



Reactive Innovations, LLC

White Paper: “Improved Non-Skid Flight Deck Coating System”
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THE DOD’S NEED FOR IMPROVED NON-SKID COATINGS

The Department of Defense (DoD) has indicated that improved performance is required for flight deck coating systems used under normal fluctuations in operating temperature and heavy traffic/load areas. Specifically, DoD has revised its military specification [MIL-PRF-24667B] for non-skid, roll or spray applied coating systems to include a “Type V non-skid”. The “Type V non-skid” is an “Extended Durability, Rollable Deck Coating” and must meet a number of more stringent performance requirements, namely:

- Improved UV Resistance
- Lower VOC content
- Improved Impact & Wear Resistance
- Improved Weatherability
- Increased Pot Life
- Reduced Weight

MIL-PRF-24667B COATINGS: CURRENT STATE OF THE ART

A number of companies, including Ameron International, International Paint and ITW/AST offer marine non-skid coating systems, which are epoxy based. Any new system must have a long service life, fast cure time, high coverage area and long shelf life. In addition, the non-skid must be able to be applied by standard (industrial) methods such as rolling or spraying, must be repairable while the ship is in service, and must not add excessive weight.

NEW DEVELOPMENTS: NOVEL NON-SKID COATINGS BY REACTIVE INNOVATIONS, LLC

During a recent NAVY program, Reactive Innovations, LLC (RIL) developed a coating formulation showing feasibility for use as a “Type V non-skid”, based upon evaluations per MIL-PRF-24667B. *This coating system is not epoxy based.* Compared to the current state of the art MIL-PRF-24667B approved (epoxy) based non-skids, such as ITW-MS440G, the new coating formulation offers the following significant improvements:

- Excellent UV Stability (2000+ hours demonstrated on base resin)
- Very Low VOCs (< 60 g/L)
- Higher Impact Resistance (factor of 2 to 3)
- Improved Corrosion / Humidity Resistance (5000+ hours demonstrated on base resin)
- Improved Pot Life (minimum of 4 hrs at 70°F)
- Reduced Weight (less than 0.4 lb/ft²) & Improved Coverage (minimum 40 ft²/gal)

As these non-skid coatings were developed to also address low radar cross section there is a tradeoff between the radar signature and coefficient of friction (COF).

KEY DATA: TEST RESULTS ON RIL COATING BASE RESIN

Base Resin Coating Formulation: The base resin formulation has properties of a high performance epoxy and an acrylic polyurethane in one system. The base resin is sprayable with excellent weatherability in sunlight and superior chemical, corrosion and impact resistance after cure. The coating adheres strongly to steel (bare and pre-coated) and inorganic coated surfaces.

Base Resin Adhesion to Substrate & Chemical Resistance: Adhesion, per ASTM D3359, was completed on fully cured samples with all samples showing a 5B rating. Samples were also immersed in chemical solutions for 2 weeks, and evaluated for wet adhesion. The following chemicals were tested, exhibiting the wet adhesion rating shown in parenthesis: Kerosine (4B), 100% Ethanol (3B), Non-Ionic Detergent (5B), Deicing Fluid (5B), Fire Fighting Foam (5B), Hydraulic Fluid (5B), Aircraft Lubricating Oil (5B), Lubricant Grease (5B).

Base Resin Wear Resistance: Abrasion resistance (per ASTM D4060) was calculated as loss in panel weight at a specified number of cycles. For the RIL base resin, the removal rate was ~50 mg at 1000 cycles (CS-17 wheel).

KEY DATA: TEST RESULTS OF RIL NON-SKID COATING

ITW MS-440G Control Non Skid: The control non-skid samples were fabricated by ITW-AST using one of their workhorse (best performing) non-skid resins, MS-440G, and its corresponding primer. For all experiments, the MS-440G coated on 0.25” carbon steel, was the control panel.

Non-Skid Impact Resistance: Testing on RIL non-skid samples was performed in accordance with ASTM D2794 (coated on 0.25” thick, 1018 Carbon Steel). The table shows the height at which the paint chipped or was separated from the surface (higher numbers = better performance). These results indicate that base resin / filler can be combined to make a non-skid formulation with significantly improved impact resistance.

RIL Non-Skid Impact Resistance Testing

Specimen ID (Manufacturer)	Max drop height (Inches)
A1 (RIL)	8
B1 (RIL)	10
D1 (RIL)	12
E1 (RIL)	12-14
MS 440G (ITW)	4

Non-Skid Resistance to Accelerated Aging: This test simulates outdoor UV exposure for long periods of time. Here, coated steel test panels (0.25”, 1018 carbon steel) were evaluated per ASTM G154 cycle 2, in an accelerated weathering tester (QUV Cabinet, operates on alternate 4-hour periods of condensation at 40 °C). The results are shown below:

- ❖ All RIL Samples (A3,C3,D1,D3): No change after 500 hours exposure to UV:A
- ❖ MS 440G (ITW): Slight discoloration after 500 hours exposure to UV:A

Non-Skid Accelerated Corrosion Resistance: Coated steel test panels (0.25” thick, 1018 carbon steel) were placed in a salt fog cabinet as specified in ASTM B117. After exposure, the coating was examined for loss of adhesion and separation between coats. A portion of the coating was removed from each panel, so the underlying steel could be observed for corrosion and evaluated per the standard.

- ❖ All RIL Samples: PASS; Slight discoloration after 500 hours exposure to salt fog
- ❖ MS 440G (ITW): PASS; Significant discoloration after 500 hours exposure to salt fog

Non-Skid Coefficient of Friction Testing: Testing for Coefficient of Static Friction (COF) was performed in accordance with ASTM G115 (rubber sled, 3 mm Neoprene) on 24” x 24” Aluminum panels. COF testing was completed in six different directions, and the values listed below are the “average” of each directional measurement.

RIL Non-Skid COF Results

Specimen ID (Manufacturer)	Dry COF (average)	Wet COF (average)	Notes/Comments
B1 (RIL)	0.96	0.93	PASS MIL-PRF-24667B
C1 (RIL)	0.95	0.93	PASS MIL-PRF-24667B
MS 440G (ITW)	1.20	1.19	PASS MIL-PRF-24667B

RIL can increase the COF by adjusting the resin additive formulation.

COMMERCIAL USE

Commercial rights to this technology are available from Reactive Innovations, LLC (RIL). The technology can be patented or can continue to be maintained as a trade secret. RIL is interested in working with a non-skid coating company to further develop this technology. RIL coated test panels of dimension 24” x 24” (see figure below, ruler is 6” long) can be provided to possible partners for their initial evaluations.



Possible collaborative strategies will depend on the agreement made between the parties; RIL can accommodate a number of agreements, including exclusive license or complete sale of the technology. Interested parties should contact Richard M. Formato by phone [978-952-6947] or email [rformato@reactive-innovations.com] to learn more about this opportunity.