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Section 4

NATURE'S EFFECT ON METAL ROOFING PRODUCTS

- Proper Roof System Design
- Expansion and Contraction
- Understanding System Loading
- Proper Fastener and Sealant Selection
- System Testing & Ratings

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Expansion and Contraction

This is one of the most important concepts of a standing seam roof system. Understanding what expansion and contraction does will save a lot of time and money due to call backs. It could also mean the difference between a roof failure and a full life roof.

Expansion and Contraction (to move independently of the structure): A term used to describe how the roof reacts to temperature changes. If the roof is not allowed to move freely, it could cause the roof and/or the fasteners to fail.

A true floating Standing Seam Roof (SSR) allows for thermal movement both at the clip and at all flashing locations. This is called a sliding flashing joint, which allows the SSR to move while maintaining water integrity at the eaves, ridge, rake and any other flashing. You cannot attach your flashings to both the panel and the structure without causing the SSR or flashing to fail.

With use of expansion clips and non-expansion clips, you can cause the roof to float in the direction you choose. By placing a non-expansion or fixed clip (pinning) at the eaves, we send all of the expansion to the ridge. Likewise, if we anchor the ridge, all thermal movement goes to the eaves. If we anchor in the middle of a panel, half of the thermal movement goes to the ridge and half goes to the eaves. This way we can control the direction of thermal movement making it easier to detail our flashings while maintaining a true floating SSR.

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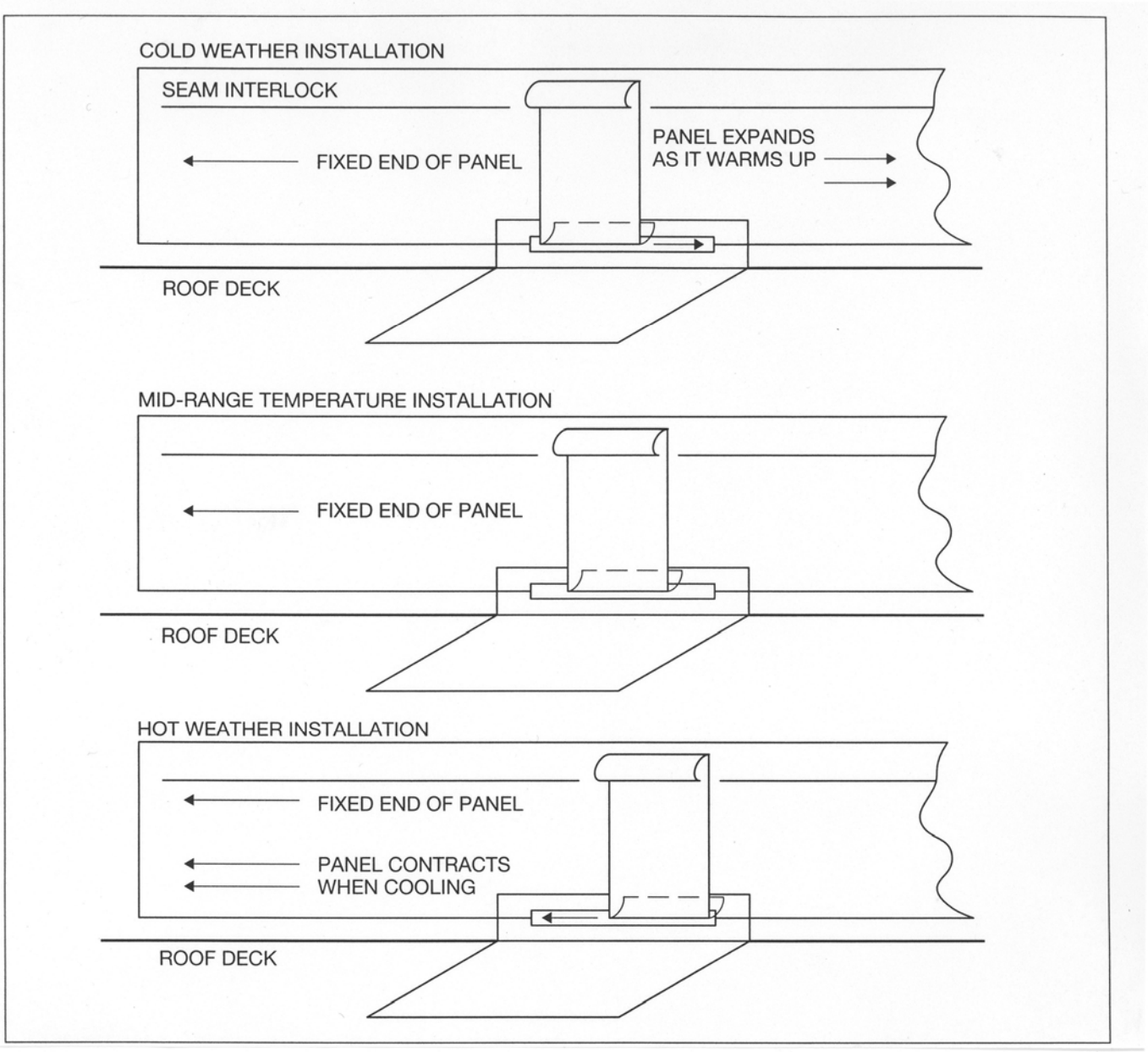

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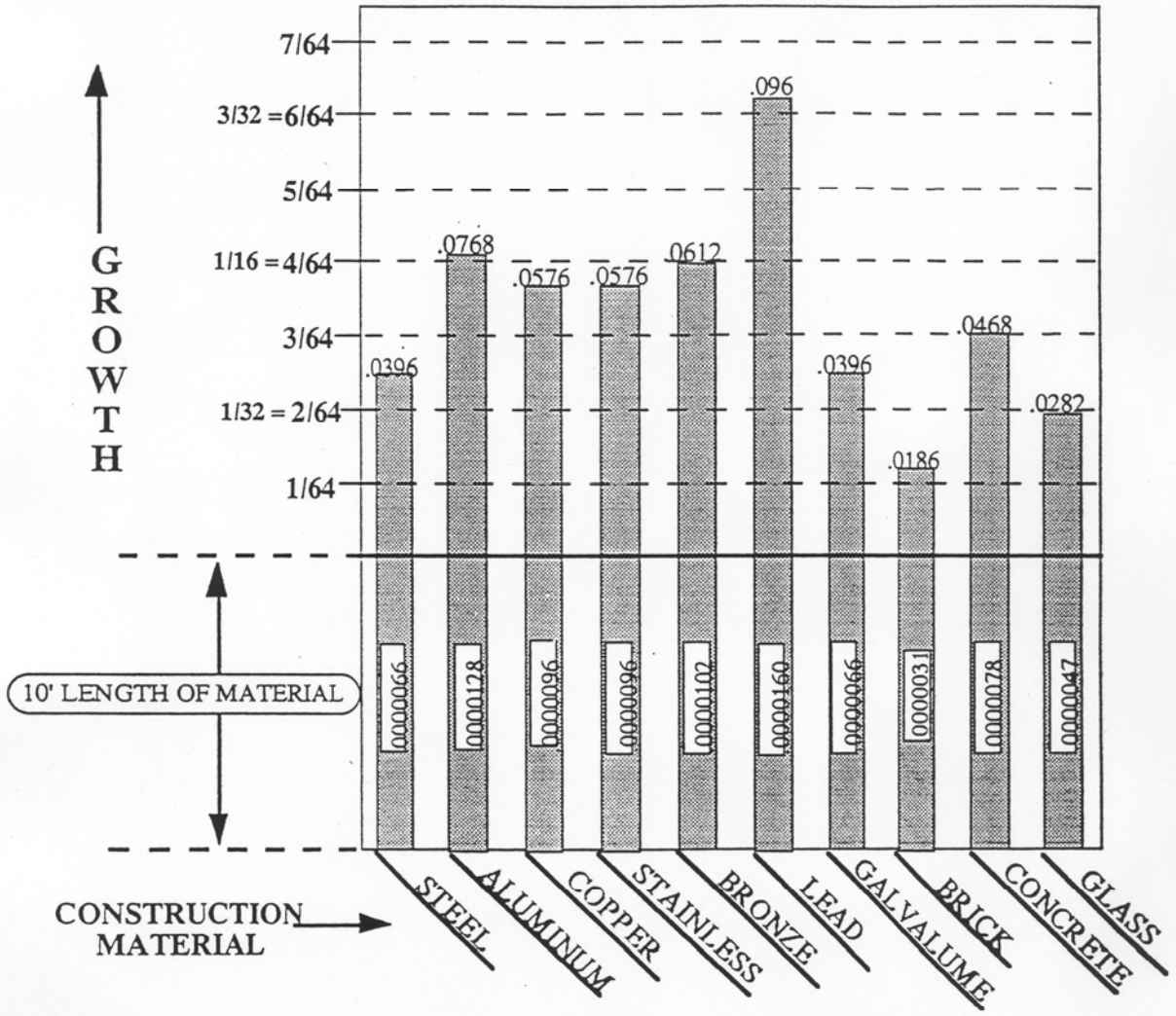
Thermal Expansion Chart

The chart below shows the growth of a 10' length of material in 64ths of an inch due to a rise in temperature (or temperature differential) of 50º F.



Mathematical Procedure: T=LxDxF or T=WxDxF

T=Total Expansion
L or W= Length or Width in inches
D= Temperature Differential
F= Thermal Expansion Factor

Thermal Expansion Factors (shown in the shaded bars above) is in inches per degree F. Check with your material supplier for the Thermal Expansion Factors (or expansion coefficient) on their or other material not listed above.

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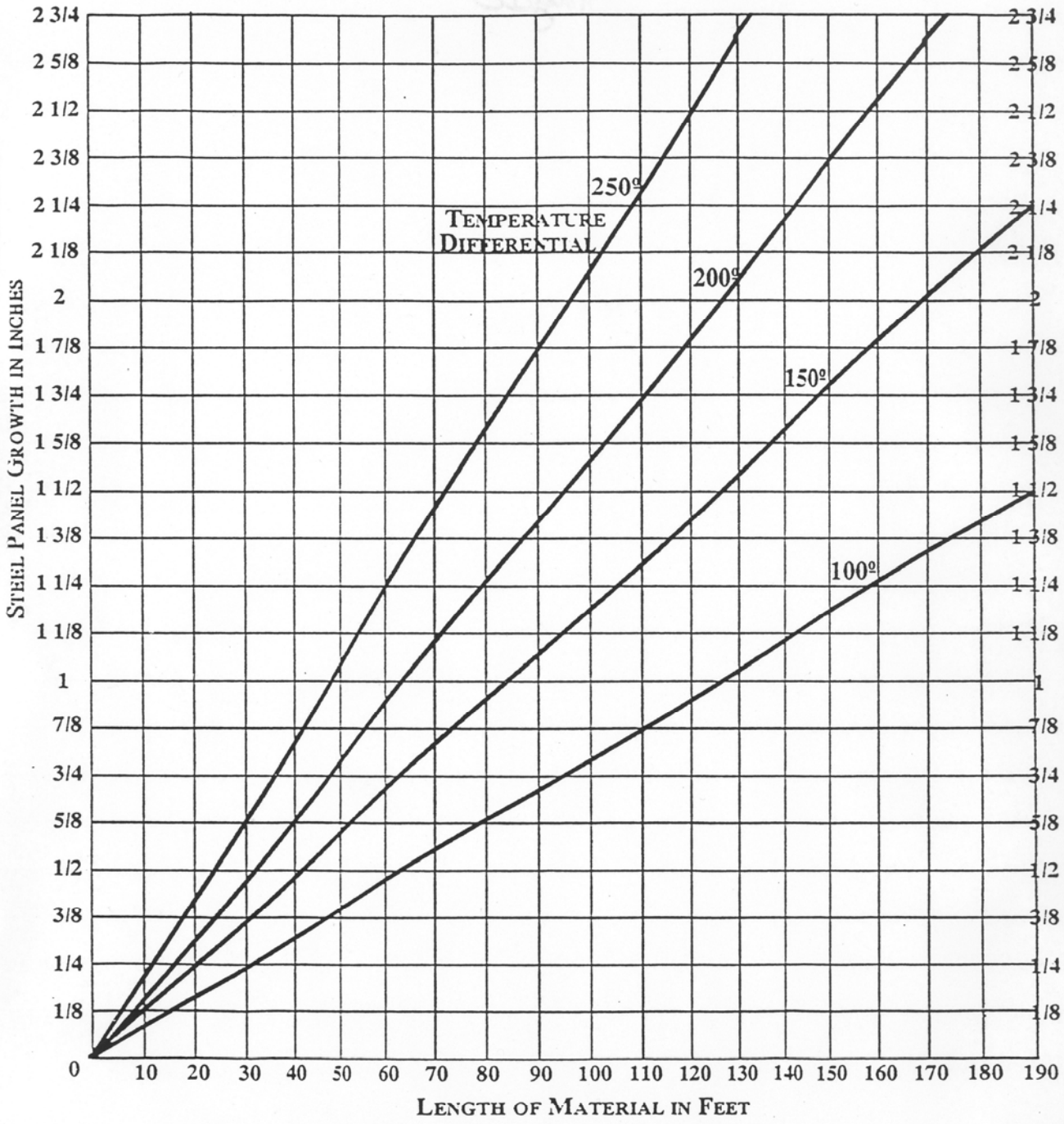

When figuring the temperature differential a minimum of 140º F or more should be used for the high temperature on light colored panels and a minimum of 180º F or more for dark colored panels. Also you should not use less than a 100º F temperature differential on any panel.

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Thermal expansion and contraction in the roofing industry is due to the heat of the sun and the cooling of our nights along with the changes in our weather such as winter to summer.

To compensate for this movement in the material, the SSR industry used expansion clips. These clips let the panel expand or contract as needed while keeping the roof anchored to the structure and maintaining water integrity. The clips also keep the roof from tearing itself apart during this process. The SSR also used sliding joint flashing and two piece curbs on the roof for the same reason.

Considering expansion and contraction, contraction is the most destructive. The reason for this is when metal that is anchored expands, it will buckle up or bow, but when the same metal contracts, it gets smaller, pulling fasteners loose and/or rips the material.

Probably the most common material used is painted galvalume, aluminum, copper, and galvanized steel.

When a roofing panel expands, it grows in two directions, lengthwise and widthwise. The lengthwise movement is compensated for by way of the clips and the flashing. The widthwise movement is compensated for by the panel itself; that is, the panel takes up this movement by bowing slightly at its center.

Different materials expand at different rates, this rate is called the thermal expansion factor. You need to know these factors to figure your expansion allowance. These factors are set for inches per degree F.

THERMAL EXPANSION FACTORS			MATHEMATICAL PROCEDURE
Steel	.0000066”		T = Total Expansion
Aluminum	.0000128”		L or W = Length or WIDTH in Inches
Copper	.0000096”		D = Temperature Differential
Stainless	.0000096”		F = thermal Factor
Bronze	.0000102”		T = L x D x F
Lead	.0000160”		T = W x D x F

Example: We have 200’ of steel panel 24” wide with a temperature differential of 165º F.

First convert the length to inches (200’ x 12) = 2400”
L = 2400” D = 165º F = .0000066” T = 2.6” total expansion lengthwise
(length) – (2400” x 165 x .0000066” = 2.6136” or 2.6” or 2-39/64”)
W = 24” D = 165º F = .0000066” T = .03” total expansion widthwise
(width) – (24” x 165 x .0000066” = .026136” or .03” or 1/32”)

As you now realize from the example, the panel grew 2.6” in length and.03” in width. Also, you now know that you would need an expansion clip with at least 2.6” of movement.

The expansion joint itself is covered in this section because expansion joints are really nothing more than sliding joint flashing. The important part about them is knowing when an expansion joint is needed.

To determine when an expansion joint is needed, you must take into account a couple of different factors:

- The first factor is: does someone make a clip with enough movement in it and
- The second factor is: what is the recommended maximum panel length by the architect or engineer on the project you are doing.

All of the above sometimes come into play when making this decision. Many times it is already figured out for you before you even bid a job, but it is always a good idea to make sure that the expansion clips will have enough movement to do the job.

Generally, the maximum length of a panel is figured by determining when the total expansion (lengthwise) reaches the limits of the clips expansion capabilities or the manufacturers' recommendation. To find the clips limits, you must check with the clip manufacturer.

Never Exceed The Manufacturers Limits On The Clip Or Panel !!!

The function of an expansion joint is to separate two building components while letting each component move freely without damaging each other or the structure they are attached to and, at the same time, maintaining water integrity where the two meet. The SSR expansion joint is where two roof sections meet and are allowed to float independently of each other while maintaining the water integrity between them.

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Understanding System Loading

As an installer, you must be able to identify the different types of loads and know when there may be a load problem. Again, this could mean the difference between a roof failure and a full life roof.

Dead Loads: The weight of all the permanent construction including the roof, framing, floor, and covering materials. This means the total weight of a building, but not the equipment, such as mechanical, electrical, ceiling, and sprinkler systems.

This information is helpful when doing a re-roof job. Let's say you are tearing off a BUR with ballast. When you consider the dead load, you realize right away that you will be lighter because the average SSR weights approximately 2 lbs. per square foot where a BUR weights between 5-9 lbs. per square foot. This in turn means that the building may not have to be re-engineered to have an SSR put on , saving the owner money and time.

Collateral Loads: The other required or specified permanent loads including the mechanical, electrical, ceiling, walkways, and sprinkler systems, but not the dead loads mentioned above.

Some collateral loads that are on the roof may be supported by the SSR itself as long as it **does not** interfere with floating. The heavier items should be supported by structural framing and not the SSR. This requires the use of double curbs; the inside curb supports the weight, while the outside curb floats with the SSR and the two are connected with flexible or sliding joint flashing.

Wind Load: The force applied to the building and/or roof from any horizontal direction. This is measured in lbs. per square foot up-lift.

When you see the U.L. listing on a roof such as U.L.-90, this means the roof (when applied to manufacturers specifications) will withstand 105 lbs. per square foot of wind up-lift.

Wind loads are the greatest at the corners, eaves, and rakes of the buildings, so extra care should be taken when fastening the SSR system in this area to prevent roof failures.

Seismic Load: The load generated on a structure due to an earthquake. As an installer, there is not much you can do about this type of load other than following the manufacturers specifications.

Live Loads: The anticipated, but not permanent, loads the SSR must be capable of handling. These loads include, but are not limited to snow, rain, service people, and construction workers. In short, any load except dead, collateral, wind and seismic loads.

Live loads must be engineered into the structure and the roofing system together to prevent a roof failure.

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Proper Fastener & Sealant Selection

Considering clip construction and uses, a clip with a U.L.-90 rating on a purling spacing of 5' and a panel width of 18" must hold at least 787.5 lbs. of uplift force. This means that the fastener(s) holding the clip to the structure must also hold at least 787.5 lbs. of uplift force before pulling out or breaking off. Fasteners play a major role in a Standing Seam Roof. Not only do they secure the panel to the structure, but are also used to attach the flashing, curbs, gutters, trim, and some closures.

To determine the correct fasteners needed for the job you are doing, remember they come in all shapes, sizes, and types (from screws to pop-rivets to toggle bolts, just to name a few).

1. Know what the uplift force on the fastener is going to be.
2. Know what type of material the fastener is going to anchor to.
3. Know what type of material the panels, clips and flashings are made of.

Remember that an SSR will last only as long as the weakest component and the last thing you want to fail is the fastening system used to secure the roof to the structure. One sure way for a fastener to fail is for it to be stripped or improperly installed. When you, as an installer, improperly install a fastener and then leave it that way, you are committing one of the biggest mistakes there is in the SSR industry.

Because there is so much uplift force on each and every clip and its fastener(s), you must **NEVER** let yourself walk away from an improperly installed fastener.

Whenever you know a fastener has been installed wrong, **FIX IT RIGHT AWAY**. The best way to avoid stripped screws is to use a screw gun properly adjusted for the job you are doing.

Always use the proper fasteners for the job and always fix improperly installed fasteners right away.

Sealants are used in the SSSR industry to maintain water integrity in the areas where negative air pressure (from inside the building) or capillary action may try to draw water in and also in areas where end lap conditions may exist. Sealants are used to maintain an SSR's water integrity at the seams.

When discussing sealants, there are two terms you should be aware of: adhesion and cohesion. Adhesion is the sealant's ability to adhere or stick to the material you are using. You need to make sure the sealant will stick to the panels coatings such as: paint, mill residues, and oils left on the material due to the manufacturing process, without affecting the sealant. Cohesion is the sealant's ability to stick to itself. This means if the sealant is pulled apart or stretched, it will elongate and web (stretch and string out). Cohesion is important to a SSR due to the expansion and contraction process.

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Proper Fastener & Sealant Selection (Continued)

Another item to be aware of with sealants is the forms that they come in. Gun Grade (or pumpable) and Sealant Tape. The basic difference between the two is the amount of solvent mixed with the solids. Solvents allow the sealant to be thinned out without affecting its adhesion or cohesion. Gun grade is generally 65% to 80% solids with the rest being solvents that evaporate after application, while tape is generally 95% to 97% solids and the rest solvent. With the choice of two types of sealants, you as an installer should consult with a Sealant Tape and Caulking Specialist or sealant supplier to make sure you are suing the latest technology of sealants for the material(s) you are working with. As you gain experience in SSR's you will know what type of sealants (gun grade or tape) works and looks best for you in different areas of the SSR.

Some of the most common places to use sealant is at any seam such as: side laps, eave details, ridge details, rake details, valley details, closure details, and at all penetrations (curbs, sky lights, vent pipes and so on). All roofs are different, so the need and the placement of sealants is going to be different and vary from job to job as is the type of sealant needed. To determine where the sealant should be place, you should first look to the Manufacturers Specifications and then to a Sealant Tape and Caulking Specialist or sealant suppler and last, but not lest, use your common sense.

You should always consult with a Sealant Tape and Caulking Specialist or sealant supplier to ensure that you are using the best sealant for the job. Remember all of the SSR's components should match, that is, do not use a 5-year sealant on a 20-year roof. Also, the sealant specialist or sealant supplier can keep you up to date on the latest technology in sealants and sealing methods for the SSR industry and can save you time and money due to sealant failures.

DO NOT CUT CORNERS WHE IT COMES TO SEALANTS !!!

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