PIM Shield® Paint: Rooftop Application

INTRODUCTION

When mitigating external Passive Intermodulation (PIM) on rooftop cell sites the "loudest" PIM sources are often found underneath the roofing membrane in front of the site antennas. Common sources of PIM originating from the roof include overlapping steel deck members, hardware used to secure insulation, and overlapping sheet metal used for flashing. Rather than reconstruct the roof, it's far more economical to apply a radio frequency (RF) barrier over the roof surface to prevent downlink signals from reaching PIM sources below the roof membrane. Such a barrier material needs to be durable, able to withstand harsh environments, and not generate PIM on its own.

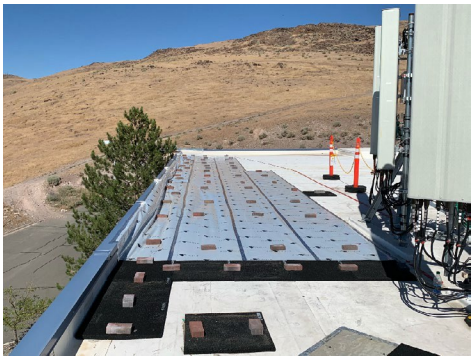
PIM Shield® Paint is a is an RF barrier material developed by ConcealFab that effectively mitigates external PIM sources and maintains its integrity in harsh outdoor environments. It is highly elastic, allowing it to withstand expansion and contraction of roofing membranes due to daily temperature swings. Greater than 17 dB RF attenuation is achieved with two coats of PIM paint, resulting in >47 dB IM3 reduction. An Application Note is available from ConcealFab that describes the extensive testing done to validate both the RF and mechanical performance of PIM Shield® Paint. This Application Note conveys the recommended process and materials for applying PIM Shield® Paint to single ply and multi-ply roofing systems such as TPO, PVC, KEE, EPDM and modified bitumen (asphalt). Guidelines are also provided on how to achieve good adhesion of PIM Shield® Paint to aluminum, stainless and galvanized steel surfaces.

PIM Shield® Paint

DETERMINE COVERAGE AREA

Before installing PIM Shield® Paint, a PIM hunt should be conducted at the cell site to identify PIM source locations. Do not guess! While PIM sources may likely exist underneath the roofing membranes, covering the roof with PIM Paint may be pointless if more powerful PIM interference originates from somewhere else at the site. ConcealFab's step-by-step PIM hunting process should be used to locate the "loudest" PIM sources before proceeding with PIM Paint application.

Once the PIM sources have been located, cover the area to be treated with a temporary RF barrier such as ConcealFab's PIM Blankets or PIM Foil. With the temporary RF barrier in place, confirm that uplink noise level (RTWP or RSSI) has improved to the required level. Take plenty of pictures and record dimensions of the area covered during this test so that the required square footage of basecoat, PIM paint, and topcoat can be calculated.



Temporary RF barrier (PIM Foil) installed on roof

RECOMMENDED MATERIALS

A basecoat material (primer) is required to guarantee adequate adhesion of PIM Shield® Paint to the roofing membrane. Different basecoat materials are required based on the type of roof membrane. Two coats of reflective topcoat material are required to reduce surface temperatures and to provide foot traffic protection. PIM Shield® Paint has been tested for compatibility and adhesion (via pull-testing) with the recommended basecoat and topcoat materials shown below. DO NOT SUBSTITUTE.

	Coating	Applied to	Coverage rate	App Temp	# Coats
Basecoat	APOC 583 Armor-Base or Johns Manville Coating Universal Base, 70005740	Modified Bitumen (Asphalt)	100 sq-ft/gal	>55 °F	1
	APOC 296 Single Ply Primer or Johns Manville Coating Single Ply Primer, 70006113	TPO, PVC, KEE, EPDM	400-600 sq-ft/gal	>50 °F	1
PIM Shield® Paint	ConcealFab PIM Shield® Paint	Basecoat	150-175 sq-ft/gal/coat	>40 °F	2
Reflective topcoat	APOC 248 Energy-Armor or Johns Manville Coating Acrylic, 70005751	PIM Shield® Paint	66 sq-ft/gal/coat	>55 °F	2

The pictures below show roof surface temperature measurements recorded immediately following a PIM paint application. PIM paint should be coated with the recommended reflective topcoat to prevent excessive heating.

White PVC roof

Black PIM Shield® paint

SURFACE PREPARATION

Before applying the basecoat layer, all surfaces must be prepared to promote good adhesion to prevent blistering and delamination. Sweep the area to be covered to remove all dust, dirt, debris, and loose granules. Remove any rust present on steel metal flashing that will be coated. Pressure wash all surfaces (use wide fan tip) and scrub with mild detergent. Remove any mildew prior to pressure washing using diluted bleach. After pressure washing, make sure that the surface has completely dried before applying the basecoat.

Before

After

COATING INSTALLATION

All coatings should be applied on warm, dry days to facilitate curing. Check the weather forecast before starting work. Do not apply coatings if rain or heavy dew is expected within 48 hours. Work should begin early each day to maximize drying time. Stir materials prior to use to ensure even mix. As a rule of thumb, allow for a minimum of 4 hours cure time between application layers. Shorter cure times may be possible in hotter, dryer environments. Refer to the manufacturer's technical datasheet for additional application instructions. Below are images showing the required process steps for a PIM Shield® Paint installation.

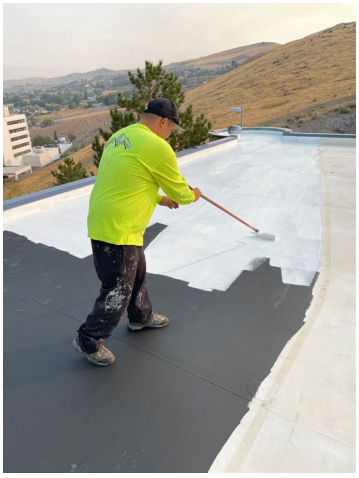
1) Clean roof surface.
Allow time to dry.

2) Apply basecoat. Cure 4 hrs.

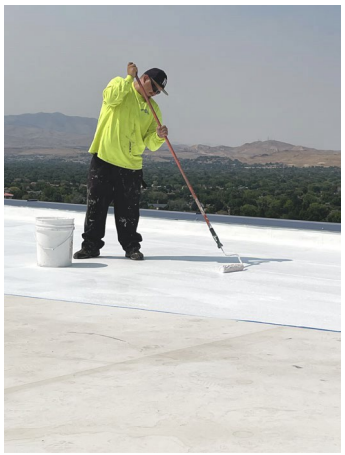
3) Apply 1st PIM Paint layer.
Cure 4 hrs.

4) Apply 2nd PIM Paint layer.
Cure 4 hrs.

5) Apply 1st topcoat layer.
Cure 4 hrs.



6) Apply 2nd topcoat layer.



CAUTIONS

The following cautions apply to PIM Shield® Paint installations at rooftop cell sites:

- Do not install without landlord approval.
- Only use the recommended basecoat and topcoat materials. Do not substitute!
- Use roofing contractors with experience deploying coating systems to perform all work.
- Coordinate with mobile operator to turn off RF transmitters while performing work in front of antennas.
- Read Safety Datasheet (SDS) for each material prior to use and abide by all safety warnings.

SURFACE PREPARATION

In some cases it may be desirable to apply PIM Shield® Paint to metallic surfaces, whether for aesthetic purposes or to mitigate a PIM source originating from the metal itself. To achieve good adhesion of paint to the metal, steps should be taken to prime the surface in addition to the basic surface preparation outlined above. The following table outlines recommended primer techniques and mix ratios for common metals:

Metal	Surface Prep	Recommended Primer mix	Mix Ratio
Galvanized Steel	Epoxy prime	Cardinal 7760 series 2k Epoxy Primer Cardinal 1600-01 Polyurethane Fast Reducer (optional) Cardinal 77EH Epoxy Hardener	**10:3:1** Primer/Reducer/ Hardener
Aluminum, Stainless Steel	Acid etch prime	Cardinal 1000-52 A/C Reducer Cardinal 4860 series 420 VOC Acid Etch Pretreatment Primer	**2:1** Reducer/Primer

Primer mixes may be air sprayed or brushed. If brushed or applying over rough/indented galvanized steel surfaces, the reducer is not recommended. After preparing the metallic surface, PIM Shield® Paint should be applied within 24 hours to prevent bubbling and delamination. If painting can not be done within 24 hours, then light buffing followed by brushing or air pressure cleaning should be performed before applying the paint.

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