PREPRODUCTION INITIATIVE-NELP
POWDER COATING TOUCH-UP KIT
TEST PLAN

SITE: MOMAU 1 NAVAL WEAPONS STATION, SEAL BEACH, CA

1.0 OBJECTIVE

The Navy is currently transitioning from liquid paint to powder coating to mark and protect its underwater mines from corrosion. Powder coating is the preferred method because it possesses advantages compared to liquid coatings, for example:

- Volatile organic compounds (VOCs) are at near nondetectable limits.
- Heat curing the powder forms a more durable finish than that achieved with liquid paint.
- Powder coating provides a healthier work environment.

A potential difficulty may exist in using the new powder coating method for small touch-up work. Liquid paint touch-up procedures require only a can and a paint brush or paint gun, and possibly some minor surface preparation of the affected area. Because powder paint is usually applied using complex automated or manual processes, minor touch-up repairs may require that the entire piece of equipment be stripped and recoated. The purpose of the powder coating touch-up kit technology is to eliminate unnecessary stripping and recoating by refinishing only damaged portions of the substrate.

This test plan describes data collection procedures for the powder coating touch-up kit and its components. The data will be used to determine the kit's efficiency, effectiveness, and overall success repairing small scratches and minor coating damage in an environmentally friendly manner. The kit is expected to:

- Simplify the powder coating repair process.
- Minimize coating waste and dusts.
- Provide a healthier work environment.
- Increase the use of powder coating systems.

2.0 DESCRIPTION

Currently, MOMAU 1 completely strips and repaints underwater mines that have sustained damage from weathering, marine growth, and continuous exposure to saltwater. The underwater mines are powder coated as needed. Once a mine has been powder coated, the powder coating touch-up kit will eliminate the need to strip and repaint the entire mine for minor damage. The site will save time and reduce overall costs because of improved efficiency, reduced man-hours, and reduced waste disposal.

2.1 EQUIPMENT DESCRIPTION

The powder coating touch-up kit includes the following equipment for surface preparation, powder coating application, heat curing, and coating inspection:

- The Nilfisk Double Action Sanding System for surface preparation—A vacuum-assisted sanding system that reduces the amount of particulate matter released into the environment during the coating removal process. The Nilfisk Electric Explosion Proof Wet/Dry Vacuum System powers the sanding system tool and vacuums up any powder residue after the powder coating has been applied.

- The Nordson Manual Powder Outfit for paint application—Consists of a dolly-mounted 50-pound hopper, a manual spray gun, and a power controller. To increase ease of operation and the efficiency of coating usage, the manual spray gun has an automatic feedback current (AFC) control, which adjusts the electrostatic voltage output to maintain the optimal powder charge and external field strength, regardless of the distance between the gun and the substrate.

- The Eastwood Infrared Light Cure System for heat curing—Consists of an infrared heater that can be either hand-held or stand-mounted. The system can cure large and small objects at various distances, positions, temperatures and, depending on the size of the object, for various lengths of time.

- The Powder Coating Inspection Test Kit for proper and accurate testing of powder-coated equipment—Includes several tools: Eban3000(F) with battery fitted and measuring probe, Testex tape roll, burnishing tool, Testex snap gauge, calibration foils, steel zero plate (located under the Eban3000), wet film gauge (stainless steel), digital thermometer, BS whirling hygrometer, dew point and relative humidity % (RH%) slide calculator, and ISO surface roughness comparator (see Appendix). These tools are used to collect data when testing for different parameters and to assist the operator in making decisions/adjustments when applying the powder coating before and after the application process.

3.0 TEST PLAN

This test plan will evaluate the effectiveness of the powder coating touch-up kit in reducing costs, man-hours, and waste disposal.

3.1 Approach

Quantitative and qualitative data will be acquired through the completion of Tables 1, 2, and 3.

3.1.1 Instructions for Completing Table 1 (Powder Coating Data Sheet)

Table 1 should be completed for each mine that is touched up.

General Data

- **Date:** Indicate date the powder coating touch-up equipment was used (month/day/year).

- **Operator(s):** Identify the individual(s) who performed the touch-up work.

- **Equipment Used:** Check off all equipment used during the entire touch-up process.

- **Serial Number:** Identify and record the serial number of the mine being touched up.

- **Mine Class:** Record the type of mine (e.g., Mk6, Mk36, Mk40, Mk52, Mk55, Mk56, Mk60, Mk65, and Mk 67).

Mine Data

- **Touch-up Area:** Record the amount of surface area covered by the powder coating method during complete stripping of the mine or touch-up. The surface area of the mine should be calculated in square inches.

- **Heat Curing Temperature:** Record the temperature (ºC or ºF) used during the curing process with the Eastwood Infrared Light Cure System according to the gauge on the system. To provide effective and reproducible performance in all properties, the cure cycle is essential. The cure cycle can best be described by the amount of time the substrate is at a given cure temperature. This can be accomplished by using manufacturers' charts that allow the operator to correctly select a cure temperature and time to ensure proper adhesion.

Operating Times

- **Surface Preparation Time:** Record the total time in minutes and/or hours that were required to properly prepare the affected surface of the mine.

- **Powder Coating Time:** Record the total time in minutes and/or hours that were required to perform touch-up recoating of the affected surface of the mine.

- **Heat Curing Time:** Record the total time in minutes and/or hours that were required to properly cure the touched-up area of the mine.

Inspection Test Kit Readings (See the appendix for detailed descriptions of the individual tools included in this kit.)

- **Surface Profile:** Sanding equipment is used to obtain a surface profile that will allow proper adhesion of the coating to the substrate. To achieve optimal adhesion for the powder coating, the surface of the underwater mines must be prepared

properly. The test equipment needed to determine the surface profile includes the Testex tape roll, brushing tool, and Testex snap gauge. The surface profile can be measured in microns, and the number should be recorded on the table. For proper use of these techniques, refer to pages 22 through 25 of the operator's manual.

- **Relative Humidity (RH%):** Water is usually linked to coating failure. Pure water in liquid form can chemically react to degrade the coating or the coating-substrate interface; this is also true for humidity. The first step when determining the RH% is to use the whirling hygrometer, apply the results to the RH% and dew point slide calculator, and record the result on Table 1. Reference pages 19 through 21 of the operator's manual for proper instruction.

- **Dew Point:** Before the coating is applied, it is necessary to ensure that the surface to be painted is dry and that moisture or dew does not form on the uncoated surface. The dew point is calculated in ºC by the slide calculator, which is determined by the wet and dry bulbs of the whirling hygrometer. The air temperature also can be used as an alternative method when calculating the dew point. Reference pages 19 through 21 of the operator's manual for proper instruction and record the result on Table 1.

- **Air Temperature:** Air temperature can also be used to determine the dew point. The digital thermometer can be used to take this reading in ºC. Record the result on Table 1.

- **Wet Paint Film Thickness:** Since improper film thickness (coating thickness) can affect the performance of a coating system, determining film thickness is extremely important and, at this stage, is where control can be demonstrated on the dry paint film coating thickness. The equipment needed to perform this procedure is the wet film gauge. This gauge determines the wet paint film thickness value, which is related to the final dry thickness that is achieved after the solvents have evaporated. The gauge displays a number (in microns) for the wet film thickness; this number should be recorded on Table 1.

- **Dry Paint Film Thickness:** Dry film thickness (coating thickness) is considered the most important measurement. This parameter ensures that extra coating material is not applied to the substrate and is a good control for monitoring the efficiency of the process. The equipment needed to perform this procedure includes the EBAN3000(F) and the measuring probe. The EBAN3000(F) coating thickness meter measures film thickness and displays a number (in microns) that should be recorded on Table 1.

- **Steel Temperature:** It is important to measure steel temperature. If the steel temperature is greater than the dew point, it will prevent moisture from condensing on the surface of the substrate. The digital thermometer and the calibrating foil are used to measure the steel temperature in ºC.

Comments

For each section listed, describe in detail for each piece of equipment used during the powder coating process its effectiveness, capabilities, and any problems, praises, or constructive criticism.

3.1.2 Instructions for Completing Table 2 (Calendar)

Consumables and repairs shall be arranged through your PPEP POCs (David Missig and Chris Mahendra), not the vendor. Please call David Missig at (856) 667-6770 if any consumables or repairs are required for the powder coating equipment.

General Data

- **Month/Year:** List the month and year during which the data is being collected. One calendar must be submitted for each month during the test period.

Downtime

- **Equipment Usage:** Each block of the calendar asks "Was equipment used?" This question refers to whether the powder coating equipment was used on that particular day. A "Yes" or "No" response must be circled for each day of the month.

- **Reason for Downtime of the Equipment:** Each block of the calendar asks "If not, why: Repair, Maintenance, or No Workload." This question refers to whether the powder coating equipment was not used because it was under repair, being maintained, or because no workload was present that day. One of the three responses must be circled for each day of the month. Also, an explanation regarding downtime due to repairs or maintenance must be recorded in the Comments section.

Consumable Data

Record the total pounds of powder coating used. This number can be derived by initially weighing the Nordson hopper at the beginning of each month. At the end of each month, the Nordson hopper should be reweighed; the difference in the two amounts equals the amount of powder coating used that month. This number should be recorded as the amount of pounds consumed.

Waste Disposal Data

At the end of each month, record the total amount of waste that did not adhere to the substrate during the powder coating application stage and the total amount of sanding waste that was created during substrate surface preparation. The filter bags are reuseable; if a filter bag needs to be emptied during the month, the filter bag must be weighed before the material is disposed.

Comments

Comments should focus on explaining any repairs, when and what maintenance was performed, and the amount of time spent on repairs or maintenance for each day indicated. Also, comment on the condition of the filters if any damage, inability of the vacuum unit to filter properly, or everyday wear and tear on the filter is noticed.

3.1.3 Instructions for Completing Table 3 (Mine Tracking Data Sheet)

Table 3 should be used every time a mine is touched up with the powder coating system and when previously touched-up mines are reexamined.

- **Serial Number:** The serial number should be recorded on the data sheet. This number corresponds to the number on the mine and will be used as tracking data.

- **Date:** The date should be recorded on the data sheet whenever the mine is touched up or reexamined after having been in the field.

- **Brief Description of Touched-up Area:** Write a brief description of the condition of the touched-up area. Note any coating failures.

4.0 REPORTING

The data entry forms are a concise method of data collection. Forms should be completed on a daily basis; data will be collected for approximately one year. During the test period, the powder coating data sheet (Table 1) and the calendar (Table 2) should be faxed at the end of each month to David Missig at (856) 667-7586, while the mine tracking data sheet (Table 3) should be turned in at the end of the test period. Any questions should be directed to Mr. Missig's attention at (856) 667-6770. The final report will include detailed results and observations, assess the efficiency and cost-effectiveness of the unit, and evaluate its ability to interface with site operations.

TABLE 1
POWDER COATING DATA SHEET

Complete this sheet for each mine that is touched up using the kit.

Date: _____
Operator(s): _____
Serial Number: _____
Mine Class: _____

Equipment Used
- ☐ Nilfisk Double-Action Sanding System
- ☐ Nilfisk Electric Explosion Proof Wet/Dry Vacuum
- ☐ Nordson Manual Powder Outfit
- ☐ Eastwood Infrared Light Cure System
- ☐ Powder Coating Inspection Test Kit

METER READINGS	
Readings	**Data**
Surface profile (microns)	
Relative humidity (RH) (%)	
Dew point (°C)	
Wet paint film thickness (microns)	
Dry paint film thickness (microns)	
Steel temperature (°C)	
Air temperature (°C)	

OPERATING TIMES	
Description of Operation	**Amount of Time (min./hrs.)**
Surface preparation time	
Powder coating time	
Heat curing time	

MINE DATA	
Description of Operation	**Data**
Touch-up area (in^2)	
Heat curing temperature (°C/ºF)	

Comments

Describe the effectiveness of the NILFISK equipment: _____

Describe the effectiveness of the Nordson manual power outfit (coating application): _____

Describe the effectiveness of the Eastwood infrared light cure system: _____

Describe the effectiveness of the powder coating inspection test kit: _____

TABLE 2
CALENDAR

1 **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**2** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**3** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**4** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**5** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**6** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**7** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload
8 **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**9** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**10** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**11** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**12** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**13** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**14** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload
15 **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**16** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Work Performed	**17** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**18** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**19** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**20** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**21** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload
22 **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**23** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**24** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**25** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**26** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**27** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**28** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload
29 **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**30** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload	**31** **Circle one response to each question:** Was equip. used? Y N If not, why? Repair, Maintenance, No Workload				

Waste Disposal =Total lbs. of excess powder and sanding waste disposed this month _____

Consumables = Total lbs. of powder coating used this month _____

Comments: _____

_____

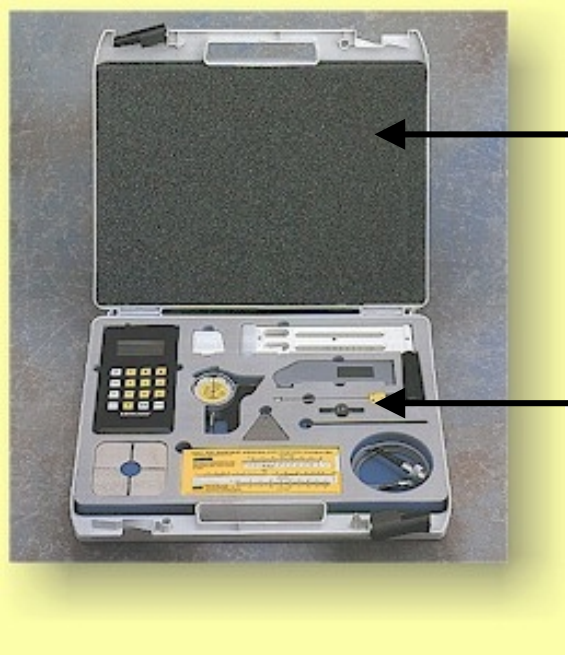
_____

_____

TABLE 3
MINE-TRACKING DATA SHEET

Serial Number	Date	Brief Description of Touched-up Area

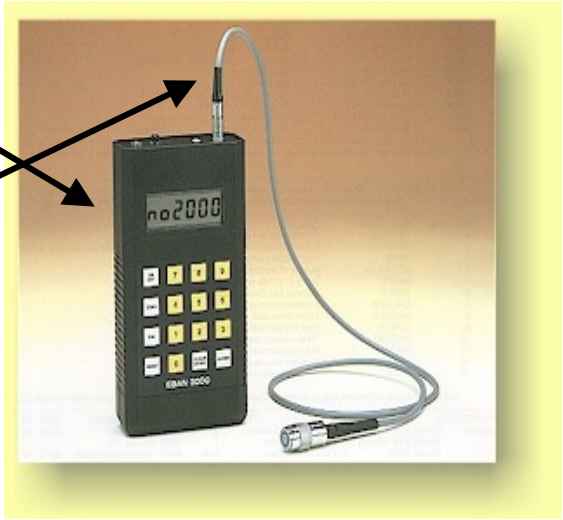
APPENDIX
PAINT INSPECTORS KIT



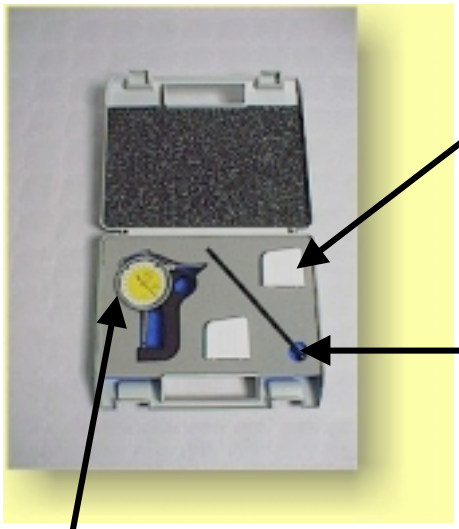
Paint Inspectors Kit: This is a carrying case that includes all of the following equipment.

Calibration Foil: The calibration foil is supplied with the EBAN3000(F) for calibration of the EBAN3000(F).

EBAN3000(F): This modular instrument has a touch pad that displays readings and is supplied with a measuring probe, calibration foil, battery, and carrying case.



Measuring Probe: The measuring probe is attached to the EBAN3000(F) and is used to measure the surface of the substrate. This measurement is then displayed on the EBAN3000(F).

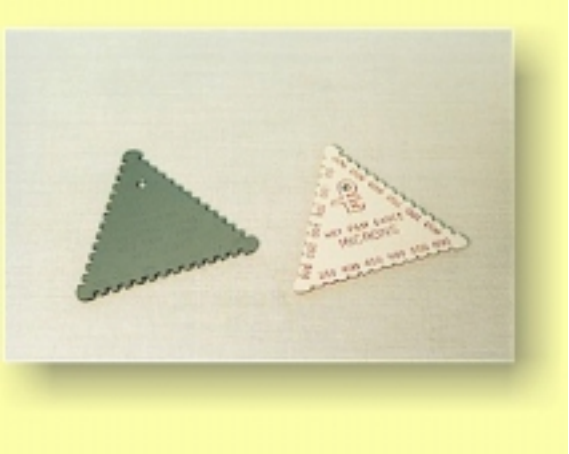


Testex Tape Roll: The Testex tape, along with the brushing tool and the Testex snap gauge, is used to measure the surface profile of the mine. The Testex tape is used to make surface replicas and to obtain the minimum peak-to-valley reading to determine the actual surface profile.

Brushing Tool: The brushing tool is used on the Testex tape. When moderate pressure is applied to the tape, it turns to a gray-colored circle. At this point, a replica of the rough surface is made and can be measured with the Testex snap gauge.

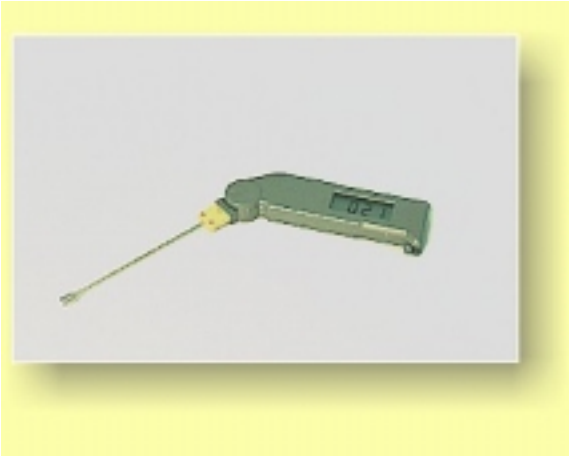
Testex Snap Gauge: The Testex snap gauge is the final piece of equipment used to determine the surface profile. By placing the Testex tape between the anvils and gently lowering the moveable anvil onto the film near the center of the replica, an accurate reading can be measured. This measurement is used to obtain the average peak-to-valley height of the surface profile.

Steel Zero Plate: The steel zero plate is used in conjunction with the calibration foils to properly calibrate the EBAN3000(F).

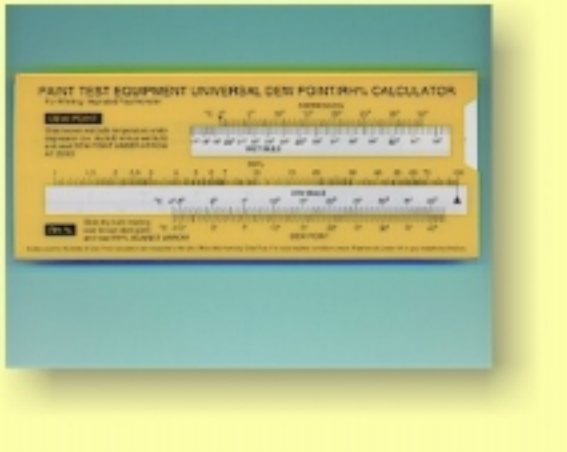


Wet Film Gauge: The triangularly shaped wet film gauge measures wet paint film thickness when it is applied to newly coated substrate.

Digital Thermometer: The digital thermometer measures air and substrate temperatures. Its range is from -50ºC to 850ºC.



BS Whirling Hygrometer: The whirling hygrometer is used to find temperature and moisture content prior to coating.



Dew Point and RH% Slide Calculator: This is an accurate slide calculator that allows dew point ºC and RH% to be calculated from the wet/dry bulb of the whirling hygrometer.

ISO Surface Roughness Comparator: The surface roughness comparator is a precision nickel comparator plate that meets International Standard ISO:8503 for grit/shortblast surface roughness comparison measurement.