Preparing Activity: NAVFAC Superseding
UFGS-09 67 23.15 (August 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 09 - FINISHES

SECTION 09 67 23.15

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SECTION 09 67 23.15

FUEL RESISTIVE RESINOUS FLOORING, 3-COAT SYSTEM
02/21

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NOTE: This guide specification covers the requirements for a three-coat, liquid flooring system with reflective urethane topcoats, slip resistance, and joint work.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
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NOTE: This guide specification contains tailoring options for Army, Navy, and NASA projects. Where an Editor's Note states a paragraph is tailored for a Service or project type, the content of the paragraph, or a portion of the paragraph, is suited specifically to be included only for that Service or project type.
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NOTE: The designer must not alter the products or processes specified herein without thorough knowledge of the need for the changes and the implications of those changes. Use of alternate coating systems must be justified by evaluating

lifecycle costs using 50 year life as a baseline.
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NOTE: The thin film flooring system is appropriate for use in: aircraft maintenance hangars, equipment maintenance shops, and all other industrial floors where resistance to abrasion and fuel is required. Installation costs: $2.00 to $4.50 per 0.1 square meters square foot. Nominal thickness: 0.375 mm 15.0 mils. Can be rejuvenated by replacing urethane topcoats, and non-skid, only. Approximate service life: Urethane top coating with non-skid grit at three or more years. The flooring system is neither conductive nor Electro-Static Dissipative (ESD), however, either formulation is easily designed upon request. This specification is not for use in overcoating existing sound floor coatings.
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NOTE: Prior to the flooring systems installation, a concrete condition assessment in accordance with the Naval Facilities Engineering Service Center's (NFESC) Users Guide (UG)-2036-SHR is highly recommended. The condition assessment is designed to identify problem floors and eliminate premature flooring failures produced by: 1) coating concrete with low surface strength, 2) coating concrete with high levels of surface contamination (such as oils, fuels, fats, and waxes), and 3) coating concrete with a high rate of Moisture Vapor Emission (MVE). The thin film flooring system is suitable for application to: A) "smooth" concrete surface texture (no greater than ICRI 310.2R CSP 5), B) concrete with a rate of MVE no more than 169.0 micrograms moisture per second, square meter 3.0 pounds moisture per 24 hours, 1000 square feet (ASTM F1869), C) concrete with surface strength greater than 1.34 MPa 200 psi (ASTM D4541), and D) concrete with fuel/oil contamination to a depth no more than 6.25 mm 1/4 inch.
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NOTE: If a concrete floor has a rate of Moisture Vapor Emission (MVE) more than 197.0 micrograms moisture per second, square meter 3.5 pounds moisture per 24 hours, 1000 square feet (ASTM F1869), apply a layered Moisture Reducing System (MRS) prior to the application of the thin film flooring system. The MRS must be compatible with the submitted flooring system and approved / warranted by the manufacturer of the thin film flooring system. Apply the MRS to shot blasted concrete and reduce the rate of MVE to less than 169.0 micrograms moisture per second, square meter 3.0 pounds moisture per 24 hours, 1000 square feet. MRSs can employ combinations of concrete sealers,

specific epoxies, and moisture insensitive grouts, with or without mesh.

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NOTE: Include Section 03 01 00 REHABILITATION OF CONCRETE for repair of minor spalls and surface deterioration to depths less than 75 mm 3 inches. Specify epoxy mortar for repairs to depths no more than 50 mm 2 inches. Specify epoxy concrete for repairs to depths from 25 mm 1 inch to 75 mm 3 inches. Contain repairs to depths greater than 25 mm 1 inch in a rectangular geometry with saw cut edges. Finish repairs to resemble surrounding concrete using a stainless steel trowel.

Include Section 32 01 29.61 PARTIAL DEPTH PATCHING OF RIGID PAVING for repair of large spalls and severe deterioration to depths from 75 mm 3 inches to 150 mm 6 inches. Specify Portland Cement Concrete (PCC) with less than 0.45 water-cement ratio, light steel trowel finish, and cure using plastic coated burlap. Provide rectangular geometry for repairs with saw cut edges to a nominal repair depth of 150 mm 6 inches. Cure PCC repair for approximately 30 days prior to the application of the flooring system. Do not cure repairs using liquid membrane-forming compounds.

For repairs to spalls and severely distressed concrete to depths greater than 150 mm 6 inches, seek material guidance from Section 03 30 00 CAST-IN-PLACE CONCRETE and procedural guidance from the American Concrete Pavement Association (ACPA) Guideline TB-002.02P "Concrete Paving Technology - Guidelines for Full Depth Repair." Contain within repair base a minimum of 50 mm 2 inchesof clean, non-reactive concrete sand over a suitable vapor retarder (0.25 mm 10 mils polyethylene sheeting). Finish repairs by light steel trowel and cured using plastic coated burlap. Cure repairs for approximately 30 days, or more, prior to the application of the flooring system. Do not cure repairs using liquid membrane-forming compounds.

Scarify to level any curled or settled slab ends with joint surfaces displaying more than 3.2 mm 1/8 inch difference in vertical height. Contain within resulting surfaces a height difference no more than 1.5 mm 1/16 inch and a surface texture equal ICRI 310.2R CSP 4.

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NOTE: Include Section 03 30 00 CAST-IN-PLACE CONCRETE for new concrete slab construction. Employ measures to control the rate of base, subbase, and subgrade Moisture Vapor Emission (MVE) to total no more than 169.0 micrograms moisture per second,

square meter 3.0 pounds moisture per 24 hours, 1000 square feet when measured on the slab's surface (ASTM F1869). Improper MVE controls have produced numerous premature coating failures. In addition to appropriate subbase drainage, specify a minimum of 25 mm 2 inches of clean, non-reactive concrete sand over no less than 0.25 mm 10 mils of polyethylene sheeting (ASTM F4397) with sealed lap joints. Specify concrete mix to be free of both accelerators containing calcium chloride and other sources of chloride ion contamination. Specify two passes of a light power troweled finish and cure using plastic coated burlap or equal method. Do not cure concrete using liquid membrane-forming compounds. Do not specify surface hardeners or dry shake finish (Section 09 97 23 METALLIC TYPE CONDUCTIVE/SPARK RESISTANT CONCRETE FLOOR FINISH). Approximately 60 days following the concrete pour and prior to the installation of the flooring system, test concrete for the rate of MVE and confirm rate is no more than 169.0 micrograms moisture per second, square meter 3.0 pounds moisture per 24 hours, 1000 square feet (ASTM D1869). Consult ACI 224.3R "Joints in Concrete Construction," ACI 302.1R "Guide for Concrete Floor and Slab Construction," ACI 360R "Design of Slabs on Grade," and other appropriate construction guidance.
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NOTE: Where tile is to be removed prior to the application of flooring system, test both tile and mastic for the presence of asbestos. If asbestos is detected, include Section 02 82 00 ASBESTOS REMEDIATION for removal and disposal.
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NOTE: If flooring system is to be applied to warehouse floors with heavy forklift traffic, a semi-flexible joint sealant is required in lieu of the specified flexible sealant. Use a semi-flexible epoxy sealant with approximately 90 percent elongation. Do not use semi-flexible sealants in areas exposed to exterior temperatures.
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NOTE: Include Section 01 45 00 01 45 00.00 40 QUALITY CONTROL, as applicable.
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NOTE: Include Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. This section defines fugitive dust, generated waste, hazardous materials, hazardous substance, hazardous waste, solid waste, construction and demolition (CD) debris, and liquid waste, and contains documentation for dangerous

waste profile, waste information sheet, waste identification document, waste generation record, landfill disposal form, and hazardous material reporting.
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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.
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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.

ASTM INTERNATIONAL (ASTM)

ASTM C679	(2015; R 2022) Standard Test Method for Tack-Free Time of Elastomeric Sealants
ASTM D412	(2016; R 2021) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D1308	(2002; R 2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D3925	(2002; R 2015) Sampling Liquid Paints and Related Pigmented Coatings
ASTM D4541	(2022) Standard Test Method for Pull-Off Strength of Coatings Using Portable

	Adhesion Testers
ASTM D6237	(2019) Standard Guide for Painting Inspectors (Concrete and Masonry Substrates)
ASTM E11	(2022) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 310.2R	(2013) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2015) Quality Management Systems-Requirements

MASTER PAINTERS INSTITUTE (MPI)

MPI 211	(2018) Floor Coating, Primer, Thin Film, for Aircraft Maintenance Facilities
MPI 212	(2018) Floor Coating, Thin Film, for Aircraft Maintenance Facilities

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC QP 5	(2022) Standard Procedure for Evaluating the Qualifications of Coating and Lining Inspection Companies
SSPC QP 8	(2015) Standard Procedure for Evaluating the Qualifications of Contracting Firms that Install Polymer Coatings, Surfacings, Linings or FRP Composites on Concrete and Other Cementitious Substrates
SSPC QS 1	(2015) Standard Procedure for Evaluating a Contractor's Advanced Quality Management System
SSPC-TU 2/NACE 6G197	(1997) Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection
29 CFR 1910.1000	Air Contaminants
29 CFR 1926.59	Hazard Communication

1.2 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Joint Sealant; G[, [_____]]

Thin Film Flooring System; G[, [_____]]

White Aluminum Oxide Non-Skid Grit; G[, [_____]]

SD-05, Design Data

Environmental Control System

SD-06 Test Reports

Joint Sealant Test Report; G[, [_____]]

Primer Coat; G[, [_____]]

Urethane Topcoat; G[, [_____]]

White Aluminum Oxide Non-Skid Grit; G[, [_____]]

Patch Test Demonstration; G[, [_____]]

Daily Inspection Report; G[, [_____]]

Adhesion Testing; G[, [_____]]

SD-07 Certificates

Coating Work Plan; G[, [_____]]

Joint Sealant Certificates; G[, [_____]]

Thin Film Flooring System Certificates; G[, [_____]]

Qualifications of Certified Industrial Hygienist (CIH)

Qualifications of Certified Protective Coatings Specialist (PCS)

Qualifications of Coating Inspection Company

Qualifications of QC Specialist Coating Inspector

Qualifications of Coating Contractors; G[, [_____]]

Warranty; G[, [_____]]

SD-08 Manufacturer's Instructions

Joint Sealant Manufacturer's Instructions; G[, [_____]]

Thin Film Flooring System Manufacturer's Instructions; G[, [_____]]

Water-Based Alkaline Degreaser; G[, [_____]]

SD-11 Closeout Submittals

Inspection Logbook; G[, [_____]]

1.3 QUALITY ASSURANCE

1.3.1 Qualifications of Certified Protective Coatings Specialist (PCS)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party PCS. Submit documentation that the specialist is certified by SSPC: The Society for Protective Coatings (SSPC) as a PCS, including certification number and date of certification/recertification. If the PCS is employed by the same coating inspection company to which the coating inspector is employed, this does not violate the independent third-party requirements. The PCS must remain certified during the entire project, and the Contracting Officer must be notified of any change in certification status within 10 days of the change. The PCS must not be the designated coating inspector.

1.3.2 Coating Work Plan

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NOTE: For maintenance painting, add requirement for pre-work determination of the existing surface condition. If paint removal is specified in another Section include this evaluation such that the paint removal operation does not create excessive profile.

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a. Include Coating Work Plan in Quality Control Plan.

b. Provide procedures for reviewing Contract Documents immediately after award to identify errors, omissions, and discrepancies so that any such issues can be resolved prior to project planning and development of detailed procedures.

c. Provide procedures for verification of key processes during Initial Phase to ensure that Contract requirements can be met. Key processes must include surface preparation, coating application and curing, inspection, and documentation, and any other process that might adversely impact orderly progression of work.

d. Provide procedures for all phases of coating operations, including planned work, rework, repair, inspection, and documentation. Address mobilization and setup, surface preparation, coating application, coating initial cure, tracking and correction of non-compliant work, and demobilization. Coordinate work processes with health and safety plans and confined space entry plans. For each process, provide procedures that include appropriate work instructions, material and equipment requirements, personnel qualifications, controls, and process verification procedures. Provide procedures for inspecting work to verify and document compliance with Contract requirements, including inspection forms and checklists, and acceptance and rejection criteria.

e. [Provide procedures for determining the existing surface profile under paint, and procedures for ensuring that the profile is not increased beyond the maximum profile specified herein.][_____]

f. Provide procedures for correcting non-compliant work. Detailed procedures are required in advance to avoid delays in meeting overcoat windows as well as to avoid delays in production. Provide procedures for repairing defects in the coating film, such as runs, drips, sags, holidays, overspray, as well as how to correct coating thickness non-compliance, any other areas of repair or rework that might be adversely affected by delays in preparing and approving new procedures.

g. If a procedure is based on a proposed or approved request for deviation, the deviation must be referenced. Changes to procedures must be noted by submittal number and date approved, clearly delineating old requirements and new requirements, so that the records provide a continuous log of requirements and procedures.

1.3.3 Design Data

1.3.3.1 Environmental Control System

Submit design details of the proposed environmental control system to

include ventilation, humidity control, and temperature regulation. Provide calculations for humidity control during separate surface preparation and coating application procedures, ventilation requirements during coating application, and maximum allowable coating application rates to coincide with ventilation. Include basis of design data on local conditions. Provide equipment layout sketches and procedures showing function of each piece of equipment and fail-safe measures. A Certified Industrial Hygienist must approve calculations, work procedures and personal protective equipment.

1.3.4 Test Reports

1.3.4.1 Joint Sealant Test Report

Submit test results that confirm sealant complies with the requirements of Table Ia. Samples must have been tested within the last three years.

1.3.4.2 Daily Inspection Report

Submit one copy of the daily inspection report to the Contracting Officer within 24 hours of the date recorded.

1.3.5 Certificates

1.3.5.1 Qualifications of Certified Industrial Hygienist (CIH)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party CIH. Submit documentation that hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification. Provide evidence of experience with hazards involved in industrial coating application work.

1.3.5.2 Qualifications of Coating Inspection Company

Submit documentation that the coating inspection company performing all coating inspection functions is certified by SSPC to the requirements of SSPC QP 5 prior to Contract award. The coating inspection company submitted and approved must remain and not changed through completion of the Contract. The coating inspection company must remain so certified for the duration of the project. If a coating inspection company's certification expires, the firm will not be allowed to perform any inspection functions, and all surface preparation and coating application work must stop, until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in coating inspection company certification status. Notify the Contracting Officer of all scheduled and unannounced on-site inspections from SSPC and furnish a copy of all inspection reports.

1.3.5.3 Qualifications of QC Specialist Coating Inspector

Submit documentation that each coating inspector is employed, and qualified to SSPC QP 5, Level II, by the selected coating inspection company. Each inspector must remain employed by the coating inspection company while performing any coating inspection functions. In addition to the handwritten records, the inspector must employ an electronic reporting program with functionality as outlined in Table II. The Administrator must be the designated Government Representative for the project.

1.3.5.4 Qualifications of Coating Contractors

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NOTE: Solicitations requiring certification for prequalification should point out the existence and location of the certification requirement on the PROJECT INFORMATION FORM. This requirement must be pointed out in the solicitation documents for the "prior to Contract award" requirement to be enforceable. Certification is a special responsibility requirement pursuant to FAR 9.104-2 Special Standards. This is analogous to requiring bidders to have a specified level of experience or expertise and GAO has sustained these types of special requirements.

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All Contractors that perform surface preparation or coating application must be certified to SSPC QP 8 and should also be SSPC QS 1 certified prior to Contract award and must remain certified while accomplishing any surface preparation or coating application. The painting Contractors must remain so certified for the duration of the project. If a Contractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in Contractor certification status. Notify the Contracting Officer of all scheduled and unannounced on-site audits from SSPC and furnish a copy of all audit reports.

[For OCONUS, non-US territories where documentation is provided that certified SSPC QP 8 with or without SSPC QS 1 Contractors did not bid and are not available, all Contractors that perform surface preparation or coating application must be certified to ISO 9001 prior to Contract award, and must remain certified while accomplishing any surface preparation or coating application. If a Contractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in Contractor certification status. Notify the Contracting Officer of all scheduled and unannounced on-site inspections from the ISO certifying organization and furnish a copy of all inspection reports.

][Minimum requirements for the installation Contractor are as follows: Completed three or more jobs within the past two years applying the specified materials to concrete surfaces in which the total area exceeds 18,587 square meters 200,000 square feet. 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 quality of materials purchased per job for work totaling 18,587 square meters 200,000 square feet within the past two years. In addition to the above requirements, be certified by the material manufacturer(s) to install the submitted coatings and sealant. Submit copy of certificates.

]1.3.5.5 Joint Sealant Certificates

Submit literature documenting the past performance of the sealant's use in automotive or aircraft maintenance shops. Minimum requirements are two or more maintenance shops with joint work totaling 3,048 linear meters 10,000 linear feet where the sealant has performed for two years with less than 1 percent combined sealant failures and defects. List location of shops, total linear feet of sealant applied per shop, shop point of contact, date sealant was applied, and the name of the installed sealant material.

1.3.5.6 Thin Film Flooring System Certificates

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NOTE: Use bracketed option when MPI certified products cannot be obtained.
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Provide manufacturer's certification of conformance to Contract requirements.

[Submit literature documenting the past performance of the coating system's use in aircraft maintenance shops and over floors with high rates of Moisture Vapor Emission (MVE). Minimum requirements are two or more aircraft maintenance shops totaling 3,160 square meters 34,000 square feet where the coating system has performed for two years with less than 0.05 percent combined premature coating failures, material defects and surface discoloration; no more than 0.03 percent discoloration from aviation chemicals, tire plasticizers, and UV exposure. Provide a minimum of two additional case histories where successful installation occurred on floor slabs with no less than 197.0 micrograms moisture per second, square meter 3.5 pounds moisture per 24 hours, 1000 square feet. List location of shops, total coated area per shop, shop point of contact, date coating system was applied, successful installation to concrete with high MVE, and the names of the installed coating materials.

]1.3.6 Product Data

1.3.6.1 Joint Sealant Manufacturer's Instructions

Submit manufacturer's printed instructions to include detailed application procedures, minimum and maximum application temperatures, and curing procedures. In accordance with 29 CFR 1926.59, include Safety Data Sheets (SDS) for the sealant to be used at the job site.

1.3.6.2 Thin Film Flooring System Manufacturer's Instructions

Submit manufacturer's printed instructions to include detailed mixing, minimum and maximum application temperatures, acceptable atmospheric and interior climatic conditions, application procedures, curing procedures, and procedures for maintenance cleaning of flooring system. Provide explicit instructions detailing surface preparation, recoat windows and remedial actions in case recoat windows are missed, and, if applicable, solvent-wiping between coats with acceptable types and grades of solvents. In accordance with 29 CFR 1926.59, include SDSs for the coatings to be used at the job site.

1.3.6.3 Water-Based Alkaline Degreaser

Submit manufacturer's printed instructions to include detailed mixing,

rate of dilution, application procedures, and rinsing procedures. In accordance with 29 CFR 1926.59, include SDSs for the water-based alkaline degreaser to be used at this job site.

1.4 DELIVERY, STORAGE, AND HANDLING

Store coatings and sealant in spaces with temperatures from 5 degrees C 40 degrees F to 24 degrees C 75 degrees F. Inspect materials on site for damage prior to use. Return to manufacturer packaged materials in dented, rusty, or leaking containers. Conduct testing by manufacture of returned materials with an expired shelf life and if compliant, reissue a shelf life extension.

1.5 COATING HAZARDS

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NOTE: Include either Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS or prepare instructions detailing each element of safety for use with this section.

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Ensure that employees are trained in all aspects of the safety plan. Follow the coating manufacturer's written safety precautions throughout mixing, application, and curing of coatings. Comply with respiratory protection requirements in 29 CFR 1910.134 and safe levels of airborne contaminants in 29 CFR 1910.1000.

1.6 JOB SITE REFERENCES

Make available to the Contracting Officer at least one copy each of ASTM D4541, ASTM D6237, SSPC-TU 2/NACE 6G197, and ICRI 310.2R, including replica standards ICRI 310.2R CSP 1 through CSP 9, at the job site.

1.7 PATCH TEST DEMONSTRATION

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NOTE: Patch test demonstration is a very important part of the submittal process. While it is unusual to require a test patch prior to the submitted coating system's approval, this flooring system is unusual in that it is required to provide extended, uninterrupted performance. A demonstration of Contractor claims, especially under conditions to be encountered in the specific project, is considered necessary.

If customer is not satisfied with the level of non-skid grit, adjustments to the specification can be made. Grit coarser than No. 60 aluminum oxide is not recommended. On architectural floors, non-skid grit broadcast rates can range from none to approximately half the specified level.

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Prior to the submitted flooring system's approval, apply the complete coating system to a 3 meter by 3 meter 10 foot by 10 foot square section of concrete as prepared in accordance with PART 3 EXECUTION. Within this area, perform three adhesion tests as described in the paragraph ADHESION

TESTING. If adhesion testing produces cohesive failures within the concrete, no less than 1 mm 40 mils concrete removed over 95 percent of each pull-off coupon, or adhesion more than 2.75 MPa 400 psi, patch test adhesion is acceptable. If concrete surface preparation was insufficient, apply an additional coating system patch to properly prepared concrete followed by the above adhesion testing. If adhesion results are unacceptable for both the topcoats and the primer, submit a new coating system manufactured by a different coating vendor. Apply a patch of the new coating system and subject patch to the above requirements for adhesion prior to approval. If customer is not satisfied with the non-skid grit application, adjustments to the specifications can be made. Grit coarser than No. 60 aluminum oxide is not recommended.

1.8 WARRANTY

Warranty materials and workmanship for a minimum period of one year following coating and sealant application. The following terms and conditions form a part of the warranty: If the applied coating system develops either blisters (chemical), checks, softening, or lifting within one year following application, rework each area at Contractor's expense. The following conditions are excluded from the warranty: A) concrete cracking, flooring system mirrors cracks in concrete; B) cosmetic imperfections due to scratching and gouging; C) application to metallic concrete finishes; and D) application to concrete with a rate of Moisture Vapor Emission (MVE) greater than 197.0 micrograms moisture per second, square meter 3.5 pounds moisture per 24 hours, 1000 square feet. If the coating system's adhesion is in question, perform one adhesion test per 9.3 square meters 100 square feet as described in the paragraph ADHESION TESTING. To satisfy the warranty, each adhesion test must produce cohesive failures, concrete removal over 95 percent of each pull-off coupon, or adhesion no less than 2.8 MPa 400 psi. Require two additional adhesion tests to confirm results for each area failing to meet adhesion requirements. Within the warranty period, remove to sound material and rework all areas unable to meet adhesion requirements. There must be zero percent sealant failures within one year. Within the warranty period, remove and rework all sealant material with chemically attacked surfaces or lifting from joint walls. Topcoat cracking over sealant is excluded from warranty.

PART 2 PRODUCTS

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NOTE: The specified materials are not appropriate for use in primary chemical containment, secondary chemical containment, or on floors subjected to spills from concentrated acids, bases, and organic solvents. Consult with the Naval Facilities Engineering and Expeditionary Warfare Center's (NAVFAC EXWC) Paints and Coatings Center of Expertise for alternative coating systems to suit specific Navy needs.

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2.1 JOINT SEALANT

Formulate the joint sealant to exhibit the properties as listed in Table Ia.

2.2 THIN FILM FLOORING SYSTEM

A three-coat industrial flooring system consisting of primer and two urethane topcoats. Apply the coating system at a Dry Film Thickness (DFT) ranging from 325 to 500 microns 13 to 20 mils and contain a broadcast of aluminum oxide non-skid grit.

2.2.1 Primer Coat

In addition to the requirements of the thin film flooring system, use MPI 211 primer coat.

2.2.2 Urethane Topcoat

In addition to the requirements of the thin film flooring system, use MPI 212 top coat.

2.3 WHITE ALUMINUM OXIDE NON-SKID GRIT

Size No. 60, dust free (washed and dry), minimum 99 percent pure, having the following sieve analysis when tested using a 1000 gram 2.2 pound sample (ASTM E11):

Sieve No. 40	100 percent passing
Sieve No. 50	15-30 percent retained
Sieve No. 60	70-85 percent retained
Sieve No. 70	0-15 percent retained

PART 3 EXECUTION

3.1 COATING SAMPLE COLLECTION

The Contracting Officer and QC Manager must witness all material sampling. Notify the Contracting Officer a minimum of three days in advance of sampling. Obtain liquid samples of each component of primer and topcoat by random selection from sealed containers and in accordance with ASTM D3925. Samples may be either individual cans of liquid material or 1.0 liter 1.0 quart quantities of properly mixed, extracted, and sealed liquid material. Identify samples by designated name, specification number, batch number, project Contract number, sample date, intended use, and quantity involved. When the applied coating system has met the requirements defined in the paragraph ADHESION TESTING, return coating to the installation Contractor for proper disposal.

[3.2 TILE AND TILE ADHESIVE REMOVAL

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NOTE: Delete this Article if concrete is not tiled.
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Remove 100 percent of tile employing one or more of the following techniques: chipping, scraping, sanding, scarification, high-pressure water, and various hand tools. Remove 100 percent of the tile adhesive using solvents and power scrubbing. Remove residual contamination using hot potable water under a minimum of 27.6 MPa 4,000 psi. Resulting surfaces must appear clean and display the gray color of concrete.

]3.3 JOINT MATERIAL REMOVAL, RE-SAW CUTTING, CRACK CHASING

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NOTE: Hairline cracks having no more than 3.2 mm 1/8 inch width are typically not repaired. However, cracks greater than 3.2 mm 1/8 inch width can be chased to a minimum depth of 12.5 mm 1/2 inch and sealed using the procedures and materials specified for joints. Cracks more than 18.75 mm 3/4 inch width can be repaired using either epoxy mortar or epoxy concrete. Sealed cracks will assist in protecting the subbase against chemical migration.
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Remove 100 percent of the existing material in all joints including material bonded to joint walls and base. Rigid material may require saw cutting equipment to remove. Joints may be widened up to 3.2 mm 1/8 inch when re-saw cutting. Chase concrete cracks identified for repair and open to a minimum depth of 12.5 mm 1/2 inch below crack surface resulting in crack(s) with smooth vertical walls. Cracks greater than 18.75 mm 3/4 inch width can be repaired using either epoxy mortar or epoxy concrete.

3.4 DEGREASING

On both coated and uncoated concrete, degrease entire floor by scrubbing using a solution of hot potable water, 49 degrees C 120 degrees F to 77 degrees C 170 degrees F, and a concentrated water-based alkaline degreaser. Perform two complete degreasing cycles on the entire floor surface. Allow solution to soak into surfaces prior to scrubbing and remove using hot potable water under a minimum of 27.6 MPa 4,000 psi. Rinsing is complete when the rinse water appears clear. If the industrial detergent is not biodegradable, collect all rinse water and dispose as hazardous waste. Squeegees and shop vacuums may be used to collect pooling rinse water. Fans may be used to aid drying of floor surfaces.

[3.5 COATING SYSTEM REMOVAL

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NOTE: Delete this Article if concrete is uncoated.
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Remove 100 percent of the existing coating system employing one or more of the following techniques: shot blasting, chipping, scraping, sanding, scarification, high pressure water blasting, and various hand tools. Impact tools, such as scabblers, may be used to remove unsound epoxy mortar flooring systems. In general, a coating system cannot be completely removed by shot blasting and, to attain 100 percent coating removal, requires a combination of the above techniques.

]3.6 SURFACE PREPARATION

Shot blast entire floor to produce a level of coarseness equal to ICRI 310.2R CSP 3. Overlap each pass of shot blasting by 6.25 mm 1/4 inches to 12.5 mm 1/2 inches. Add new shot to shot blasting equipment prior to blasting. Prepare surfaces inaccessible to shot blasting, base of perimeter walls and under secured equipment, using diamond disk grinding or light scarification to produce a level of coarseness equal to ICRI 310.2R CSP 2 or ICRI 310.2R CSP 4, respectively. Resulting surfaces

must appear clean and contain the appropriate level of surface coarseness. If the resulting level of cleanliness cannot be determined, place numerous drops of water on surfaces that appear contaminated. If the water drops soak into concrete, the surfaces are free of hydrocarbon contamination (oils, grease, skydrol). If the water drops bead up and do not flatten out, surfaces require additional degreasing as detailed in the Article DEGREASING. Shot blasting coarse concrete or broom finished concrete can produce a level of coarseness equal to ICRI 310.2R CSP 5: employ a best-effort attempt to minimize over-shot-blasting of coarse concrete. If coarse concrete is encountered, shot blasting to a level of coarseness equal to ICRI 310.2R CSP 5 is acceptable: however, extremely coarse concrete can require resurfacing prior to the flooring system's installation. Sweep, vacuum, and run a high powered magnet over all surfaces to be coated, including joints.

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NOTE: At this point in the installation sequence, minor spalls and surface deterioration to depths less than 75 mm 3 inches can be repaired. Use epoxy mortar for repairs to depths no more than 50 mm 2 inches. Use epoxy concrete for repairs to depths from 25 mm to 75 mm 1 inch to 3 inches. Finish repairs to depths greater than 25 mm 1 inch with a rectangular geometry with saw cut edges. Repairs must be finished to resemble surrounding concrete using a stainless steel trowel. Include Section 03 01 00 REHABILITATION OF CONCRETE if concrete repairs of this nature are required.

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3.7 JOINT TREATMENT

Use the "Conventional Sealed Joint" as detailed in Figure 1 of SSPC-TU 2/NACE 6G197 to seal joints. Employ measures to reduce contamination from equipment and foot traffic. Limit floor access to essential Contractor personnel. Confirm joint surfaces are sufficiently clean.

3.7.1 Install Backer Rod

Install a continuous length of round, closed-cell polyethylene backer rod into each joint using a backer rod tool. For 12.5 mm 1/2 inch, 9.4 mm 3/8 inch, and 6.25 mm 1/4 inch wide joints, place backer rod to a depth of 9.4 mm 3/8 inch (depth equals the distance from the concrete's surface to the highest point on the backer rod). For joints greater than or equal to 18.75 mm 3/4 inch width, place backer to a depth of 15.6 mm 5/8 inch below the concrete's surface. Fit backer rod tight between joint walls (30 percent compression). Remove and reinstall all backer rod that is installed using either the incorrect size (loose fit) or at the incorrect depth. Following backer rod installation, apply painter's tape to surfaces adjacent joints to protect from sealant.

3.7.2 Joint Sealant Application

Apply sealant directly into joints using a bulk-caulking gun. At room temperature, the resulting sealant application must exhibit a concave recess between 3.2 mm 1/8 inch to 1.6 mm 1/16 inch below the concrete's surface. Remove and reapply cured sealant remaining either flush or greater. Following sealant application, remove painter's tape and sealant

drips on concrete surfaces. Cure sealant a minimum of 24 hours, prior to the application of coatings.

3.8 PRE-APPLICATION TESTING FOR CONTAMINATION

Spot check surfaces for oil/grease contamination using the water break test. At a rate of 5 tests per 95 square meters 1000 square feet, place one to two drops of water onto surfaces and observe for beading. Test all other surfaces that show visible signs of potential contamination. Apply additional degreasing techniques to surfaces displaying water beading in accordance with the Article DEGREASING.

3.9 COATING APPLICATION

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NOTE: Use epoxy primer the same color, either white or ultra-light gray, as the selected topcoats. Ultra-light gray is preferred to white.

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Vacuum flooring space one additional time prior to coating application.

3.9.1 Primer Application

Apply MPI 211 epoxy primer to flooring space at 175 microns 7.0 mils to 375 microns 15.0 mils Dry Film Thickness (DFT). If the prepared concrete resembles an ICRI 310.2R CSP 3 surface, apply the primer at a minimum of 175 microns 7.0 mils DFT. If the prepared concrete resembles an ICRI 310.2R CSP 5 surface, apply the primer at a maximum of 375 microns 15.0 mils DFT. The previously applied sealant may be lightly coated.

3.9.2 Non-Skid Grit Broadcast

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NOTE: Aircraft hangars servicing light aircraft with weight less that 18,140 kg 40,000 pounds may require a higher loading of non-skid grit. The additional grit will assist in towing aircraft under wet conditions; however, the additional grit will decrease coating aesthetics. Up to 450 grams 1 pound per 93 square meters 100 square feet of additional non-skid grit can be required.

On either warehouse or architectural floors, considerably less non-skid grit may be appropriate. Broadcast rates can range from none to less than 450 grams 1.0 pound per 93 square meters 1000 square feet.

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Broadcast non-skid grit at a rate of 680 grams 1.5 pounds per 9.3 square meters 100 square feet into the second urethane top coat and backroll. Map floor into 55.8 square meter 600 square foot sections where 4080 grams 9.0 pounds of non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 55.8 square meter 600 square foot section.

3.9.3 Application of Topcoats

Apply two coats of MPI 211 epoxy urethane topcoat to the epoxy primer and broadcast white aluminum oxide non-skid grit directly into the second

urethane topcoat.

3.9.3.1 First Topcoat

Apply a full coat of the urethane topcoat at a spreading rate from 62.5 to 80 microns 2.5 to 3.2 mils Dry Film Thickness (DFT). Stripe coat perimeter edges and around equipment footings. Monitor and record a minimum of one Wet Film Thickness (WFT) reading per 55.8 square meter 600 square feet of floor surface. Sealant is to be lightly coated.

3.9.3.2 Second Topcoat

Apply a second coat of the urethane topcoat at a spreading rate of 62.5 to 80 microns 2.5 to 3.2 mils DFT. Stripe coat perimeter edges and around equipment footings. Monitor and record a minimum of one WFT reading per 55.8 square meters 600 square feet of floor surface prior to broadcasting non-skid grit. When the correct WFT has been applied per 55.8 square meters 600 square feet of area, immediately and evenly broadcast non-skid grit directly into the second topcoat of urethane and backroll in two directions. Test the adhesion of the thin film flooring system in accordance with the paragraph ADHESION TESTING.

3.9.3.3 Walkway Stripe and Grounding Rod Markings

Place the walkway stripe and grounding rod markings according to Government drawings, if applicable. When the second topcoat is within its recoat window, apply a walkway stripe of the red/orange urethane topcoat at 75 microns 3.0 mils DFT, completely hiding the top coat, in one coat. If insufficient hiding occurs, apply one additional coat of the walkway stripe. Lightly broadcast non-skid grit into the wet walkway stripe. Use solvent-resistant tape to protect the floor coating against stripe coat bleed. A thin clear coat of either epoxy or urethane may be required to prevent stripe coat bleed prior to the full application of the colored stripe coat. Apply grounding rod markings using similar procedures, urethane top coat, and colors and size according to Government drawings.

3.10 CURING

Cure installed materials to display performance equal to manufacturer's product literature. Remove and reapply improperly cured material.

3.11 FIELD QUALITY CONTROL

3.11.1 Coating Inspector

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NOTE: Insert directly into Section 01 45 00 01 45 00.00 40 QUALITY CONTROL, as applicable, requirement for SSPC QP5 Level II Coating Inspector.

A) Modify Section 01 45 00 01 45 00.00 40 QUALITY CONTROL to include SSPC QP5 Level II Coating Inspector as follows:

1. In the Submittals Article, add submittal requirement "SD-07 Certificates," add "SSPC QP5 Level II Coating Inspector; G" and add the following paragraph below the addition of "SSPC QP5 Level II Coating Inspector; G."

2. Add the following to the table in the paragraph "QC Specialists Duties and Qualification:" under the heading "Qualification/Experience in Area of Responsibility, add "SSPC QP5 Level II Coating Inspector;" under the heading "Area of Responsibility," add "Surface preparation, flooring system installation, field tests, and field inspection;" and under the heading "Frequency" add "Full-time during surface preparation, flooring system installation, field tests, and field inspection."

3. Use SSPC QP5 Level II Coating Inspector on all flooring projects or, as a minimum, on flooring projects with greater than 232.25 square meters 2,500 square feet.

B) Modify Section 01 45 00 QUALITY CONTROL to include SSPC QP5 Level II Coating Inspector as follows:

Add SSPC QP5 Level II Coating Inspector to paragraph CQC PERSONNEL and its associated Experience Matrix. The SSPC QP5 Level II Coating Inspector must be directly employed by the prime Contractor. Use the following for the Qualifications column:

The SSPC QP5 Level II Coating Inspector will act as QC Specialist.

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Consider the Coating Inspector as a QC Specialist, who works for the QC Manager, and qualified in accordance with Section 01 45 00 01 45 00.00 40 QUALITY CONTROL. The Coating Inspector must be present during all field tests, surface preparation, flooring application, initial cure of the flooring system, and during all flooring repair work. The Coating Inspector must provide all tools/equipment necessary to perform field tests and inspection. The Coating Inspector is responsible for field tests and specified level of inspection.

3.11.2 Inspection

Document weather conditions, job site occurrences, and report conditions and occurrences potentially detrimental to the flooring system. The listed inspection requirements are in addition to the QC inspection and reporting requirements defined in Section 01 45 00 01 45 00.00 40 QUALITY CONTROL. The Coating Inspector must prepare a project reference sheet outlining all requirements, tests, test methods, and evaluation criteria, and hold regular meetings with Contractor personnel, including shot blasting operators and applicators, to review requirements/evaluation criteria for upcoming work prior to execution. At the start of coating operations and every hour following until daily work is complete, record air temperature, substrate temperature, and relative humidity. Following the application of each coat, inspect surfaces for improperly cured material, blisters, inadequate or excessive coating thickness, and other defects. Document each inspection, test, non-compliant area, and location of each non-compliant area. List method of evaluation, evaluation criteria, areas requiring rework, and all other pertinent observations.

3.11.2.1 Daily Inspection Report

Submit to the Contracting Officer one copy of the daily inspection report completed each day when performing work under this Section. Use Appendix X1 "Inspection Checklist" of ASTM D6237 to monitor daily activity and to assist in preparing the daily inspection report. Note each non-compliant issue and each issue identified for rework in accordance with the QC documentation procedures of Section 01 45 00 01 45 00.00 40 QUALITY CONTROL. Use of forms containing entry blocks for all required data is encouraged. The data must be legible and presented in a professional format. Submit report within 24 hours of the report date.

3.11.2.2 Inspection Logbook

Maintain a continuous record of all activity related to this Section on a daily basis. A computer / software package as outlined in Table II is preferred to record all information provided in the Daily Inspection Reports, as well as other pertinent observations and information including photo documentation where appropriate. The designated Government Representative for the project is assigned the highest level Administrator privileges and only the Administrator must be able to modify reports. In areas where photography is not allowed, the computer must come with verification that the camera / photo capability has been removed.

Alternatively, a continuous record of all activity related to this Section must be maintained in an Inspection Logbook on a daily basis. The logbook must be hard or spiral bound with consecutively numbered pages, and must be used to record all information provided in the Daily Inspection Reports, as well as other pertinent observations and information. Submit the original Inspection Logbook to the Contracting Officer upon completion of the project and prior to final payment.

3.11.2.3 Inspection Equipment

Use equipment in good condition, operational within its design range, and calibrated as required by the specified standard for use with each device.

3.11.3 Adhesion Testing

Perform a minimum of three adhesion tests in accordance with ASTM D4541 to the thin film flooring system. Select three random flooring locations spaced a minimum of 6 meters 20 feet between each location. Prior to attaching pull-off coupons, lightly sand flooring surface and attach pull-off coupons containing a grit-blasted anchor profile. Adhere directly to the center of each sanded surface a 18.75 mm 3/4 inch diameter pull-off coupon. When pull-off coupon adhesive has sufficiently cured, score circumference of each pull-off coupon to concrete substrate. Test adhesion and evaluate results. If testing produces cohesive failures within the concrete, no less than 1 mm 40 mils concrete removed over 95 percent of each pull-off coupon, or adhesion more than 2.75 MPa 400 psi coating system's adhesion is acceptable. If the above requirements are not satisfied, then perform one adhesion test per 9.3 square meters 100 square feet using the above procedures. Perform two additional tests per non-compliant area to confirm results. Remove to sound material and rework all areas unable to meet adhesion requirements. Repair each adhesion test using a combination of primer, sand-filled epoxy mortar (for deep cohesive failures, if applicable), and two urethane topcoats. Make repairs flush with adjacent coatings and display an equivalent appearance.

3.12 FINAL CLEANUP

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

TABLE I - MATERIALS REQUIREMENTS	
TABLE Ia	
Test	Minimum Requirement (maximum where indicated)
Sealant System (two-pack: self-leveling)	Polysulfide (Manganese Cure; MnO2) or Urethane
Percent Volume Solids	100 percent
Chemical Resistance to JP-8 plus 100 Fuel at 21 degrees C (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Chemical Resistance to Motor Oils at 21 degrees C (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Chemical Resistance to Skydrols at 21 degrees C (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Hardness (ASTM D2240:Shore A)	20
Tensile Strength (ASTM D412) (or ASTM D638)	1.0 MPa
Percent Elongation (ASTM D412) (or ASTM D638)	500 percent
Tack Free at 18.3 degrees C (ASTM C679)	12 hours maximum
Adhesion to Concrete	0.96 MPa
Adhesion to Urethane Topcoats (paintable sealant)	0.96 MPa
NOTES: (1) Immerse and test a minimum of three 50 mm by 12.5 mm by 12.5 mm sections of cured sealant.	

TABLE I - MATERIALS REQUIREMENTS	
TABLE Ia	
Test	Minimum Requirement (maximum where indicated)
Sealant System (two-pack: self-leveling)	Polysulfide (Manganese Cure; MnO2) or Urethane
Percent Volume Solids	100 percent
Chemical Resistance to JP-8 plus 100 Fuel at 70 degrees F (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Chemical Resistance to Motor Oils at 70 degrees F (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Chemical Resistance to Skydrols at 70 degrees F (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Hardness (ASTM D2240: Shore A)	20
Tensile Strength (ASTM D412) (or ASTM D638)	150 psi
Percent Elongation (ASTM D412) (or ASTM D638)	500 percent
Tack Free at 65 degrees F (ASTM C679)	12 hours maximum
Adhesion to Concrete	140 psi
Adhesion to Urethane Topcoats (paintable sealant)	140 psi
NOTES: (1) Immerse and test a minimum of three 2 inch by 1/2 inch by 1/2 inch section of cured sealant.	

TABLE II
Reporting Program Requirements QA/QC
Administrative Controls:
Administrators must be able to turn on and off unique access to specific jobs and Contracts.
Administrators must be able to remotely enable and disable access for users.
All enabled users must view the same active report in real time. There must be no opportunity for multiple versions of the same report to exist.
Administrators must be able to setup unique approval processes for each project and promote or remove unique people from this process at any time.
Administrators must be able to associate Contract specific documents and specification limits quickly and easily.
Administrators must be able to associate PDS, SDS, blueprints, scope of work and Contracts uniquely to each job.
Objectivity Controls:
Data Entry fields must be by multi-selectable choices, numeric keypads, pickers and skip logic to ensure repeatable data entry in a way that makes running analytics and metrics easy and objective.
The program / hardware package must be able to communicate with inspection devices that provide (batch) data export capability such as Elcometer and Defelsko gages.
The program / hardware package must automatically time, date and GPS stamp all reports without input or interference from the inspector.
Real Time Syncing:
Forms must be available for approved associates to view at all times.
Retrievable storage must be provided for all job related reports and documents for a minimum time of 5 years from completion of the job or project. Archiving of the documents after 5 years will be the responsibility of the Government.
Document Library:
All reports must be in searchable and annotatable PDF format.
The Administrator must be able to upload and annotate job specific reports in real time. Examples include but not limited to Safety Data Sheets, Product Data Sheets and Blueprints.

TABLE II
Annotations and modifications must be locked and associated with the document. Only the Administrator has rights to modify or delete annotations or allow modifications to the document library especially all related inspection reports.
Customization:
The program must be capable of being customized to specific jobs, Contracts or specifications.

-- End of Section --