

Test and Evaluation of Primers with Extended AF Overcoat Window

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Lead Technical Team Member: US Naval Research Laboratory (NRL) James Tagert

Teaming Partners: BAE Systems, Bath Iron Works, Huntington Ingles Ind. Sherwin Williams, PPG Paint, International Paint



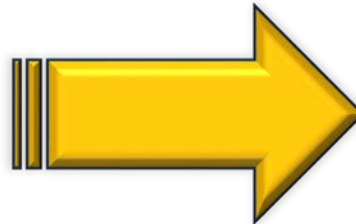
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Introduction:

• Current Process



Alternative Process



• 009-32

- Section 3.1.19: Second coat of primer must be tacky when applying the ablative antifouling (AF) topcoat
- Section 3.6.3: Defines tacky as the cured state of a coating where a fingertip is gently pressed into the surface (without twisting) and no residue is present on the fingertip, only a slight impression is left behind on the surface

Cure up to 72 hours

- Allow to apply while tacky or for up to 72 hours after application

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Benefits of Extended Recoat Times

*Schedule Flexibility * Reduced Risk* Enhanced Quality*

- Allows ablative AF to be applied beyond the epoxy's tacky state
- Eliminates a “tacky” inspection that can be subjective
- Minimizes the risk of AF adhesion failure and schedule impacts if the tacky state is exceeded before or during AF application due to:
 - Work stoppage due to weather conditions
 - Work stoppage due to equipment failures
 - Variations of sun and wind exposure within the dry dock
- Provides improved schedule integration with other critical path dry dock events
- Provides for enhanced inspection of the 2nd coat of anti-corrosion (DFT vs. WFT, more thorough visual holiday inspection; e.g. in sea chests or other hull recesses



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Background:

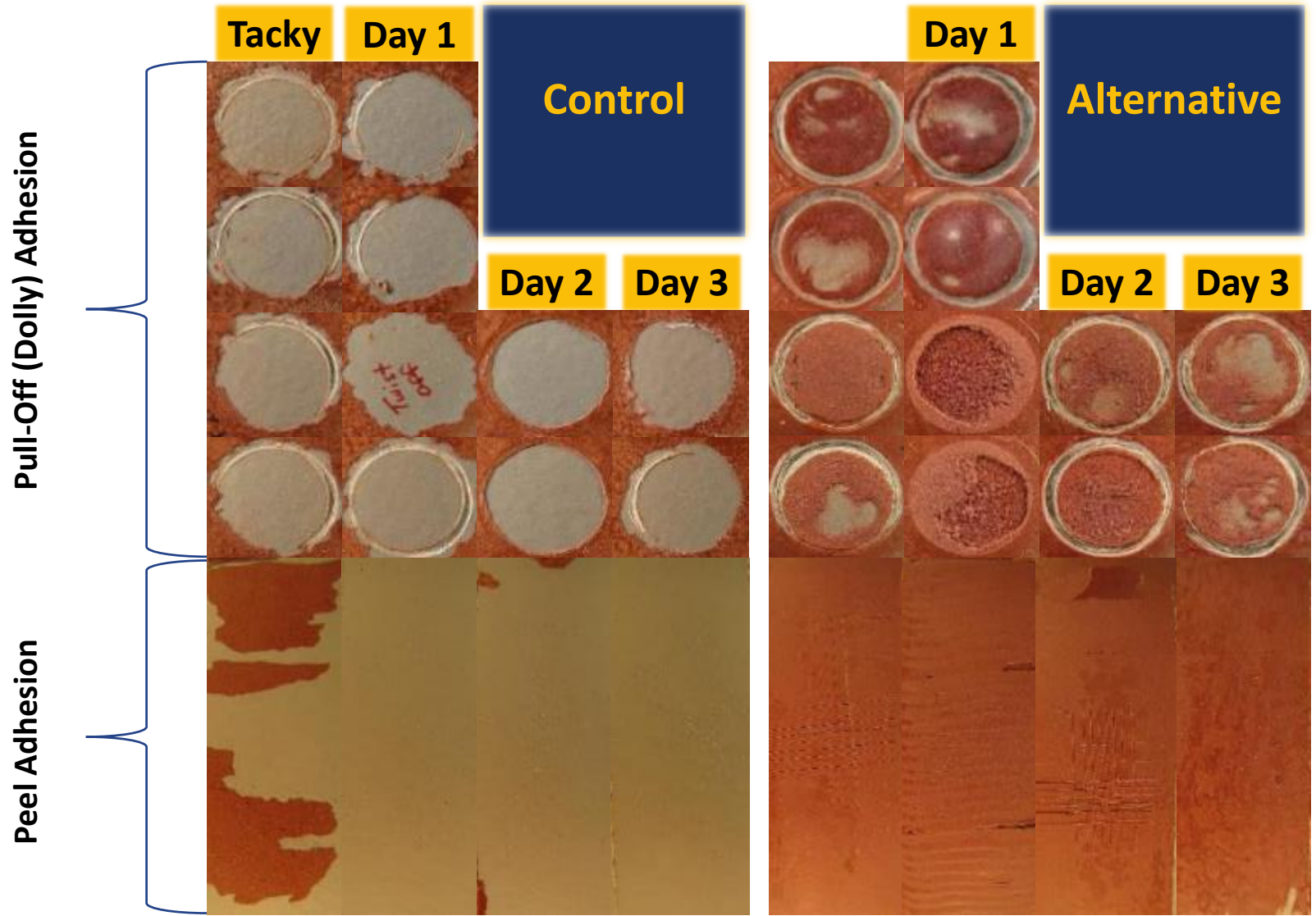
NRL initial testing focused on evaluating properties of the primers that would be conducive to an extended overcoat window. This window is related to the amount of time the coating is “chemically active” to allow proper bonding of the next coating layer without the need for surface preparation

- Primers were applied to test panels and allowed to cure for different time intervals before an AF top coat was applied
- Tg and hardness measurements were made at the same time intervals to gain an understanding of cross-link density and solvent resistance of the primers during curing
 - These tests provided an indication if solvent in the AF top coat is able to diffuse into the primer creating a bond between the two systems
 - The Tg of the alternative primer had a larger decrease when exposed to solvent in AF top coat
 - This could be related to good adhesion properties
- Considering results of all testing:
 - Alternative primers had the best results in adhesion tests with a preferred cohesive failure mode of AF top coat
- Alternative primers tested can extend the overcoat window for MIL-PRF-24647, Type II AF paint for several days
 - Length of overcoat window needs to be balanced against surface contamination risk

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Background:

Adhesion Between Primers and Antifouling Topcoat:



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Background:

Pressure Washer Test:

System (AF Top Coat 1
with Primer):

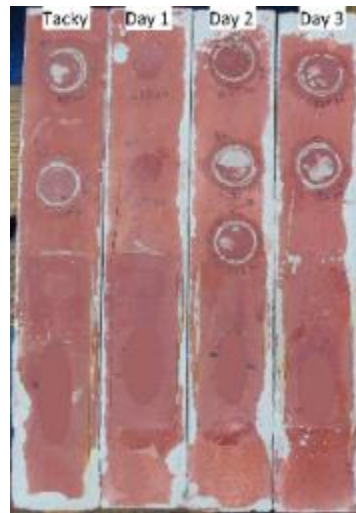
Before



After



Alternative Primer



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Background and NSRP Demonstration:

- **PCoE Funded Demonstration:** Amphibious Construction Battalion One (ACB-1) on the underwater hull of a barge. Testing was successful
- **NSRP Shipyard Demonstration:** Underwater hull of shipyard asset, or large test plates
- For both demos, primer will cure for 3 days before applying AF top coat.



ACB-1 Demo – Completed July 2019

- Qualify alternative primers to MIL-PRF-24647 as part of a system
 - 1st coat: MIL-PRF-23236 anti-corrosive primer (cathodic protection)
 - 2nd coat: NEW MIL-PRF-24647 primer (tie coat)
 - 3rd coat: MIL-PRF-24647 antifouling paint system
- Update ASTM F-718 with new primer/tie coat requirements

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NSRP Demonstration:

Alternative Coating Systems Applied to Test Plates

Manufacturer	Primer	Alternative Tie Coat	AF
PPG	Amercoat 235	Sigmacover 520	ABC 3
International	Intergard 9000NP	Intergard 267	Interspeed 640
Sherwin Williams	Fast Clad Primer	Fast Clad Primer	Seaguard Ablative
Sherwin Williams	Seaguard 5000HS	Hempel 47183	Seaguard Ablative
Hempel	Hempel 17630	Hempel 47183	Olympic Ablative

Control plates will be coated with each manufacturers' MIL-PRF-24647 currently approved System and IAW current 009-32 requirements

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NSRP Demonstration: Test Article Preparation

- Panel size: 4' X 8' steel
- One (1) panel for each of the four tie coat primers being tested
- Three to four MIL-PRF-24647 coating systems with tie coat primers will be tested
- The host facility (shipyard) will advise for a way to secure the panels in the water that will minimize movement and / or damage during the submersion cycles
- Each panel will be coated with test primers and AF on both sides
- Following the first prime coat, all edges and any holes or other attachments installed by the shipyard for securing purposes will receive a stripe coat (of the first coat material) of contrasting color
- Each panel will receive one of the tie coat primers on both sides
- After 72 hours cure cycle for each tie coat, the manufacturers corresponding AF will be applied, using the diagram provided for guidance
- Follow full credible cure, the panels will be submerged in salt or brackish tidal water and secured at the shipyard



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NSRP Demonstration: Test Article Preparation



Intergard 267 and Sigmacover 520 Systems Completed at BAE JSR in December 2019
Panels Submerged in January 2020



Fast Clad Primer and Hempel 47183 Systems Completed in March 2020

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NSRP Demonstration: Test Article Preparation



Panels submerged at BAE in January 2020



Panels submerged at HII in January 2020

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NSRP Demonstration: Test Article Evaluation

- 5/19/2020; The Intergard 267 and Sigmacover 520 panels prepared at BAE JSR were removed from the water, scraped and pressured washed (3500 PSI)
- Due to COVID-19 travel restrictions, BAE assembled a video and photo team to record the testing and evaluation outlined in the Project Test Plan. A video call (Face Time) was also scheduled for Tim Wise and Jimmy Tagert (NRL) to witness the evaluation
- No adhesion failure or detachment between the alternative tie coat and AF was noted.



Sigmacover 520

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NSRP Demonstration: Test Article Evaluation



Intergard 267

Note area in way of abrasion / mechanical damage showing no sign of delamination

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Current Project Status:

- A no cost extension (NCE) was granted in March 2020. The new Project end date is 8/15/2020
- Due to some delays and COVID-19 impact, the 6 month immersion testing has been removed from the SOW and Test Plan and approved by NSRP. All tests and evaluation will be conducted at ~90 days immersion
- Submitted SSRAC change for 009-32 FY22:
Add paragraph 3.1.20 to read: “ The requirement for the last coat of epoxy to be tacky shall be waived if the NAVSEA-Reviewed ASTM F718 for the epoxy states the minimum and maximum over coat interval between the last coat of epoxy and the first coat of AF”

Next Steps:

- Schedule execution of adhesion pull-off testing for the plates at BAE JSR
- Schedule removal and all testing for the plates at HII.
- Due to security restrictions, HII cannot support video or video call. Travel to HII will be required to complete the required testing.

