

# Your First Step to Coating Success:

# SUBSTRATE PREPARATION

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The largest growth segment in the roof-coating marketplace is roof-coating systems that are being used as restorative solutions on existing roofs. As roof coating technology evolves and improves, roof coatings are being used on virtually any existing substrate to extend the service life of the original roof system. Bituminous systems are usually an easy match for most coating products on the market, while single-ply systems that used to be “off limits” are routinely coated with the aid of newer technology primers. Metal roofs of all configurations can have color fading, minor surface rust, and appearance issues addressed by refreshing with a roof coating system engineered for metal roof recovery.

Growth in the use of roof coatings is mainly attributable to their economic advantages. The typical roof coating application will be significantly cheaper than a membrane overlay or a reroof. Added to that is the tax advantage of a roof coating installed as a maintenance system rather than a capital improvement. Capital and maintenance budgets are significant drivers of the majority of roof coating solutions.

With all of the market growth come issues because not every roof coating is created equal. Each product has its own strengths and limitations, and every product carries significant text in its application guidelines under “Jobsite Requirements,” “Existing Conditions,” or “Substrate Preparation.” This is the tedious fine print that is routinely glossed over by nearly everyone in the project process at one time or another because let’s face it—everyone wants to flip open can lids and start applying material. As every roof coating manufacturer stresses “clean, dry, and

debris-free,” this article will go beyond those watchwords to provide designers, specifiers, installers, and owners with some areas to watch for on their projects.

#### COATING FAILURE MODES

Before we get started on how to prepare substrates to accept coating systems, we need to understand why coatings and coating systems fail in the first place. Roof coatings individually—or functioning as a system—fail in three distinct ways: through adhesion, cohesion, or substrate failure. We will examine each failure mode.

**Adhesion** is the simple concept of the coating sticking to the surface it is applied to. Every coating has its limitation, but the basic concept is the coating should be able to stick to its substrate if it can resist at least five pounds of force. Since adhesion measures the ability of the coating to remain engaged with the substrate, substrate preparation can have a big impact on the adhesion of the coating product or coating system. If there are any questions about adhesion, apply test strips on the roof to be coated and take test pulls prior to application of the entire system.



*A well-prepared substrate can support a restorative coating solution that will extend the service life of a roof.*



*Figure 1 – Metal roofs have many prep steps prior to recoating. Check for the compatibility of sealants and patching materials prior to coating application.*

**Cohesion** is a failure within the coating itself. Cohesion failures are usually attributed to product quality from the point of manufacture or product degradation due to improper storage. These circumstances can lead to a change in product chemistry that can affect the product as a whole. Cohesive failure can also be within the layers of the coating system. Potentially, this could be categorized as adhesion, but since the multiple layers of primer, base coat, and finish coat have been conceivably engineered to bond to each other, we will call this a cohesive failure. Violation of successive coating windows is typically to blame for this sort of failure. Many primers and base coats need to be coated within hours—not days or weeks—to ensure bonding of successive layers. Consult product and system application guides to make sure everyone is on the same page for the work effort required on the roof. Application beyond product shelf life can also be a cohesive failure issue, but should it have been applied in the first place? Please be cognizant of this easy-to-conclude reason for product exclusion or rejection at the jobsite.

**Substrate failure** (and this is where the preparation comes in) can happen in two scenarios: undetected and unaddressed. Undetected conditions relate to soundness or integrity of the substrate. Was there a

proper infrared scan to detect moisture in the roof system to be coated? Was there an attachment issue with a layer of the existing substrate? Does the concrete have a weak surface layer due to over-finishing? Is there a “split-slab” condition that is driving moisture to the surface at different times of the day or year? These are the “due-diligence” items that proper design of a roof coating system must address. Unaddressed issues result from too much reliance on product performance or cavalier attitudes that the little things don’t mean so much to overall project outcome. Unaddressed items can be negligent attitudes towards the “clean, dry, and debris-free” watchwords, inadequate budgets, or project oversight that does not give enough credence to site preparation. In summary, unaddressed items are inexcusable.

#### **TYPES OF SUBSTRATES**

Each potential substrate that may receive a roof coating or roof coating system has to be looked at as a project-specific condition. Very few products have “one size fits all” performance without some attention to what the coating is being applied over. Even rarer is the substrate that is 100% ready to receive the coating project. Just like any other roofing project, detailed on-site evaluation needs to be made of every potential

project to assess coating adhesion in horizontal or field areas and transition to the vertical or rooftop details. All coating manufacturers have standard details that address the common rooftop interfaces and give some guidance on how to tackle those site-specific conditions.

Common to every project and universal to every manufacturer is the “clean, dry, and debris-free” advice. Clean means free of contaminants. Are there greases, oils, and other chemical contaminants on the roof that could inhibit adhesion? These need to be cleaned off or “blocked” with primers or other surface preparation coatings. Dry

means dry, and most coating products have a surface moisture tolerance of less than 5% moisture content. So that means pick the time of day or time of year to apply a coating. Stay out of rainy seasons, or apply later in the morning after the morning dew has burned off. Simple moisture meters can give a good indication if surface moisture is present, while more intrusive probe systems will be required for concrete substrates. Debris-free means all loose material that is in the area to be coated needs to be removed. Tree limbs, branches, twigs, leaves, and garbage come to mind as the usual suspects for removal. Dirt and loose granules are commonly found in drainage areas on the roof. Sometimes the dirt is so entrenched it has become a part of the roof system. No matter how stuck, it needs to be removed, as it will be a bond breaker for the roof coating to be applied. Following this most basic advice takes effort by all parties to identify the scope of work that will be required before the roof coating starts.

#### **BUR and Mod-Bit**

Old-school built-up roofs (BUR) and modified bitumen (mod-bit) roofs have been receiving solvent-based and asphalt emulsion coating systems for decades and, more recently, water-based coatings. The bituminous coatings can be used as a

means to resaturate the roof and bond new gravel or granules to the roof. Aluminum-based products are used to provide ultraviolet (UV) resistance for smooth-surfaced BUR and mod-bit sheets. While declining in use and under attack from volatile organic compound (VOC) regulations, they are still out there. White elastomeric coatings are seeing increasing use to make these black or gray roofs achieve the energy conservation and LEED benefits of white reflective roof membranes. The great benefit of BUR and mod-bit is that they have multiple plies of defense. Unfortunately, that means a lot of seams and flashings to be prepped on an aged roof. No matter the roof coating system selected for the project, all seams need to be walked and repaired with a flashing cement or adhesive compatible with the coating system. Roof details need to be inspected, and many times, all vertical flashings and penetrations must be replaced prior to the roof coating project.

### Single-Plies

Single-ply roofs present more preparation issues, because roof coating adhesion has been the typical failure mode—especially with thermoplastic roof systems. Seams and flashings must be inspected and rewelded or “stripped-in” if needed, while EPDM roof systems can have new seam tape applied. Many manufacturers have special primers to wash off or dissolve any chalking and promote adhesion and bond of the final roof coating system on a single-ply roof. Lastly, be very wary of application over mechanically fastened systems, which can have movement due to membrane flutter or billowing from inside air pressure. These areas of movement can relate to premature coating system failure and are typically not approved for a warranty installation.

Existing coating systems can be overlaid with a new coating system. Compatibility between the two systems is important (Figure 1). Aluminum coatings can typically only be recoated with new aluminum; silicones, only with silicones. And sometimes that is difficult. Extensive preparation is needed to scarify the surface, as the existing coating tends to be slick and will not promote good adhesion. An adhesion test is recommended before recoating an existing coating system.

All existing roof systems—regardless of membrane type or coating—need to have a comprehensive examination for wet insula-

tion in the system. Minor roof breaches can lead to extensively damaged areas in the roof. Infrared thermography has become the most efficient method for finding the wet areas and marking the roof for areas of replacement. The roof is then cut open and all wet insulation and cover board materials are removed and replaced. Then the roof membrane is replaced. It is this process and the area associated with it that typically determine the cost-benefit analyses between installing a roof coating system or proceeding with a complete tear-off and reroof.

### Metal

Metal roofs require special attention to the integrity of the metal pans or panels and the fasteners used on the project. Prior to any coatings being applied, the roof has to be walked to tighten or replace all fasteners. Then most coating specifications require sealing all joints and laps on the entire roof with a caulk or special paste-like primer. All scale and loose rust must be mechanically removed and primed with a rust-inhibiting primer. Damaged or rusted-through panels must be replaced.

### SPF

Roof coatings and spray polyurethane foam (SPF) roofs go hand-in-hand at the time of the application of an SPF roof. Continual coating of the SPF roof maintains the waterproofing integrity of the roof and the underlying foam insulation. At the time of a recoat, the foam system needs to be inspected for any damaged areas that need to be patched with SPF, and then an infrared scan must be performed for any potential wet areas, which should be replaced as well. After any loose material is removed, the roof surface should be ready to accept a compatible roof coating. While many coating systems will work on SPF roofs, look for a coating system that is specially formulated for SPF compatibility.

### Gypsum and Cement Cover Boards

Many coating systems have been designed with continuous reinforcement for use over gypsum and cement cover boards. This allows for protection of the underlying substrate while providing a smooth and strong surface to accept the coating system. The big issue with boards is what to do with the joints and fasteners. Joint prep is time-consuming and needs to effectively bridge the gap between boards so the coating system will not develop reflective cracks.



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Look for a reinforced joint detail that will provide long-term performance to resist building movement. Similarly, the fasteners and plates need to be reinforced in the same fashion as the board joints to minimize “scuffing” issues with the fastener and plate profile. This can be easily mitigated by using a low-rise foam adhesive to attach the board, as these adhesives provide a lot of flexibility due to their adhesion to multiple substrates.

### Concrete

Lastly, roof-coating systems applied directly to concrete decks must deal with the concept of “cure” vs. “dry.” Many newly placed concrete decks will go with a 28-day cure window, and then the general contractor says, “Start!” Experience has told all of the players in the industry that it’s not that easy. The 28-day window is an indication of ultimate concrete strength—not moisture content. So on what does a designer, installer, or manufacturer rely to ensure

product adhesion and mitigate the risk of being subjected to moisture drive that could cause blistering?

The ASTM D4263 Plastic Sheet Method, while a good indicator of moisture presence, has been discarded in favor of more accurate methods. Moisture meters are good at indicating a numerical value of moisture in the concrete, but typically only penetrate the first inch or two of a concrete roof deck. Relative humidity probes are the latest technology that gives an indication of the conditions in the entire slab thickness. In addition, the floor coating industry has developed many moisture mitigation membranes—several which are epoxy-based—that can be utilized in roof decks.

This advice can apply to almost any concrete deck: structural, lightweight structural, and concrete in unvented pans. Stay close to this subject, as more guidance is evolving for all parties. Just because the concrete is not freshly poured does not mean you are free to go. Concrete placed decades ago can be soaking wet, depending on what it has been exposed to over the years. All exposed concrete needs to be checked, regardless of age.

Concrete also has a finishing component to its placement that can greatly affect the adhesion of a coating system. In general, the rougher, the better, to provide for more surface area for coatings to bond against (*Figure 2*). The International Concrete Repair Institute (ICRI) Technical Guideline 310 designates concrete surface profiles (CSPs) or “roughness” that surfaces should be prepared to for proper adhesion of coatings. Most coatings adhere to an ICRI CSP of 3 to 5. The key is to remove enough of the surface contaminants, like curing compounds, and open up the pores of the concrete so they can be sealed during the coating process.

### PREPARATION METHODS

Now that we have identified the roof coating system and the type of roof to which we want it applied, we have to use the proper methods to get the roof substrate prepared. The first reference for any project should be the manufacturer’s installation guidelines. This is the best resource for product-specific assistance on surface prep, product storage, product application, and quality assurance/quality control. Let’s get back to what work lies beyond that “clean, dry, debris-free” guideline.

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*Figure 2 – Concrete surface preparation can be achieved by many forms of scarification. Refer to ICRI Surface Profiles for proper roughness.*

preference should be given to mechanical means of surface preparation over water blasting. Compressed air is one of the most effective methods for freeing and removing loose materials from the roof surface. Compressed air does not introduce moisture. Compressed air can get a lot of work done very quickly. Used with a stiff bristle broom or even a rotary power broom, a lot of the surface dirt can be removed as well. Even using a leaf blower is a decent substitute for an air compressor.

Finished metal found on a roof tends to be prefinished or very smooth from the factory. The goal is to provide some surface area on the face of the metal to receive the roof coating so there is some “bite” between the coating and the metal. Grinding with a hand-held cup grinder tends to yield the best results. Wire brushing and wire wheels on drills tend to polish the metal and leave it as slick as it was to start with. Even simple #60 grit sandpaper can do the job on some sheet metal. Watch out for Kynar®-coated metals, as those tend to have their own custom primer due to the high-grade finish.

Concrete prep is needed to remove old coatings, curing compounds, and other surface contaminants that have accumulated over the years. The final result is to open up the concrete pores and achieve a roughness factor that will allow the roof coating system to bond. If there is an option for any new concrete pours, steer away from hard-troweled surfaces. Concrete prep is a noisy and messy process. Shot blasting, bead blasting, and large area grinding are the routine methods for achieving the ICRI CSP of 3-5.

As mentioned previously for cover boards, the board-to-board joint interface needs to be addressed to mitigate reflective cracking or the “picture frame effect” that can move up from below (Figure 3). Many manufacturers specify a three-step process similar to finishing dry-wall joints with slurry and mesh or fabric reinforcement. Others use “non-gassing,” “no-sag” caulks that provide a seal and allow for a flush finish at the joint interface. Consider using an adhesive so the fastener

heads and plates do not also require treatment. Test all primers on the boards before large-scale application. Many low-viscosity primers will get sucked into the board like a sponge and require a second application.

The one tool that is both a blessing and a curse to the roofing industry is the power washer. Adding water to the substrate preparation phase of the job only introduces delay time for drying and potential damage if not done properly. Power washing can be done correctly if done “down shingle” so as not to open laps and seams or “degranulate” mineral-surfaced cap sheets. Power washing is best done on a roof with plenty of slope so you don’t introduce drainage issues from all of the water. Keep pressures down to 1500 psi or lower, and keep the wand at least a foot or more from the roof surface; remember, we are trying to clean the roof, not hydroblast it. A more benign alternative is a garden hose and push broom. Power washing is really a last resort after all of the previously mentioned mechanical preparation methods.

#### TALES FROM THE FRONT

To validate the substrate preparation scope of work, methods, and overall effort required, several conversations were held with some of the top roof coating contractors nationwide to get their feelings on the subject. All agreed that the “clean, dry, and debris-free” advice is the key to getting the job done on the roof. “If you just do that, it makes the job easier,” said one respondent. The subject of product storage was also raised; have a good staging

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Figure 3 – Check the cover board joint treatment requirements for the coating system to be installed to reduce reflective cracking.

area and make a shade structure to keep reactive or two-part products out of direct sunlight. That led into a conversation on substrate temperatures and application temperatures. So many products in the roofing industry have a “sweet spot” for application, and 50° to 80°F (10° to 27°C) is the “prime time” for roof coatings. Cooler temperatures cause coatings to take longer to set up, and hotter temperatures and hotter substrates tend to create rapid cure times that make hand-applied material difficult, necessitating a sprayer.

Even the contractors noted that primers are routinely underestimated. “Primers take prep time, dry time, and attention



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*Figure 4 – Manual labor is an essential element of substrate preparation. Do not underestimate the effort.*

to the application rate—which is always different than the final coating, so you need to get back on it while it is tacky.” A contractor focused on spraying advised, “Multiple thin coats work better than one thick coat.”

Validating what designers are seeing in the field, one contractor has purchased all of the necessary moisture detection equipment to check concrete deck conditions at the time of bidding and during the project, saying, “It’s a way to validate what I have to do instead of being told what to do later.” As an industry, we can expect more guidance on concrete deck procedures in the future.


The final comment concerned the estimating phase of the project. “We always budget 5% up to 35% for surface preparation, depending on the product and the surface conditions.” This was refreshing news, knowing that so many of the issues addressed in this report are actually being implemented by contractors to provide the best possible installation (Figure 4). Many roof coating projects are undertaken as a value-based rehabilitation, but let’s not sidestep the surface preparation effort and cost as part of the value approach.

One last piece of advice not routinely seen in a coating manufacturer’s literature is to check for the existence of a manufacturer’s warranty. Many warranties will not allow for additional coatings to be applied or will require a coating system offered only from the original membrane manufacturer. Please ask this simple question so as not to void an existing roof warranty.

## CONCLUSION

This article is intended to serve as a refresher on good roofing practice for all parties in the project process. A roof coat-

ing project, like any other roofing project, really depends on a solid design, executed by a competent contractor, supported with a sufficient owner’s budget to perform the scope of work. Spending time at the design and bid stage to identify the substrate preparation items and assess their existing state and

the effort required to bring them up to an acceptable condition to receive the roof coating is essential in meeting project expectations. Designers/specifiers and bidding contractors have to work together to achieve this. So while you contemplate your next roof coating project, know your substrate, and select the most compatible roof coating system for overall project success. 

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