sealant is fully adhered to the substrate. It is also important to know the type and nature of the old sealant/primer system.

If the adhesion of the old sealant is sound, it may be possible to apply a new, sealant directly on to the residue of the old one. This will be a cost effective way of carrying out the remedial work, since the joint preparation work described above will not be necessary.

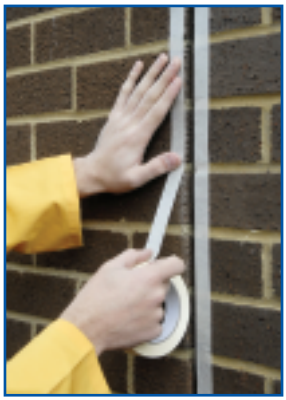
It is essential that the sealant applicator consults with the sealant manufacturer to ensure that the appropriate selection of the primer/sealant system is made. *Only sealant manufacturers are able to recommend suitable systems.*

(See Module 4: Surface Preparation and Adhesion - page 29).

The following steps apply to both new build and remedial.

APPLYING MASKING TAPE

Masking tape should be used where it is important to protect the face of the joint from primer and/or sealant contamination (Fig 9). On less critical surfaces and recessed joints, it is possible to dispense with the use of masking tape (experienced applicators).



– The masking tape must be suitable for the surface (adhering, non-contaminating).

– It must be easy to remove after sealing and not pull away the surface layer.

– On removal it must not leave behind any of the tape adhesive (a cause of dust pick up).

– Tape must always be removed as soon as possible after application of the sealant.

APPLYING BOND BREAKER

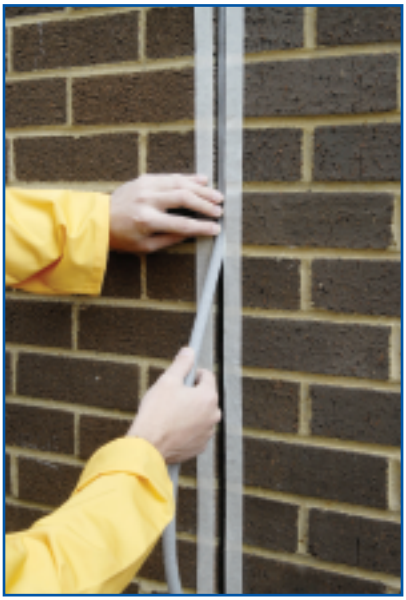
So that the sealant can move freely as the joint moves, it is important that the sealant adheres to the two principle surfaces only. A bond breaker (typically polyethylene tape or film to which the sealant will not stick) will be required to prevent adhesion to the third surface.

(See Module 7: Principles Behind Joint Sealing - page 53).

In many joints, backer rod serves as the bond breaker.

APPLYING THE BACKER ROD

Backer rod is pushed into the joint to ensure the correct and uniform sealant depth along the whole length of the joint. Backer rod makes it easier to completely fill the joint with sealant, controls the sealant depth, reduces sealant wastage and supports the sealant during tooling. The backer rod acts as a non-adherent gap filler, preventing the sealant from penetrating behind the joint and adhering to other surfaces. In horizontal joints, the backer rod will support sealant subject to pedestrian or vehicular traffic.



Where the sealant depth is fixed by the design of the joint, backer rod is not required. However, bond breaker tape might be.

Commercial backer rod comes in many forms and materials. It is compressible and flexible, but relatively stiff to avoid being distorted or pushed back during the application of the sealant or during tooling. The most common types are:

– Sheets of polyethylene or polyurethane foam from which backer rod of the required width is cut. This must be placed in the joint such that the foam skin faces the sealant. The polyurethane foam might be open cell or closed cell.

– Circular rod of polyethylene or polyurethane foam with a surface skin, supplied in various diameters.

Adhesion to polyethylene is generally poor and so bond breaker tape need not be used. However, if other materials are used, which might bond with the sealant or interact in someway with the sealant e.g. bitumen impregnated fibreboard, a bond breaker should used between the sealant and the backer material. Seek the sealant manufacturer's advice regarding compatibility.

When inserting the backer rod into the joint use the following procedure and precautions:

– Use backer rod whose width or diameter is greater than the width of the joint (at its widest point), such that it is held firmly in compression when in place. (Typically 25% compression, but see the manufacturer's recommendations).

– Push the backer rod into the joint to the specified depth (the depth should be half the joint width and never less than 6mm in non- trafficked joints), using a suitable T-piece tool or wheel, taking care not to twist or fold the backer rod.

– If the skin of a closed cell foam is inadvertently punctured during insertion, allow any gas to escape before putting sealant on top (at least 30 minutes). Failure to do so may result in bubbles forming in the wet sealant.

– When using open cell foams, it is important to ensure that they are not subject to water exposure as any trapped moisture can lead to blistering.

– Where one length of rod finishes, butt up the new length so there is minimum of discontinuity.

– If a bond breaker tape is used, apply it carefully so as not to displace the backer rod.

(See New build/remedial. Module 3: Application of Sealants - page 21).

MODULE 3:

APPLICATION OF COLD APPLIED SEALANTS TO THE JOINT

By this stage, the joint surfaces are fully prepared (new build or remedial) and masking tape, backer rod and bond breaker are in place as required (LINK TO MODULE 2: PREPARING SURFACES FOR SEALING - PAGE 11).

Whether the joint is a butt joint, fillet joint or floor joint, the procedures for priming, sealant application and tooling are basically the same.

If the weather is suitable, proceed with priming and sealing, following to the agreed schedules.

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APPLYING THE PRIMER

The main purpose of using a primer is to aid adhesion of the sealant to the joint faces. Primers are used most frequently on porous surfaces such as concrete, brick and natural stone. They are used on non-porous surfaces too, for example to improve the adhesion of certain sealants to difficult surfaces such as thermoplastics. Primers can help consolidate the surface of a material with a tendency to crumble, but you should NEVER rely on a primer to consolidate friable surfaces.

(Link to Module 3: Substrates, Surface Preparation and Adhesion - page 21).

CORRECT APPLICATION OF THE PRIMER IS AS IMPORTANT AS THE APPLICATION OF THE SEALANT. ALWAYS FOLLOW THE ADVICE OF THE SEALANT MANUFACTURER. NEVER SUBSTITUTE ONE PRIMER SYSTEM FOR ANOTHER WITHOUT PRIOR CONSULTATION.

The following procedures and precautions should be used:

- Be sure that the primer being applied is the one specified for the surface being sealed.
- *Take particular care* if the two surfaces forming the joint are of two different materials (e.g. stone and powder coated steel) requiring two different primer systems.
- Check prior to use that the primer is in date.
- Ensure that reactive primers are in good condition (no signs of hydrolysis or reaction or stringiness).
- If the primer is a two component system, mix the components as per the manufacturer's instructions. Use within manufacturers recommended pot life.
- Make sure there is sufficient primer to prime the joint being sealed in one visit. Only use newly opened containers of primer. The primer should be decanted into a smaller container for application, do not return dregs to the bulk container, but discard them into the allocated waste vessel.
- Schedule the priming so that the subsequent sealing can be done within the time recommended by the sealant manufacturer.
- Some primers dry to a very thin film, which is invisible. Make sure there is a system in place which says which surfaces have been primed and which have not.
- Apply the primer to the dry surface using a soft paint brush of a size compatible with the width of the specific joint. Some thin film primers/surface conditioners for non-porous surfaces can be applied with a clean lint-free cloth (follow the sealant/primer manufacturer's advice).
- For porous materials, work the primer to ensure complete surface penetration.
- Do not spread the primer too thinly.
- Do not apply excess primer.
- Do not miss ANY areas.

WHEN USING PRIMERS ENSURE THAT YOU FOLLOW ALL CURRENT RELEVANT HEALTH & SAFETY GUIDELINES.

DO NOT INSERT ANY BACKER MATERIAL UNTIL THE PRIMER IS DRY.

SEALING THE JOINT

The joint is now ready to seal - properly prepared, clean and intact and primed where necessary, backer rod and masking tape in place.

To be effective the sealant must fill the joint to the specified depth and be pressed firmly against the surfaces forming the joint. Tooling is essential to ensure that the sealant wets out the substrate surface and optimizes adhesion.

Sealants are supplied as single or multi-component systems, in a variety of chemical types and several different packaging options e.g. cartridge, sausage (sachet) or tins and are applied using a cartridge gun (open or closed body, manual or air powered).

(See Module 8: Sealants - page 61).

Once the components of the sealant have been mixed the cure begins. The sealant must be used as soon as possible and well within the work life as indicated by the manufacturer. (N.B. the hotter the weather the shorter the work life).

Follow the manufacturer's instructions for using the sealant cartridge. For a typical one component cartridge cut the end off the screw top of the cartridge or puncture the foil diaphragm before affixing the nozzle to allow the sealant to extrude.

Cut off the end of the nozzle to give a hole size appropriate to the width of the joint being sealed.

MIXING MULTI-COMPONENT SEALANTS

Two (or more) part (component) sealants must be mixed together. They are supplied in several types of packaging including tins, pouches and cartridge systems:

The base and the cure paste are usually different colours, so the final mixed system should be free of stripes (a good way to check this is to spread a thin film of the mixed sealant onto a piece of waste material).

IT IS CRITICAL THAT THE TWO (OR MORE) COMPONENTS ARE MIXED COMPLETELY AND SEALANT MANUFACTURERS INSTRUCTIONS SHOULD BE FOLLOWED:

(A) FOR THE CURE CHEMISTRY TO PROCEED TO COMPLETION
(B) FOR COLOUR UNIFORMITY.
(C) TO AVOID CROSS-CONTAMINATION OF UNUSED MATERIAL.

APPLYING THE SEALANT

The type, configuration and location of the joint will determine whether it is necessary to use bond breaker, backer rod or masking tape.

(Link to Module 2: Preparing the Surfaces for Sealing - page 11).

Extrude the sealant into the joint. The surest way is to *push* the nozzle along the joint, not pull. Pulling can lead to under filling and air being trapped behind the sealant, especially if the nozzle is moved too quickly along the joint. However, pulling the nozzle along the joint need not be a problem for experienced applicators.

Extrude the sealant firmly into the corners of the joint and against the backing, making sure to avoid air voids from being formed. *Slightly* overfill the joint.

There are some situations where the sealant is required to be recessed, e.g. some floor joints, some stone cladding.

If the joint is wider than the cartridge nozzle, first extrude the sealant into the corners of the joint. Then fill in the space between these sealant beads. Repeat this process until the joint is full.

At the end of a sealing run, release the cartridge pressure if necessary.

When a new cartridge is needed mid run, make sure there is full contact between the sealant already applied and the new start. Ideally, do not allow the sealant already applied to skin over or cure before restarting.

When sealing a joint in the middle of a run after a prolonged delay, e.g. an overnight cure or after a weekend break, cut away a section of the cured sealant already applied with a clean dry knife or blade, to leave a clean cut surface with no contaminants present. Apply the fresh sealant to the cut surface with sufficient pressure on the gun to prevent air voids forming at the interface, and then continue with the sealant application.

TOOLING THE JOINT

The prime purpose of tooling is to ensure the sealant is pushed firmly against the sides of the joint - an essential for good adhesion.

A variety of tooling devices are available which can be used to produce the required surface profile.

SHRINKAGE OF THE SEALANT DURING CURING SHOULD BE TAKEN INTO CONSIDERATION WHEN TOOLING. SEE MANUFACTURERS INSTRUCTIONS.

Tooling also gives the finished joint a professional, aesthetically pleasing appearance.

Most applicators have their own tooling devices for different size joints. Do not use the finger or thumb to tool.

There are no hard and fast rules as to what should be used, other than smooth and usually slightly curved to give a concave surface. To provide a smooth clean finish to the joint, it is possible with some sealants to wet the tool with water or dilute soap solution (check with the sealant manufacturer). If this technique is utilized the length of the joint must be completely filled with sealant to prevent the water/soap solution from contaminating the bonding surfaces in unsealed areas.

TOOLING MUST BE DONE BEFORE THE SEALANT HAS SKINNED OR EXCEEDED ITS POT LIFE. IN HOT AND HUMID WEATHER AND WITH SOME TYPES OF SEALANT THERE IS VERY LITTLE TIME BETWEEN APPLICATION AND SKINNING.

USE THE FOLLOWING GENERAL GUIDELINES:

Run the tooling device along the sealant, feeling resistance as the sealant presses against the back of the joint.

Using a spatula or similar tool remove any excess sealant.

Using the tooling device, smooth the sealant surface. Do not use the finger or thumb.

If using masking tape, remove immediately after tooling and before the sealant skins or cures, by peeling it in a direction across the joint. If the sealant has cured the sealant surface will be damaged when the tape is removed, causing aesthetic or physical damage to the sealant joint.

*For **fillet joints**, the volume of sealant applied must be sufficient for sealant contact/adhesion to both bonding substrates.*

*For **floors or flat roofs** the sealant may be a self leveling grade and can be tooled flush if necessary. Sometimes the edges of the joint can be chamfered and the sealant is poured (or gunned) to be level with the bottom of the chamfer.*

(See Module 6: Principles Behind Joint Sealing - page 49)

CLEAN UP

FOR GOOD PRACTICE AND TO COMPLY WITH REGULATIONS IT IS IMPORTANT TO KEEP EQUIPMENT CLEAN AND TO DISPOSE OF WASTE MATERIALS PROPERLY.

(See Module 6: Health and Safety and Environmental issues - page 49).

IF SOLVENTS ARE USED CONSULT THE MANUFACTURERS MSDS FOR SPECIFIC INFORMATION ON USE.

Immediately after use clean primer brushes, mixers blades, spatulas, tooling sticks etc. according to the manufacturer's instructions.

INSPECTION

Dispose of used rags, paper and masking tape, spent cartridges and nozzles, empty sealant and cure paste tins, used follower plates, empty primer tins, disposable gloves and any other contaminated items in the appropriate waste containers in accordance with local authority requirements.

Likewise, dispose of waste primer and solvents according to current legislation/local authority guidelines.

The responsible site officers may conduct a final full inspection of the sealed joints.

The applicator should undertake regular inspections during sealant installation and the manufacturer should be contacted if the inspection reveals any of these problems:

At the end of a shift, check that sealant applied at the start of the day is skinning and losing tack or hardening by gently touching the sealant.

Look for variations in colour, slump of sealant from the joint or lack of self-levelling where expected.

MODULE 4:

SURFACE PREPARATION FOR OPTIMUM ADHESION

SURFACE PREPARATION AND ADHESION

Introduction

The most common cause of failure in sealed joints is loss of adhesion. For the long term durability of the seal it is necessary:

i. To use a sealant (or sealant/primer combination) which gives good initial adhesion,

ii. The sealant is correctly applied to suitably prepared substrate surfaces,

iii. To ensure the adhesion is sufficient to survive the mechanical and environmental stresses to which the sealed joint is likely to be exposed.

Sealant systems are formulated to adhere to a wide range of different materials. It is possible for a sealant to lose adhesion:

i. because its properties have changed (e.g. hardening, embrittlement, chalking) and the adhesive bond becomes the weak link in the joint, or,

ii. the adhesive bond itself has deteriorated due to an external factor (e.g. water, uv degradation).

These two routes to adhesive failure can be minimised by the correct selection of sealant (sealant/primer).

HOWEVER, ALL THIS CARE IS WORTH NOTHING IF THE SURFACES TO WHICH THE SEALING SYSTEM IS TO BE APPLIED ARE NOT.

The principles of adhesion

For a sealant to adhere to a surface it is necessary to have:

1. **Good contact.** The sealant must make very close contact with the topography of the surface. Only by making close contact with the whole of the surface area is adhesion maximised. This is easy on relatively flat, smooth surfaces such as glass, plastics, and metals (Fig. 1a). In fact, smooth surfaces have microscopic roughness. This is an advantage, as the sealant has something to 'key' into (Fig. 1b). For very rough surfaces, such as mortar and wood, the viscous sealant cannot seep into the deep crevices and it only makes contact with the peaks, giving only small areas of adhesion (Fig. 1c).

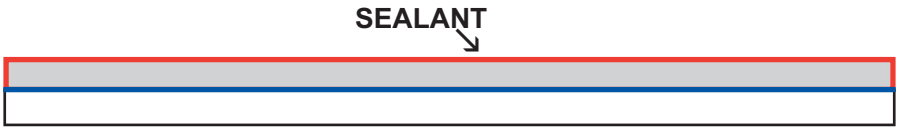


Fig.1a Smooth surface - good contact

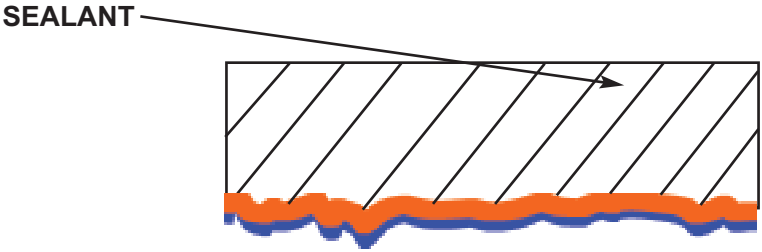


Fig.1b Smooth surface (magnified) - good contact

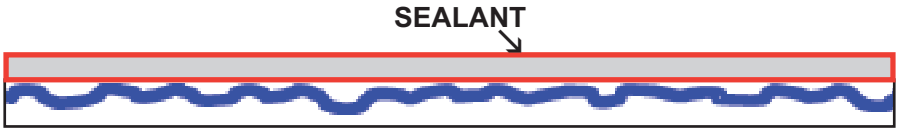


Fig. 1c Rough surface - poor contact

Primers have a lower viscosity and flow into the crevices, filling the roughness and presenting a level and consistent surface to the sealant (Fig 1d)

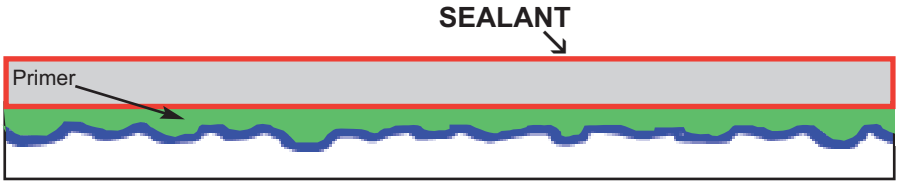


Fig 1d Primed surface – good contact

2. **Cleanliness.** The surface must be free of dust, dirt, old sealant, grease, laitance etc. (Fig. 2a and Fig. 2b). The purpose of cleaning the surface prior to applying the sealant (or primer) is to remove the contamination. Contamination places a barrier between the sealant and the surface, preventing adhesion. It can also inhibit the natural adhesion built into the sealant formulation.

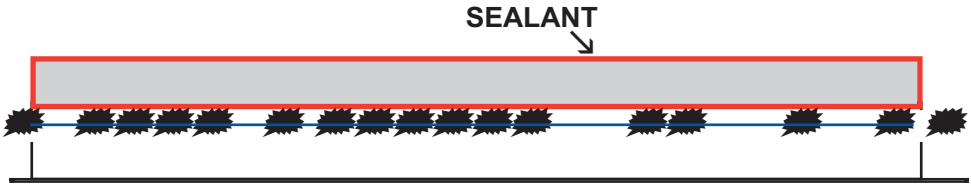


Fig 2a Dirt, dust, old sealant on surface - poor contact

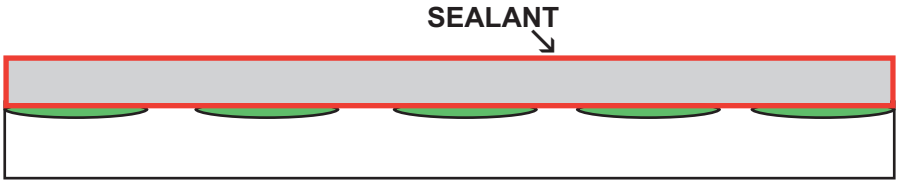


Fig. 2b Oil, grease on surface - poor contact

3. **Integrity.** The surface must be strong and not disintegrate when the sealant is extended. A common example is concrete spalling. If there is evidence of this, the loose surface material must be removed or bound in some way. Primers will bind and consolidate loose surfaces sufficiently in many cases.

4. **Good 'wetting'.** Wetting is a fundamental parameter in the science of adhesion. In simplest terms it says something about the compatibility of sealant (or primer) with the surface material. To illustrate this, consider a drop of water put onto polyethylene or PTFE. If the surface is clean it will form small droplets and not spread across the surface. It has not wet the surface (Fig 4a). However, if the water is dropped onto clean metal it will form puddles, spreading across and wetting the surface (Fig 4b). Clearly the surfaces are fundamentally different.

5. At a molecular level, the sealant (or primer) also should 'wet out' the surface onto which it is applied, ideally spreading and covering the surface evenly. If the sealant (or primer) and the surface are incompatible, the sealant will not 'wet' the surface, but will make poor contact. This poor contact gives rise to weak, patchy adhesion.

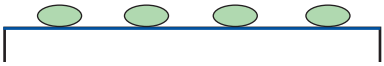


Fig 4a Poor 'wetting'

Fig 4b Good 'wetting'

5. **Good sealant/primer formulation**. The sealant formulator controls adhesion by:

   – Selecting formulation ingredients which enhance adhesion.

   – Optimising the viscosity of the sealant so that it will flow into the surface roughness, but not slump from the joint.

   – Recommending primers when necessary. Primers are designed for specific surface/sealant combinations. The primer must wet out and adhere to the surface; the sealant must wet out and adhere to the primer coat. Primers are not universal, but designed to be used with designated sealants only. Some sealants form thick films on the surface (e.g. as might be used on mortar). Others are very thin film, and behave more like surface conditioners (e.g. as might be used on anodised aluminium).

The preparation of surfaces prior to sealing

All surfaces can be dusty, dirty, oily etc, In addition, some surfaces have specific contamination associated with them (see Tables below) The Tables give some general principles on cleaning. For more information see BASA sealants module 2.

In all cases follow the sealant manufacturers' instructions.

Porous substrates		
Surface	**Contamination**	**Cleaning procedure**
Cast concrete	Dust	Brush away loose dust. Wipe surface with a lint-free cloth dampened with water or a solvent (moving in one direction, using the two-cloth technique). Allow surface to dry prior to applying primer/sealant.
	Laitance	Remove with wire brushing. Wipe away residual dust as above.
	Shutter release oil	Abrade to a clean surface with a wire brush. Remove dust as above.
	Oil/grease	Clean off excess contamination with a solvent. Care should be taken not to spread the contaminated solvent onto clean surfaces. If the oil has penetrated the surface, it may be necessary to grind back to a fresh surface. Remove resulting dust as above.
	Spalling	Chisel or wire brush loose concrete to a firm surface. Remove dust as above. Make good large defects with a suitable resin/mortar compound.
Cut or ground concrete	Dust	Water wash soon after cutting (power wash if possible). Dry. Check dried surface for residual dust. Remove as above.
Natural stone	Dust	Brush away loose dust. Wipe surface with a lint-free cloth, dampened with water or solvent (moving in one direction, using the two cloth technique). Care should be taken not to spread the contaminated solvent onto clean surfaces. Allow surface to dry prior to applying primer/sealant.
Exterior Insulating Finishing Systems (EIFS)	Dust	Brush away loose dust. Wipe surface with a lint-free cloth, dampened with solvent (moving in one direction, using the twcloth technique).
Timber	Saw dust, natural oils	Brush away loose dust.

Non-porous substrates		
Surface	**Contamination**	**Cleaning procedure**
Glass	Any	Wipe with lint-free cloth dampened with solvent.
Aluminium anodised	Any	Wipe with lint-free cloth dampened with solvent.
Aluminium milled	Oil, oxide layer	Abrade with emery paper. Wipe with lint-free cloth dampened with solvent.
Steel	Oil, rust	Abrade with emery paper. Wipe with lint-free cloth dampened with solvent.
Steel galvanised	Any	Wipe with lint-free cloth dampened with solvent.
Steel painted	Chalking, flaking	Abrade with emery paper. Wipe with lint-free cloth dampened with solvent.
Steel – stainless	Any	Wipe with lint-free cloth dampened with solvent.
PVC -u	Any	Wipe with lint-free cloth dampened with solvent.
Painted timber	Chalking, flaking	Remove loose paint. Sand down. Brush away dust. Solvent wipe.

REMEDIAL WORK
ADHESION TO OLD SEALANT

Prior to remedial sealing it is necessary to remove all old sealant from the joint surfaces (See Module 2: Remedial - page 11).

However, where a sealant has failed cohesively (torn down its complete length), it may be possible to apply a new, more elastic sealant directly on to the residue of the old one.

Critical to this approach is the choice of the primer/sealant system. Only sealant manufacturers are able to recommend suitable systems and without clear direction such an approach should not be considered.

MODULE 5:
JOINT FAILURES AND PROBLEMS

INTRODUCTION

The annual UK costs of the failure of sealed joints in structures runs into millions of pounds.

There are many reasons for joint failure which can lead to loss of the sealing function and the potential to damage a structure and its contents.

In addition there are aesthetic failures where the sealing remains intact but the appearance of the sealant or the adjacent surfaces is unsatisfactory. Deterioration in the appearance of a building façade as a result of changes in sealant appearance or staining can lead to costly litigation, especially with prestigious structures.

In either case, the sealant will have to be removed and the joint resealed. As the cost of remedial sealing nearly always exceeds the cost of the original work, the old saying 'Get it right first time' is very true. The sealant manufacturer and applicator play a pivotal role in this. For example, through experience and education they are able to see potential problems before the sealing work begins. Improper joint design and sloppy construction can lead to sealant failure. If potential defects can be identified before the sealing commences there is an opportunity for pre-emptive action.

Material specification is most important to the durability of sealants in joints. During their life sealants are subject to mechanical stresses due to movement and chemical stresses due to the environment. For all applications, but especially those in the most difficult environments, the correct selection of sealant, primer and ancillary materials is critical.

The Ways in which Sealed Joints Fail

Failure in sealed joints falls into two general categories.

1. Mechanical failure (leading to loss of the sealing function):
   - loss of adhesion
   - loss of cohesion (splitting)

Sometimes, cohesive failure is very near to the joint surface, with only a trace of sealant left on the surface. This is referred to as thin film cohesive (boundary) failure.

2. Aesthetic failure (sealing function remains intact):
   - poor workmanship (mixing, masking, gunning, tooling, …)

- surface deterioration (cracking, discoloration, chemical attack...)
- staining of adjacent surfaces.

As a general rule, aesthetic failures only matter in highly visible joints, in public places. However, deterioration of the sealant surface may be accompanied by a change in the properties of the sealant and indicate impending mechanical failure.

There are many factors that bring about both of these two general types of failure. They may relate to the design of the joint, to the joint preparation or to the application of the sealant.

The principal factors controlling the durability of a sealed joint, both mechanically and aesthetically are:

- The selection of the sealing system (sealant, primer)
- Compatibility of the sealant with adjacent materials
- Incompatible sealant chemistries
- Inadequate surface preparation

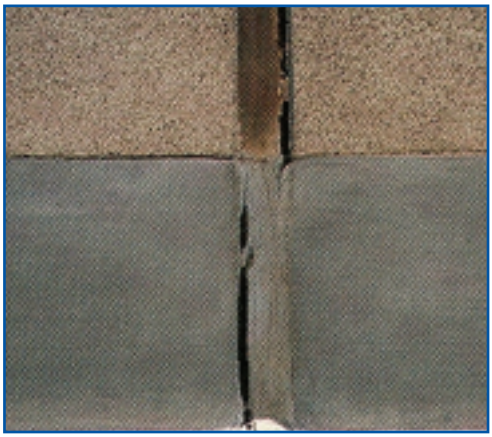
Many national and international standards do not test long-term durability. Therefore, when selecting your sealant, ensure it meets the long term durability needed, as well as the requirements for movement and adhesion.

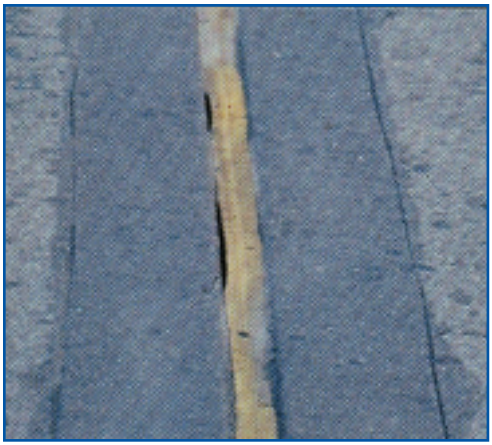
It is essential for good co-operation between all parties, at all stages of the construction project. Architects should be aware of the limitations of sealants and avoid designing joints which are too narrow or inaccessible.

Consult the sealant manufacturers regarding the durability of their products. It is recommended that construction companies use qualified and experienced sealant applicators.

Reputable sealant manufacturers are experts in the relevant aspects of construction. They understand joint design, adhesion science, surface preparation and sealant application. They also know their products and their limits. They act responsibly when proposing sealing systems. They know the cost of failure. Use this knowledge.

ADHESIVE FAILURE (Separates from Substrate)





See table on following page

Adhesive failure

(See Module 4: Surface Preparation and Adhesion - page 29).

Reason for loss of adhesion	*How to avoid*
Contaminated surface. Recommended procedures for cleaning the surface, such as brushing, solvent wipe, etc not followed. Old sealant / primer not removed as directed in remedial work.	*Follow recommended cleaning procedures.*
Incorrect sealant system for good adhesion. For the *combination* - particular surface, the sealant had no inherent adhesion. A primer should have been used or, if one was used, the wrong type of primer was used.	*Ask for evidence of adhesion testing for the particular sealant / primer / surface.*
Sealant system inadequate for the *(either the joint as designed or as eventually built).* Sealant had inadequate movement capability, coupled with weak adhesion.	*For the anticipated joint* ***joint*** *movement, ensure adequate sealant movement capability, with margin for error.*
Sealant with poor durability. As the sealant aged in the joint, so its movement capability reduced, leading to stress at the surface and loss of adhesion.	*For critical joints, ask for evidence ofsealant durability, through case history or laboratory tests.*
Depth of sealant insufficient. The area of adhesion between sealant and surface too small for strong, durable adhesion**.**	*Use the standard guideline for width to depth ratio for the type of joint. Set the backer rod at the correct depth. Post sealing checks should find this fault, which can be remedied immediately.*
Three-sided adhesion. moving joint, the sealant adhered to the two moving surfaces **and** a third unmoving surface, leading to distortion and stress in the sealant and eventually loss of adhesion to one of the joint surfaces.	*Use bond breaker tape* In a *three-sided adhesion. Use backer rod, which does not bond with sealant.*

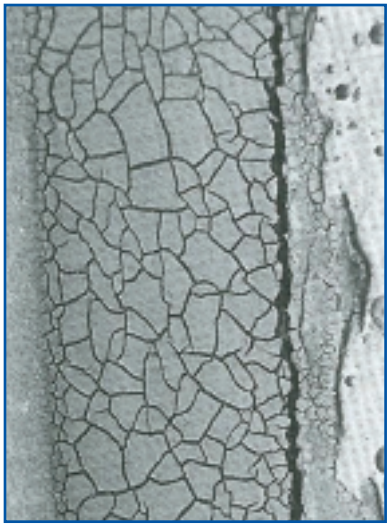
COHESIVE FAILURE (Sealant Splitting)

See table on following page

Cohesive failure (splitting)

Reason for cohesive failure	***How to avoid***
Sealant system inadequate for the joint *(either the joint as designed or as eventually built).* Sealant had inadequate movement capability, coupled with poor tear resistance.	*For the anticipated joint movement, ensure adequate sealant movement capability, with margin for error.*
Sealant with poor durability. *i)* As the sealant aged in the joint, so its movement capability reduced leading to internal stress and tearing.	*For critical joints, ask for evidence of sealant durability, through case history or laboratory tests.*
Sealant with poor durability. *ii)* The sealant surface deteriorated with time as a result of attack by the environment (heat, UV light, water, chemicals) leading to crack development and splitting.	*For critical joints, in harsh environments, ask for evidence of sealant durability, through case history or laboratory tests.*
Depth of sealant insufficient. At full extension, the tensile stress on the sealant exceeds the strength of the sealant in the thin cross section.	*Use the standard guideline for width to depth ratio for the type of joint. Set the backer rod at the correct depth. Post sealing checks will find this fault, which can be remedied immediately.*
Three-sided adhesion. In a moving joint, the sealant adhered to the two moving surfaces **and** a third unmoving surface, leading to distortion and stress in the sealant and eventually tearing of the sealant.	*Use bond breaker tape where directed to eliminate three-sided adhesion. Use backer rod, which does not bond with sealant.*

AESTHETIC FAILURE



See table on following page

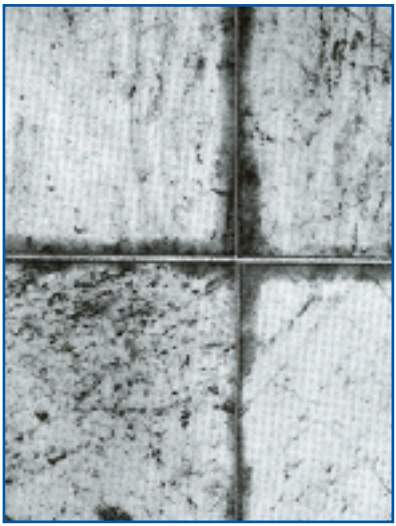
Aesthetic Failure: Visual deterioration with time, deterioration of the sealant surface

***Problem and* Cause**	***How to avoid***
Discoloration. Sealant with poor colour stability used. Under the influence of the weather (UV light, rain) the sealant colour changes, either fading or chalking.	*Where sealant appearance is important, ask for evidence of sealant colour stability, through case history or laboratory tests.*
Surface cracking. *i)* Sealant with poor durability used. Under the influence of (UV light, heat, the weather rain) or other environmental factors (water, chemicals, ozone) the surface hardens and, with joint movement, cracks (eg 'mud cracking') *ii)* Sealant over-painted. A flexible sealant over-painted with a less flexible coating, which cracks following joint movement.	*For critical joints, in harsh environments, ask for evidence of sealant durability, through case history or laboratory tests.* *Ask for guidance from the sealant manufacture on the viability of over-painting with the sealant used.*
Distortion. *The surface of the sealant is no longer flat, but displays distortions (folds, bulges, dips).* The sealant was compressed or extended before it was fully cured. Some sealants take up a permanent set during extension or compression.	*For narrow, fast moving joints, select a sealant which cures rapidly. Similarly, do not use a stress relaxing sealant.*
Dirt pick- up. A long tack free time coupled with air blown dust/sand.	*Ask sealant supplier about tack free time, especially if the ambient temperature is low and/or when the relative humidity is low.*
Mould. *In damp environments (weather facing surfaces, bathrooms, etc) fungal growth can occur on the surface of the sealant, feeding either directly on the sealant or on contamination on the sealant surface (eg soap, dirt).* Inappropriate sealant for damp environment used.	*For damp environments, where sealant appearance is important, seek guidance from the sealant manufacturer.* NB For long term protection against mould growth an appropriate and regular cleaning regime must be used.

APPLICATION RELATED PROBLEMS

***Problem and* Cause**	***How to avoid***
Primer residues on joint surfaces. Poor brush work whilst applying primer. Run-down due to excess primer on brush.	*More care with brush work. Ideally use masking tape.*
Sealant residues on joint surfaces. Poor gunning and or tooling.	*More care with gunning and tooling. Ideally use masking tape.*
Unacceptable surface finish on sealant. Poor tooling skills or no tooling at all.	*Proper training.*
Repair work using sealant of different colour/shade.	*Proper site procedures and controls.*

STAINING PROBLEMS



See table on following page

Staining Problems

CONSULT THE SEALANT MANUFACTURER/SUPPLIER TO ENSURE THAT THE SELECTED SEALANT IS SUITABLE TO AVOID STAINING PROBLEMS.

***Problem and* Cause**	***How to avoid***
Dark band along either side of the joint. *A particular problem for natural stone and other porous substrates. This may darken further with exposure to the weather or with dirt pick-up. Under rare circumstances staining can fade on exposure to the elements.* Ingredient migrating from the sealant into the substrate material (and then to the surface).	*Ask for case histories for the specified sealant and the specific stone (or very similar). Do not rely on short term staining tests.*
Surface contamination along either side of the joint. *This is similar to the above, but is more noticeable on non-porous substrates.* Ingredient migrating from the sealant onto the joint surfaces. The contamination along the length of the joint may darken and is susceptible to dirt pick up. This may also lead to differential wetting by rainwater, where the rain forms droplets on the contaminated surface, but wets out the uncontaminated surface.	*Ask for case histories for the specified sealant and the specific substrate material. Do not rely on short term staining tests. It may be possible to remove this contamination by cleaning (eg from glass), but there is no guarantee it will not return.*
Ingredient leached out of the sealant by rainwater*. This is seen largely as surface staining below and along the length of horizontal joints. (NB sometimes this type of staining results from run-down of efflorescence from the concrete or stone and is incorrectly assigned to the sealant).*	*Ask for case histories for the specified sealant and the specific substrate. Do not rely on short term staining tests.*

MODULE 6:
HEALTH AND SAFETY

HEALTH & SAFETY

READ MATERIAL SAFETY DATA SHEETS (MSDS) FOR ALL THE MATERIALS. IF THERE ARE ANY DOUBTS, CONTACT THE MANUFACTURER. RETAIN MSDS ON FILE. ALSO NOTE THE DISPOSAL RECOMMENDATIONS GIVEN ON THE MSDS AND ANY SITE AND LOCAL AUTHORITIES REQUIREMENTS. MATERIALS LABELED WITH THE 'FLAMMABLE' OR OTHER HAZARD SIGNS SHOULD BE STORED FOLLOWING SITE REGULATIONS AND IN ACCORDANCE WITH THE SUPPLIER RECOMMENDATIONS.

The health and safety regulations for construction site workers are set out by the regulatory authorities. As such this module is intended only as general guidance to the appropriate local and national regulations.

THE PREPARATION OF JOINT SURFACES AND THE APPLICATION OF SEALANTS CAN BE RELATIVELY LOW RISK PROCESSES. HOWEVER, THE CONSTRUCTION SITE CAN BE A HAZARDOUS ENVIRONMENT AND WORKERS MUST FOLLOW SITE REGULATIONS.

Joint Preparation and Sealing

It is the responsibility of the job supervisor to ensure that a risk assessment is carried out for each sealing job. If possible it should be done in co-operation with the construction site foreman. The risk assessment should be kept on file.

APPLICATORS SHOULD BE AWARE OF THE HAZARDS ASSOCIATED WITH THE WHOLE JOB, AND NOT JUST THE APPLICATION OF SEALANT. PROPER SAFETY TRAINING IN THE USE OF EQUIPMENT MUST BE GIVEN AND DOCUMENTED IN ACCORDANCE WITH THE APPROPRIATE REGULATIONS AND SITE SPECIFIC REQUIREMENTS.

CLOTHING

It is the responsibility of the employer to assess the risks involved and to supply the necessary personal protection clothing and safety equipment to employees.

It is the responsibility of the employee to use such suitable clothing and safety equipment on site.

Typical clothing and equipment choices would be:

– Hard hats

– Safety boots or shoes

– Appropriate workwear

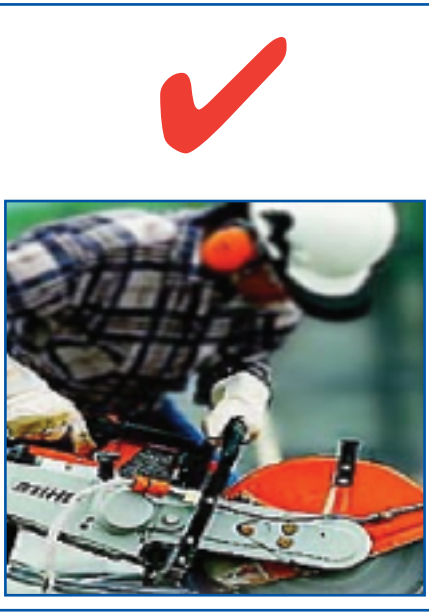
– High visibility

– Correctly fitting suitable gloves

– Safety glasses, goggles or face

– Ear protectors

– Dust masks or respirators



ACCESS

The applicator must recognise the hazards associated with accessing the point of work in its site surroundings.

Access to the point of sealant application can be dangerous, involving ladders, scaffolding, hoists, elevated work platforms, cradles etc.

OVER-REACHING WHILST APPLYING PRIMER OR SEALANT NOT ONLY LEADS TO POOR WORKMANSHIP BUT IS VERY DANGEROUS.

MODULE 7:

PRINCIPLES BEHIND JOINT SEALING IN CONSTRUCTION

BASICS

A joint is the space left between the constituent parts of a structure to allow for the movement of those parts. The joint might be formed between units of the same material (concrete – concrete, aluminium – aluminium) or dissimilar materials (brick - wood, glass – plastic). When the temperature rises, the materials expand and the width of the gap between the structural units decreases; when it cools the materials contract and the gap widens again. If the gaps were not there, the structure would buckle or break.

Generally, these joints should not be left open to the elements, otherwise moisture would penetrate the joint, causing damage to the structure (see figure 1) and/or its contents. Heat will be lost from a building through an unsealed joint; the cold wind will enter around doors and windows. Hence, the joints are sealed. Sometimes, the sealant in a joint has a more functional, additional role, for example, in sanitary, pedestrian or fire stopping applications.

A joint may open and close as a result of temperature or humidity changes, or the structural elements may move due to shrinkage, settlement, wind-sway or earthquakes. The sealant must accommodate this movement for many years without a loss of adhesion or cohesion. (Figure 2).

Figure 1. Corrosion to steelwork caused by water entering through a failed joint sealant.

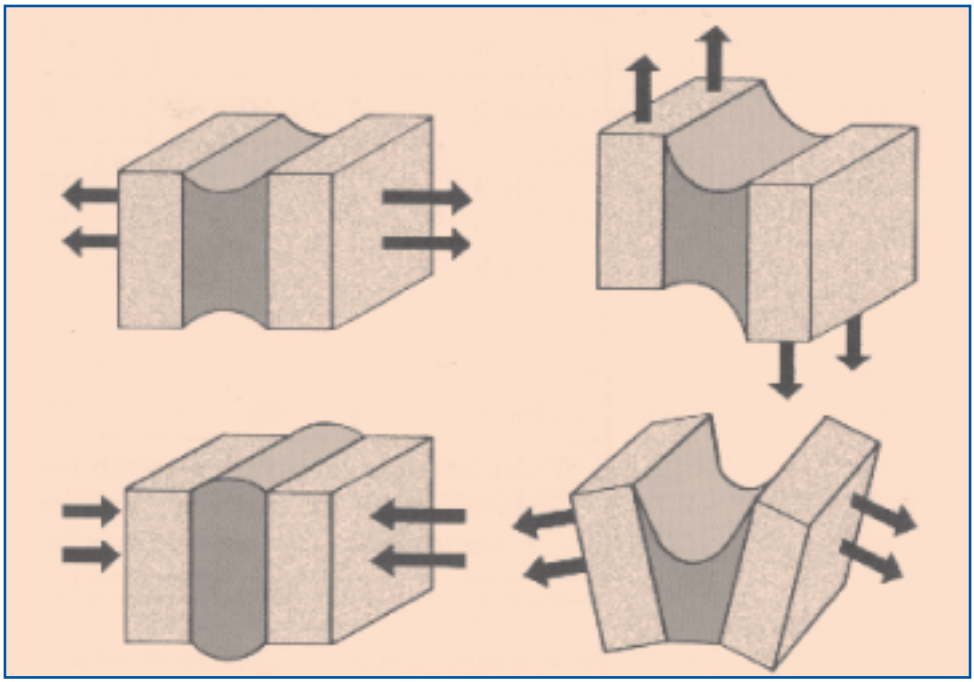


Figure 2 Strain exerted on sealants in moving joints

The sealant must be flexible enough to accommodate the amount of movement predicted for the joint. This is called the Movement Capability of the sealant (see below).

For a given amount of movement, wide joints will place less induced stress on the sealant than narrow joints, with implications for durability.

For example consider a 5mm movement:
10mm bead – the movement is 5/10 x 100% = 50%
20mm bead - the movement is 5/20 x 100% = 25%

This fundamental principal is the same for all types of joint design. The two main joint designs are butt joints and shear joints.

THE DESIGN OF JOINTS

Most joints are designed at the drawing stage of a project.

When incorporating a joint into a structure, the architect will take into account the following factors before specifying the sealant:

- The purpose of the joint (movement accommodation, water retention, chemical resistance, fire containment, a combination of these).
- The type of joint (expansion, compression, shear, contraction).
- The type of material(s) forming the joint.
- The coefficient of linear expansion of the material(s).
- The maximum and minimum temperatures predicted for the components (based on air temperature and the heat capacity of the material(s). Colour has an influence).
- Potential for movement from other influences (humidity, wind sway).
- The dimensions of the structural elements forming the joint (these are sometimes determined by engineering norms, e.g. The spacing of joints in flat concrete. Elsewhere, the size of elements and hence the frequency of joints may be dictated by design considerations and the aesthetic appearance of the building).
- The location and number of fixing points or other constraints on the structural element.

– The orientation of the joint (straight butt joint, l-shaped joint, perimeter joint).

– External influences, e.g. Water, fuel, aggressive chemicals, cleaning fluids, foot or vehicular traffic.

– Other functional requirements e.g. Firestopping, sanitary, walkways.

Design/build flaws in joints

A sealant may fail for many reasons (See Module 5: Failures and Problems - page 37).

There may also be design/build flaws leading to the incorrect specification of the sealant.

– Incorrect substrate information given to the sealant specifier

– Total movement in the joint underestimated–

– The built joint was much narrower than the one designed.

Sometimes, the joint is designed (or occurs) that is beyond the capability of any commercial sealant.

In all these instances, the joint has to be redefined and a new sealant specification drawn up. In the case of the joint where no sealant meets the requirements, consideration has to be given to the possibility of 'rebuilding' the joint before remedial sealing. (the simplest example would be to open up the joint, by cutting out e.g. In brick or concrete).
(See Module 2: Preparing the Surfaces for Sealing - page 11).

THE SEALANT SELECTION PROCESS

MOVEMENT CAPABILITY

The design drawings will detail all joints to be sealed. From the dimensions of the joint, the materials forming the joint and knowledge of the annual weather patterns for the location of the joint it will be possible to determine the maximum movement of the joint. The movement capability of the sealant has to cope easily with this movement. (See module 9: Standards - page 65).

The design of very narrow joints can give rise to two possible problems and may lead to early sealant failure and costly remedial work:

1. Over-reliance on good construction techniques and encroachment into the building tolerances. The narrow joint may be even narrower in the finished structure, requiring re-specification of the sealant. (see design/build flaws on previous page).

2. Sealant properties may change with time/exposure to the elements and as a result the sealant's movement capability may be reduced.

ADHESION

When specifying a sealant, good adhesion is as important as movement capability. This is a more complex subject, simply because of the wide range of different materials a sealant is supposed to stick to. For every generic type of material (anodised aluminium, concrete, plastic) there are countless variations, each with slightly different surface chemistry.
(See Module 4: Adhesion - page 29).

The sealant manufacturers are best placed to advise on adhesion. Their knowledge will be based on extensive laboratory testing of their products and, most likely, many years of field history. They will be able to recommend and supply primers if necessary.

MODULUS

The third key property of a fully cured sealant is modulus. This relates to the force required to extend a sealant by a fixed amount. High modulus sealants require a lot of force, low modulus sealants less. It is a measure of the stiffness or hardness of the sealant. High modulus sealants are relatively hard to the touch when fully cured, low modulus sealants relatively soft. The modulus of sealants may change at extremes of temperature or after many years exposed to the environment.

When a sealant in a joint is extended, a force is exerted on the surfaces forming the joint. If it is a high modulus sealant, the force will be high and possibly result in *either* the surface material failing *or* in failure of the adhesion between the sealant and the surface. Thus it is has become common practice to use low modulus sealants for high movement joints. High modulus sealants are used in joints with lower movement, especially if the sealant is subjected to pedestrian traffic or high hydrostatic pressure.

STRESS-RELAXING SEALANTS

It is worth mentioning that certain sealants, namely the Elasto-plastic type of sealants, possess the ability to stress relax when subjected to joint movement. Such sealants can dissipate the force that is exerted on the surfaces forming the joint through internal chemical and physical mechanisms. These mechanisms reduce the stress at the sealant – substrate interface so that the sealant is less likely to fail adhesively or to cause the surface material to fail when the joint is extended. In practice this means that higher modulus Elasto-plastic sealants can be used in high movement joints. Sealants that stress-relax are more suited for use in joints that move slowly or only once.

OTHER FACTORS

TO COMPLETE THE SPECIFICATION THE SPECIFIER WILL FULLY DESCRIBE THE OTHER REQUIREMENTS FOR THE SEALANT:

- non-slump or self-levelling
- colour
- in-service location
- potable water
- water
- vehicular traffic
- foot traffic
- chemical/fuel/oil spillage
- food contact
- very high UV
- very high temperature
- very low temperature

British Standard **BS6213** covers the selection of construction sealants.

International Standard **BSENISO1600** covers the classification of construction sealants.

BASA has published guidance notes to these standards.
(WWW.BASAONLINE.ORG)

British standard **BS 6093** covers the design of joints.

FOR FURTHER INFORMATION ON THE DEVELOPMENT OF BUILDING CONSTRUCTION SEALANT STANDARDS FOR THE UK OR TO PURCHASE STANDARDS CONTACT
WWW.BSI-GLOBAL.COM **.**

THE COMMITTEE DEALING WITH BUILDING CONSTRUCTION SEALANTS IS B/547.

MODULE 8:

THE CHEMISTRY OF COLD CURE SEALANTS FOR BUILDING CONSTRUCTION

This module gives a general description of the *main elastomeric* sealant types used in the building construction industry. These sealants are used in movement joints. The amount of movement a specific commercial sealant can accommodate will depend on its chemical type *and its overall formulation*. The same comment applies to the sealant's durability.

The module describes the general sealant characteristics, the chemical make up and optimum properties.

The following tables list the sealant chemistries most commonly available in **alphabetical** order. This is not an exhaustive list and illustrates the most common uses for each chemical type. For details of BASA members who manufacture or supply sealants see www.basaonline.org /Product Search. Consult the manufacturers for the general properties of the cured sealant.

ACRYLIC SEALANTS (WATER BASED)

General description. Acrylic sealants are water-based, one–component, room temperature curing products. The cured sealant is flexible and can be elastic.	General purpose builder sealant and DIY product. Used largely indoors (but are used outdoors). • Perimeter joints (around doors, windows etc.) • Kitchen and Bathroom • Fire protection • Internal glazing.
Chemical description. Water based acrylic sealants contain emulsions of long chain molecules (polymer) typically based on mixtures of acrylic monomers with the general chemical structure CH_2=C(R)(COOR'), where R is hydrogen or an organic group and R' is an organic group.For acrylic sealants the polymer is usually compounded with inorganic fillers, organic plasticisers, adhesion promoters and other additives to control flow, slump, etc. The amount of polymer and the types and levels of compounding ingredients directly influence performance and cost. Acrylic sealants cure by loss of water. They skin rapidly, but the rate of through cure depends on the prevailing temperature and humidity.	

POLYSULFIDE SEALANTS

General description. Polysulfide sealants for building construction are sold mainly as two-component, room temperature curing products. They are also available as one-component sealants. The cured sealant is elasto-plastic possessing both elastic and stress relaxing properties. The sealant can be formulated to be fuel and solvent resistant.

Products are available which cover the range high to low modulus:

- General building
- Facades
- Glazing
- Fire protection
- Civil engineering.

Chemical description. Polysulfide sealants are based on long chain molecules (polymer) made from repeating units of $-(S\text{-}S\text{-}CH_2CH_2\text{ - }0-\ CH_2\text{-}O\text{-}CH_2CH_2\ )-$. By weight the polysulfide molecule is 39% sulfur, which gives it many of its unique properties. The polymer has mercaptan (-SH) end groups used in the cure.

For polysulfide sealants the polymer is usually compounded with inorganic fillers, organic plasticisers, adhesion promoters and anti-slump aids. The amount of polymer and the types and levels of compounding ingredients directly influence performance and cost.

The main type of curing agent used with two component polysulfide sealants is inorganic peroxide, dispersed in plasticiser. Manganese dioxide is the most popular curing agent and the resulting cured product is usually light grey. When white or coloured sealant is required then sodium perborate is used as the curing agent. Single component products use light coloured peroxides, such as sodium perborate, which can result in white sealants or, if pigments are used, a range of coloured sealants.

POLYURETHANE SEALANTS

General description. Polyurethane building construction sealants are mainly one-component, room temperature curing products. Two-component products are available. Self-levelling grades are available. The cured sealant is highly elastic and tough.

Sold across most end uses. Products are available which cover the range high to low modulus.

- General building
- Facades
- Pedestrian walkways
- Civil engineering.

Chemical description. Polyurethane sealants are based on long chain molecules (polymer) having an organic structure consisting of repeat polyether units e.g.$(-CH_2CH_2 - O-\ CH_2CH_2\ -)$. The polymer has hydroxyl (-OH) end groups that are reacted with isocyanates as part of the cure chemistry.

For polyurethane sealants the polymer is usually compounded with inorganic fillers, organic plasticisers, adhesion promoters and anti-slump aids. The amount of polymer and the types and levels of compounding ingredients directly influence performance and cost.

SILANE MODIFIED POLYMER SEALANTS

General description. Silane modified polymer sealants are sold as one- and two- component, room temperature curing products. The cured sealant is highly elastic.	Sold across most end uses. Products are available which cover the range high to low modulus, • General building • Facades • Civil engineering.

Chemical description. The structure is that of a polyurethane polymer, but with the same end groups as a silicone polymer. The cure chemistry is that used in silicone sealants.

The polymer is usually compounded with plasticisers, inorganic fillers, anti-slump agents and adhesion promoters. The amount of polymer and the types and levels of compounding ingredients directly influence performance and cost.

SILICONE SEALANTS

General description. Silicone sealants for building construction are mainly one-component, room temperature curing products, supplied in cartridges and sachets. For most silicone sealants, skinning times are short and through cure is rapid. The cured sealant is highly elastic. Products are available which cover the range high to very low modulus.	Sold across most end uses, • General building • Facades • Glazing • Sanitary • Fire protection • Civil engineering.

Chemical description. Silicone building construction sealants are based on long chain molecules (polymer) having an inorganic structure consisting of repeat siloxane units (–Si-O-).

For silicone sealants the polymer is usually compounded with silicone fluids or cheaper organic fluids and reinforced with silicas (eg fumed silica) and other inorganic fillers. The amount of polymer and the types and levels of compounding ingredients directly influence performance and cost. There are three main types of cure chemistry used with commercial one-component silicone sealants: Acetoxy cure, Neutral cure and, Amine cure.

MODULE 9:

STANDARDS FOR CONSTRUCTION SEALANTS

To ensure that the most appropriate sealant for the job is used, the sealant specifier must be aware of the variety of sealants available and be able to satisfy themselves that they are choosing the most suitable sealant for the application taking into account service life requirements.

To carry out this process involves many factors but, as a guide to the performance of a sealant and its physical properties, the sealant manufacturer will be able to supply a sealant classed according to International or British Standards.

There are many standards for sealants and many different test methods used by sealant manufacturers but the European Standard is often used in the UK market:

BS EN ISO 11600
Building Construction – Jointing Products – Classification and requirements for sealants

This document prescribes the test methods required to classify most common sealants.

Products can be designated as Glazing Sealants (G), Façade Sealants (F) or classed as both if the supplier has tested and proved that the sealant can be used in either construction application.

BS EN ISO 11600 acts a guide to classify the sealant by:

1. Movement Capability – Maximum of 25%
2. Modulus (High or Low)
3. Elasticity or Plasticity
4. Adhesion

For sealants with a claimed movement accommodation factor of greater than 25% refer to BS8449.

THE MOVEMENT CAPABILITY AS CLASSIFIED BY BS EN ISO 11600 IS THE TOTAL AMOUNT OF MOVEMENT AS A PERCENTAGE THAT THE SEALANT CAN ACCOMMODATE.

A CLASS 25 SEALANT CAN BE USED IN A JOINT WHICH OPENS NO MORE THAN 25% FROM ITS MINIMUM WIDTH OR CLOSES NO MORE THAN 25% FROM ITS MAXIMUM WIDTH.

For a complete guide to BS EN ISO11600 and all the test methods used for testing and classifying sealants please consult www.basaonline.org and specifically the BASA Guide to BS EN ISO 11600 Classification of Sealants for Building Construction document.

In addition to BS EN ISO 11600 there are also standards relating to the selection of sealants and the design of joints (BS6213 & BS6093). BS8000-16 - Workmanship on building sites - Code of practice for sealing joints in buildings using sealants, is also a useful reference document.

For information on the development of sealant standards in the UK or to purchase standards please refer to www.bsi-global.com.

Specific work on these standards is driven by the B/547 committee.

MODULE OVERVIEW:

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