1. SELECTING THE URETHANE SEALANT

The intended function of sealant determines the specific product that will be appropriate for use in the application. A brief overview of selection guidelines is found in this section. If further assistance with urethane sealant selection is required, then contact Tremco's Technical Services or consult Tremco's Sealant Selection Guide; this guide is available at www.tremcosealants.com. Provided below is a list of items to consider while selecting a urethane sealant.

1.1 Movement Capacity

Many joints into which sealants are installed must be considered dynamically moving entities, and the sealant must be able to accommodate the magnitude of dynamic movement that the joint will experience. The sealant's ability to accommodate joint movement is provided as ratings for the extension and compression capabilities. The movement capability of a urethane sealant is published on the product data sheet and reported under the "Applicable Standards" Section as the "class" distinction within ASTM C920 - *Standard Specification for Elastomeric Joint Sealants.*

1.2 Modulus

The modulus property of a sealant is a relative value measured as a ratio of stress to strain during joint extension. To define this property simply, modulus describes the amount of force, load, or stress required to extend a sealant to a predetermined strain or elongation. Low-modulus sealants exhibit less stress at the location of the sealant-substrate bond line when the sealant is exposed to joint movement; generally, low-modulus sealants demonstrate greater movement capabilities when compared to their higher-modulus counterparts. Low-modulus sealants are a more forgiving selection for high movement joints, joints that have opposing substrates with dissimilar coefficients of thermal expansion, and joints that have interfaces that can be pulled apart by movement stresses maintained by higher-modulus sealant materials. Low-modulus urethane sealants are the preferred selection for joints that interface with EIFS. Medium-modulus and high- modulus sealants can provide durability in joints where a less significant amount of joint movement is expected and when the substrate is rigid enough to accept higher levels of stress.

1.3 Single-Component or Multi-Component

This portion of selection pertains to equipment available to dispense the sealant, speed of sealant cure-through, and preference of the applicator. A multi-component sealant is usually packaged in bulk containers and requires mixing as well as specified dispensing equipment, while single-component sealants are ready for immediate dispensing from packaging types that have a smaller volume, such as cartridges or sausages.

1.4 Non-Sag or Pourable

A non-sag material is required in applications marked with joints in vertically-oriented substrates and can be used in skyward facing horizontal joints; pourable sealants cannot be used in vertically-oriented joints and may be preferred in skyward facing horizontal joints as they promote ease of use by reducing the intensity of tooling that the applicator must perform after the sealant is initially applied. The "gun-grade" and "non-sag" sealant terms are synonymous. The "self-leveling" sealant term is descriptive for "pourable sealant".

1.5 Paintability

Where sealant joints are to be painted, urethane sealants are typically paintable, this does not imply adhesion to and compatibility with all paints. Please refer to Tremco Technical Bulletin No. S-09-05 for more information.
Contact Tremco Technical Services if you have any questions regarding the sealant selection process.

2. TESTING

Tremco recommends project-specific testing be completed prior to starting production at any job-side conditions. Upon request, Tremco's Technical Services laboratory performs in-house testing of sealants for adhesion, compatibility, and potential staining on submitted project substrate materials. Project-specific recommendations regarding surface preparation, primer use, and urethane sealant product recommendation is made after the completion of Tremco's project-specific testing process. Contact Tremco Technical Service for details on how to initiate, complete, and interpret laboratory testing

procedures, requirements, and results. Consult Tremco Technical Service's bulletin for more detailed information pertaining to each test performed within Tremco's Technical Service laboratory.

In some instances, in-field testing may be adequate for qualifying a sealant for use in a specific application. Contact your local Tremco Sales Representative for assistance with testing at the job site.

3. STORAGE

3.1 Prior to use, all urethane sealants must be stored in original, undamaged packaging in a clean, dry, protected location with temperatures between 40 to 100 °F (5 to 43 °C). Once the packaging of a single-component is opened, the material will begin to cure. Preserving the sealant from developing and undesired cure of the material can be achieved by promptly closing the sealant's container immediately after completion of use.

3.2 The curing mechanism of a single-component urethane sealants is initiated with the introduction of airborne water vapor to the exposed sealant. The seals of Tremco sealant containers are effective at isolating the sealant from the atmosphere, and the water vapor that is contains, for extended periods of time.

3.3 Storage of packaged urethane sealants in locations that experience significant temperature fluctuations and/or cyclic temperature changes may be problematic, as these are known to accelerate the migration of air and water vapor into the sealant container, unduly exposing the sealant to conditions that will ultimately reduce the effective shelf life of the material or the overall performance of the sealant when applied. Therefore, it is recommended to ensure that the storage of urethane sealants be in a temperature-controlled environment with a stable ambient air temperature.

4. SURFACE PREPARATION

The five key steps for a successful sealant installation can be summarized as: clean, prime (if necessary), pack with joint backing material, gun the sealant, and tool the surface of the sealant. Specific instructions for each of these installation steps are provided in subsequent sections within this document below.

4.1 Two-Cloth Cleaning Method

The two-cloth cleaning method is completed by first wiping the substrate with a clean, white, lint-free cloth that is dampened with an approved cleaning solvent, such as isopropyl alcohol. The cleaning cloth should never be introduced or inserted directly into the solvent vessel or its contents to prevent contamination. Immediately follow the solvent-wipe, before the cleaning solvent has flashed off the substrate, with a wipe of a second cloth that is dry, clean, white, and lint-free to remove loosened dirt or oil. It is recommended to clean non-porous substrates using this cleaning method immediately before apply a urethane sealant, and the substrate must be cleaned again if two or more hours have elapsed between the time that the substrate was cleaned, and the sealant is applied.

4.2 Taping of Surfaces Surrounding the Joint

Applying masking tape at the perimeter of a sealant joint is optional and is generally to support aesthetically favorable appearances of the sealant joint and to promote easier clean-up procedures. The masking tape must be removed immediately after the sealant's surface is tooled and before the sealant begins to develop a skinned surface.

4.3 Masonry

Concrete and masonry surfaces must be stable, clean, dry, and free of contaminants. If film-forming curing aids or form release agents are present on a concrete substrate, they must be completely removed. If non-film-forming curing or form release agents have been used, adhesion testing must be employed to determine if they would be deleterious to adhesion.

The rough surfaces of these substrates can be prepared by sandblasting, mechanically abrading, wire brushing, grinding, or any combination of these preparation methods. These abrasive surface preparation procedures will introduce dust and other particles to the application area that must be treated as contaminants and thoroughly removed by blowing the affected substrate with oil free compressed air or by brushing the contaminants away from the application area with a soft bristle brush.

Recommendation on the use of primer is determined via project-specific testing. Tremco always recommends that a mock-up or field adhesion test be performed on the actual materials being used on the job to verify the need for primer, proper cleaning, and prep requirements. Specifics on priming substrates of this type can be found in section 5 of this document "Priming". These substrates are porous in nature; where deemed necessary, use Vulkem® 191 Primer or porous substrates for the sealant to develop adequate adhesion.

4.4 Tile

The surfaces must be clean, dry, and free of any contaminants. Clean the substrate using the two-cloth cleaning method described above. Preventing oily fingertips from being introduced onto these substrates is an important precaution to maintain cleanliness and create an ideal surface for the sealant to develop adhesion to.

Recommendation on the use of primer is determined via project-specific testing. Tremco always recommends that a mock-up or field adhesion test be performed on the actual materials being used on the job to verify the need for a primer, proper cleaning, and prep requirements. Specifics on priming substrates of this type can be found in section 5 of this document "Priming". These substrates are non-porous in nature; where deemed necessary, use TREMprime® Non-Porous Primer for the sealant to develop adequate adhesion.

4.5 Wood

Tremco's urethane sealants will typically develop adhesion to dry, fresh wood that is clean and free of contaminants. Many species of wood, such as teak, contain oils that dry out very slowly. Oil bearing woods are usually not suitable substrates for urethane sealants to develop adhesion with unless sufficient time has been allotted for the oils to vacate the substrate. Applications of the urethane sealant onto wood that will be painted or stained at a later time must utilize adequate masking techniques to ensure that the urethane sealant does not get onto surfaces to be painted or stained.

When applying urethane sealants to painted wood surfaces and adhesion will develop with the paint, it is important to note that the bond between the paint is of no more value than the bond between the paint and the wood. Recognize the need for additional prudence because stresses of movement introduced to the sealant joint will be transferred to the paint material at the bond line. Use of a low-modulus sealant would be preferrable to a medium- or high-modulus sealant to minimize such transfer of movement stress. Tremco recommends that any paint on the surface of the wood at the bonding areas to removed mechanically, so bare wood is the exposed surface for the urethane sealant to bond to. Where paint is not fully removed from wood and well-bonded residual pain is left after scraping or abrading, a low-modulus sealant is the preferred selection. Urethane sealants have historically been found to readily develop adhesion with a wide variety of different types of paint, but it is always recommended to confirm with the implementation of project-specific testing with the materials present at the application site.

4.6 Metal

The bonding surface of the urethane sealant must be clean, dry, and free of any contaminants. Metal substrates must be cleaned using the two-cloth cleaning method described previously within this document. Preventing oily fingertips from being introduced onto these substrates is an important precaution to maintain cleanliness and create an ideal surface for the sealant to develop adhesion to.

Metals that have the potential to corrode via oxidation pose a threat to the long-term adhesion of sealant as oxidation can creep beneath the sealant bond line over time to cause failure. It is for that reason that factory-applied primers are recommended on steel substrates.

4.7 Recommendation on the use of primer is determined via project-specific testing. Tremco always recommends that a mock-up or field adhesion test be performed on the actual materials being used on the job to verify the need for a primer, proper cleaning, and prep requirements. Specifics on priming substrates of this type can be found in section 5 of this document "Priming". These substrates are non-porous in nature; where deemed necessary, use TREMprime® Non-Porous Primer for the sealant to develop adequate adhesion.

4.8 Plastics

Plastic surfaces must be clean, dry, and free of contaminants prior to the application of urethane sealant. These substrates must be cleaned with the two-cloth cleaning method described previously within this document. Preventing oily fingertips from being introduced onto these substrates is an important precaution to maintain cleanliness and create an ideal surface for the sealant to develop adhesion to.

Recommendation on the use of primer is determined via project-specific testing. Tremco always recommends that a mock-up or field adhesion test be performed on the actual materials being used on the job to verify the need for a primer, proper cleaning, and prep requirements. Specifics on priming substrates of this type can be found in section 5 of this document "Priming". These substrates are non-porous in nature; where deemed necessary, use TREMprime® Non-Porous Primer for the sealant to develop adequate adhesion.

4.9 Insulated Concrete Forms

Nudura Insulated Concrete Forms (ICF) or insulated concrete forms must be dry, clean, free of dust, mud, or any other substances that might prevent placement and bonding of sealant. After UV exposure it is recommended to rasp and clean substrate to the standards above. Contact Tremco and/or Nudura Technical Services for additional information.

5. PRIMING

5.1 Porous Substrates

Tremco commercial urethane sealants will typically develop adhesion without the need of a primer to most common porous construction materials. When priming it is determined to be necessary, by conclusions derived from results from testing with project-specific materials, then Vulkem® 191 Primer or Vulkem® Primer #171 for porous substrates is recommended. Contact Tremco Technical Services for primer recommendations. These are single-component primers that are used to enhance the adhesion of urethane sealant to porous surfaces, such as concrete, limestone, or brick. They also provide a barrier to moisture at the bonding area when the substrate becomes wet and brings to wick moisture throughout its body.

Vulkem® 191 Primer and Vulkem® Primer #171 are to be applied generously with a clean brush or roller. Do not apply in excess where it will puddle or pond. At 70 °C (21 °C), allow 30 to 45 minutes for primer to become tacky before applying sealant, coating, or membrane. Do not allow the primer to dry completely. Do not apply sealant or coating if perimeter becomes hard or glossy.

Urethane Sealants can be applied onto a primed substrate for up to eight hours after primer has been applied. If sealant has not been applied to the primed substrate after eight hours has elapsed, the surface must be cleaned and primed with the recommended Porous Primer again.

5.2 Non-Porous Substrates

Tremco commercial urethane sealants will typically develop adhesion without the need of primers to most common non-porous construction materials. When priming is determined necessary, by conclusions derived from results acquired with testing of project-specific materials, then TREMprime® Non-Porous Primer is recommended. This is a single-component primer used to enhance adhesion of urethane sealants on non-porous surfaces, such as glass, metal, or plastics. When TREMprime Non-Porous Primer is applied to the bonding surfaces, the substrate is often reduced, when compared to applications of the sealant onto identical unprimed substrates.

To apply the TREMprime Non-Porous Primer, the primer must be applied directly to a clean, lint-free, white cloth. The cloth used for this primer's application should never be inserted directly into the contain of TREMprime Non-Porous Primer, as this significantly increases the potential for the primer to become contaminated. Before the primer can be applied to the substrate, it is recommended to remove all excess primer from cloth, so the cloth is merely dampened with the primer. This will help prevent the over-application of primer onto the substrate. Apply TREMprime Non-Porous Primer from the dampened cloth directly onto the substrate as a thin layer. When applied correctly, this primer dries after approximately 15 minutes, at conditions of 70 °F (21 °C). The primer must be completely dry before applying sealant. Applying the sealant to a surface that is still wet with freshly applied primer will become a detriment to the sealant’s ability to cure properly, develop adhesion to the substrate, and/or achieve it's expected physical properties.

Urethane sealants can be applied onto a primed surface for up to six hours after primer has been applied. If the sealant has not been applied to the primed substrate within six hours, then the surface must be cleaned with the two-cloth cleaning method and primed with TREMprime Non-Porous Primer again.

6. APPLICATION

6.1 Backing Materials

Closed cell or reticulated polyethylene backer rods are recommended as joint backing to control sealant depth and to ensure intimate contact of sealant with joint walls when tooling. Where depth of joint will prevent the use of a backer rod, and adhesive backed polyethylene tape (bond breaker tape) should be used to prevent three-sided adhesion. All backing should be dry at the time of sealant application.

6.2 Joint Designs and Dimensions

Tremco recommends that individuals responsible for designing sealant joints and those to apply Tremco urethane sealants become familiar with the versions of the following industry guidelines and best practices that have been published most recently:

- ASTM C1193 - *Standard Guide for use of Joint Sealants*
- ASTM C1472 - *Standard Guide for Calculating Movement and other Effects When Establishing Sealant Joint Width*

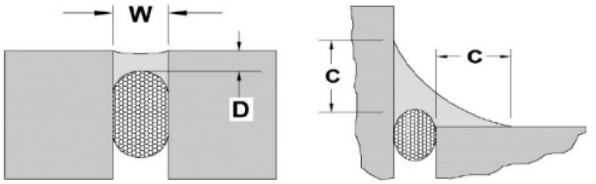

Figure 1 Non-structural sealant bead width and depth recommendations and appropriate joint design

All urethane sealant joints that are not structural tensile bead must be designed and installed in accordance with ASTM C1193 and ASTM C1472.
W = Sealant Joint Width
D = Sealant Joint Depth
C = Sealant Contact Depth

Expansion Joints - The minimum width and depth of any sealant application should be 1/4" x 1/4" (6 mm x 6 mm). The depth (D) of sealant may be equal to the width (W) of joints that are less than 1/2" wide. For joints ranging from 1/2" to 1" (13 mm x 25 mm) wide, the sealant depth should be approximately one-half of the joint width. The maximum depth (D) of any sealant application should be 1/2" (13 mm). For joints that are wider than 1" (25 mm) contact Tremco Technical Services or your local Tremco Sales Representative.

Window Perimeter - For fillet beads, or angle beads around windows and doors, the sealant should exhibit a minimum surface contact areas (C) of 1/4" onto each substrate, with provisions for release at the heel of the angle using a backer rod or bond breaker tape.

6.3 Applying Sealant

After the joint is verified to be clean, dry, and free of contaminants, primer has been applied (if necessary), and the backing material has been properly installed, the application of the urethane sealant may begin.

The process of gunning sealants is completed by dispensing sealant from its packaging, through a nozzle, and into the sealant joint. Two considerations must be acknowledged when gunning the sealant:

1. The joint is to be filled from the backside to the front side. It is not recommended practice filling the joint from the front to the back, as this introduces the potential for air to become entrapped within the body of the sealant bead. If air becomes encapsulated within the body of the sealant bead, then the sealant joint may demonstrate a reduced capacity to perform when exposed to dynamic movement.
2. Complete contact between the sealant and joint bonding surfaces of the substrate is required for the sealant to be expected to perform as intended when the sealant joint was designed. Substrate joint surfaces must be fully "wetted" with sealant, meaning that there must be contact between the urethane sealant and the substrate along the entire depth of the sealant-substrate interface. If the sealant does not fully contact the substrate along the bond line from the face of the sealant joint to the backer rod, then there is assumed potential for the sealant joint to be ineffective at preventing leaks and/or fail prematurely when exposed to a load or stress. Some force exerted during gunning of the sealant may be required to accomplish full "wetting" of the sealant onto the bonding surfaces as tooling, alone, may not be sufficient to force the sealant fully into the joint.

6.4 Tooling

Tooling is always a required step within the installation of a sealant bead to achieve an optimally performing sealant joint. Tooling the sealant joint will assist to create an installation that has full "wetting" of the sealant onto the joint interfaces, to achieve the desired hourglass shaped cross-sectional joint geometry, and to shape the visible surface of the sealant joint to a clean and consistent appearance. The sealant joint should be deliberately tooled to a shape to actively shed water and prevent the ponding of water on the surface of the joint.

Tooling can only be accomplished prior to the sealant achieving a skinned surface. Once the sealant has begun to form a skinned surface, the joint can no longer be effectively tooled. For information regarding the skin time of any Tremco Sealants, consult the data sheet created for the specific sealant or contact Tremco Technical Service.

Tooling is the process of applying constant pressure to the sealant body through the exposed face of the sealant bead by running a rounded tip spatula along the exterior surface of the sealant bead. A slightly concave surface at the exterior surface of the sealant bead is one characteristic of a properly tooled sealant bead. Pressure is applied by the applicator with the tooling spatula to the face of the sealant bead of a substantial enough magnitude to ensure the sealant is completely filled into the joint. The use of controlled force while tooling is a practice that is intended to provide additional assurance that the sealant has fully "wetted" the bonding interfaces of the substrates. The applied pressure is also effective in ensuring that the installed sealant has achieved complete contact with the backing material. Care must be observed while tooling the joint to not introduce enough pressure to displace the joint backing material.

Tremco recommends dry tooling be used to tool the surface of the sealant joint. The practice of dry tooling is completed without the use of tooling agents, such as water, soap, or detergent solutions. Sealant joints should be tooled to shed water and eliminate ponding.

6.5 Curing and Adhesion Development

The applied sealant bead must be left undisturbed until it has sufficiently cured to resist damage or deformation when contacted. The rate at which a one-component sealant will cure is heavily dependent on the environmental conditions, most notably temperature and relative humidity, that it is exposed to. Please refer to the product data sheet for cure times.

The development of adhesion occurs more slowly than the cure-through with is why adhesion testing may be required two or more weeks before executing.

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