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FLOOR COATING DEMONSTRATION: AIRCRAFT MAINTENANCE SHOP



by
C. Dave Gaughen

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EXECUTIVE SUMMARY

This report was prepared to document the efforts of the Naval Facilities Engineering Service Center (NFESC) in demonstrating the application of a new floor coating specification designed for Aircraft Maintenance Shops. The demonstration was performed on the floor surface of a 1,700 ft² Electronic Equipment Maintenance Shop (Bldg. 1055) located at the Naval Air Station Joint Reserve Base (NAS JRB) Dallas – Fort Worth, Texas.

The coating specification, designed by NFESC and enclosed in Appendix A, is based upon a four-coat, thick film (1/4-inch), chemically resistant, interior flooring system with slip resistance. Within the report, photographs taken during the demonstration have captured the sequential application of the above coating system.

A combination of funding from NFESC's Demonstration/Validation program (DEMVAl) and NAS JRB was used to perform all work associated with this effort.

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INTRODUCTION

This report was prepared to document the efforts of the Naval Facilities Engineering Service Center (NFESC) in demonstrating the application of a new floor coating specification designed for Aircraft Maintenance Shops. The demonstration was performed on the floor surface of a 1,700 ft² Electronic Equipment Maintenance Shop (Bldg. 1055) located at the Naval Air Station Joint Reserve Base (NAS JRB) Dallas – Fort Worth, Texas. A combination of funding from NFESC's Demonstration/Validation program (DEMVVAL) and the NAS JRB was used to perform all work associated with this effort.

CONDITION ASSESSMENT

Building 1055 has 1,700 ft² of floor surface covered with resilient tile. The concrete's surface has a cohesive strength of 200 psi (average concrete strength) with approximately a 1/16-inch deep layer of surface contamination. Two Moisture Vapor Emission Test Kits (MVETK) were used to determine an average moisture vapor transmission rate of 1.5 lbs moisture/1,000 ft² in 24 hours (results signifies dry concrete). The following chemicals are used in the maintenance shop: Coolant fluid (Mil-PRF-87252C), skydrol (hydraulic fluid), isopropyl alcohol, and various oils and greases. Within the maintenance shop and in adjacent rooms, tiles were disbonding as a result of spills from the above chemicals (chemicals penetrated through the base of concrete masonry unit walls and into adjacent rooms).

COATING SPECIFICATION

The coating specification, designed by NFESC and enclosed in Appendix A, consists of a four-coat, thick film (1/4-inch), highly chemical resistant, interior flooring system with slip resistance. The specification details the following: A) Contractor qualifications, B) Scheduling, C) Warranty, D) Material requirements, E) Material application (including surface preparation), and F) Quality control. Presented in the sections below are photographs, taken during the demonstration, of the sequential installation of the specified coating system.

SURFACE PREPARATION

TILE REMOVAL



Hand tool scraping.



Power tool chipping.

Floor coatings should never be applied over tiled surfaces. Tiled surfaces require complete removal prior to the application of floor coatings. Tiles were removed using a combination of hand and power tools.

REMOVAL OF TILE ADHESIVE AND DEGREASING



Black tile adhesive.



Tile adhesive removal using mechanical scrubbing and organic solvents.



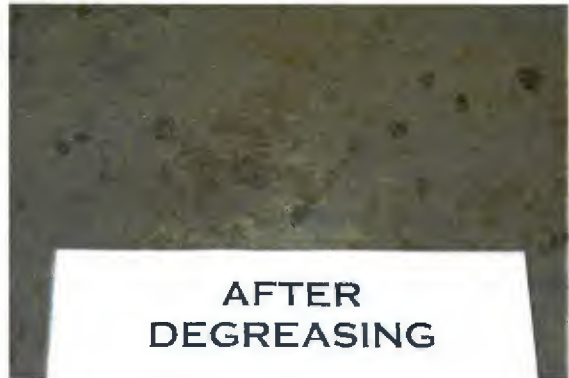
Pressure rinsing.



Vacuuming up rinse water.



Resulting surface following degreasing.



Close-up of concrete after degreasing.

In order to develop sound adhesion between coating primers and concrete surfaces, surface contamination such as the above tile adhesive requires 100% removal. The tile adhesive was removed using mechanical scrubbing and organic solvents. A water-based caustic degreaser was used to remove concrete surface contamination (fuels, oils, skydrol) and residual organic solvent. Hot potable water under a pressure of 4,000 psi was employed to remove the caustic degreaser from concrete surfaces.

SHOT BLASTING



Shot blasting unit.



Two passes of shot blasting produced the above concrete profile (ICRI CSP 5).

Shot blasting removes weak surface cement (laitance), surface contamination, and opens up micro-pores within the concrete's surface. As such, shot blasting increases penetration and the resulting adhesion of coatings to concrete. Floor surfaces received two passes of shot blasting. The resulting surface profile was equivalent to the International Concrete Repair Institute's Concrete Surface Profile 5 (ICRI CSP 5).

POWER GRINDING



Power grinding the base of Concrete Masonry Unit (CMU) walls.



Resulting CMU profile from grinding (ICRI CSP 2).

In areas inaccessible to shot blasting, power tool grinding is used to prepare concrete surfaces. The following areas received power tool grinding: A) Floor surfaces at the base of walls, B) Four inches up the base of vertical walls, and C) Under secured equipment. Resulting surface profiles were equivalent to ICRI CSP 2.

KEYING SURFACES AND AESTHETICS



Keyed groove in area of heavy traffic.



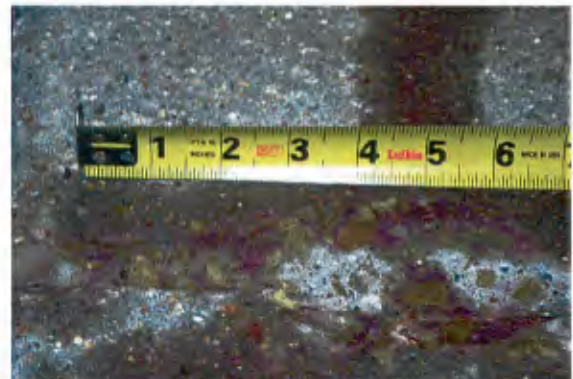
Cove strip installed for aesthetics.

Entrance and exit areas receiving high levels of traffic require a “keyed groove” to prevent thick film coating systems from disbonding which, if desired, enables coatings to be finished flush with adjacent surfaces. Keyed grooves were placed at the base of each doorway. The transition area between the coating system and wall surfaces may be aesthetically enhanced by the addition of a cove strip. Cove strips were installed four inches up the base of each perimeter wall.

DEGREASING FOLLOWING SHOT BLASTING



Shot blasted surface with skydrol saturated construction joint (Dark color).



Close-up of skydrol contaminated joint.



Shot blasted surface with oil contamination (Wet looking grid).



Commercially available portable adhesion testers: Dyna Tester and Elcometer™.

If following shot blasting, concrete surfaces appear either discolored or wet-looking when the concrete is dry, concrete requires additional degreasing. To quantify the degree of cleanliness, adhesion testing on contaminated surfaces may be performed using a portable adhesion tester. If adhesion results produce cohesive failures within the concrete (chunks of concrete attached to pull-off coupons), then concrete is sufficiently clean. If cohesive failures are not produced within the concrete and, in addition, adhesive values are below 200 psi, concrete requires additional degreasing. Three additional degreasing cycles were performed to remove surface contamination following shot blasting.

APPLICATION OF COATINGS

PRIMER AND INTERMEDIATE COAT APPLICATION



Squeegee application.



Roller application.



Screed application of intermediate coat.



Trowel application of intermediate coat.



Power trowel used to finish intermediate coat.



Cove trowel used to finish vertical walls.

Primers are applied by squeegee and roller, whereas sand filled intermediate coats are applied by screed and trowel application. The intermediate coat was finished using a combination of hand and power trowels. The resulting cured surface was sanded to enhance leveling and remove surface imperfections.

GROUT COAT AND TOPCOAT APPLICATION



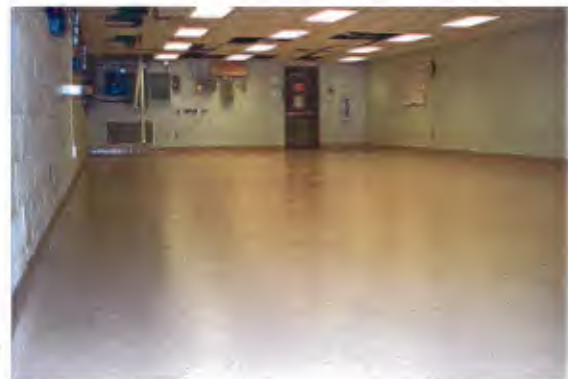
Application of grout coat.



#60 mesh emery ore non-skid (aluminum oxide).



Application of topcoat.



The finished flooring system.

Applied to the intermediate coat to seal and subsequently fill surface voids is the grout coat. Once applied and cured, the grout coat may require sanding to further remove surface imperfection. Applied over the grout coat and with a broadcast of non-skid grit is the chemically resistant topcoat.

DISCUSSION

With an anticipated service life of 7 to 10 years, the coating system costs approximately \$6.00 to \$10.00 ft² installed. Up to two weeks maintenance shop down time is required for installation and curing prior to service. The coating system may be cleaned using a water-based pH neutral detergent followed by warm water rinsing. Floor cleaners containing either bleach or abrasive particles are not recommended.

ACKNOWLEDGEMENTS

For providing the demonstration site, the author wishes to thank LCDR Greg Simmons and Mr. Wes Cloud (NAS JRB). For his skillful degreasing technique and flawless application of the specified coating system, the author wishes to thank Mr. Craig Gruenler (Installation Contractor).

APPENDIX A

COATING SPECIFICATION FOR INTERIOR AIRCRAFT MAINTENANCE SHOP FLOORS

PART 1 GENERAL

1.1 References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM C 307 1994 Test Method for Tensile Strength of Chemical Resistant Mortars, Grouts, and Monolithic Surfacing
- ASTM C 579 1996 Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- ASTM D 412 1998 Test Method for Vulcanized Rubber and Thermoplastic Rubber and Thermoplastic Elastomers - Tension
- ASTM D 638 1996 Test Method for Tensile Properties of Plastics
- ASTM D 2240 1997 Test Method for Rubber Property-Durometer Hardness
- ASTM D 4541 1995 Test Method for the Pull-off Strength of Coatings Using Portable Adhesion Testers
- ASTM E 11 1995 Standard Specification for Wire Cloth and Sieves for Testing Purposes
- ASTM E 831 1993 Test Method for Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis

FEDERAL STANDARDS

- Federal Standard SS-S-200E: Two Component Sealants, Concrete Pavement
- Federal Standard 595B: Colors

CODE OF FEDERAL REGULATIONS (CFR)

- 29 CFR 1926.59 Hazard Communication
- 40 CFR 261 Identification and Listing of Hazardous Waste

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

- ICRI Technical Guideline No. 03732: "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays".

1.2 Submittals

All submittals shall be submitted to the Government for approval and records.

- a. Two Component Self-leveling Chemically Resistant Sealant
- b. Two Component Epoxy Polyamine Coating System Primer
- c. Three Component Epoxy Polyamine Intermediate Coat
- d. Two Component Epoxy Polyamine Grout Coat
- e. Two Component Epoxy Novolac Topcoat
- f. White Aluminum Oxide Non-Skid Grit
- g. Degreaser(s)
- h. Material Certificates (Section 1.2.2)
- i. Contractor Qualifications (Section 1.2.3a)
- j. Procedural Variation(s) (Section 1.2.4)
- k. Scheduling (Section 1.2.5)
- l. Warranty (Section 1.2.6)
- m. Certified Coating and Sealant Applicator (1.2.2g)

1.2.1 Instruction

For materials a. – g., submit formulator's printed instructions to include brand name, catalog numbers, and name of manufacturer. Include in the instructions (if applicable) date material was manufactured, shelf-life, detailed mixing and application procedures, quantity of material to be used on job, minimum and maximum application temperatures, and curing procedures. Include copies of Material Safety Data Sheets (MSDS) for all materials to be used at the job site in accordance with OSHA & 29 CFR 1926.59. All coatings shall be manufactured by one coating manufacturer.

1.2.2 Certificates

- a. *Two Component Self-leveling Sealant*
Submit certified conformance to the requirements set forth in Section 2.1.1.
- b. *Two Component Epoxy Polyamine Coating System Primer*
Submit certified conformance to the requirements set forth in Section 2.2.1.
- c. *Three Component Sand Filled Epoxy Intermediate Coat*
Submit certified conformance to the requirements set forth in Section 2.3.1.
- d. *Two Component Epoxy Polyamine Grout Coat*
Submit certified conformance to the requirements set forth in Section 2.4.1.
- e. *Two Component Epoxy Novolac Topcoat*
Submit certified conformance to the requirements set forth in Section 2.5.1.
- f. *White Aluminum Oxide Non-Skid Material*
Submit certified conformance to the requirements set forth in Section 2.6.1.
- g. *Certified Installation Contractor*
Installation contractor shall be certified, by both the coating and sealant manufacturer, in the correct handling, mixing and application of their materials. Submit copy of certificates.

1.2.3 Statements

- a. Contractor Qualifications

Minimum requirements for installation contractor are as follows: Installation contractor shall have completed three or more jobs within the past two years applying the materials listed in

Section 1.2.1 (a – g.) exclusively to concrete surfaces in which the total area exceeds 100,000 square feet. Contractor shall submit documentation listing location of work, point of contact at job site, total square footage of applied materials, listing of both materials and equipment used, and validation from coating manufacturer documenting quantity of materials purchased per job for work totaling 100,000 sqft and within the past two-years. Customers referenced by contractor shall be contacted by Government to confirm contractor's work is acceptable.

1.2.4 Work Procedure

Contractor shall submit all procedural variations different than those outlined in Part 3 titled Execution.

1.2.5 Scheduling

Contractor shall submit procedural scheduling, for Government approval, to complete work within twelve (12) consecutive days (weekends and evenings may be included). Contractor shall assign one supervisor to the job who is to remain on site throughout all phases of work who, in addition, is to act as the primary point of contact between Government and Contractor. This person shall be identified in the submitted schedule. All work shall be performed in a manner as to cause the least interference with the normal functions of the Government activity.

1.2.6 Warranty: Installation and Materials

Materials and workmanship used to perform spall repairs, crack repairs, coating work, and sealant work shall be warranted by the "Installation Contractor" for a minimum of one-year following material application. Materials and workmanship shall be subjected to the terms and conditions defined as follows. If $\geq 1.0\%$ of the total coated surface becomes either brittle, soft, blistered, or disbonds (either intercoat or from substrate) within one-year following application, then the entire floor coating system shall be removed and replaced at the expense of the installation contractor (costs include material plus application). Within the warranty period, failures greater than 3/8" diameter (of the above type) totaling less than 1.0 % of coated surfaces (including spall repairs) shall be identified and repaired at contractor's expense. Cosmetic imperfections due to scratching and gouging are excluded from the warranty. If the coating system's adhesion is in question, one adhesion test (ASTM D 4541) shall be performed per 100 sqft section. Each adhesion test shall produce cohesive failures within the concrete above 250 psi with concrete chunks attached to each pull-off coupon. All areas tested for adhesion that do not produce cohesive failures within the concrete and, in addition, exhibit adhesion values below 250 psi shall require removal and replacement at installation contractor's expense. There shall be 0 % sealant failures within one year. All sealant material, within the warranty period, that is swollen, cracked, or has disbonded shall be removed and reinstalled at the expense of the installation contractor.

1.3 Materials: Condition, Storage, Disposal

Materials on site shall be inspected for damage prior to use. Packaged materials in dented, rusty, or leaking containers and, in addition, materials with an expired shelf life shall be returned to manufacturer. Packaged materials shall be unloaded and stored out of sun and weather, preferably in air-conditioned spaces. All unused material, whether in its cured or uncured state, shall be remove from the job site by contractor.

1.4 Safety

Ensure that employees are trained in the requirements of OSHA & 29 CFR 1926.59 and understand the information contained in the MSDS's for their protection against toxic and hazardous chemical effects. Follow safety procedures as recommended by manufacturer. Procedures may include employing the use of impervious clothing, gloves, face shields, and other appropriate protective clothing necessary to prevent eye and skin contact with materials.

PART 2 PRODUCTS

2.1 Two Component Chemical Resistant Self-leveling Sealant

Two component elastomeric, 100 % solids, self-leveling, chemical and UV resistant sealant capable of withstanding ± 25 % joint movement.

2.1.1 Sealant

The two component sealant shall be formulated to exhibit the following properties as listed in Table 1.

Table 1: Properties of Sealant

| | |
|---|---|
| Percent Volume Solids | ≥ 98 % |
| Fed. Std. 200E | Pass |
| Chemical Resistance to JP-8 Fuel | 120 hours immersion: Excellent ¹ |
| Chemical Resistance to Lubricating Oils | 120 hours immersion: Excellent ¹ |
| Chemical Resistance to Skydrols | 120 hours immersion: Excellent ¹ |
| Hardness Shore A (ASTM-D-2240) | 25 – 30 |
| Tensile Strength (ASTM-D-412) | 150 – 200 psi |
| Percent Elongation (ASTM-D-638) | ≥ 500 % |
| Tack Free at 65°F | 24 hours maximum |
| Full Cure at 65°F | 72 hours: Full Chemical Resistance |
| Bond to sand filled epoxy polyamine | ≥ 130 psi |
| Bond between epoxy novolac topcoats (paintable sealant) | ≥ 130 psi (chemically compatible) |

¹After 120 hours immersion and 4 hours of drying, the sealant shall not exhibit any swelling, softening, disbonding from concrete or other sealant defects.

2.2 Two Component Epoxy Polyamine Coating System Primer

Two-component, 100 % solids epoxy polyamine, penetrating primer for use on properly prepared concrete.

2.2.1 Primer Coat

The two component primer coat shall be formulated to exhibit the following properties as listed in Table 2.

Table 2: Properties of Primer Coat

| | |
|--|--|
| Resin System | Epoxy Polyamine |
| Percent Volume Solids | 100 % |
| Color | Clear to Amber |
| Application Thickness | 5 to 20 mils Dry Film Thickness per coat |
| Chemical Resistance to JP-8 Fuel | 48 hours immersion: Excellent ¹ |
| Chemical Resistance to Lubricating Oils | 48 hours immersion: Excellent ¹ |
| Chemical Resistance to Skydrols | 48 hours immersion: Excellent ¹ |
| Adhesion to Concrete (ASTM-D-4541) | ≥ 400 psi |
| Softening Point (ASTM E 831) | ≥ 175 °F |
| Mean Coefficient of Thermal Expansion (0°F – 120°F:ASTM-E-831) | 3.0 – 60.0 x 10 ⁻⁶ in/in°F |

¹After 48 hours immersion and 4 hours of drying, the coating shall not exhibit any blistering, softening, or other coating defects.

2.3 Three Component Sand Filled Epoxy Polyamine Intermediate Coat

Three component, 100 % solids sand filled epoxy polyamine intermediate coat.

2.3.1 Intermediate Coat

The three component epoxy intermediate coat shall be formulated to exhibit the following properties as listed in Table 3.

Table 3: Properties of Sand Filled Epoxy Intermediate Coat

| | |
|--|---|
| Resin System | Epoxy Polyamine |
| Percent Volume Solids | 100 % |
| Color: Light Gray (Fed. Std. 595B) | Either 35622, or 35550, or 36495 |
| Application Thickness | 125 to 400 mils Dry Film Thickness per coat |
| Chemical Resistance to JP-8 Fuel | 48 hours immersion: Excellent ¹ |
| Chemical Resistance to Lubricating Oils | 48 hours immersion: Excellent ¹ |
| Chemical Resistance to Skydrols | 48 hours Immersion: Excellent ¹ |
| Compressive Strength (ASTM-C-579) | 7,600 psi ± 1000 psi after 7 days |
| Tensile Strength (ASTM-C-307) | 1,800 psi ± 300 psi |
| Hardness (ASTM-D-2240: Shore D) | 80 – 92 |
| Mean Coefficient of Thermal Expansion (0°F – 120°F:ASTM-E-831) | 3.0 – 11.5 x 10 ⁻⁶ in/in°F |
| Adhesion to Epoxy polyamine (ASTM-D-4541) | ≥ 400 psi |
| Bond Strength to Concrete | ≥ 400 psi |

¹After 48 hours immersion and 4 hours of drying, the grout shall not exhibit any blistering, softening, or other defects.

2.4 Two Component Epoxy Polyamine Grout Coat

Two component, 100 % solids epoxy polyamine grout coat for use in filling the surface voids of three component sand filled intermediate coats.

2.4.1 Grout Coat

The two component grout coat shall be formulated to exhibit the following properties as listed in Table 4.

Table 4: Properties of Grout Coat

| | |
|--|--|
| Resin System | Epoxy Polyamine |
| Percent Volume Solids | 100 % |
| Color: Light Gray (Fed. Std. 595B) | Either 15622, or 15550, or 16495 |
| Application Thickness | 5 to 20 mils Dry Film Thickness per coat |
| Chemical Resistance to JP-8 Fuel | 48 hours immersion: Excellent ¹ |
| Chemical Resistance to Lubricating Oils | 48 hours immersion: Excellent ¹ |
| Chemical Resistance to Skydrols | 48 hours immersion: Excellent ¹ |
| Adhesion to Concrete (ASTM-D-4541) | ≥ 400 psi |
| Adhesion to Epoxy-polyamine (ASTM-D-4541) | ≥ 400 psi |
| Softening Point (ASTM E 831) | ≥ 175 °F |
| Mean Coefficient of Thermal Expansion (0°F – 120°F:ASTM-E-831) | 3.0 – 60.0 x 10 ⁻⁶ in/in°F |

¹After 48 hours immersion and 4 hours of drying, the coating shall not exhibit any blistering, softening, or other coating defects. Slight staining is unacceptable.

2.5 Two Component Epoxy Novolac Topcoat

Two component, epoxy novolac topcoat formulated to increase chemical resistance.

2.5.1 Epoxy Novolac Topcoat

The two component epoxy novolac topcoat shall be formulated to exhibit the following properties as listed in Table 5.

Table 5: Properties of Topcoat

| | |
|--|---|
| Resin System | Epoxy Novolac |
| Percent Volume Solids | 100 % |
| Formulation | 0 % Benzyl Alcohol |
| Application Thickness | 3 to 20 mils Dry Film Thickness |
| Color | Customer's Choice |
| Hiding Power | Complete hiding of light gray at 4 mils DFT |
| Chemical Resistance to JP-8 Fuel | 120 hours immersion: Excellent ¹ |
| Chemical Resistance to Lubricating Oils | 120 hours immersion: Excellent ¹ |
| Chemical Resistance to Skydrols | 120 hours immersion: Excellent ¹ |
| Service at 48 hours cure (65°F) | Heavy Traffic, Full Chemical Resistance |
| Adhesion to Concrete (ASTM-D-4541) | ≥ 400 psi |
| Adhesion to Epoxy polyamine at 48 hrs cure, 75°F | ≥ 350 psi |
| Softening Point (ASTM E 831) | ≥ 175 °F |
| Mean Coefficient of Thermal Expansion (0°F – 120°F:ASTM-E-831) | 3.0 – 60.0 x 10 ⁻⁶ in/in°F |

¹After 120 hours immersion and 4 hours of drying, the coating shall not exhibit any blistering, softening, or other coating defects. Slight staining is unacceptable.

2.6 White Aluminum Oxide Non-Skid Material

Size #60 White Aluminum Oxide Non-Skid Material.

2.6.1 Aluminum Oxide

Size #60 white aluminum oxide shall exhibit the following size gradations and formulation as listed in Table 6.

Table 6: Properties of #60 White Aluminum Oxide

| | |
|--|--------------------|
| Percent White Al ₂ O ₃ | ≥ 99% |
| Sieve No. 40 (ASTM E 11) | 100 % Passing |
| Sieve No. 50 (ASTM E 11) | 15 – 40 % Retained |
| Sieve No. 60 (ASTM E 11) | 60 – 85 % Retained |

PART 3 EXECUTION

Notes A – E shall be treated as part of the specification.

NOTES A - E

Note A: Protection shall be provided by Contractor to prevent damage to adjacent areas, equipment, fixtures, finishes, electrical utilities, mechanical services, “Grounding Rods”, and existing work. Damage to above items while performing work shall be repaired or replaced with new items at no additional cost to the Government.

Note B: Care shall be taken to reduce the spread of dust and debris to all areas in the building where work is being performed. Dust, waste, and debris resulting from work shall be cleaned and removed “daily” from the Activity.

Note C: Minor materials and work not specifically mentioned herein but necessary for the proper completion of the specified work shall be furnished without additional cost to the Government.

Note D: Should deteriorated materials of a major nature be uncovered in the course of the work, it shall be brought to the attention of the Contracting Officer. Repairs shall be made as directed, in writing, and an adjustment will be made in the contract price in accordance with the terms of the modifications.

Note E: All work that is not performed in accordance to either the specification or manufacturer’s recommended procedures shall be replaced and reworked at contractor’s expense. If a dispute exists between specification and manufacturer’s procedures, the procedure which offers the greatest degree of prudence shall supercede.

“The following procedures have been presented in the order in which the work shall proceed starting with Section 3.1.”

3.1 Removal of Material in Joints

Remove 100 % of the existing material in all expansion and contraction joints including material bonded to joint walls and base. Rigid material may require the use of saw cutting equipment to remove. Saw Cutting equipment shall be capable of producing straight lines with sporadic joint spalls less than 1/16". All joints that were not originally saw cut to a minimum depth of 1" or were previously filled with coating material shall be re-saw cut open to a depth of 1". Joints may be widened by up to 1/8" when re-saw cutting.

3.2 Material Application

A minimum period of 36 hours following degreasing and 48 hours following heavy rain shall be used to allow concrete surfaces a chance to dry prior to the application of concrete repair material, coatings, and sealants.

3.2.1 Temperature and Humidity Requirements

During all coating and sealant operations, relative humidity shall be below 80 % whereby concrete, ambient air temperatures, and paint temperature shall be between 55°F to 90°F and, in addition, a minimum of 5°F above the dew point temperature. If temperatures and humidity exceed the above ranges, then work shall stop until either acceptable temperatures and humidity or material manufacturers approve application under existing conditions.

3.2.2 Mixing and Application of Materials

Mix and apply all materials in accordance to manufacturer's requirements. The use of spray equipment to apply materials is prohibited. Epoxy coatings, once mixed and prior to application, may require time to initiate their chemical reaction (induction period). The epoxy primer, sealant primer, and sealant shall be applied in the late afternoon after the heat of the day when both the air and concrete temperatures are decreasing and prior to the dew point temperature. It is recommended that representatives from the material manufacturers be on site to view both the mixing and application of their materials.

3.3 Removal of Existing Coatings and Tiles

Remove 100 % of the existing coating system including tiles employing a combination of one or more of the following techniques: shot blasting, chipping, scraping, sanding, scarification, high pressure water blasting, and various hand tools. The use of impact tools (such as scabblers) may not be used to remove the existing coating system. Prior to blasting, old shot shall be removed and replaced with new shot. Shot blasting to remove existing coatings shall stop when the concrete's surface resembles an ICRI CSP 5 profile.

3.4 Removal of Tile Adhesive

If tiles were previously installed, remove 100 % of the tile adhesive. Tiles adhesives may be removed using organic solvents followed by power scrubbing. Resulting surfaces shall appear visually clean with the gray color of concrete.

3.5 Degrease Floor Surfaces

Degrease entire floor by scrubbing (manual and power) using a solution of hot potable water (170°F – 190°F) and a concentrated aqueous-based caustic degreaser (water-based alkaline degreaser). Solution shall be allowed to soak into surfaces prior to scrubbing and removed using hot potable water (170°F – 190°F) under 4,000 psi pressure. Rinsing shall be complete when rinse water appears clear. Two complete degreasing cycles shall be performed on entire floor surface and, in addition, one additional cycle of spot degreasing shall be performed on all areas where either the existing coating system or existing joint sealant has failed. If the industrial detergent is not biodegradable, all rinse water shall be collected and disposed of as hazardous waste. Use of industrial degreasers containing either phosphates or organic solvents is prohibited. Squeegees and shop vacuums may be used to collect pooling rinse water. Fans may be used to aid drying of floor surfaces.

3.6 Surface Preparation of Concrete

Surface preparation techniques employing acid, extreme heat (flame), impact tools (scabblers) and scarification is prohibited. After degreasing and when concrete is dry, shot blast entire floor to produce a surface profile equivalent to ICRI CSP 5. Each pass of shot blast shall be slightly overlapped (1/4" – 1/2" overlap). All previously used shot shall be removed and replaced with new shot prior to blasting. Concrete surfaces inaccessible to shot blasting (base of perimeter walls and under secured equipment) shall be prepared using diamond disk grinding to produce an ICRI CSP 2 profile. *If perimeter walls are constructed out of Concrete Masonry Units (CMU), surface preparation shall include preparing a minimum of 4" up the base of each interior perimeter wall.* Perimeter wall surfaces shall be prepared to an ICRI CSP 2 profile. Resulting surfaces shall appear visually clean and contain the appropriate level of surface profile. If the resulting level of cleanliness can not be determined, adhesion testing (ASTM D 4541) shall be performed on the dirtiest areas of concrete. Each adhesion test shall produce cohesive failures within the concrete (concrete chunks attached to each pull-off coupon). If the above adhesion results are not produced, then up to two additional degreasing cycles shall be performed using the materials and procedures outlined in Section 3.5.

3.7 Key Entrances and Exits

Key all surfaces directly below doorways and in exit areas. Resulting key shall contain one vertical wall at a depth between 3/8" to 5/8" with a 1.5" to 2" sloped surface leading down to the resulting vertical depth. A hand held concrete saw may be used to cut the correct vertical depth followed by power tool grinding to attain the above sloped surface.

3.8 Install Cove Strip

A cove strip may be installed at a height of four inches up the base of each perimeter wall. The cove strip shall be constructed out of either stainless steel or solvent resistant plastic and installed using a solvent resistant adhesive.

3.9 Application of Primer, Intermediate Coat, and Grout Coat

Sweep, vacuum, and run a high powered magnet over all areas that are to receive the coating system. *Prior to coating, mark all joints using either nails or other appropriate devices.* Concrete joints are to be filled using the coating system and re-saw cut open after the application of the grout coat and prior to topcoating. If contractor fails to mark joints and applies coating system, destructive testing shall be performed to determine the location of each joint and repaired at contractor's expense. *The primer and intermediate coating shall be applied first to floor surfaces and, when semi-cured, applied up the base of each perimeter wall. Coating materials may only be applied up the base of perimeter walls constructed out of either Concrete Masonry Units (CMU) or concrete.* Mix and apply all coating materials in accordance to Section 3.2.

3.9.1 Primer Application (*Floor Surfaces*)

Apply a full coat of the epoxy primer specified in Section 2.2 at 10.0 mils wet to floor surfaces.

3.9.2 Intermediate Coat Application (*Floor Surfaces*)

Apply the intermediate coat specified in Section 2.3 directly into the wet primer at 250 mils wet. The sand filled intermediate coat is best applied by screed application and finished

using a steel power trowel. Directly above areas previously keyed and at a distance of 1.0" to 1.5" away from the coating's outer edge, slope the intermediate coating down and flush with the concrete's surface. The resulting angle shall terminate flush with vertical cut of the previously keyed groove. Perimeter edges and adjacent equipment footings may require finishing by steel hand trowel. When cured, sand entire floor surface. Resulting surface shall appear level, contain uniform thickness, and be free of surface imperfections including trowel marks.

3.9.3 Primer Application (*Up the Base of Perimeter Walls*)

Apply a full coat of the epoxy primer specified in Section 2.2 at 8.0 mils wet 4" up the base of each perimeter wall.

3.9.4 Intermediate Coat Application (*Up the Base of Perimeter Walls*)

Apply the intermediate coat specified in Section 2.3 directly into the wet primer at 250 mils wet. A cove trowel shall be used to create a rounded transition between floor surfaces and the base of perimeter walls. When cured, sand the base and 4" up perimeter walls. Resulting finish shall contain a rounded transition of uniform thickness between floor surface and vertical walls. Resulting surface shall be free of surface imperfections including trowel marks.

3.9.5 Grout Coat Application

Sweep and vacuum up residual dust from intermediate coat sanding. Apply the grout coat specified in Section 2.4 at 10 mils wet to the intermediate coat. If the resulting cured grout coat feels oily/greasy, an amine blush has occurred which requires removal. The coating manufacturer shall be consulted to recommend an appropriate amine blush removal procedure. Epoxy amines may blush during cool temperatures with high humidity which, in effect, interferes with topcoat adhesion. *A minimum of 24 hours following grout coat application, the coating system's adhesion shall be tested in accordance to Section 4.1.1.*

3.10 Saw Cut Joints

Saw cuts shall be placed directly above and, in addition, through each existing joint. Each saw cut shall be 1/4" wide and placed to a minimum depth of 1.5". Care shall be taken to reduce grease and oil contamination from saw cutting equipment and foot traffic on coating system. Floor access shall be limited to essential contractor personnel. When performing joint work, it is recommended that clean rolled cardboard be placed adjacent joint surfaces. This practice will decrease coating system contamination.

3.11 Sand Grout Coat

Lightly sand grout coat to a dull appearance with visible scratches. Resulting surface shall be 100 % absent of gloss with zero shiny spots. Perimeter edges and around equipment footings shall also be lightly sanded. Care shall be taken to minimize the removal of coatings when sanding.

3.12 Application of Sealant

Sweep and vacuum up dust from floor surface and within joints.

3.12.1 Install Bondbreaker

Install, using a backer rod tool, round closed cell polyethylene backer rod into each new saw cut. For 1/4" wide saw cuts, backer rod shall be either 5/16" or 3/8" diameter and placed at a depth of 3/8" below the joint's surface (depth equals the distance from the joint's surface to the highest spot on the backer rod). Backer rod shall fit tight between joint walls (30 % compression). All backer rod that is installed using either the incorrect size (loose fit) or at the incorrect depth shall be removed and reinstalled. Once backer rod is installed, apply painter's tape to both sides of joint to protect adjacent surfaces from sealant.

3.12.2 Sealant Application

Mix and apply the sealant material specified in Section 2.1 to joints. Although the joint sealant is self-leveling, it is best applied using a bulk caulking gun. Resulting sealant finish shall exhibit a recess between 1/8" – 1/32" below the surface of each joint. All sealant which remains either flush or greater shall be removed and reapply by contractor at contractor's expense. Immediately following sealant application, remove painter's tape and sealant drips on surface of intermediate coating. Sealant shall be allowed to cure a minimum of 24 hours following application and prior to coating. If temperatures remain below 60°F, sealant shall cure a minimum of 36 hours prior to the application of coatings.

3.13 Topcoat Application

Sweep and vacuum up all residual dirt and dust prior to the topcoat application and, in addition, inspect floor for shinny grease spots and spot degrease using a pH neutral degreaser followed by potable water rinsing. One coat of the epoxy novolac topcoat (Section 2.5) shall be applied with non-skid grit (Section 2.6). White aluminum oxide non-skid grit shall be broadcast into the topcoat(s) at the *Customer's desired rate and size* specified in Section 3.13.1.

3.13.1 Non-skid Grit

a. Light Broadcast of Non-skid Grit

Number 60 white aluminum oxide shall be broadcast at a rate of 1.0 lbs per 100 sqft into the topcoat and backrolled. The floor shall be broken down into 600 sqft sections where 6 lbs of #60 non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 600 sqft section.

b. Medium Broadcast of Non-skid Grit

Number 60 white aluminum oxide grit shall be broadcast at a rate of 2.0 lbs per 100 sqft into the topcoat and backrolled. The floor shall be broken down into 600 sqft sections where 12.0 lbs of #60 non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 600 sqft section.

c. Heavy Broadcast of Non-skid Grit

Number 60 white aluminum oxide grit shall be broadcast at a rate of 4.0 lbs per 100 sqft into the topcoat and backrolled. The floor shall be broken down into 600 sqft sections where 24.0 lbs of #60 non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 600 sqft section.

3.13.2 Application of Topcoat

A minimum of 24 hours following sealant application (temperature dependant) apply a full coat of the topcoat specified in Section 2.5 at a spreading rate of 6.0 mils DFT. Contractor shall monitor and report a minimum of one WFT reading to Government per 600 sqft section of floor surface prior to broadcasting #60 grit. Stripe coat perimeter edges and around equipment footings. When the correct thickness has been applied per 600 sqft area, immediately and evenly broadcast the desired quantity of #60 white aluminum oxide grit into the topcoat and backroll in two directions. Wet topcoat in excess of 3 mils on sealant surfaces shall be removed by light brushing. The topcoat shall provide sufficient hiding to completely hide the light gray grout coat. If insufficient hiding occurs, contractor shall apply one additional topcoat containing the above size and quantity of non-skid at no additional charge to the government. If either fisheyes or paint separations appear in the topcoat, grout coat has been contaminated and topcoat application shall stop. Contractor shall degrease entire floor using a pH neutral degreaser followed by warm potable water rinsing under low pressure.

3.14 Curing

All applied material shall cure in accordance to manufacturer's requirements. Improperly cured material shall be removed and reapplied by contractor at contractor's expense. It is recommended that a material representative(s) sign off on the contractor's finished product.

3.15 Final Cleanup

Following completion of work, remove debris, equipment, and materials from the site. Remove temporary connections to Government furnished water and electrical services. Restore existing facilities in and around the work areas to their original condition.

PART 4 QUALITY CONTROL

It is recommended that either a Navy Coating Specialist or a National Association of Corrosion Engineers (NACE) Certified Coating Inspector be on site prior to and during all coating operations. The Coating Inspector's role will be to enforce the specification by documenting and reporting on the quality of workmanship. Differences between coating specification and contractor's work shall be immediately reported to either Public Works or the Resident Officer In Charge of Construction. *Mixed material samples shall be taken during the application of each material and stored in labeled plastic containers.* Clean plastic bottle caps may be used for sampling materials. Fill one bottle cap per mixed material sample (liquid) to an approximate thickness of 1/8". If the coating system prematurely fails, the above samples will be used in the failure analysis.

4.1 Adhesion of Coating System

Either the Government or a third party coating inspector shall perform the below adhesion testing.

4.1.1 Adhesion of Grout Coat/Intermediate Coat/Primer Coat

Three modified adhesion tests (ASTM D 4541) shall be performed on the coating system (left side, center, right side) twenty-four hours following grout coat application. The coating system shall be completely cored through and 1/4" into the concrete using a 1" diameter core bit. 3/4" pull-off coupons shall be used and attached directly to the middle of each cored surface (coating surface shall be sanded prior to attaching pull-off coupons). If adhesion values are either greater than 250 psi or produce cohesive failures within the concrete (removal of concrete chunks), coating system is acceptable for topcoat application. If the above requirements are not satisfied, then one adhesion test shall be performed per .100 ft² section using the above procedures. Adhesion results per area shall satisfy the above requirements or coating system shall be 100 % removed to bare concrete and reapplied at contractor's expense. Contractor shall repair each area tested for adhesion. Core holes shall be filled using the specified primer (Section 2.2) followed by the gray sand filled intermediate coat (Section 2.3). Resulting repairs shall be flush with adjacent coatings.

4.1.2 Topcoat Adhesion

Forty-eight hours following topcoat application, three adhesion tests (ASTM D 4541) shall be performed on the topcoat (left side, center, right side). Each adhesion test shall be performed without coring through the coating system and into the concrete. Lightly score the circumference of each pull-off coupon to depth where the gray grout coat becomes visible. If each adhesion value is greater than or equal to 250 psi, then coating system is acceptable and ready for service. If adhesion values are below 250 psi, contractor shall remove topcoat, re-sand grout coat, degrease entire floor (use a pH neutral degreaser with warm water followed by potable water rinsing), and re-apply the topcoats at contractor's expense. Contractor shall repaint the tested areas using the specified topcoat (Section 2.5) and #60 grit (Section 2.6). Resulting repairs shall be flush with adjacent coatings.



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