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WARM WEATHER SURFACE TOLERANT COATINGS

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OBJECTIVE

TO INVESTIGATE COATINGS FOR NAVY USE IN SEAWATER BALLAST TANKS THAT ARE:

SURFACE TOLERANT

CAN BE APPLIED IN WARM WEATHER (50°F OR GREATER)

SAFE TO USE

MEET CURRENT AND PREDICTED FUTURE ENVIRONMENTAL REGULATIONS

### BACKGROUND

THESE TOUCHUP COATINGS ARE NEEDED SINCE COMPLETE GRITBLAST-ING AND REPAINTING OF BALLAST TANKS WILL OCCUR WITH LESS FREQUEN-CY IN THE FUTURE DUE TO THE EXPENSE AND ENVIRONMENTAL PROBLEMS.

### FINAL PRODUCT

## FINAL PRODUCT WILL BE A MODIFICATION TO MIL-SPEC-23236B FOR TOUCHUP PAINTS DETAILING PRODUCT QUALIFICATION TEST PROCEDURE AND RECOMMENDED PAINTS FOR SURFACE TOLERANT APPLICATIONS.

#### APPROACH

SURVEY THE COMMERCIAL INDUSTRY FOR SURFACE TOLERANT COATINGS THAT PERFORM WELL AND DEVELOP SHORT TERM TESTING PROTOCOL FOR PREDICTING FIELD PERFORMANCE.

### TEST PAINT CRITERIA

- 1. SURFACE TOLERANT OVER TIGHT CLEAN RUST
- 2. VOC LESS THAN 340 GR./LITER
- 3. CLOSE CUP FLASH POINT GREATER THAN OR EQUAL TO 100<sup>O</sup>F
- 4. EASY TO APPLY

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5. AVOID CARCINOGENS, TOXIC MATERIALS, AND MINIMIZE SOLVENTS AND OTHER HAZARDOUS MATERIALS

# LABORATORY AND MARINE SITE TESTING

32 PAINTS ARE CURRENTLY TESTED OVER HALF RUSTED AND HALF PAINTED PANELS AND TOTALLY RUSTED PANELS.

- A. SOLVENT BASED EPOXY
- B. 100% SOLIDS EPOXY
- C. WATER BASED EPOXY
- D. LATEX
- E. ACRYLIC EMULSION

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F. PRETREATMENTS

# APPLICATION OF TEST PAINTS TO PANELS

- A. EACH TEST PAINT APPLIED TO 14 PANELS.
- B. PANELS GRIT BLASTED TO A NEAR WHITE METAL FINISH (2-3 MILS PROFILE).
- C. 6 PANELS ARE HALF PAINTED WITH MIL-P-24441 PAINT (NAVY FORMULA 150, 152 AND 151, TYPE 1).
- D. PAINT GIVEN 10 DAYS TO CURE.
- E. ALL PANELS ARE HUNG ON A FENCE BY THE CHESAPEAKE BAY TO CORRODE.
- F. AFTER CORRODING ABOUT 1 YEAR, THE PANELS ARE WIRE BRUSHED TO GIVE A TIGHT RUST. THE PAINT IS ALSO WIRE BRUSHED TO ROUGHEN THE SURFACE.
- G. TEST PAINT APPLIED TO ALL PANELS AT ONCE ACCORDING TO MANUFACTURES INSTRUCTIONS.
- H. THE CONTROL FOR EACH SET OF PAINTS BEING TESTED IS MIL-P-24441, TYPE 1 (NAVY FORMULA 150, 152 AND 151).

#### TEST PROCEDURES

- A. SALT SPRAY (ASTM B 117) FOR 3240 HOURS
- B. DEIONIZED 180<sup>O</sup>F HOT WATER IMMERSION BLISTER RESISTANCE TEST FOR 10 DAYS
- C. MARINE TEST SITE LONG TERM IMMERSION TEST
- D. FIELD TEST BEST PERFORMING TOUCHUP PAINTS ON NAVY SHIPS

#### MARINE TEST SITE

1. FOUR CONDITIONS ARE TESTED.

- A. GALVANICALLY ISOLATED; UNSCRIBED (2 ALL RUSTED PANELS)
- B. CONNECTED TO A ZINC ANODE; UNSCRIBED (2 ALL RUSTED PANELS)
- C. CONNECTED TO A ZINC ANODE; SCRIBED (2 HALF PAINTED AND HALF RUSTED PANELS)
- D. CONNECTED TO A ZINC ANODE; UNSCRIBED (2 HALF PAINTED AND HALF RUSTED PANELS)
- 2. PANELS IMMERSED IN SEAWATER FOR 3 MONTHS IN A DARK TANK. SEAWATER FILTERED TO PREVENT HARD FOULING, ONLY SLIME IS PERMITTED.
- 3. PANELS ARE AIR DRIED FOR 2 WEEKS IN A HUMID TANK.
- 4. CYCLE REPEATED UNTIL PANEL FAILS OR SIX CYCLES.
- 5. TO ENSURE BETTER REPEATABILITY IN FUTURE TESTING THREE PANELS INSTEAD OF TWO SHOULD BE TESTED.

#### RESULTS

RESULTS FOR BEST PERFORMING PAINTS ARE GIVEN AND COMPARED TO THE CONTROL (TYPE 1; F-150, 152 AND 151 POLYAMIDE EPOXY). THE FOLLOWING RESULTS WERE OBTAINED FOR 23 PAINTS TESTED. THESE PAINTS CONSISTED OF:

- A. HIGH SOLIDS SOLVENT BASED EPOXY
- B. WATER BASED EPOXY
- C. PRETREATMENTS
- D. 100% SOLIDS EPOXY PAINT

BEST OVERALL PERFORMING PAINT AT THE MARINE TEST SITE WAS A HIGH SOLIDS SOLVENT BASED EPOXY.

#### RATING PANELS

1. PANELS ARE RATED FOR THE FOLLOWING:

- A. & CORROSION USING EXTENT DIAGRAMS.
- B. BLISTERING USING ASTM D 714.
- C. UNDERCUTTING OF THE SCRIBE.
- D. DEL'MINATION USING EXTENT DIAGRAMS.

2. PANELS WITH EXCESS CORROSION (5% OR GREATER) OR EXCESS BLISTERING (MEDIUM DENSE OR GREATER) FAIL AND ARE REMOVED FROM THE TEST.

## ACCELERATED BLISTER RESISTANCE TEST

TEST PROCEDURE: 180<sup>O</sup>F, DEIONIZED WATER, 10 DAYS DURATION; OVER RUSTED PANEL

### RESULTS

A. CONTROL: 3.5 \*

TYPE 1 F-150, 152, 151 POLYAMIDE EPOXY

- BEST PERFORMING PAINT IN THIS TEST: 5.5
   ONE COMPONENT ALUMINUM PIGMENTED SOLVENT PAINT
- C. HOW DID A GOOD HIGH SOLIDS SCLVENT BASED EPOXY PAINT PERFORM IN THIS TEST? 4.7
  - \* RATINGS FROM BLISTER POPULATION AND SIZE
     10 BEST WITH NO BLISTERS
     0 WORST WITH TOTAL AREA BLISTERED

# SALT SPRAY RESULTS

TWO ALL RUSTED AND TWO HALF PAINTED HALF RUSTED PANELS WERE TESTED FOR EACH PAINT SYSTEM. PANEL SIZE WAS 4" X 6".

A. BEST PERFORMING PAINTS IN THIS TEST WERE: 100% SOLIDS EPOXY, HIGH SOLIDS EPOXY, MIL-P-24441, TYPE 1 (CONTROL)

HALF PAINTED - HALF RUSTED PANELS

TOP HALF: 0% CORROSION AND 0% BLICTERS BOTTOM HALF: 0% CORROSION AND 0% BLISTER SCRIBE: NO UNDERCUTTING

ALL RUSTED PANELS:

0% CORROSION AND 0% BLISTERING. SCRIBE: NO UNDERCUTTING.

B. HOW DID A GOOD HIGH SOLIDS SOLVENT BASED EPOXY PERFORM IN THIS TEST?

HALF PAINTED - HALF RUSTED PANELS

TOP HALF: 0% CORROSION AND 0 BLISTERS BOTTOM HALF: 0% CORROSION AND 4 MD BLISTER SCRIBE: NO UNDERCUTTING

ALL RUSTED PANELS:

0.01% CORROSION AND 6 M BLISTERING. SCRIBE: NO UNDERCUTTING.

# MARINE TEST SITE

AFTER 21 MONTHS EXPOSURE AT THE MARINE TEST SITE, THE FOLLOWING RESULTS WERE OBTAINED AND ARE BEING PROPOSED FOR THE MODIFICATION TO MIL-SPEC-23236B. 21 MONTHS WAS FOUND TO BE SUFFICIENT TO SCREEN COATINGS AND ACHIEVE A CORRELATION WITH SHIPBOARD RESULTS.

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MINIMUM PERFORMANCE SPECIFICATION FOR WARM WEATHER TOUCHUP PAINTS AFTER SIX CYCLES

### Immersion Resistance Results.+

	&Corrosion			Blistering N			Undercutting		
1. Attached to Zinc Anode, All Rusted, Unscribed	2	0.1%		2-8	MD		None		
2. Electrically Isolated, All ruste	ed,	0.3%		2-8	M**		None		
r	lop	Bottor	n To	qc	Bott	Com	Тор	Bottom	
3. Attached to 0. Zinc Anode, Unscribed Half Rusted	.1%	0.1%	2-8	MD	2-8	M**	None	None	
4. Attached to 0. Zinc Anode, Scribed Half Rusted"	18	0.1%	2-8	MD	2-8	MD	1.5"	1.5"	
+ For at least 2 of 3 panels, ignore effects within one inch of any edge ** 8 MD Blisters allowed									

### OVERALL RESULTS

- 1. THE NAVY HAS INVESTIGATED SURFACE TOLERANT COATINGS USING THREE SHORT TERM TESTS AND FIELD TESTS ON NAVY SHIPS.
- 2. FOR THE MARINE TEST THE BEST PERFORMING COATINGS BECOME APPARENT IN 21 MONTHS.
- 3. A TESTING PROTOCOL FOR SURFACE TOLERANT PAINTS HAS BEEN DEVELOPED. THE RESULTS FROM THE FIELD TEST CORRELATE WELL WITH THE MARINE TEST.