DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

FROM: HQ AFCESA/CES
139 Barnes Drive, Suite 1
Tyndall AFB, FL 32403-5319

SUBJECT: **Engineering Technical Letter (ETL) 96-5: Hangar Concrete Floor Reflective Coating Criteria**

1. Purpose. This ETL provides guidance for selection and application of reflective chemical resistant coating on existing uncoated or coated concrete floors. Design and construction of new hangar floors must satisfy Air Force pavement criteria in AFM 88-6CH3, *Rigid Pavements for Airfields.*

NOTE: Reflective dry-shake surface hardeners may be substituted for reflective chemical resistant coating on new hangar floors. Refer to paragraph A4.2.

2. Application: All types of aircraft facilities determined to require reflective floor coating, including but not limited to maintenance, servicing, and storage hangars; corrosion control hangars; fuel cell repair hangars; depot overhaul facilities; R&D/testing facilities housing aircraft; and all types of aircraft shelters. Compliance with this ETL is mandatory for:

- projects that have not completed the Project Definition (PD) phase;
- projects beyond the PD phase but not in active design status.

NOTE: The decision to coat hangar floors is the responsibility of the installation and the MAJCOM. A cost/benefit analysis should be conducted which includes the following considerations.

- Installation cost: $2.50 to $4.00 per 0.09 square meters (1 square foot), including surface preparation.
- Maintenance cost: Includes purchase of sweeper and scrubbers ($17,000 - $34,000), cleaning compounds and chemicals, and 1 man-hour/93 square meters (1,0000 square feet)/week contract or maintenance labor.
- Service life: 2 to 5 years.
- Continuing requirement to recoat.

2.4. Authority: AFI 32-1065, *Grounding Systems.*

2.5. Effective Date: Immediately. Expires five years from date of issue.

2.6. Coordination: Civil Engineer functional staff of HQ AETC, HQ ACC, HQ AMC, HQ PACAF, U.S. Army CERL, and NAVFACLANTDIV.

3. Referenced Documents.

3.1. Air Force:

- AFI 32-1065, *Grounding Systems*
- AFP 88-6CH7, *Standard Practice for Sealing Joints and Cracks in Rigid Flexible Pavements*
- TO 00-25-234, Chapter VII, *General Shop Practice Requirements for the Repair, Maintenance, and Test of Electrical Equipment (ATOS),* Warner Robins Air Logistics Center, Change 12, 30 August 1993
- *Air Force Policy and Guidance on Lead-Based Paint in Facilities,* HQ USAF letter, 24 May 1993

3.2. DoD:

- MIL-HDBK-1110/1, *Handbook For Paints And Protective Coatings For Facilities*

3.3. Navy:

- Naval Facilities Engineering Command Guide Specification (NFGS) 03010, *Light Reflective Non-Oxidizing Metallic Aggregate Floor System*

3.4. Federal Standards:

- FED-STD-141, *Paint, Varnish, Lacquer, and Related Materials: Methods of Inspection, Sampling and Testing*
- FED-STD-101C, *Color Code for Pipelines and for Compressed Gas Cylinders*
- FED-STD-313, *Material, Safety Data, Transportation Data For Hazardous Materials Furnished to Government Activities*
- FED-STD-595, *Colors Used in Government Procurement*

3.5. Federal Register:

- CFR 261.7, *Hazardous Waste Disposal*

3.6. Military Specifications:

- MIL-C-46168D, *Coating, Aliphatic Polyurethane Chemical Agent Resistant*
- MIL-H-83282C, *Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric,* NATO Code Number H-537

3.7. U.S. Department of Labor Occupational Safety and Health Administration (OSHA) Regulations:

- 29 CFR 1910.134, *Respiratory Protection*
- 29 CFR 1910.68, (c)(3)(v), *Slip Resistance of Painted Steel Surfaces*

3.8. American Conference of Governmental Industrial Hygienists (ACGIH):

- ACGIH TLV-BKLT, 1991-1992, *Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)*
- ACGIH TLV-DOC, *Documentation of Threshold Limit Values and Biological Exposure Indices,* sixth edition

3.9. American Society for Testing and Materials (ASTM):

- C 920-86, *Elastomeric Joint Sealants*
- D 562-81, *Consistency of Paints Using the (R1985) Stormer Viscometer*
- D 823, *Standard Practices for Producing Films of Uniform Thickness of Paints, Varnish, and Related Products on Test Panels*
- D 1308-79, *Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes*
- D 1640-83, *Test Method for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature*
- D 1737-85, *Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus*
- D 2134-66, *Softening of Organic Coatings by (R1980) Plastic Compositions*
- D 2240-86, *Test Method for Rubber Property - Durometer Hardness*
- D 2370-82, *Test Method for Tensile Properties of Organic Coatings*
- D 2697-86, *Test Method for Non-Volatile Matter in Clear or Pigmented Coatings*
- D 2794-84, *Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)*
- D 3363-74, *Test Method for Film Hardness by (R1980) Pencil Test*
- D 4060-84, *Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser*
- D 4263-83, *Standard Test Method, Indicating Moisture in Concrete by the Plastic Sheet Method*
- D 4541-85, *Pull-Off Strength of Coatings Using Portable Adhesion Testers*
- D 5893-96, *Standard Specification for Cold-Applied, Single Component, Chemically Curing Silicone Sealant for Portland Cement Concrete Pavements*
- E 97-82, *Test Method for Directional Reflectance Factor 45-deg 0-deg, of Opaque Specimens by Broad-Band Filter Reflectometry*

3.10. American National Standards Institute (ANSI):

- B74.12-1976, *Specifications for the Size of Abrasive Grain Grinding Wheels, Polishing and General Industrial Uses*
- 99-1990(13), *Conductivity Test*
- Z287.1-1979, *Practice for Occupational and Educational Eye and Face Protection*

3.11. National Institute of Occupational Safety and Health (NIOSH):

- 86-101, *Certified Equipment List*

3.12. Electrical Overstress/Electrostatic Discharge Association, Inc. (EOS/ESD):

- EOS/EDS S7.1, *Surface Resistance Point to Point, Point to Ground*

4. Definitions.

4.1. *Reflective chemically resistant coating:* A coating system that reflects light and increases illumination and is resistant to chemicals used in aircraft maintenance operations in hangars.

4.2. *Chemically Resistant Urethane (CRU):* A generic type of reflective chemically resistance coating.

4.3. *Conductive coating:* A coating with a resistance of 25,000 to 1,000,000 ohms.

4.4. *Non-conductive coating:* A coating system with a resistance of 1 gigaohm or above.

4.5. *Electrostatic Dissipative (ESD) coating:* A coating with a resistance of 1 megaohm to 1 gigaohm.

4.6. *Non-ferrous metallic aggregate dry-shake aggregate:* A dry aggregate mixture applied to wet concrete during construction and troweled into the surface to form a light reflective non-oxidizing surface.

5. Requirements.

Note: Chemical-resistant coating systems for hangar floors typically consist of an epoxy primer, a two component aliphatic urethane topcoat that incorporates grit to provide slip resistance, and one or two additional urethane topcoats. However, other coating systems may be acceptable for this service. They must meet or exceed the criteria listed in Table A1 to provide equivalent service on hangar floors. Abrasion resistance may be compared to assess relative durability of coating systems. Coating systems with the highest wear index (wear cycles per million with 1000-gram load) should be selected to ensure maximum durability.

5.1. Responsibilities.

5.1.1. Bidders. Bidders should visit the site, carefully examine the specifications, and identify all conditions which may affect the work or associated costs. Bidders will identify discrepancies or omissions in the specifications, and immediately notify the Contracting Officer (CO) to obtain clarification prior to submitting a bid. Bidders will submit with their bids the following information, documents, and certifications:

- A list of experience in the application of reflective chemical resistant coatings on concrete floors.
- A certified history of the contractor's use of the materials proposed for use in the contract provided by the coating manufacturer.
- Evidence of sufficient financial resources to meet contract obligations.
- A list of materials, equipment, and personnel to be used in the performance of the contract.
- Complete instructions for surface preparation and application prepared by the coating manufacturer, including Manufacturers' Material Safety Data Sheets, brochures, technical data sheets, and bulletins describing coating properties.

- A work schedule.
- A list of safety equipment and precautions required at the job site. The list will include written procedures for handling non-hazardous waste, a chemical composite sample breakdown, and pH testing of the etching compound

NOTE: The coating applicator must have a minimum of five years' experience applying the specified coating system. Work experience should include at least ten jobs or 23,226 square meters (250,000 square feet) of successful applications. The required number of jobs and square feet of applications may be increased with concurrence of the CO.

5.1.2. Technical Representative. A technical representative furnished by the manufacturer will assist the CO in ensuring the coating system is properly installed in accordance with manufacturer's recommendations. The technical representative will provide a written statement that the floor is ready for installation of the coating system. After coating installation, the technical representative will provide a letter stating installation was performed according to manufacturer's instructions.

5.1.3. Contractor. The contractor will be responsible for the presence of the technical representative during all floor preparations and coating operations. The contractor will be responsible for expenses of the technical representative.

5.1.4. Contracting Officer (CO). The CO will designate the form for reporting bidder financial resources.

5.1.5. Base Civil Engineer (BCE) and Bioenvironmental Engineer. The BCE and Bioenvironmental Engineer will review the bidder's list of safety precautions and equipment for compliance with city, state, and Federal guidelines for containment and waste disposal.

5.2. Coordination of Operations. All coordination during execution of the contract will be with the CO or authorized representative. Work will be phased so that only one-half of the building is turned over to the contractor at one time. Any equipment or material temporarily stored will be moved by government personnel upon reasonable notice of at least 5 days of intent to work in the area. Due to unplanned or emergency conditions, the government may require the building be returned to government use prior to contractor completion. In such cases, the government will modify the contract to accommodate reasonable added expense of resuming work when the building becomes available again.

5.3. Safety. The contractor will provide health and fire safety precautions for contractor personnel, and will conduct operations in coordination with station operations so that no station personnel are exposed to hazardous amounts of airborne dust particles and solvent vapors. During coating application, the following paragraphs will apply, unless in conflict with a manufacturer's recommendations or other requirements of a recognized legal authority, in which case those requirements take precedence. Volatile

organic compound (VOC) content must be equal to or less than all applicable Federal, state, and local regulations.

5.3.1. Protection Against Vapors. Personnel must wear canister-type respirators or fresh air supply masks when applying coatings, working with chemical strippers in a confined location, or handling hazardous liquid materials (paragraph 5.3.2). Respiratory protective devices must conform to OSHA 1910.134 and be approved by the Mining Enforcement and Safety Administration, or be acceptable to the U.S. Department of Labor for the specific contaminant personnel will encounter. Personnel wearing respiratory protective devices must be instructed in their use. Ensure an adequate supply of replacement cartridges for respirators; regularly inspect and maintain all respiratory protective devices.

5.3.2. Protection Against Liquids. Wear protective clothing, gloves and eye and face protection when applying coatings or when handling liquid materials. Face protective equipment must meet the requirements of ANSI 287.1.

5.3.3. Ventilation. The work area must be ventilated properly at all times to prevent accumulation of hazardous fumes.

5.4. Environmental Conditions. Do not apply coatings unless temperatures of both the slab and ambient air are at least 16 °C (60 °F) and no higher than 32 °C (90 °F). If coating must be applied at temperatures outside this range, the coating manufacturer must submit a statement certifying an alternative temperature range.

5.5. Protection and Cleanup. The contractor will protect areas adjacent to surface preparation and coating operations, and will protect the work area with barricades, warning tape, and signs. When work is complete, the contractor will remove these items (including masking tape); and will remove accumulated debris.

5.5.1. Nonpainted Areas. Areas, devices, or items not to be coated must be masked off. The contractor will provide proper masking material, masking tape, polyethylene sheet, or other materials as required to protect areas from overspray, splatter, foot tracking, and spills.

5.5.2. Waste Removal.

5.5.2.1. The contractor will remove from the base liquid waste material from cleaning operations that cannot be safely flushed into the sewer systems, and coating or solvent residue and containers. The contractor will analyze a sample of the residue by Toxicity Characteristic Leaching Procedure (TCLP) - Metals. If the material is hazardous, the contractor will coordinate with the base Environmental Coordinator and dispose of the material as hazardous waste in accordance with all Federal, state, and local regulations.

5.5.2.2. During removal of paint and coatings from hangar floors, the contractor will collect and store in drums all paint and abrasive residue.

5.5.2.3. The contractor will consult with the Base Environmental Coordinator and CO to determine an approved disposal method for non-hazardous waste.

5.6. Warranty. The contractor will warrant the applied floor coating system with a safety non-slip surface for a period of not less than two years against defects such as: peeling; loss of adhesion; loss of static dissipative properties; film softening; or failure from chemicals or fluids used in hangar operations. The contractor will warrant the coating materials free of formulation or manufacturing defects.

> **CAUTION:** Before developing specifications for reflective floors, conduct tests in paragraphs 5.8.1 and 5.8.3.3.1. If hydrostatic water or toxic materials are present, project design should include these factors, or application of reflective floor coating should be reconsidered.

5.7. Products.

5.7.1. Reflective Chemically Resistant Coating Systems.

5.7.1.1. Coating System. The reflective chemically resistant floor coating system will consist of primer, midcoat, and topcoats, and appropriate grit. System components, including grit, will be applied in the quantities and sequence specified by the coating manufacturer in the bidder's submittals, and as further described in paragraph 5.8.4. (See Attachment 4.)

5.7.1.2. Coating System Components. The coating system selected must, without grit, meet requirements of Table A1. All components of the reflective floor coating system, including coatings and grit, must be supplied by the same manufacturer.

5.7.1.3. Grit. Alumina grit (Nos. [36][46][54]) is preferred and must be mechanically broadcast into the wet-applied midcoat.

Note: No specific safety or OSHA regulations specify a coefficient of friction or test to measure slip resistance for hangar floor coatings. Slip resistance of hangar floor coatings can be enhanced by incorporating grit. As applied, slip resistance can be varied by grit size and density. Paragraph 5.7.1.3 recommends several grit sizes and densities based upon work by NCEL in actual test hangar applications. In maintenance hangar service, grit will be lost from wear and abrasion and slip resistance will decrease with time. Liquids will also decrease slip resistance. Grit selection should be made based on the work performed in the hangar and the amount of abrasion expected from work operations. Number 46 alumina grit has provided the best retention under working conditions, lasting approximately one year. The base safety office should be consulted for local, state and Federal requirements, including 29 CFR 1910.68 (c)(3)(v), that might apply to floor safety.

5.7.2. Conductance of Chemically Resistant Floor Coating System (Attachment 4). Non-conductive coatings must meet the criteria for Class A in Table A1; conductive

coatings must meet the criteria for Class B in Table A1; Electrostatic Dissipative [ESD/SDS] systems must meet the criteria for Class C in Table A1. Allowable limits for sizing alumina grit are given in Table 2 of ANSI B74. 12-1976. Polypropylene grit, when selected, must be equivalent to Hercoflat 1200, and premixed into the first coat before application.

Note: To obtain even distribution, grit may be applied in any 0.023 square meters (36 square inches) as follows: Grit No. 36 at 250 particles; Grit No. 46 at 500 particles; Grit No. 54 at 750 particles. Grit No. 46 bleached alumina is suitable for a typical aircraft maintenance hangar floor. For a floor that is more slip resistant but will lose grit more easily in rough or even normal usage, Grit No. 36 alumina can be used. Grit No. 56 alumina can be used for a less slip resistant floor, but is easier to clean and maintain. Polypropylene grit provides slip resistance, but is less abrasive than alumina grits.

5.7.3. Joint Sealants. Joint sealants will be same color as top coat, silicone sealant conforming to ASTM D 5893-96.

5.7.4. Materials For Surface Preparation. Various chemicals are used in surface preparation of concrete prior to coating application, including detergents for cleaning, solvents for oil and grease removal, and acids for etching of the surface (paragraph 5.8).

5.7.5. Striping Coatings. Traffic markings and other striping coatings must be compatible with the reflective coating systems or ESD/SDS systems. Traffic marking paints are not acceptable. Striping coatings should be chemical-resistant, but moisture-cured urethane marking coatings are acceptable.

5.7.6. Other Materials. All materials required to complete work will be furnished by the contractor. All coatings, chemicals and sealants used will be approved by the manufacturer of the coating system.

5.8. Surface Preparation and Coating System Application. Prepare concrete surfaces and apply coatings according to manufacturer's instructions. Use the procedures in the following paragraphs as a guide or in absence of manufacturer's instructions.

5.8.1. Test of Floor For Hydrostatic Water Pressure and Water Content. Remove any existing coating; using a Delmhorst moisture meter with a probe and scale for wood, test the water content of the floor. If a reading of more than 20 is obtained, test the floor using ASTM D 4263-83, Standard Test Method, Indicating Moisture In Concrete by the Plastic Sheet Method. If moisture is present, contact the CO immediately and do not proceed until authorized by the CO.

5.8.2. Pre-Award Test Application. The selected coating system should be tested in accordance with the following.

5.8.2.1. Test Area. Before final award of the contract, the contractor will apply the coating on an area of the hangar floor, designated by the CO, representative of all existing floor conditions. The test area will measure at least 4.6 meters by 4.6 meters

(15 feet by 15 feet), and include at least 3 meters (10 linear feet) of expansion seam and a grounding point in the center.

5.8.2.2. Test Procedure. A test application will be accomplished in accordance with the contract specifications, including temperature, humidity, and dryness of the concrete. The test will include all phases of coating system application: surface preparation (cleaning, scarification); seam repair; and application of each coat. Each coat will be cured for the recommended time and evaluated for application properties, curing, and film properties. The total system will be cured 10 days prior to test and evaluation. After 10 day's curing, the final coat will be evaluated for:

- adhesion between coats and to the substrate surface.
- film properties.
- color.
- reflectance.
- chemical resistance spot test.
- conductivity (if required).
- grit concentration (particles/square yard).

If the coated area fails any one of the criteria, the coating system should be rejected. The CO should evaluate the test results, then award the contract, require retesting, or reaward the contract.

5.8.3. Surface Preparation. Comply with the surface preparation instructions of the coating manufacturer. Thoroughly clean all surfaces to be coated. As a minimum, sweep the floor, remove debris, and clean the floor with a mechanical scrubber and a heavy-duty alkaline detergent. Allow the detergent solution to soak for 20 to 30 minutes before final scrubbing. Scrub while rinsing with clear water. Correct all damage which occurs during the surface preparation.

Note: Dust from dry grinding of the floor may be undesirable in recoating operations. Scarifiers may damage the surface of the concrete if not used by experts. Shot blasting tends to produce very rough surfaces because the shot will bounce off a resilient coating while damaging the concrete.

Different surface preparation is required for new concrete, for previously used uncoated concrete, and for previously used concrete with reflective coatings. Select guidance from following paragraphs as appropriate to conditions.

5.8.3.1. New Concrete. New concrete must age until it meets the moisture content requirements of paragraph 5.8.1. Remove any curing membrane, coating overspray, and oil from the concrete using solvents and detergents designed to remove these materials.

5.8.3.2. Uncoated Older or Active Hangar Floors. Remove oily residues, markings and other contaminants using solvents and detergents designed for the purpose.

5.8.3.3. Existing Coated Concrete.

5.8.3.3.1. Test For Hazardous/Toxic Materials. Before starting work, test the floor for the presence of lead, heavy metals, and other hazardous materials that may require containment and disposal as hazardous waste. Consult with the Base Bioenvironmental Engineer and Environmental Coordinator for sampling procedures and test methods used to analyze existing coating, and the confidence level required to assure hazardous materials are not present.

5.8.3.3.1.1. Hazardous Materials Present. All materials must be contained and disposed of as hazardous waste. Dry grinding, shot blasting, and scarification procedures are not recommended unless approved by the Bioenvironmental Engineer. Sweep the floor and remove all debris, dust, and dirt from the concrete surface. Remove old paint, sealers, and hardeners with a nonflammable paint remover using manufacturer's recommended procedure. If required, paint remover should be applied at the rate of 38 liters per 93 square meters (10 gallons per 1,000 square feet). Collect all solid and liquid materials and test by Toxicity Characteristic Leaching Procedure (TCLP) for metals; dispose as directed by the Bioenvironmental Engineer.

5.8.3.3.1.2. No Hazardous Materials Present. Remove all areas of the existing coating with poor adhesion, peeling, blistering, or other film defects, including poor resistance to Skydrol and chemicals. Scarification or bead blasting procedures may be used to remove old coatings. Retained coatings should be abraded to remove any gloss or shininess with sand paper, steel wool, or mechanical brushes. When existing coatings are to be completely removed, retain only tightly bonded areas less than one inch in diameter. Remove all oily residues from newly exposed concrete using solvents and detergents as appropriate. Containments or vacuum pick-ups should be used to confine and collect dust and debris during these operations. Bids will be based upon removing existing coating from approximately [_____] percent of the total area indicated for coating.

5.8.3.4. Removal of Contaminants. Check that the concrete is free of contaminants by wetting it with water. If it is not readily wetted, repeat cleaning with solvents and detergents as often as necessary.

5.8.3.5. Preparation of Expansion Joints. Using suitable hand or power tools, rake all existing joints to a depth (D) of 25 millimeters (1 inch), and width (W) at least 25 millimeters and no more than 38 millimeters (1-1/2 inches).* Thoroughly clean the joints and keep them clean by filling with wood strips, backer rods, or other material. After coating work is complete, remove the temporary fillers and fill joints flush with a silicone joint sealant conforming to ASTM D 5893-96. Asphalt-containing sealers tend to bleed into the coating. Existing joints in good condition that do not have exposed asphalt-containing sealants can be coated without removing the sealant.

5.8.3.6. Surface Repairs. Repair surfaces in accordance with AFM 88-6CH7.

*[D/W (in millimeters) = 25:25 minimum, 25:38 maximum; D/W (in inches) = 1:1 minimum, 1:1-1/2 maximum.

5.8.3.7. Etching Concrete. Acid etching should be required for new concrete and may be used for existing concrete if suggested by the coatings manufacturer. Acid etching roughens the surface of smooth concrete but does not remove contaminants. Remove all contaminants before etching concrete. Etch the clean concrete surface with a dilute solution of acid in accordance with the coating manufacturer's recommendations. Apply the solution uniformly to allow small bubbles to form. Where the acid does not properly wet the floor and fails to form bubbles, remove contaminants again in accordance with paragraph 5.8.3.4 and repeat the procedure until the concrete is clean. Allow the acid to stand on the floor for five minutes to complete the reaction. Scrub the floor to remove invisible salts, while rinsing with fresh water. Add detergents or ammonia during this scrubbing process if recommended by the reflective coating manufacturer. From the beginning of the etching process until the final water rinsing, do not allow any portions of the floor to dry. After rinsing, remove water by vacuum pickup; or with squeegees and damp mops, if necessary, to ensure water is removed from all depressions, including tie-down points, grounding points, and expansion joints. The surface of the concrete must be at least as rough as fine sandpaper. Where it is too smooth, repeat the etching process. Allow the floor to dry overnight or as recommended by the coating manufacturer.

5.8.4. Coating System Application. Carefully apply the coating system in accordance with the instructions of the coating manufacturer. Any conflict between these instructions and the general instructions which follow must be resolved by the Technical Representative at the pre-construction conference.

5.8.4.1. Preliminary. Ensure there will be no interference in coating operations from station personnel or from other trades, hangar doors operate properly for adjusting ventilation, general instructions are followed, and concrete is dry enough for the primer application. Test the floor for moisture. A Delmhorst moisture reading of no more than 20 must be obtained, using the probe and scale intended for wood. If a water-dispersed primer has been used, retest the floor before applying solvent-based midcoats or topcoats to assure the proper reading. Vacuum or sweep the floor to provide a clean surface.

5.8.4.2. Coating Application. Mix two component coatings completely prior to application. Do not mix more materials than can be used in a 3-hour period. Allow the manufacturer's recommended induction period before the mixed coating is applied, before water is added to a water dispersible coating, and before grit that will be premixed is added to the coating. Do not add thinner unless specified for a first coat.

5.8.4.2.1. Apply the mixed coating with a medium nap roller or other suitable method. Do not spray. Apply all coats fully up to edges, around pipes, structural supports, conduits, and other items.

5.8.4.2.2. Observe the manufacturer's minimum recommended drying times. If any coat dries more than 24 hours before recoating, consult the manufacturer before proceeding. If recommended, buff the surface with No. 1 steel wool or with No. 100 sandpaper, and vacuum or sweep thoroughly before recoating.

5.8.4.2.3. Grit Application. Thoroughly premix polypropylene grit in the coating prior to application. Uniformly broadcast alumina grit with a mechanical seeding device, such as a “Whirly Bird.” Move the seeder blades uniformly; hold the seeder horizontally. Keep the seeder at least one third full when grit is dispensed. Do not drop residues in the seeder on the coating. Ensure a minimum of [500] [250] [750] particles of grit on any 0.023-square-meter (36-square-inch) area.

5.8.4.3. Traffic Markings. After the final coat has dried 24 hours, apply traffic lanes, fire lanes, static grounding point markings, and other needed markings. Use masking tape to delineate such lines and areas. If the final coat has dried more than 48 hours, buff the area to be marked with No. 1 steel wool or No. 100 sandpaper to provide a good bond. Wipe areas clean before coating. Apply one coat of each required color.

5.8.5. Final Curing. After all coats of the system have been applied, allow the final coat and traffic striping to dry 12 hours before light foot traffic is permitted and 24 hours before general foot traffic is permitted. Protect the coated surfaces until the work is completed and the coating is cured. Inform the CO of curing requirements for the coating system, including the time required until the coating is ready for normal industrial use. Advise the CO that special care must be taken for 28 days not to drag objects on the floor, and that aircraft wheels or other heavily loaded wheels should be placed on aluminum sheets if they are to remain stationary for more than two hours.

5.9. List Of Coatings And Suppliers. The coating systems in listed in Attachment 2 have provided satisfactory performance in previous hangar applications. This list is not an approved products list but is provided for information. Other coating systems may be considered, but they should meet the requirements of Table Al (Attachment 1).

6. Point of Contact. Lt Col Michael J. W. Kaminskas, HQ AFCESA/CESE, DSN 523-6217, commercial (904) 283-6217, FAX 523-6219.

William G. Schauz, Colonel, USAF
Director of Technical Support

5 Atch
1. Table A1. Reflective Floor Coating Criteria
2. Table A2. Reflective Floor Coatings In Use at Air Force Bases
3. Maintenance Equipment and Supplies
4. Criteria Notes
5. Distribution List

Table A1. Reflective Floor Coating Criteria

The reflective chemically resistant floor coating system will consist of a high abrasion resistant coating with an anti-slip grit. The system components will be applied in the quantities and sequence recommended by the manufacturer. The complete reflective coating system, including all coatings and the grit, will be supplied by the same manufacturer. Grit used in the coating will not contain sand or silica. Preferred grit is 36, 40 and 54 mesh alumina and 60 and 100 mesh polypropylene.

Property	Value	Test Method
Solids Content: % by Volume	65	ASTM D 2657
Volatile Organic Compounds (VOC)	400g/L	EPA Protocol
Drying Properties: 21 °C (70 °F) @ 50% RH		
Dry-to-Touch Time, HR (Maximum)	4	ASTM D 1640
Dry-to-Recoat Time, HR (Maximum)	8	ASTM D 1640
Dry for Foot Traffic, HR (Maximum)	24	
Dry to Full Chemical & Traffic Resistance (Days)	10	
Reflectance, % (Minimum) White Light Gray	 85 65	 ASTM E 1347 ASTM E 1347
Tensile Strength, kPa (psi) (Minimum)	37,921 (5500)	ASTM D 2370
Elongation, % (Minimum)	6	ASTM D 2370
Abrasion Resistance CS17 wheel 1,000-gram load, wear cycles per mil (min)	1500	ASTM D 4060(B)
Chemical Resistance 24 hr spot test, Hydraulic Fluid, MIL-H-83282 Skydrol 500B4 Change in pencil hardness (max) Hydraulic Fluid, MIL-H-83282 Skydrol 500B4	 No visible effects No visible effects 2 3	ASTM D 1308 ASTM D 3363
Metals Content of Dry Film Total metals and soluble metals	Metals content of dry film will not exceed requirements of 55FR 55 111798, 19 Mar 1990, of hazardous waste defined by (TCLP) CFR 261.7.	
Grit Content		(paragraph 5.7.1.3)
Slip Resistance		(paragraph 5.8.2.2)
Application Properties	No film defects; i.e., blisters, orange peel, or wrinkling.	ASTM D 823; FED STD 141, Method 4331.1
Conductivity Properties Of Installed Coating		
Class A - Non-Conductive Floor Coating		
Point to point (minimum) Point to ground (minimum)	1 gigaohm 1 gigaohm	ANSI/NFPA 99-1990 (13)

Table A1. Reflective Floor Coating Criteria (Continued)

Class B - Conductive Floor Coating		
Point to point (maximum)	1 megaohm	ANSl/NFPA 99-1990(13), Section 12-4.1.3.8(b)(7)
Two points three feet apart (minimum)	25,000 ohms	Same as above
Point to ground (minimum)	25,000 ohms	Same as above
Class C - Electrostatic Dissipative Floor Coating		
Point to point (minimum) (maximum)	1 megaohm 1 gigaohm	EOS/ESD - DS 7.1 at 100V
Point to ground (minimum) (maximum)	1 megaohm 1 gigaohm	EOS/ESD - DS 7.1 at 100V
Body voltage generation (maximum)	1 KV	AATCC/ANSI 134 for maximum and minimum voltage
Static decay (maximum)	1 second	Federal Test Method Standard 101 C, Method 4046

ENVIRONMENTAL REQUIREMENTS: Coating system including thinners shall not contain materials that do not meet local, state and Federal laws and regulations. Cured coating film must meet requirements for disposal as a nontoxic waste in accordance with Federal Register (FR), Volume 55, paragraph 11798, March, 1990.

TOXICITY: The manufacturer shall certify that the coating system, thinners, cleaners and materials used in surface preparation and application of the CRU coating system does not contain lead in excess of 0.06% by weight of the dry paint film, asbestos or asbestos-form pigments, benzene, toluene, chlorinated solvents, any ACGIH carcinogenic or AACGIH suspected carcinogenic compounds. The coating shall have no adverse effect on the health of personnel when used for its intended purpose.

Table A2. Reflective Floor Coatings In Use at Air Force Bases

Coating System	Manufacturer
Florock® CRU and Florock® CRU/ESD	Crawford Lab 4165 S. Emerald Chicago, IL 60609 (312)376-7132
CuCoat CRU	Federal International Chemicals, Inc. 1191 South Wheeling Wheeling, IL 60090 (312)541-9000
Garland CRU and Garland ESD/CRU	Garland Floor Co. 4500 Willow Parkway Cleveland, OH 44125 (800)321-4100 FAX (216)883-9076
Soloxirane® 2033	Advanced Polymer Sciences, Inc. Avon, Ohio 44011 (800)334-7193 (216)937-5046
Tennant CRU Tennant CRU/EDS	Tennant Inc. 701 North Lilac Dr. P.O. Box 1452 Minneapolis, MN 55440-1452 (612)540-1200

Maintenance Equipment and Supplies

A3.1. Frequent maintenance of installed floor coatings is essential to retain reflectivity and cleanliness. Adequate equipment and cleaning supplies are required based on the scope of your coating area.

A3.1.1. Equipment is authorized in Table of Allowances 010.

A3.1.1.1. Subdiv A-RFMS Vehicles:

- NSN 3825-00-806-8184 “Sweeper - Not Gas Self-Propelled Riding Type,....with or without scrubber...”. 1 per 67,000 sq ft of floor.

or

- NSN 3825-00-817-6284 “Scrubbing - Sach Pavement Tractor Mtd.” meeting Military Specification MIL-S-38725. Minimum scrubbing capacity, m^2(SF)/hr: 1 per 6225 m^2(67,000 SF) of floor.
  Type I: 5203 m^2(56,000 SF)
  Type II: 7061 m^2(76,000 SF)

Approximate price range: $12,000 - $29,000.

A3.1.2. And Subdiv E - Non - REMS Vehicles:

- NSN 3825-00-243-9727 “Sweeper Walker Type, Battery Powered with or without Scrubber PN 42EHD.” Approximate price range with scrubber: $4,500 - $5,100.

A3.2. Supplies are available from over a dozen vendors. Cleaning supplies should be selected based on the equipment vendor’s recommendations. Federal Stock Class 7930 applies; see GSA Catalog.

Criteria Notes

A4.1. Non Conductive, Conductive And Electrostatic Dissipative (ESD) Floor Coating Criteria. The operational tenants of a hangar or facility establish the requirement for a conductive floor based on their survey, in accordance with AFI 32-1065. If a conductive floor is required, then the criteria for the coating system with the desired conductivity should apply.

A4.1.1. Most CRU hangar floor coatings applied prior to 1993 had no resistance requirement. Measurement of these coatings at three bases were above 1×10^9 ohms (1 gigaohm). Most CRU coatings applied in the field probably are non-conductive.

A4.1.2. Conductive floors (resistance 25,000 ohms to 1×10^6 or 1 megaohm) satisfying AFI 32-1065 protect operating and maintenance personnel from shock hazards where personnel may otherwise become exposed to low resistances (25,000 ohms) to ground at voltages of an electrical distribution or other hazardous area system.

A4.1.3. Electrostatic dissipative floors (ESD) (resistance range of 1×10^6 to 1×10^9 or 1 megaohm to 1 gigaohm) bleed accumulated static electricity from personnel walking, standing, and working on them. Charge can be generated on an individual wearing insulative or non-conductive footwear even though the floor is static dissipative. The Aerospace Guidance and Metrology Center (AGMC) provides guidance for use of ESD controls. TO 00-25-234 also clearly defines when and where an ESD control "flooring system" is required for protection of electronic components. A "flooring system" must include both flooring and footwear with specific resistance ratings.

A4.1.3.1. As stated in TO 00-25-234, factors such as humidity, body capacitance, and the location of items having different electrostatic potential influence a given amount of discharge energy level. In extremely dry conditions (10% relative humidity or less) an electrostatic discharge level of 1154 volts must be obtained before reaching the minimum ignition energy (MIE) of JP-4 at the lower explosive limit. If both the floor and footwear have adequate resistance body voltage generation remains well below the 1000 volt threshold.

A4.1.3.2. Typically, an ESD floor is unnecessary in hangars. Protection of electronics during hangar aircraft maintenance is limited to use of wrist straps for pulling "black boxes", LRUs and SRUs, and applying static shielding caps to connectors prior to shipment to the repair organization.

A4.2. Light Reflective Dry Shake Floor Topping. The following information on dry shake toppings is contained in Navy Guide Specification (NFGS) 03010, *Light Reflective Non-Oxidizing Metallic Aggregate Floor System.*

> Surface hardener shall consist of specially processed, malleable, non-oxidizing metallic aggregate, specially selected cement plasticizer and water-reducing admixtures, formulated and processed under stringent quality control of the manufacturer.

"Lumiplate" as manufactured by Master Builder Technologies and "Diamond Plate" as manufactured by the Euclid Chemical Company meet these specifications. The hardener shall be proportioned and sealed in standard moisture-resistant bags. The manufacturer shall guarantee their metallic aggregate to be free of rust, non-metallic material, corrosive materials, oil, petroleum, or other water-base materials, when delivered. (A surface evaporation retardant as recommended by the) manufacturer and certified to be compatible with the surface hardener shall be used in drying conditions in accordance with manufacturer's recommendations.

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Construction Criteria Database (1)
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