

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

Jul 28, 1997

SUBJECT: **Engineering Technical Letter (ETL) 97-2 (Change 1): Maintenance and Repair of Rigid Airfield Pavement Surfaces, Joints, and Cracks**

**1. Purpose.** This ETL provides guidance to help the Base Civil Engineer (BCE) and other users specify the materials and minimum standards of performance for the repair of rigid airfield pavement surfaces.

**2. Application:**

**2.1.** Authority: AFM 88-6CH7, *Standard Practice for Sealing Joints and Cracks in Rigid and Flexible Pavements*; and AFM 88-6CH8, *Standard Practice for Concrete Pavements*.

**2.2.** Effective Date: Immediately. ~~Expires five years from date of issue.~~

**3. Referenced Publications.**

**3.1.** AFM 88-6CH3, *Rigid Pavements of Airfields*.

**3.2.** AFM 88-6CH10, *Repair of Rigid Pavements Using Epoxy-Resin Grouts, Mortars, and Concretes*.

**3.3.** AFP 88-71, *Standard Details for the Construction and Repair of Airfield Pavement Systems*.

**3.4.** ACI (American Concrete Institute) 503R-89, *Use of Epoxy Compounds with Concrete*.

**4. Specific Requirements.**

**4.1.** Attachments 1 and 2 are complementary and are to be included as companion documents in Indefinite Delivery/Indefinite Quantity contracts. Each may also stand alone as a technical specification for a repair contract for rigid pavements.

**4.2.** Notes to the designer in Attachments 1 and 2 are included to allow modifications to meet local construction practices. These notes should be removed before the documents are published as technical requirements of a contract.

**APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED**

**5. Point of Contact:** Mr. James L. Lafrenz, P.E., HQ AFCESA/CESC, DSN 523-6332, commercial (904) 283-6332, or INTERNET [lafrenzj@afcesa.af.mil](mailto:lafrenzj@afcesa.af.mil).

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

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1. Repair of Airfield Pavement Surfaces, Rigid Pavement Systems
2. Repair of Joints and Cracks, Rigid Airfield Pavement
3. Figures A3a - A3e, Repair of Concrete Pavement
4. Distribution List

**REPAIR OF AIRFIELD PAVEMENT SURFACES  
RIGID PAVEMENT SYSTEMS**

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GENERAL INSTRUCTIONS:

These specifications will be modified by the designer to include options. An election of a construction management philosophy must be made for the document to be complete. Where options are to be elected the sections are identified by preceding asterisks, indentation, and following asterisks. The section you are reading is an example of an instruction to the designer or an option. Prior to incorporating these specifications into a contract document all comments, instructions, and/or options will be deleted from the text.

These guide specifications incorporate a Quality Assurance/Quality Control (QA/QC) construction management philosophy. The Government will use the results of testing materials and/or products to "assure" that the construction, as placed, satisfies the salient requirements of this specification. The QA results are used by the Government for acceptance of the built product. The QA management procedures used by the Government may be implemented by professional services contract, by in-service, or a combination thereof.

The Contractor is required to provide testing services (QC) to monitor the construction processes.

This specification should not be used with guide specifications which do not incorporate a QA/QC philosophy for construction management. It is the responsibility of the designer to assure that technical sections used to build a contract document are consistent in management philosophy.

The point of contact for this document is HQ AFCESA/CESC, 139 Barnes Drive-Suite 1, Tyndall AFB, FL, 32403-5319. The document coordinator is Mr. Jim Lafrenz, 904-283-6332.

When preparing contract documents for maintenance and repair of rigid pavement systems refer to: AFM 88-6, Chapter 8, *Standard Practice for Concrete Pavements*; AFP 88-71, *Standard Details for the Construction and Repair of Airfield Pavement Systems*; AFM 88-6, Chapter 7, *Standard Practice for Sealing Joints and Cracks in Rigid and Flexible Pavements*; and, AFM 88-6, Chapter 10, *Repair of Rigid Pavements Using Epoxy-Resin Grouts, Mortars, and Concretes*.

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**SECTION**

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The section number should be inserted in the specification heading and will also be prefixed to each page number in the project specifications. For example, for a section numbered 02525, the page number would be located at the bottom of the page; e.g., page 15 would be 02525-15.

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**PART 1 - GENERAL**

1. **APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

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The designations for publications are those that were in effect when this guide specification was prepared. To minimize the possibility of error, the letter suffixes, amendments, and dates are retained here and are omitted in the specifications.

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**1.1 Department of the Army, Corps of Engineers, Handbook for Concrete and Cement:**

CRD-C 55-92	Test Method for Within-Batch Uniformity of Freshly Mixed Concrete(used for determination of the minimum time of mixing)
CRD-C 100-75	Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing
CRD-C 104-80	Method of Calculation of the Fineness Modulus of Aggregate
CRD-C 112-69	Method of Test for Surface Moisture in Aggregate by Water Displacement
CRD-C 119-91	Standard Method of Test for Flat and Elongated Particles in Coarse Aggregate (ASTM D 4791-89)
CRD-C 300-90	Corps of Engineers Specifications for Membrane-Forming Compounds for Curing Concrete
CRD-C 400-63	Requirements for Water for Use in Mixing or Curing Concrete

**1.2 American Society for Testing and Materials (ASTM)  
Publications:**

A 184M-90	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
A 497-4a	Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
A 615M-94	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 616M-93	Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
A 617M-90	Specification for Axle Steel Deformed and Plain Bars for Concrete Reinforcement
C 29/29M-91	Test Method for Unit Weight and Voids in Aggregate
C 31-91	Practice for Making and Curing Concrete Test Specimens in the Field
C 33-94	Concrete Aggregates
C 70-94	Test Method for Surface Moisture in Fine Aggregate
C 78-94	Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
C 94-94	Specification for Ready Mixed Concrete
C 117-95	Test Method for Material Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
C 123-94	Test Method for Lightweight Pieces in Aggregate
C 136-5a2	Test Method for Sieve Analysis of Fine and Coarse Aggregates
C 142-78 (1990)	Test Method for Clay Lumps and Friable Particles in Aggregates

C 143-90a	Test Method for Slump of Hydraulic Cement Concrete
C 150-95	Specification for Portland Cement
C 172-90	Practice for Sampling Freshly Mixed Concrete
C 173-94a	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C 174-87(1991)	Test Method for Measuring Length of Drilled Concrete Cores
C 192-90a	Practice for Making and Curing Concrete Test Specimens in the Laboratory
C 231-91b	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C 260-94	Specification for Air Entraining Admixtures for Concrete
C 494-90	Specification for Chemical Admixtures for Concrete
C 618-94a	Specification for Cool Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
C 881-90	Specification for Epoxy-Resin Base Bonding Systems for Concrete
D 422-63(1990) <sup>E1</sup>	Test Method for Particle Size Analysis of Soils
D 558-82(1990)	Test Method for Moisture-Density Relations of Soil Cement Mixtures
D 559-89	Test Method for Wetting and Drying Tests of Compacted Soil-Cement Mixtures
D 1241-68(1994)	Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses
D 1556-90	Test Method for Density of Soil in Place by the Sand Cone Method

- D 1557-91 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))
- D 1632-87 Practice for Making and Curing Soil Cement Compression and Flexure Test Specimens in the Laboratory
- D 1633-84(1990) Test Method for Compressive Strength of Molded Soil-Cement Cylinders
- D 1751-83(1991) Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous types)
- D 1752-84(1992) Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- D 2167-94 Test Method for Density and Unit Weight of Soil In Place by the Rubber Balloon Method
- D 2487-93 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D 2922-91 Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- D 2937-94 Test Method for Density of Soil in Place by the Drive-Cylinder Method
- D 3017-88(1993) Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- D 4318-93 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- E 548-94 Guide for General Criteria Used for Evaluating Laboratory Competence

**2. Quality Assurance/Quality Control (QA/QC) Procedures:**

**2.1 CONSTRUCTION MATERIAL TESTING (QA) BY GOVERNMENT:** The Government will accomplish materials and products testing for acceptance of the construction. Testing by the Government does not relieve the Contractor of the quality control (QC) testing and process monitoring.

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Paragraph 2.1 requires the Government to employ a testing laboratory (QA LAB). The QA LAB will work directly for the Government. The QA LAB will perform material testing supplemental to the Contractor QC functions. The QA LAB will perform that testing required to evaluate the performance requirements of the construction. When a QA LAB will not be used, paragraph 2.1 will be changed to the paragraph which follows.

2.1 The Government will use the results of material testing accomplished by the Contractor to evaluate the construction for acceptance. The Contractor shall provide copies of all quality control testing results and product certifications to the Contracting Officer Representative. All test results will be reported the Contracting Officer within 24 hours of the completion of the respective tests.

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**2.2 Construction Material Testing (QC) by Contractor:** The Contractor shall retain the services of an independent commercial testing laboratory, herein after referred to as the QC LAB. The QC LAB shall perform those quality control (QC) functions which are necessary to monitor the work. The QC LAB shall do concrete mix designs, soil cement design, soils analysis for compaction control, and supporting construction process monitoring. The minimum daily monitoring requirements are described in paragraph Contractor Quality Control. Within 15 days of the Notice to Proceed date, the Contractor shall submit the qualifications statement of the QC LAB. The Government will review the qualifications of the laboratory and, if necessary, visit the QC LAB. The Contracting Officer will, within 7 working days from the date that all qualifications data is received, either approve or reject the proposed laboratory. Evaluation criteria which will be used to determine the suitability of the QC LAB shall include, as minimum, local area industry standards, ASTM E 548, and respective State Highway Department certifications when applicable.

**2.3 Mixture Proportioning Studies:** After an aggregate source is approved, described in paragraph Material Acceptance Testing, but at least 30 days before materials are placed at the work, the QC LAB shall do mixture proportioning studies. Proportioning studies shall be accomplished for the cement stabilized base



material and for the Portland Cement concrete mixtures. The results of the proportioning studies and the recommended mix designs shall be submitted to the Contracting Officer. The Contracting Officer will issue written notice that the mix designs are appropriate before the Contractor places materials on the work.

**2.4 Construction Test Section:** Before proceeding with the work the Contractor shall demonstrate that he can perform to the intent of this specification. The Contractor shall place a test section in an area designated by the Contracting Officer. The Contractor shall demonstrate the ability to do pavement removal, subgrade preparation, base placement, and concrete mixing placing and finishing. The Contractor shall demonstrate work for both partial and full depth concrete repairs. The construction of joints, protection of the work, and quality control procedures will be incorporated into the test section. A test section which does not meet the performance requirements of these specifications will be removed from the work at the expense of the Contractor. All procedures and materials used by the Contractor to construct an acceptable test section shall be the standard of evaluation for performance of the work. The Contractor shall receive written approval of the test section from the Contracting Officer before proceeding with the work. The Government will expect to see equipment, materials, and procedures used for the approved test section incorporated into the work.

**3. MATERIAL ACCEPTANCE AND TESTING:**

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Paragraph 3.1 requires that the Government do the acceptance testing of the materials to be used by the Contractor. Materials acceptance testing is to be accomplished by the QA LAB. When the laboratory is not used as a part of the QA function, paragraph 3.1 must be written to require that the Contractor do materials quality testing and evaluation. A sample of all materials used for the work is to be retained by the Government regardless of the mechanism used for materials acceptance testing. The Government should be present when materials which are to be used in the work are sampled for quality testing. Certified copies of all test results performed by or for the Contractor shall be submitted to the Contracting Officer.

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**3.1 Pre-construction Sampling and Testing:**

**3.1.1 Aggregates for Concrete Mixtures:** Aggregates shall be produced from sources of the Contractors choosing. The aggregates will be tested to determine specific gravity, absorption, Los Angeles Abrasion, sulfate soundness, freeze and thaw durability, alkali or carbonate reaction, and

organic impurities. A petrographic analysis will be performed.

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Use one the following for paragraph 3.1.2.

3.1.2 Sampling and Testing: Within 15 days after the Notice to Proceed date, samples, in quantities exceeding those specified in CRD-C 100, shall be collected by the Contractor under the observation of the Contracting Officer representative. Samples are to be delivered to an address designated by the Contracting Officer. Sampling and shipping of test specimens shall be at the Contractors expense. Acceptance testing of the aggregates shall be at the expense of the Government. Additional sampling and testing due to poor aggregate quality shall be at the expense of the Contractor. The maximum time required by the Government to perform the acceptance testing of the aggregates is listed in Table I. Time used for re-testing poor quality aggregates will be deducted form the Contractor performance period.

TABLE I  
Estimated Performance Periods for  
Acceptance Testing of Aggregates

<u>Test</u>	<u>Days Required</u>
Coarse Aggregate - Sieve Analysis, Specific Gravity, Absorption, Sulfate Soundness, and Abrasion Resistance	15
Fine Aggregate - Sieve Analysis, Specific Gravity, Sulfate Soundness, and Organic Impurities	15
Unsound or Light-Weight Particles	5
Particle Shape	5
Deleterious Substances, Lightweight Particles	10
Petrographic Analysis	10

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3.1.2 Sampling and Testing: The Contractor shall accomplish aggregate sampling and testing of the aggregates for quality determination. The Contracting Officer Representative will observe the aggregate sampling. Split samples will be provided to the Government. All quality testing results will be provided to the Contracting Officer at least 10 days before the start of the mix proportion study. The Contracting Officer representative will either approve or reject the aggregate source within 7 days from the date all qualifying information is received.

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3.1.3. **Cement:** Cement to be used in the work shall be from a producer which has industry recognition as a manufacturer. The Contractor shall submit, not later than 15 days after the Notice to Proceed date, data which identifies the brand of the cement to be used and the engineering characteristics of the proposed cement. The Contracting Officer representative shall either accept or reject the source of the cement within 7 days from the submittal of all qualifying information.

3.1.4. **Soil Cement Mixture:** The Contractor shall identify the source of the soil which will be used as a part of the soil cement mixture. The grain size distribution of the soil will be determined and submitted to the Government for approval. The Contracting Officer representative will either approve or reject the source for the soil material within 7 days from the submittal of all qualifying information.

3.1.5. **Admixtures:** The Contractor may use admixtures. The selection of the admixtures is the option of the Contractor. Within 15 days after the Notice to Proceed date the Contractor shall provide a list of those admixtures proposed for use in the material mixtures. The Contractor assumes all responsibility for the use of admixtures.

3.1.5.1. **Pozzolan:** The Contractor shall identify the source and the engineering characteristics of the pozzolan proposed for use in the concrete or soil cement mixture. All mix proportion studies will be accomplished with the pozzolan included.

3.1.5.2. **Manufactured Admixtures:** The Contractor shall submit a manufacturer statement for each admixture proposed for use. The statement shall describe the characteristics of the admixtures, the expected performance of the mixes with the admixture, and specific statements about the compatibility of the admixtures with the proposed aggregates, cement, and other admixtures when multiple products are proposed. All mix proportion studies will be accomplished with the admixtures included in the trial mixes.

3.1.6. **Curing Compound:** At least 30 days before the material is used on the work, the Contractor shall submit a statement of the manufacturer that warrants that the material conforms to the intent and the technical requirements of these specifications. A sample of the material proposed for use on the work will be provided to the Government.

3.1.7. **Epoxy-resin Material:** At least 30 days before the material is used on the work, the Contractor shall submit a statement of the manufacturer that warrants that the material conforms to the intent and the technical requirements of these specifications. A sample of the material proposed for use on the work will be provided to the Government.

#### 4. **CONSTRUCTION TOLERANCES AND ACCEPTANCE CRITERIA:**

4.1 **Construction Tolerances:** Variation in the thickness of the cement stabilized base or the concrete surface caused by grade irregularity in the subgrade or the base thickness will not be permitted. Surface smoothness criteria will be applied for both full depth and partial depth repairs. Density criteria will apply to the subgrade and the base course when doing full depth repairs.

4.1.1 **Subgrade and Base Course Smoothness:** When full depth repairs are made for a full slab, a partial slab, or multiple slabs of adjacency the subgrade and the base finished elevation surfaces will be checked for smoothness using a rigid straight edge of suitable length. The finished surfaces will not vary more than 13 millimeters (1/2-inch) when checked with the straightedge.

4.1.2. **Subgrade and Base Course Compaction:** The density of the placed or stabilized materials will be determined by testing. A minimum of three density tests will be accomplished within each area of full depth repair. The placed materials will be evaluated for consistency. Areas of the repair which vary by more than three percentage points (3%) of optimum within an area will be cause for mitigation. Mitigation will be accomplished using the procedures described in paragraph Deficiencies and Corrections.

4.1.3. **Surface Smoothness:** The finished surfaces of rigid pavements shall be within the tolerances specified in TABLE II when using a 3.6-meter- (12-foot-) long rigid straight edge. The procedure for the determination of smoothness is described in paragraph Surface Smoothness Determination.

TABLE II  
SURFACE SMOOTHNESS CRITERIA  
AIRFIELD PAVEMENTS

<u>Pavement Category</u>	<u>Direction of Testing</u>	<u>Tolerance</u>
Runways and Taxiways	Longitudinal	3 MM (1/8")
	Transverse	6 MM (1/4")
Aprons and Hardstands	Longitudinal	3 MM (1/8")
	Transverse	3 MM (1/8")
Other Paved Areas	Longitudinal	6 MM (1/4")
	Transverse	6 MM (1/4")

4.1.4. **Thickness:** Deficiencies in the thickness of placed materials, either base course or surface course, will be mitigated using the procedures in paragraph **Deficiencies and Corrections**. Permissible deviations in thickness will be up to 13 millimeters (1/2-inch).

4.2. **Finished Surfaces Evaluation Techniques:** The finished surface of the concrete, and the subgrade and cement stabilized base for full depth repairs, will be evaluated for surface smoothness and thickness. Subgrade and base course, soil materials, will be evaluated for density.

4.2.1. **Equipment:** The Contractor shall furnish and maintain at the job site a rigid straightedge which is to be used to check the surface smoothness of constructed surfaces. The straightedge used to check the smoothness of concrete surfaces will be 3.6 meters (12 feet) in length. The straightedge should be of I-beam or channel construction of a light-weight material; e.g., aluminum.

4.2.2. **Surface Smoothness Determinations:** When the surface of the subgrade, base course, or concrete, respectively as applicable, has been finished it will be checked for smoothness. Surface smoothness determinations will be witnessed by the Government. The straight edge will be placed on the surface and moved about to reveal surface irregularities. For checking concrete surfaces at the joint with other surfaces, the straightedge shall be held in contact with the surface and advanced along a straight line across the jointed surface. When a high area is found the height will be determined by placing the middle of the straight edge at the high area and measuring the distance between the pavement and the straightedge with one end of the straightedge grounded. One half the measurement will be the height of the high area.

4.2.3. **Thickness Determinations:** The placed thickness of the pavement, or base thickness for full depth repairs,

shall be determined by the Government. The method of thickness determination will be by measurement from the surface to the subgrade and from the surface to the top of the base course.

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Paragraph 4.2.3 obligates the Government to have a construction inspector on the work when the Contractor exposes subgrade on full depth repairs or slab replacement. If the Government will not have a QA LAB or an inspector on the work, the paragraph is to be modified accordingly.

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**4.2.4. Concrete Quality Determination:** Concrete samples will be taken by the Contractor to determine the slump, air content, and strength of the concrete. The tests are a part of the Contractor quality control program. Concrete samples will be taken a minimum of two times on random selected batches for each day of concrete placement or for each 200 cubic yards of concrete placed, whichever is least.

4.2.4.1. Slump Test: Slump will be maintained within 25 millimeters (1 inch) of the design slump.

4.2.4.2. Air Content: Air content shall be maintained within one-and-one-half percent (1.5%) of the design mix. Air content shall be 6 percent.

4.2.4.3. Strength Tests: One set of test beams shall be made for testing at the ages of 7 days and 28 days.

**4.3. Surface Deficiencies and Corrections:**

4.3.1. **High Areas:** High areas of concrete surfaces shall be reduced either by rubbing the freshly finished concrete with carborundum brick or by grinding of the hardened concrete. Grinding will not be done until the concrete is at least 36 hours old. High areas in subgrade or base course shall be trimmed and the area scarified and compacted.

4.3.2. **Thickness Deficiency:** When the measurements of the base course or the concrete surface are deficient by more than 13 millimeters (1/2-inch) the deficient layer will be removed and corrections accomplished.

4.3.3. **Density Deficiency:** When the subgrade or the base course is determined to be less than the required compaction, the effected layer shall be removed, the lower

lift will be re-compacted, and the defective lift will be replaced and compacted.

**4.3.4. Concrete Quality Deficiency:**

4.3.4.1. **Slump and Air Content:** When two consecutive tests or more than twenty percent (20%) of the individual tests (one test in the last five) are outside the tolerance concrete placing on the work will cease. The mixture proportions shall be evaluated and the cause of non-compliance determined. The mixture proportions shall be changed if necessary.

4.3.4.2 **Strength Deficiency:** When the average of any five consecutive 7-day strengths; or, when one (1) of the last five consecutive tests of the same age group are less than the design mix minimum, the concrete placement on the work will cease. The cause of the low strength will be determined before proceeding with concrete placement on the work. When necessary the mixture proportions will be changed. Concrete which will not meet the 28-day strength requirement shall be removed and replaced by the Contractor without cost to the Government.

**5. ACCEPTANCE OF CONSTRUCTION PROCEDURES:**

5.1 **Plant and Equipment:** The Contracting Officer representative will have access to the mixing plant, aggregate and soil storage area, and equipment during the progress of the work. Equipment determined to be detrimental to the progress of the work will be taken out of service and shall be replaced by the Contractor.

5.2. **Construction Methods:** The Contracting Officer representative will review and either approve or reject special construction methods.

5.2.1. **Cold Weather Requirements:** The Contractor shall prepare a cold weather concreting plan. The plan shall describe the materials and procedures to be used by the Contractor when protection is required. The Contractor shall describe in the plan the prevailing weather conditions which would require use of the cold weather provisions.

5.2.2. **Hot Weather Conditions:** The Contractor shall prepare a hot weather concreting plan. The plan shall describe the materials and procedures to be used by the Contractor when protection is required. The Contractor shall describe in the plan the prevailing weather conditions which would require use of the hot weather provisions.

5.2.3. **Demolition:** The Contractor shall prepare and submit for approval or rejection a demolition plan. The plan shall describe the methods to be used for removal of existing pavements and the protection of pavement designated to remain. Debris from the demolition will be removed from the job site daily. Dust and fugitive debris shall be controlled at all times. Debris from the demolition shall be controlled so that it does not become a nuisance in areas outside of the immediate area of construction.

5.2.3.1. **Environmental Protection:** Demolition work will be performed to comply with environmental controls, policies and directives.

5.2.3.2. **Burning and Explosives:** Burning and the use of explosives will not be permitted.

5.3. **Pavement Construction Test Section:**

5.3.1. **Construction Methods:** The Contractor shall place a pavement replacement and/or repair test section at a location on the work which will be designated by the Contracting Officer. When a satisfactory test section is constructed the section will become a portion of the project work. A minimum of one full depth repair and one partial depth repair will be included in the test section. The Contractor shall include the quality control procedures into the test section.

5.3.2. **Test Section Acceptance:** The Contracting Officer and his representative will observe the test section work being performed. If the section is rejected, the reasons shall be specifically documented. The Contractor shall remove and replace test sections which are not accepted by the Government. The test sections will be repeated until the Contractor successfully demonstrates an acceptable construction procedure.

6. **MEASUREMENTS:**

6.1. **Concrete Repairs, Full Depth, Full Slabs:** The quantity of concrete to be paid for will be the number of full slabs removed and replaced. The unit measurement will include the removal and disposal of existing concrete, base course, and subgrade for placement of the new pavement materials.

6.2. **Concrete Repairs, Full Depth, Partial Slabs:** The quantity of concrete to be paid for will be the number of square meters (square yards) of concrete removed and replaced. The unit measurement will include the removal and disposal of existing concrete, base course, and subgrade for placement of the new pavement materials.



6.3. **Concrete Repairs, Partial Depth:** The quantity of concrete to be paid for will be the number of square feet of concrete removed and replaced. The unit of measurement includes saw-cutting, chipping, disposal of debris, grouting exposed faces, placement and finishing of concrete.

6.4. **Steel Reinforcement, Dowels, and Tie Bars:** Steel reinforcement used in odd shaped slabs, and where designated on the drawings, will be included in the cost of concrete. Dowels and tie bars will not be measured for payment but shall be included in the cost of concrete for full depth repairs.

6.5. **Cement Stabilized Base Course Material:** The quantity of cement stabilized base course material will not be measured for payment but shall be included in the cost of concrete for full depth repairs.

6.6. **Unsuitable Subgrade:** The quantity of unsuitable subgrade material removed and replaced will be measured by the cubic meter (yard).

7. **PAYMENTS:** The quantities paid for at the unit prices shall include the cost of all labor, materials, equipment and tools required to provide a complete and functional unit.

**PART 2 - PRODUCTS**

**8. MATERIALS:**

8.1. **Cement:** Cement may be furnished in bulk or packages. When cement is furnished in packages, batch proportions shall be adjusted to require complete packages. Portland Cement shall conform to ASTM C 150, Type \_\_\_\_\_.

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The type of cement to be used on the work will be specified in paragraph 8.1.

Type I - For use when the special properties specified for any other type are not required.

Type II- For general use when moderate sulfate resistance or moderate heat of hydration is desired.

Type III-For use where high early strength is required.

Type IV- For use where low heat of hydration is desired.

Type V - For use where high sulfate resistance is required.

Unless there are special circumstances, the Type of cement specified will be either Type I or Type II. The designer should determine the Type of cement used by local suppliers of concrete products.

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8.2. **Admixtures:** The Contractor shall have the option to use admixtures. When admixtures will be used they will be included in the proportions for concrete mix design and trial batches.

8.2.1. **Pozzolan:** Pozzolan, when used as a mineral admixture, shall conform to ASTM C 618, Class F or C. When fly ash is used there will be a minimum of 5-1/2 bags of Portland Cement (approximately 234 kilograms [517 pounds]) per 0.76 cubic meters (1 cubic yard) of concrete mix yield. The fly ash shall be considered cementitious material and the weight of fly ash added to the weight of portland cement will be the "total cementitious material." The total amount of fly ash used shall not be less than 15 percent nor more than 25 percent by weight of the total cementitious material in the concrete mix.

8.2.2. **Air-Entraining Admixtures:** The air entraining admixture shall conform to ASTM C 260.

8.2.3. **Accelerator:** Calcium chloride shall not be used.

8.2.4. **Retarder:** A retarding admixture shall meet the requirements of ASTM C 494, Type B or D. The six month and the one year compressive strength tests are waived.

8.2.5. **Water-Reducer:** A water-reducing admixture shall meet the requirements of ASTM C 494, Type A. The six month and the one year compressive strength tests are waived.

8.3. **Curing Materials:** Curing compounds shall be white pigmented membrane-forming conforming to CRD-C 300.

8.4. **Dowels:** Dowels shall be cut to length before delivery to the site. They shall be clean, straight, and free of loose flaky rust and scale. Dowels shall be plain steel bar conforming to ASTM A 615, Grade 40 or 60; ASTM A 616, Grade 50 or 60; or ASTM A 617, Grade 40 or 60.

8.5. **Tie Bars:** Tie bars shall be deformed steel bars conforming to ASTM A 615, A 616, or A 617.

8.6. **Reinforcement:** All reinforcement shall be clean and free of loose flaky rust or scale, free of oil or grease, or free of coatings that might reduce the bond between the steel and the concrete.

8.6.1. **Bar Mats:** Bar mats shall conform to ASTM A 497.

8.6.2. **Wire Fabric:** Welded steel wire fabric shall conform to ASTM A 497.

8.6.3. **Deformed Wire Fabric:** Welded deformed steel wire fabric shall conform to ASTM A 615, A 616, or A 617.

8.7. **Joint Filler for Expansion Joints:** Filler shall be preformed materials conforming to ASTM D 1751 or ASTM D 1752.

8.8. **Epoxy-Resin:** Epoxy resin materials shall be two component materials conforming to the requirements of ASTM C 881. The materials shall be Type II. Epoxy resin used for anchoring dowel bars shall be Type III.

8.9. **Water:** Water shall be free from deleterious substances and shall comply with CRD-C 400.

8.10. **Coarse Aggregate for Concrete Mixes:** Coarse aggregate shall be crushed gravel, crushed stone, or a combination thereof. Aggregates shall be clean, hard, uncoated particles which meet the requirements specified in ASTM C 33. Particles shall be generally cubical in shape. The quantity of flat or elongated pieces in any size group shall not exceed 20 percent by weight when determined by procedures of CRD-C 119. A flat particle is defined as one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3.

8.10.1. **Aggregate Size and Grading:** The nominal maximum size of the coarse aggregate shall be ..... millimeters (inches). Gradation shall conform to ASTM C 33 Size Number ....., Class (4S) (4M) (1N).

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The maximum size of the coarse aggregate should be 19 millimeters (3/4-inch). Maximum top size will depend upon the expected depth of the partial depth repairs. The top size should be one size less than one half (1/2) the minimum depth of the partial repair in millimeters (inches).

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8.10.2. **Deleterious Substances:** The amount of deleterious substances in each size group of coarse aggregate shall not exceed the limits given in Table 3, ASTM C 33, except that clay and friable particles shall not exceed 1.5 percent.

8.11. **Fine Aggregate:** Fine aggregate shall be natural sand, manufactured sand, or a combination of the two.

8.11.1. **Grading:** Grading of the fine aggregate shall conform to the requirements of ASTM C 33. The fine aggregate shall have a fineness modulus of not less than 2.30 nor more than 3.10. The grading of the fine aggregate shall be consistent such that the fineness moduli will not vary more than 0.20 from the average moduli of the sand used for the mix design. Fineness modulus shall be determined by CRD-C 104. When pozzolans are used as an admixture, the material passing the No. 50 and No. 100 sieve sizes shall be reduced as allowed in ASTM C 33.

8.11.2. **Deleterious Substances:** The amount of deleterious substances shall not exceed the limits given in Table 1, ASTM C 33.

8.12. **Soil for Soil Cement Mixture:** The material to be used for a soil cement mixture shall be select material conforming to the requirements of ASTM D 1241. Stones larger than 38 millimeters (1-1/2 inches), wood, sticks, debris, and deleterious materials shall be removed from the material before mixing with the cement. Not more than 45 percent of the material should be retained above the No. 4 sieve.

9. **CONCRETE MIXTURE PROPORTIONING:** Concrete shall be a mixture of cement, water, fine and coarse aggregates, and admixtures. Admixtures are the option of the Contractor. The Contractor shall be responsible for determining the proportions of the concrete materials.

9.1. **Flexural Strength:** Proportioning of the concrete materials shall be such that a flexural strength of 4482 kPa (650 psi) is attained at 28 days when tested using the procedures of ASTM C 78. The Contractor shall do the mix design studies. Curves will

be developed for the selected mix at three water cement ratios using strength of specimens at 7 days age, 14 days age, and 28 days age. The water cement ratios used for the strength gain curves shall be in -0.03 increments above the design mix. The slumps of the respective mixes will be reported. The strength gain curves will be used by the Government for acceptance of placed concrete using the procedures described in paragraph SURFACE EVALUATION AND ACCEPTANCE: Concrete Quality Determination.

9.2. **Air Content:** The air content by volume based upon measurements made immediately after discharge from the mixer shall be ..... percent plus or minus one-and-one-half percent when determined using ASTM C 231.

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The air content shall be 6 percent for those geographic areas which experience frost action. The air content will be 5 percent in other geographical areas.

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9.3. **Slump:** The concrete slump shall be determined in accordance with ASTM C 143.

10.0. **SOIL CEMENT MIXTURE PROPORTIONING STUDIES:** The soil cement mixture shall be a uniform blend of Portland Cement and select borrow material. The mixture will be placed and compacted to produce a pavement course. The mixture will be placed over the compacted subgrade.

10.1. **Strength:** The Contractor shall develop the proportions for the soil cement mixture to produce a minimum compressive strength of 1379 kPa (200 psi). The compressive strength shall not exceed 5171 kPa (750 psi). Unconfined compression tests on moist cured seven (7) day old specimens shall be done using the procedures in ASTM D 1633.

10.2. **Compaction:** Moisture density tests shall be conducted using the procedures in ASTM D 558. Method A or Method D, depending upon the gradation of the mix, of ASTM D 1557 shall be used to compact the mixture. The optimum moisture content and density of the compacted mix will be reported. The compaction curve will be used for acceptance of the soil cement mixture.

**END PART 2 - PRODUCTS**

### PART 3 - EXECUTION

11. **DEMOLITION:** Before beginning any demolition work, the Contractor shall survey the site. Work shall not begin until the Contractor can provide assurance that the work can be executed the way the drawings and specifications have established the intent.

11.1. **Protection of Existing Pavement:** The Contractor shall take all necessary precaution to avoid damaging pavements designated to remain. Any damage to existing pavement will be repaired by the Contractor without cost to the Government.

11.2. **Disposition of Material:** All materials removed by the Contractor become the property of the Contractor and shall be disposed of off base. Existing ground rods or aircraft tiedowns will be salvaged and re-installed by the Contractor. At full depth repair areas, existing base course materials, or other materials below the existing concrete, will be excavated to a depth which will allow installation of the replacement pavement section.

11.3. **Unsatisfactory Materials:** Unsatisfactory materials shall be any material classified using ASTM D 2487 as Pt, OH, OL or any soil comprised of vegetative matter, sod, mulch, or rubbish. Unsuitable materials shall be those which classify as MH or CH. Unsatisfactory or unsuitable materials shall be removed and replaced with select backfill.

11.4. **Backfill:** Backfill material shall be placed in maximum 101-millimeter (4-inch) loose layers and compacted to the grade and cross-section.

12. **PARTIAL DEPTH REPAIR OF PAVEMENTS:** The Contractor shall reference Figure A3a and Figure A3b for partial depth spall repairs. The intent of the partial depth repair is to restore the slab edges for effective joint sealing and to deter further deterioration.

12.1. **Establishing Repair Boundaries:** The limits of the unsound concrete shall be determined by sounding with a steel rod. The rod shall be dropped from a height of 100 to 150 millimeters (4 to 6 inches). The sounding will produce a dull sound in areas of delaminated concrete. A sharp ringing sound will be heard when there is sound concrete.

12.1.2. **Sawcutting:** A diamond blade sawcut shall be made at the limits of the repair boundary which shall be a minimum of three inches into sound concrete and outside the unsound concrete. The boundaries shall be sawcut in a rectangular pattern square to the slab edges. Sawcuts at right angles, including existing joints, shall be overlapped by at least 25 millimeters (1 inch). The depth of sawcut shall be 51 millimeters (2 inches), minimum. When the boundaries of multiple partial depth repairs areas

are closer than 609 millimeters (24 inches), the repair areas shall be combined as one repair. A sawcut of minimum depth shall be made along the joint face to remove old joint sealant and to make a clean vertical face at the joint.

**12.1.3. Removal of Existing Concrete:** Existing concrete within the boundaries of the repair shall be removed by chipping with pneumatic tools. Pavement breakers or hydraulic rams shall not be used. Concrete will be removed to the depth of the sawcut or to sound concrete, whichever is deeper. After all concrete has been removed the faces will be cleaned and sounded. Sounding within the limits of the repair will ensure that all damaged and unsound concrete has been removed. When the depth of the unsound concrete exceeds one-half of the slab depth, the work will stop. The Government will inspect the area and either allow patching or direct the Contractor to proceed with a full depth repair. Under no circumstances will a partial depth repair be allowed to rest on a dowel bar.

## **12.2. Patching and Finishing:**

**12.2.1. Cleaning:** The exposed faces of the patch area shall be washed with high pressure water and air-blown dry. There shall be no residual material left on the exposed concrete face.

**12.2.2. Joint Preparation:** The potential for bond between the partial depth patch and the facing joint shall be eliminated by placing a compressible insert along the joint prior to patching. The joint formed between the partial depth patch and the facing joint shall have a width less than or equal to the existing joint width.

**12.2.3. Concrete Surfaces Preparation:** The exposed areas of the patching area will be coated with an epoxy resin bonding agent. The agent shall be applied by the instructions of the manufacturer. Application shall be by stiff bristle brush to assure that a thin coat is applied to all exposed patch areas. The bonding agent shall not be allowed to puddle. Concrete patching material shall not be placed until the bonding agent is tacky.

**12.2.4. Patching Materials Placement and Finishing:** Fresh concrete shall be placed into the patch area and consolidated with hand tools or a small vibrator up to 25 millimeters (1 inch) in diameter. When a vibrator is used, the probe will be extracted at the first sign of water forming around the probe. The surface shall be finished to the cross-section of the existing pavement. A screed shall be used to move surface material from the center of the patch areas to the outsides. The edges which meet with sawcuts shall not be edged. The finish surface shall be given a burlap drag or broom finish. A curing compound

shall be applied and the area protected from damage. A joint seal will be applied when the patch is cured.

13. **FULL DEPTH REPAIR OF PAVEMENTS:** The Contractor shall reference Figure A3c and Figure A3d for full depth concrete repairs. The intent of the full depth repair is to restore the damaged areas to the original condition and make the repair a part of the existing slab. The repair is to be tied to the parent slab.

13.1. **Establishing Repair Boundaries:** Full depth slab repair is required where there is a corner break, patch deterioration (or where a patch depth exceeds one-half the slab depth), shattered slabs, or full depth longitudinal or transverse cracks which have opened and are spalling. Full slab replacement is required when the repair to a distress area will exceed one-half the slab width. A minimum repair width of 3 meters (10 feet)—or one-half of the slab length, whichever is less—is required for full depth repair when load transfer is provided.

13.1.1. **Sawcutting:** The repair boundaries shall be diamond blade sawcut. Full depth sawcuts shall be made at existing joint faces. A sawcut of a minimum depth of 51 millimeters (2 inches) shall be made at the boundaries of the repair which are not at a joint. All sawcuts shall be square to the existing joints forming a rectangular pattern around the area of the full depth repair. All partial depth sawcuts shall be a minimum of two feet from an existing joint or crack. All sawcuts shall overlap at sawcut intersections.

13.1.2. **Removal of Existing Concrete:** There are two methods for concrete removal. The removal shall not result in the spalling or the cracking of concrete pavement designated to remain.

13.1.2.1. The break-up and clean out method is accomplished using pneumatic tools and/or a pavement breaker with removal by backhoe. When this method results in spalling of the slab face designated to remain, the size of the break-out equipment will be reduced or the sawcut shall be made to full depth of the slab. The pavement breaker shall not strike closer than 460 millimeters (18 inches) to the perimeter saw cuts or existing joints. Break-out shall proceed from the center of the repair area to the perimeter saw-cuts.

13.1.2.2. The lift-out method is accomplished using a crane or front end loader to lift the deteriorated concrete out of the repair area. The repair area shall have double full-depth perimeter saw-cuts.

13.2. **Earthwork for Full Depth Repairs:** The Contractor shall perform excavation of the materials below the existing concrete to the depth and grade necessary to install the new pavement



section. The work generally includes excavation, dressing to grade, shaping, scarifying, and compacting.

13.2.1. **Subgrade Compaction Requirements:** The *in situ* material shall be compacted to 90 percent of maximum laboratory value. Testing shall be accomplished using the procedures described in paragraph Contractor Quality Control. Compaction shall be accomplished using equipment which can be operated in the excavation without damage to the prepared surface. Hand operated vibratory compactors shall be used adjacent to existing pavement designated to remain.

13.2.2. **Soil-Cement Base:** Portland Cement and soil will be mixed in a central plant. The material shall be wetted to the optimum and placed on the prepared subgrade, compacted, and smoothed to form a base for the concrete. Material shall be placed in loose lifts not exceeding 100 millimeters (4 inches) and compacted to 100 percent of maximum laboratory density.

13.2.2.1. **General Requirements:** The mixture shall be hauled to the work site in trucks equipped with protective covers. The underlying course shall be moistened before the mixture is placed for compaction. Each lift of soil cement mixture shall be compacted to a uniform density. A uniform density is obtained when the results of a minimum of three tests for density across the area of the current work vary by not more than three percent.

13.2.2.2. **Finishing:** When compaction has been attained, the surface of the finished grade of soil cement mixture shall be shaped to the required smoothness. An application of concrete curing compound, applied at a rate of 18.6 square meters per 3.8 liters (200 square feet per gallon), or an application of asphalt emulsion prime coat will be applied. The vapor barrier shall be applied within 2 hours of the mixing of the soil, cement and water.

13.3. **Dowel Bar and Tie Bar Placement:** Holes for either smooth steel dowel bars or deformed steel tie bars shall be drilled in the appropriate locations of the exposed concrete faces. The holes shall be drilled by a drill mounted in a rigid frame that will prevent drill wandering and will hold the drill horizontal to the pavement surface. The holes shall be drilled 1.5 millimeters (1/16-inch) larger than the bar diameter at one-half the slab thickness at the designated spacing. The holes shall be injected full with epoxy-resin and the bar placed into the pre-drilled holes. The bar shall be turned one revolution and forced to seat. The excess epoxy squeezed from the hole shall be removed from the concrete with a straight edge and the area brushed with a stiff bristle brush. The bar ends coated with epoxy-resin shall be clean and free of all dirt, oil, and other coatings.

13.3.1. **Dowel Bar Preparation:** Dowels are intended to accommodate the movement of adjoining slabs. The end that extends into the repair area shall be painted and oiled to prevent any bonding with the patch material.

13.3.2. **Tie Bar Preparation:** Tie bars are deformed steel which are intended to lock and anchor surrounding concrete. Tie bars are placed at patch interfaces with existing concrete and are not intended to allow movement. Tie bars will be clean and free of any rust, flaking metal, oil, or other coatings.

13.4. **Patching and Finishing:**

13.4.1. **Cleaning:** The exposed faces of the patch area shall be air blown to clean and remove loose debris on the exposed concrete faces. Residual material shall not be left on the concrete faces.

13.4.2. **Concrete Surfaces Preparation:** The exposed areas of the patching area will be coated with an epoxy resin bonding agent. A bonding agent shall not be applied to the faces of existing joints. Existing joint faces shall be cleaned by air pressure and brushing. The agent shall be applied by the instructions of the manufacturer. Application shall be by stiff bristle brush to assure that a thin coat is applied to all exposed patch areas. The bonding agent shall not be allowed to puddle. Concrete patching material shall not be placed until the bonding agent is tacky.

13.4.3. **Patching Materials Placement and Finishing:** Fresh concrete shall be placed into the patch area and consolidated using portable spud vibrators. The surface shall be finished to the cross-section of the existing pavement. For repair areas less than 3.6 meters (12 feet) in length, the concrete is to be struck off with a screed operated parallel to the centerline of the pavement. The edges which meet with sawcuts shall not be edged. The surface shall not be over-finished. The finish surface shall be given a burlap drag or broom finish. A curing compound shall be applied and the area protected from damage. The joint seal reservoir of existing joints adjacent to patching shall be sawcut when the concrete has cured. A joint seal will be applied after the patch is cured.

14. **PRODUCTION OF CONCRETE:** The batching plant or the truck mixer shall produce a mixture which when tested will conform to the requirements of CRD-C 55. The mixing time for each batch will be determined by using the procedures of CRD-C 55. Each batch product delivered to the work for placement will be consistent as measured by the uniformity tolerances of TABLE III.

The uniformity tolerances apply only to the individual within batch characteristics.

TABLE III  
UNIFORMITY TOLERANCES IN  
CONCRETE MIXERS

Parameters	Permissible Range in Results From Three Locations in the Concrete Batch
Weight per cubic foot calculated to an air free basis	0.45 kg (1.0 lb)
Air content, volume percent	1.0
Slump	25 mm (1.0 inch)
Coarse aggregate portion, percent	6.0
Average compressive strength at 7 days based upon the average of all samples, percent	10.0
Water content portion, percent	1.0

**15. CONCRETE CURING AND PROTECTION:**

**15.1. Curing of Concrete:** Concrete shall be protected from loss of moisture for at least seven (7) days. Fresh concrete shall be protected from rain and free water. A uniform coating of a white pigmented membrane-forming curing compound shall be applied to the surface of the fresh concrete as soon as the free water disappears. The compound shall be hand applied at a rate of about 18.6 square meters per 3.8 liters (200 square feet per gallon) from a spray applicator. The compound shall be applied in two coats, the second coat being applied in a direction which is perpendicular to the first coat. Curing compound shall be re-applied to surfaces which have been subject to heavy rainfall within three hours of the initial application of compound.

**15.2. Pavement Protection:** The Contractor shall protect the pavement from damage prior to acceptance of the work by the Government. Traffic shall be excluded from the repair areas for a minimum of 14 days. Barricades and signs shall be used by the Contractor to protect the work.

**16. CONTRACTOR QUALITY CONTROL (QC):** The Contractor shall perform the minimum inspection and tests described herein as the quality control program. The results of the inspections and tests requires the Contractor to take an action. The actions, testing and reporting described below are the responsibility of the Contractor. Testing shall be accomplished by an independent testing laboratory which is employed by the Contractor.

**16.1. Inspection Details and Frequency of Inspection:** The following are the minimum number of tests or inspections which are to be done by the Contractor.

**16.1.1. Concrete Production:**

16.1.1.1. Mixer Performance: Before the start of concrete production for placement on the work the uniformity of the mixed concrete shall be determined. Adjustments in the mix or the mixing time shall be made until the results of testing using CRD-C 55 are satisfactory.

16.1.1.2. Fine Aggregate: Once during each 8-hour shift of concrete production, or portion thereof, there shall be one sieve analysis and one determination of fineness modulus. Testing shall be done in accordance with the procedures in ASTM C 136 and CRD-C 104. The fine aggregate shall be sampled at the bin feed. The Contractor shall maintain a fineness modulus control chart with the limits drawn 0.20 units above and below the mix design determination. Moisture contents of the fine aggregate shall be accomplished when the slump of the mixed concrete is out of the specified limits.

16.1.1.3. Coarse Aggregate: Once during each 8-hour shift of concrete production or portion thereof, there shall be a sieve analysis of the coarse aggregate. Samples shall be taken at the bin feed. Moisture contents of the coarse aggregate shall be accomplished when the slump of the mixed concrete is out of the specified limits.

16.1.1.4. Batch Control: A daily record shall be kept of all constituent materials and the portions of each batch of concrete prepared for and delivered for placement on the work. The daily report shall identify when the proportions of the concrete change and the necessity for the change.

16.1.1.5. Concrete Samples: Samples shall be collected by the Contractor and shall be used to determine the slump, air content, and strength of the concrete placed on the work. One set of test beams shall be prepared for each 8-hour shift, or portion thereof, or each day of concrete production. The test beams shall be tested using the procedures in ASTM C 78 at the ages of 7 and 28 days. When the 7-day age breaks exceed the mix design strength curve the work will be accepted. When the work is accepted based upon 7-day ages the 28-day specimens do not require testing. Air content and slump shall be determined twice during each 8-hour shift of concrete production.

One of the samples for air content and slump shall be when strength beams are cast.

**16.1.2. Subgrade and Backfill:**

16.1.2.1. Compaction Curves: A compaction curve for each of the materials shall be prepared using the procedures in ASTM D 1557. The compaction curves shall be developed in the laboratory before the compaction of surfaces in the field begins.

16.1.2.2. Field Density Testing: Field density of soil materials shall be determined using the procedures in ASTM D 1556, ASTM D 2167, or ASTM D 2937. After a calibration curve has been developed for each of the soil types, density may be determined using ASTM D 2922. The calibration curve shall be developed for each soil type by doing side by side testing. When ASTM D 2922 is used to determine density, a check of the calibration curve, doing side by side testing, shall be done at each twenty-first test point. The density of the subgrade, or backfill, shall be checked for consistency. A minimum of three test points shall be accomplished in each area of exposed subgrade. The variation of any one test from the average of all three shall not vary by more than three percent (3%).

**16.1.3. Soil Cement Mixture:**

16.1.2.1. Compaction Curves: A compaction curve for the soil cement mixture shall be developed as a part of the mixture proportioning study. The compaction curves shall be developed in the laboratory before the compaction of surfaces in the field begins.

16.1.2.2. Field Density Testing: Field density of soil materials shall be determined using the procedures in ASTM D 1556, ASTM D 2167, or ASTM D 2937. After a calibration curve has been developed for each of the soil types, density may be determined using ASTM D 2922. The calibration curve shall be developed for each soil type by doing side by side testing. When ASTM D 2922 is used to determine density, a check of the calibration curve, doing side by side testing, shall be done at each twenty-first test point. The density of the subgrade, or backfill, shall be checked for consistency. A minimum of three test points shall be accomplished in each area of exposed subgrade. The variation of any one test from the average of all three shall not vary by more than three percent (3%).

**16.1.4. Finished Surfaces:** The Contractor shall perform that testing within his responsibility which is required for each repair area. Testing shall be for smoothness and grade.

16.2. **Action Required for Deficiency Correction:**

16.2.1. **Aggregates Testing:** When the amount retained on any one sieve size is outside the specification limits a second sample shall be taken and the test repeated. If the second sample fails, the data shall be recorded on the control chart and the frequency of the testing shall be doubled. If there is a consecutive test outside of the control limits, all of the concrete production shall be stopped and the cause of non-compliance determined. Concrete shall not be delivered for placement on the work until the cause of deficiency has been corrected.

16.2.2. **Concrete Quality:**

16.2.2.1. **Strength:** The results of the 7-day strength tests shall be plotted on a control chart. When more than one of the last five, including the current value, consecutive tests are less than the specified value; or, when the average of the last five consecutive tests, including the current value, is less than the specified value, the mixture proportions shall be changed. When the average of any five consecutive 28-day age tests are less than the specified value, the area of the placement shall be determined and the defective concrete shall be removed and replaced.

16.2.2.2. **Air content:** The results of testing for air content shall be plotted on a control chart. Whenever the points on the control chart approach one of the limits, adjustments of the mix proportions shall be made. When two consecutive points on the control chart fall outside the control limits, the concrete production shall be stopped and no concrete shall be delivered to the work until the deficiency has been corrected.

16.2.2.3. **Slump:** The results of slump testing shall be recorded on a control chart. Whenever the points on the control chart approach the control limits, adjustments shall be made in the batch weights of the fine aggregate and the water. Testing of the slump shall be made after a adjustment is made until the test results are satisfactory. Whenever the slump exceeds the upper control limit the batch of concrete shall be rejected and shall not be placed on the work.

16.2.3. **Compaction Density:** When a lift of soil or soil cement mixture is below the minimum specified density, the lift shall be scarified, aerated, smoothed, and compacted to the proper density. Soil cement mixture which is wet or dry of optimum by more than two percent (2%) will be rejected and will not be placed on the work.

16.3. **Reports:** All results of testing shall be reported to the Contracting Officer representative within 24 hours of completion of the physical portion of the test. Each report will include the updating of the control charts. The daily reporting will not relieve the Contractor of the responsibility to immediately report, failures, equipment problems, or construction difficulties or deficiencies. Immediate reports shall be given verbally and followed up on the daily quality control reports.

**END PART 3 - EXECUTION**

**REPAIR OF JOINTS AND CRACKS  
RIGID AIRFIELD PAVEMENT**

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GENERAL INSTRUCTIONS:

These specifications will be modified by the designer to include construction options. An election of a construction management philosophy must be made for the document to be complete and meaningful. Where modifications are to be made, or elective procedures are to be specified, the sections are identified by preceding asterisks, indentation, and following asterisks (as is this instruction). Prior to publication of these documents as part of the project, all comments/instructions/options which are identified as such will be deleted from the text.

These guide specifications incorporate a Quality Assurance/Quality Control (QA/QC) construction management philosophy. The Government will use the results from the testing of materials and/or products for "Assurance" that the construction, as placed, satisfies the salient requirements of this specification. The QA results are used by the Government for acceptance of the built product. The QA management procedures used by the Government may be implemented by professional services contract, by in-service, or by combination thereof. These documents are to be modified according to the selected QA/QC philosophy elected.

The Contractor is required to provide testing services (QC) to monitor his processes.

This specification should not to be used with guide specifications which do not incorporate a QA/QC philosophy of construction management. It is the responsibility of the writer/editor to assure that technical sections used to build a contract document are consistent in construction management philosophy.

The point of contact for this document is HQ AFCESA/CESC, 139 Barnes Drive - Suite 1, Tyndall AFB, FL, 32403-5319. The document coordinator is Mr. Jim Lafrenz, (904)-283-6332.

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In preparing contract specifications for repair of rigid concrete pavement, reference AFM 88-6, Chapter 7, *Standard Practice for*



*Sealing Joints and Cracks in Rigid and Flexible Pavements, and AFM 88-6, Chapter 8, Standard Practice for Concrete Pavements.*

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**SECTION \_\_\_\_\_**

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The section number should be inserted in the specification heading and also prefixed to each page number in the project specifications. For example, for a section numbered 02525 the page number would be located at the bottom of the page; e.g., page 16 would be 02525-16.

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**PART 1 - GENERAL**

**1. APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

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The designations for publications are those that were in effect when this guide specification was prepared. To minimize the possibility of error, the letter suffixes, amendments, and dates indicating specific issues are retained here and omitted in the specifications.

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**1.1. American Society for Testing and Materials (ASTM) Publications:**

- C 509-94            Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
  
- C 603-90            Test Method for Extrusion Rate and Application Life of Elastomeric Sealants
- C 639-95            Test Method for Rheological (Flow) Properties of Elastomeric Sealants
  
- C 661-93            Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer

- C 679-87 Test Method for Tack-Free Time of Elastomeric Sealants
- C 719-93 Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
- C 792-93 Test Method for Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants
- C 793-91 Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants
- D 412-92 Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
- D 789-94 Test Method for Determination of Relative Viscosity Melting Point, and Moisture Content of Polyamide (PA)
- E 548-94 Guide for General Criteria Used for Evaluating Laboratory Competence

**1.2. Department of the Army, Corps of Engineers, Handbook for Concrete and Cement:**

- CRD-C 525-89 Test Method for Evaluation of Hot Applied Joint Sealants for Bubbling Due to Heating

**1.3. Federal Specifications:**

- FS SS-S-200E Sealants, Joint, Two Component, Jet-Blast Resistant, Cold-Applied, for Portland Cement Concrete Pavement
- FS SS-S-1401C Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements
- FS SS-S-1614A Sealants, Joint, Jet-Fuel-Resistant, Hot Applied, for Portland Cement and Tar Concrete Pavements

**2. QUALITY ASSURANCE/ QUALITY CONTROL (QA/QC) PROCEDURES:**

**2.1 Construction Material Testing (QA) by Government:** The Government will accomplish materials and products testing for acceptance of the construction.

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Paragraph 2.1 requires the Government to employ a commercial testing laboratory (QA LAB). The QA LAB will work directly for the Government and will perform material testing supplemental to the Contractor QC function. The QA LAB will test materials for compliance with the performance requirements of the pavement. If a QA LAB is not used, paragraph 2.1 is to be changed to read as follows:

2.1 The Government will use the results of material testing accomplished by the Contractor to evaluate construction for acceptance and payment. The Contractor shall provide copies of all testing results and product certifications to the Contracting Officer representative within 24 hours of completion of testing.

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**2.2 Construction Material Testing (QC) by Contractor:** The Contractor shall retain the services of an independent commercial testing laboratory, herein after referred to as QC LAB, to perform Quality Control (QC) functions necessary to the work. The QC LAB shall test the joint seal material to be used on the work and will perform monitoring of the work on a daily basis. The minimum daily monitoring requirements are described in paragraph **CONTRACTOR QUALITY CONTROL**. Within 15 days of the Notice to Proceed date the Contractor shall submit the qualifications statement of the QC LAB. The Government will review the qualifications of the laboratory and, if necessary, visit the QC LAB. The Contracting Officer will, within 7 working days from the date that all qualifications data are received, either approve or reject the proposed laboratory. Evaluation criteria shall include, as minimum, local area industry standards for the performance of materials testing, ASTM E-548, and respective State Highway Department certification where there is a State program.

**2.3 Pavement Repair Test Section:** Before proceeding with the work the Contractor shall demonstrate that he can perform to the intent of this specification. The Contractor shall place a test section in an area designated by the Contracting Officer. The Contractor shall demonstrate his ability to clean and prepare joints and cracks, place the joint sealing material, and perform the quality control functions specified. All processes and procedures used by the Contractor to construct an acceptable test section shall become the standard of evaluation for performance on the work. The Contractor shall obtain written approval of the test section before proceeding with the work. The Government

will expect to see equipment, materials, and procedures which were used at the test section incorporated into the work.

**3. MATERIAL ACCEPTANCE by TESTING and SUBMITTALS:**

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Paragraph 3.1 requires that the Government do the acceptance testing of materials (QA). The Contractor is responsible for providing samples. A commercial laboratory, independent of the one used by the Contractor, must be employed to do quality testing of the materials. Samples of the joint seal material should be sent to the Waterways Experiment Station (WES), U.S. Army Corps of Engineers, Vicksburg, MS when a qualified commercial testing laboratory is not available. Coordination of the joint seal testing should be made with WES before the project specifications are published. WES will require a fund cite for doing the testing. When the laboratory is not used as a part of the QA procedures, paragraph 3.1 must be changed to require the QC LAB to do quality testing.

\*\*\*\*\*

**3.1 Preconstruction Sampling and Testing:**

**3.1.1 Joint Sealant Material:** The Contractor shall provide a sample of the joint sealant material which is to be used on the work. The sample will be tested to determine compliance with Federal specifications for materials characteristics.

\*\*\*\*\*

Use one of the following paragraphs as 3.1.2.

**3.1.2 Sampling and Testing:** Within 15 days after date of notice to proceed, samples of the joint sealant material shall be delivered to an address designated by the Contracting Officer. Sampling and shipping of test specimens shall be at the Contractor's expense. Acceptance testing of the joint sealant shall be at the expense of the Government. Additional sampling and testing because the material samples fail to meet the quality requirements shall be at the expense of the Contractor. The maximum number of days required to perform the acceptance testing is 30 days. Time required to retest because the sealant does not meet Federal specifications shall be deducted from the Contractors period of performance.

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**3.1.2 Sampling and Testing:** The Contractor shall accomplish sampling and testing of the joint sealant for compliance with Federal specifications. Split samples of the sealant will be

provided to the Government. All quality testing results will be provided to the Contracting Officer at least 10 days before starting work. The Contracting Officer representative will either approve or disapprove the source within 7 days of receipt of test data submittal.

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**3.2. Submittal of Manufacturer Instructions:** The manufacturer of the joint sealant shall provide an installation procedures instruction to the Contractor. The Contractor shall submit a copy of the instructions to the Government. The submittal shall be made concurrent with the results of testing and/or samples of material.

**4. ACCEPTANCE OF CONSTRUCTION PROCEDURES:**

**4.1. Cleaning of Joints, Cracks, and Clean-up:** Debris from the removal of existing joint sealant, crack routing, and joint facing shall be removed from the job site on a daily basis. Work shall not proceed from one area of attention to another without clean-up of the initial effort. Dust, debris, water, and fugitive materials shall be controlled at all times. Debris from the work area shall not become a nuisance in areas outside of the designated area of the work.

**4.2. Environmental Protection:** Work from the cleaning and preparation of joint faces will be performed to comply with local environmental controls, policies and directives.

**4.3. Pavement Joint Seal and Crack Repair Test Section:**

**4.3.1. Construction Methods:** The Contractor shall perform the work necessary to clean, prepare joint faces, and reseal a minimum of 61 meters (200 feet) of joint at a location designated by the Contracting Officer. The Contractor shall route and seal one full slab width crack at an area designated by the Contracting Officer. When a satisfactory test section, of either method, is accepted the work will be paid for as a part of the work. The Contractor shall use those methods, materials, and equipment used to do the test section for the remainder of the work. Quality control shall be included in the test section.

**4.3.2. Test Section Acceptance:** The Contracting Officer and the designated representative of the Contracting Officer will observe the test section work being performed. Corrections to the Contractors procedures, if required, will be made. If the section is rejected, the reasons shall be specifically documented. The Contractor shall remove and replace test sections which are not accepted by the Government. Test sections shall be repeated until the

Contractor successfully demonstrates an acceptable construction procedure.

**5. MEASUREMENT:**

5.1. **Joint Cleaning and Sealing:** The quantity to be paid for will be the number of meters (linear feet) of joints that are cleaned and re-sealed approved and accepted by the Contracting Officer.

5.2. **Crack Routing and Sealing:** The quantity to be paid for will be the number of meters (linear feet) of cracks which are routed and sealed and accepted by the Contracting Officer. The measurement will be the straight line dimension from the point of beginning to the point of ending of the repair on a single full slab.

6. **PAYMENT:** The quantities paid for at the unit prices shall include the cost of all labor, materials, equipment, and tools required to provide a complete and functional unit.

**END PART 1 - GENERAL**

**PART 2 - PRODUCTS**

**7. MATERIALS:**

7.1. **SEALANTS:** Materials for sealing cracks in the paved areas of the work shall be as follows:

FS SS-S-200E Type H and Type M	Sealants, Joint, Two Component, Jet-Blast Resistant, Cold-Applied, for Portland Cement Concrete Pavement
FS SS-S-1401C	Sealant, Joint, Non-Jet-Fuel- Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements
FS SS-S-1614A Resistant,	Sealants, Joint, Jet-Fuel-  Hot Applied, for Portland Cement and Tar Concrete Pavements

\*\*\*\*\*

The type of sealant should be specified. When more than one sealant type is specified, the areas where each type is to be used is to be indicated in the project drawings.

**IMPORTANT NOTE:** None of the sealants which are listed here will be used within 7.6 meters (25 feet) of a LOX storage area. A 7.6-meter (25-foot) buffer will be maintained between use of the joint seal materials and a fixed LOX operation.

1401C is an asphalt-based sealant. It is not resistant to jet fuel or hydraulic oils. 1401C sealant materials have a history of bubbling when applied to portland cement concrete joints. The material should be used only for sealing cracks in asphalt concrete or joints between rigid and flexible pavements. 1401C will not be used on airfield areas subject to fuel spillage. Use is limited to shoulders, taxiways, and runway interiors.

1614A is a jet fuel resistant material. It is a tar-based material. In some areas, the material may be considered as a hazardous waste. 1614A will be used on aprons, hardstands, runway ends, and aircraft maintenance pads. 1614A cannot be used to seal asphalt materials because the sealant will react with the asphalt.

SS-200E Type M can be used in Portland cement concrete pavements. Type M is mixed in a one-to-one ratio by volume for machine application. Type M can be used for large areas and on areas where fuel spillage and jet-blast can occur.

SS-200E Type H is designed for hand-mixing. Type H sealants are generally used on small areas for spot repairs. Type H sealants can be used to repair joint seal failures in areas of fuel spillage and jet blast.

Single component cold-applied silicone sealants are not described by current Federal specifications. When silicone sealants are required, the following shall be used to specify the material.

Silicone Sealant shall be self-leveling, non-acid curing, and shall meet the following requirements:

<u>TEST</u>	<u>TEST METHOD</u>	<u>REQUIREMENTS</u>
Weight Loss	ASTM C 792 Modified (1)	10 percent max.
Flow	ASTM C 639 (Type I)	Smooth and level
Extrusion Rate	ASTM C 603	30 sec maximum
Tack Free Time	ASTM C 679	5 hours max
Hardness(Shore 00) (see note 2)	ASTM C 661	30-80
Tensile Stress at 150% Elongation (see note 2)	ASTM D 412 (Die C)	207 kPa (30 psi) max
Percent Elongation (see note 2)	ASTM D 412 (Die C)	700 min
Accelerated Weathering	ASTM C 793	Pass 5000 hours
Bond and Movement Capability	ASTM C 719	Pass 10 cycles at ±50% movement (no adhesion or cohesion failure)
Flame Resistant	FS-SS-S-200	Pass

NOTES:

1. Percent weight loss of wet (uncured) sample after placing in forced down draft oven maintained at 70°C ±2°C (158°F ±3.6°F) for two hours.

2. Specimen cured 21 days at 23°C ±2°C (73°F ±3.6°F) and 50% ±5% humidity.

3. Accelerated Weathering Factory Test Report: In lieu of testing of actual joint seal to be used on the project, a report



of a factory test, performed within two years of contract award, may be submitted.

\*\*\*\*\*

7.2. **Primers:** Primers, when recommended by the sealant manufacturer, shall be included in the work.

7.3. **Backer Materials:** The backup material, backer rod, shall be a compressible, non-shrinking, non-staining, non-absorbing material. The backer material shall not be of a composition to react chemically with the sealant material. The backer shall have a melting temperature exceeding the application temperature of the sealant. The backer shall be 25 percent larger than the size of the reservoir in which the material is placed.

**END PART 2 - PRODUCTS**

**PART 3 - EXECUTION**

**8. PREPARATION OF JOINTS:** All joints shall be thoroughly cleaned before the installation of new joint sealant. All deleterious substances shall be removed from the joint seal reservoir before the application of new sealant.

**8.1. Existing Sealant Removal:** The sealant in cracks or joints shall be removed with a joint plow, or other equipment, which shall remove joint seal and back-up material. Any procedure or equipment which results in damage to the concrete shall be terminated and other methods employed. Hand tools should be used to remove bulk materials from random cracks or irregular joint faces.

**8.2. Re-facing of Joints:**

**8.2.1. Procedures:** Joint faces shall be re-faced using a self-propelled concrete saw with diamond blades. The saw shall have a gang mounted blade with the outside blades spaced to slightly enlarge the joint and remove all materials which adhere to the joint faces. The blade shall be stiffened with dummy blades or washers. Immediately following the saw shall be a high pressure water jet which shall remove all debris and mortar paste from the saw cuttings. High pressure air shall be used to blow out residual free water and debris in the joint reservoir. After air blowing, joint faces shall be inspected for cleanliness and loose debris. Additional sawcutting, pressure washing, and air jetting shall be accomplished where residual joint seal material is on the joint faces. Power rotary wire brushes shall not be used.

\*\*\*\*\*

The designer should use the procedures of AFM 88-6, Chapter 7, to compute the maximum width of the joint re-facing. Maintaining the proper width to depth ratio is important to the function of the joint sealant.

\*\*\*\*\*

**8.2.2. Limitations:** Joints which will equal or exceed a width of 1 inch after refacing shall be rebuilt using procedures for rigid pavement repairs. The Contractor shall show the Government where joint must be rebuilt. The Government shall direct the Contractor on the repair procedures to be used.

**8.3. Facing Random Cracks:** Random cracks shall be routed with a vertical spindle router or a concrete saw with a small diameter blade. Rotary impact routers shall not be used. Cracks shall be pressure-washed to remove all loose debris and cement mortar.

Crack routing details are provided in Figure A3e. Cracks shall be routed to a minimum width of 13 millimeters (1/2-inch) and 19 millimeters (3/4-inch) depth. When routing must be wider to match the crack width, the depth shall equal the width. When backer rod material is required the depth shall be increased to accommodate the backer rod. Guidelines for crack repair follow:

8.3.1. Low severity cracks: Hairline to 6 millimeters (1/4 inch), with no spalling shall not be repaired. Low severity cracks with spalling shall be routed and sealed.

8.3.2. Cracks from 6 millimeters (1/4-inch) to 13 millimeters (1/2-inch) wide shall be routed and sealed.

8.3.3. Cracks 9 millimeters (3/8-inch) to 19 millimeters (3/4-inch) wide with major spalling shall be repaired using rigid pavement repair procedures.

8.3.4. Cracks 19 millimeters (3/4 inch) to 38 millimeters (1-1/2 inch) with no spalling shall be routed and sealed. Backer rod material shall be used if the crack is greater than 19 millimeters (3/4-inch) wide. Cracks with major spalling shall be rebuilt as a joint using the rigid pavement repair procedures.

8.3.5. Cracks wider than 38 millimeters (1-1/2 inch) shall be rebuilt as a joint using the rigid pavement repair procedures.

**9. SEALANT APPLICATION:**

**9.1. Preparation of Sealants:**

\*\*\*\*\*

The paragraphs which are not applicable, based upon the sealant type being used, shall be deleted.

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9.1.1. **Hot Poured Sealants:** Sealants shall not be heated in excess of the safe heating temperature recommended by the sealant manufacturer. Sealants shall not be allowed to cool below the minimum application temperature during application of joint sealant material. Sealant which is overheated, maintained at operating temperature for more than 4 hours, or remains in the applicator at the end of the days work shall be wasted.

9.1.2. **Type M Sealants:** The FS SS-S-200 Type M sealant shall be inspected, prior to use, for water, caking, separation of components, jelling, or unsatisfactory appearance. If any of the defects are observed, the

material shall be wasted. The components shall be warmed or kept in a warm location, not exceeding 32°C (90°F) before transfer to the applicator. Under no circumstances shall the use of open flame, kettle, or kettle without an oil bath be used to warm the material.

9.1.3. **Type H Sealants:** The sealants shall be mixed in the container furnished by the manufacturer or a similar cylindrical metal container with a volume of at least 50 percent more than the mixed volume of the material. Mixing shall be in strict accordance with instructions provided by the manufacturer. Mixing shall continue until the material has a uniform consistency.

9.1.4. **Cold-Applied Sealants:** Containers shall be inspected for damage or evidence of product contamination prior to use of the material. Any materials which are found to contain water, are caked, have separated components, or otherwise appear unsatisfactory shall be wasted.

9.2. **Installation of Sealant:**

9.2.1. **Time of Application:** Joints and cracks shall be sealed immediately following final cleaning and directly following installation of the backer material. When rain, or other adverse conditions, interrupt sealant application, the work shall stop. When work can resume, joints and cracks shall be re-cleaned and dried before resumption of the sealant application. New concrete joint faces shall be allowed to cure for a minimum time of seven days before sealant application.

9.2.2. **Sealing Joints and Cracks:** A final cleaning of the joints and cracks, using heated high pressure air, shall precede the application of sealant material. The application shall not be more than 15 meters (50 feet) behind the final cleaning procedure. Joints and cracks shall be filled from the bottom up to 6 millimeters (1/4-inch), plus or minus 1.5 millimeters (1/16-inch), from the top of the pavement surface. Excess sealant at overfilled joints, or spillage, shall be removed from the pavement and discarded.

10. **PROTECTION OF THE WORK:** The Contractor shall protect the work from damage prior to final acceptance of the work by the Government. Traffic shall be excluded from the pavement by erecting barricades and signs. The work area shall be kept clean and any spillage of materials shall be cleaned up when the spillage occurs.

11. **CONTRACTOR QUALITY CONTROL (QC):** The Contractor shall perform the minimum inspection and tests described. The results of the inspections or tests require action by the Contractor.

The QC function shall be accomplished by an independent testing laboratory.

**11.1. Inspection Details and Frequency of Testing:** The following is considered to be the minimum acceptable for each of the described processes.

**11.1.1. Certification of Materials:** When the Contractor is required to do the testing to show compliance with the appropriate Federal specification, the QC LAB shall accomplish the testing. The QC LAB shall verify that the materials used on the work are of the same lot as that tested for compliance.

**11.1.2. Equipment Check:** When hot-applied sealants are to be used, the temperature recording devices on the applicator reservoirs shall be calibrated at the beginning of the work. Faulty temperature indicators or gauges shall be replaced or a calibration curve shall be provided. Equipment used to mix materials and proportion components shall be calibrated to assure that a uniform mixture is supplied to the applicator.

**11.1.3. Joint Cleaning:** Joints shall be inspected during the cleaning process. Joints and cracks shall be inspected for residue and damage to pavement.

**11.1.4. Joint Sealant Application:** The application shall be checked as the sealant is applied to the joint or crack. Conformance with temperature, proportioning, and mixing shall be monitored. Any evidence of bubbling, improper installation, or failure to cure as defined by the manufacturer, shall be cause to stop the work until the causes of the deficiency are identified and corrective action is effected.

**11.1.5. Joint Sealant Curing:** The sealant shall be checked for proper curing, set, and bonding to the joint walls. A sample of applied material shall be extracted from the joint or crack for each 305 meters (1000 feet) of applied material, or portion thereof. Sealants exhibiting any deficiencies, or which do not perform as described in manufacturer instruction and guidelines, shall be removed from the work, wasted, and replaced. The Contractor shall repair all test locations with fresh sealant application.

**11.2. Action Required for Deficiency Correction:**

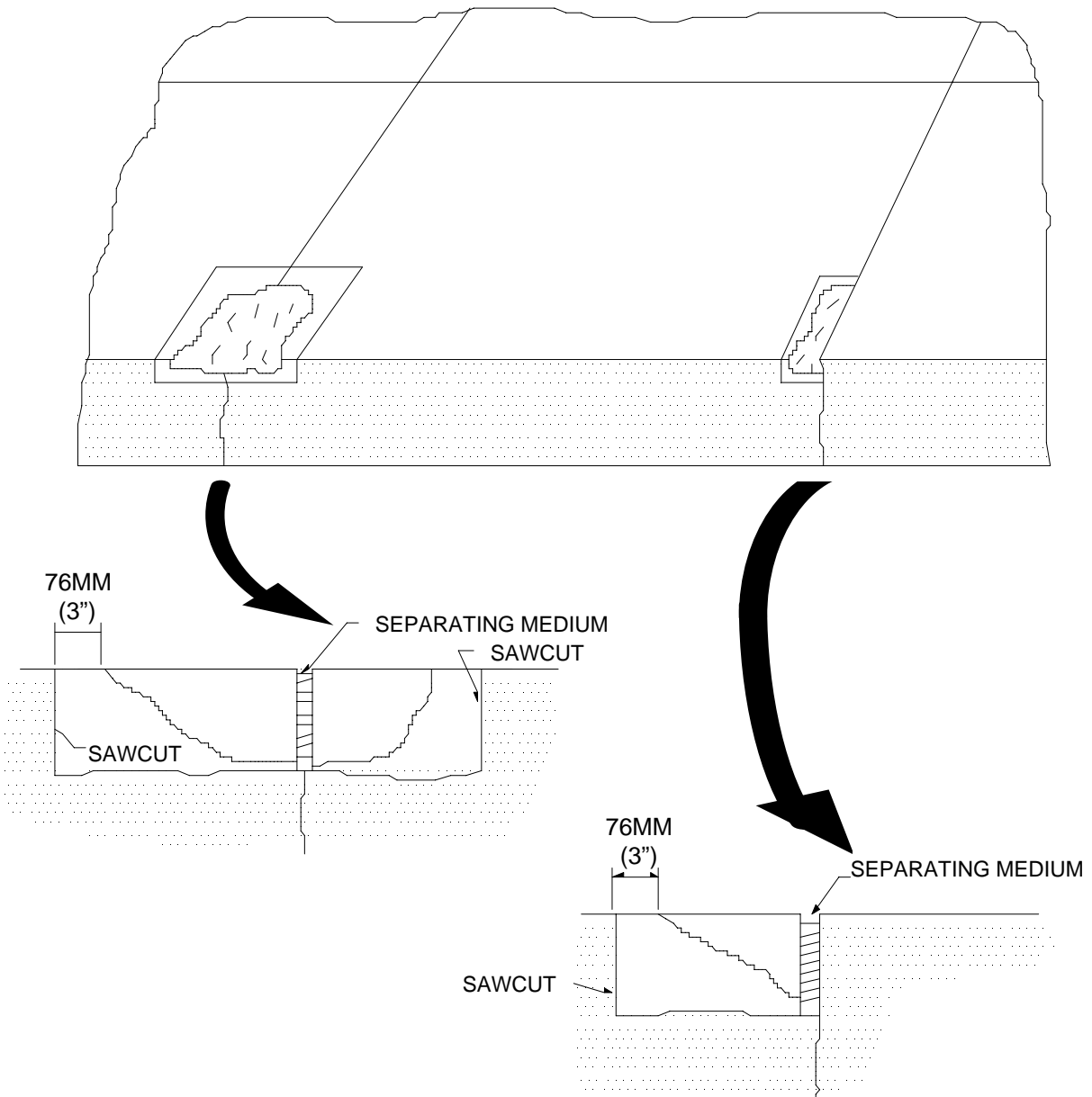
**11.2.1. Materials Certification:** When a material is found not in compliance with Federal specifications, the lot shall be rejected and a new lot submitted for testing.

11.2.2. **Equipment Checks:** Equipment found to be defective shall be replaced or repaired prior to being placed on the work.

11.2.3. **Joint Cleaning:** Joints or cracks which have residual materials shall be cleaned and/or refaced to remove the debris. Joints or cracks which will exceed width or depth limitations for resealing shall be identified to the Government.

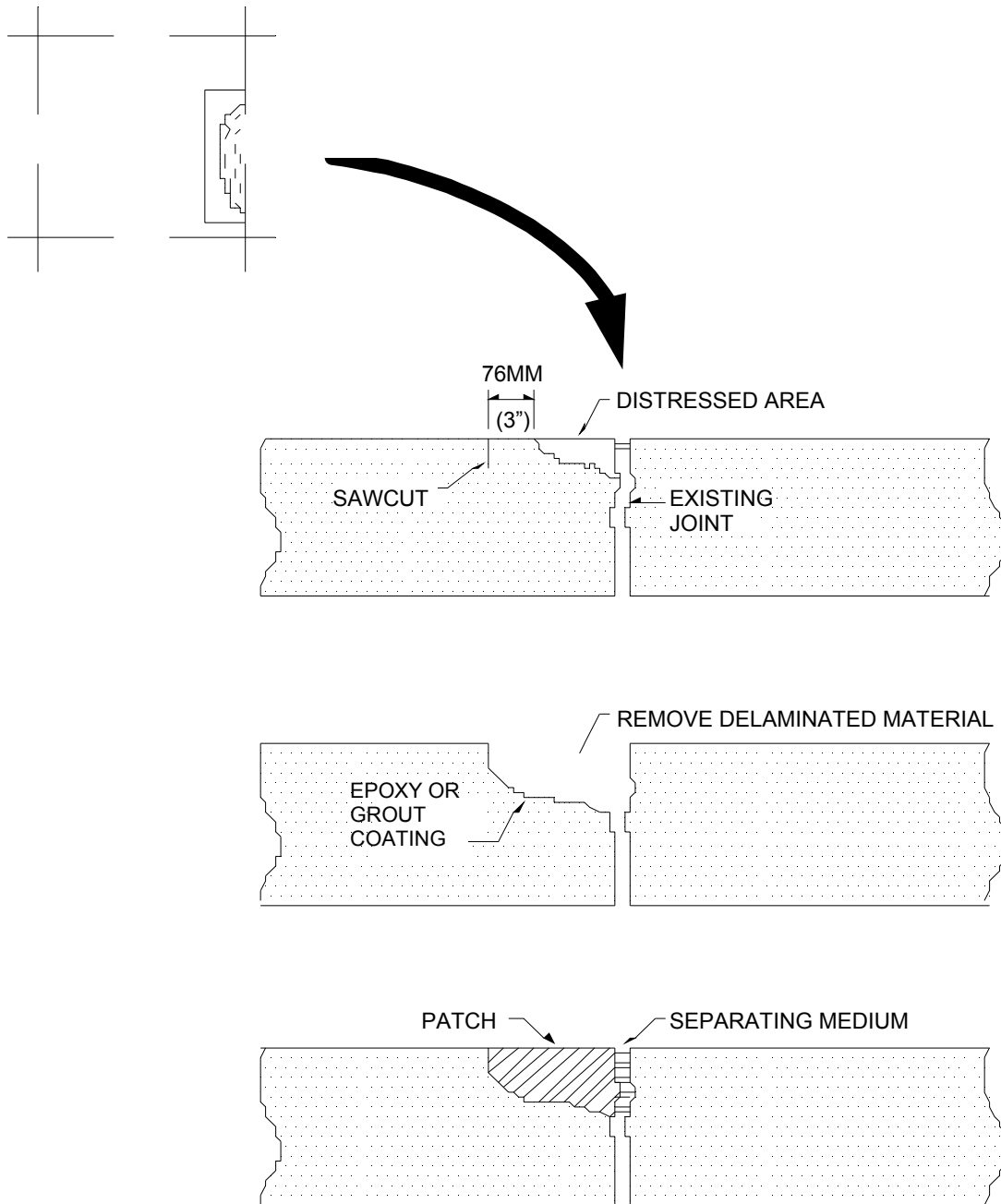
11.2.4. **Joint Sealant Application:** Sealant which is overheated, too cool, or fails to cure properly, shall be removed and replaced. Joints and cracks from which sealant has been removed shall be cleaned and refaced.

11.3. **Daily Reports:** Daily progress reports shall be submitted to the Contracting Officer representative. The reports shall document any actions taken to resolve all identified discrepancies. Reports shall be submitted within a 24-hour period of the respective day; e.g., a report for activities on Wednesday is due Friday morning.



MAKE VERTICAL SAWCUT 51 MILLIMETERS (2 INCHES) DEEP, APPROXIMATELY 76 MILLIMETERS (3 INCHES) FROM DISTRESSED AREA. REMOVE ALL CONCRETE WITHIN SAWED AREA TO SOUND CONCRETE, OR 51-MILLIMETER (2-INCH) MINIMUM DEPTH. TO MAINTAIN AND PROTECT JOINT, USE A SEPARATING MEDIUM. GROUT AND PATCH WITH CONCRETE. AFTER CURING, CLEAN JOINT AND APPLY JOINT SEALANT.

**Figure A3a. Repair of Concrete Pavements (Spall).**

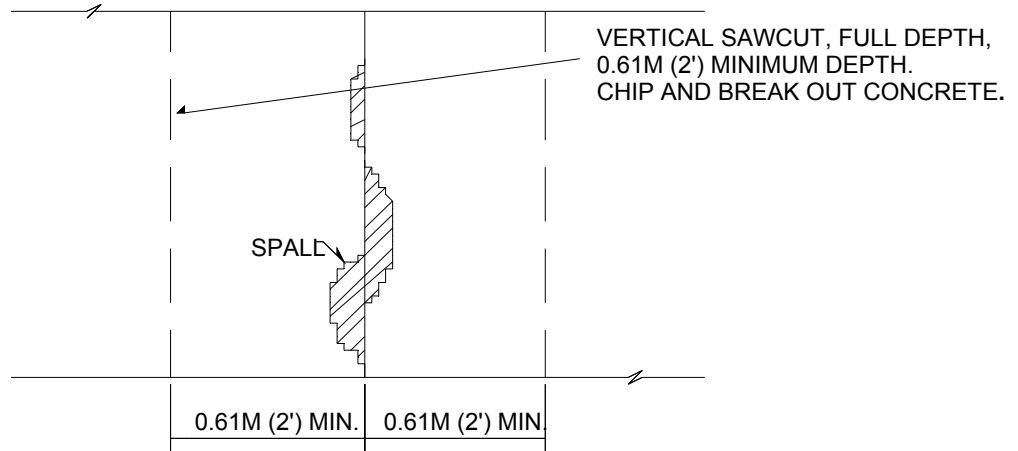


MAKE VERTICAL SAWCUT 51 MILLIMETERS (2 INCHES) DEEP, APPROXIMATELY 76 MILLIMETERS (3 INCHES) FROM DISTRESSED AREA. REMOVE ALL CONCRETE AND LOOSE MATERIAL WITHIN SAWCUT AREA TO SOUND CONCRETE (76-MILLIMETER [3-INCH] MINIMUM DEPTH), USE A SEPARATING MEDIUM TO MAINTAIN AND PROTECT JOINT. USE A BONDING AGENT TO ENSURE GOOD CONTACT BETWEEN EXISTING PAVEMENT AND PATCH. AFTER PATCH HAS CURED, CLEAN JOINT AND APPLY JOINT SEALANT.

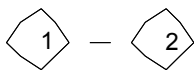
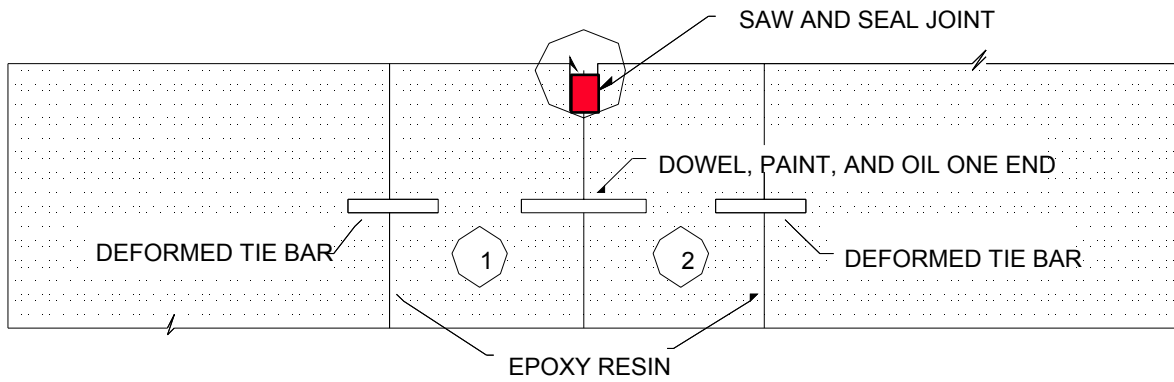
**Figure A3b. Repair of Concrete Pavements (Partial Depth).**



A.



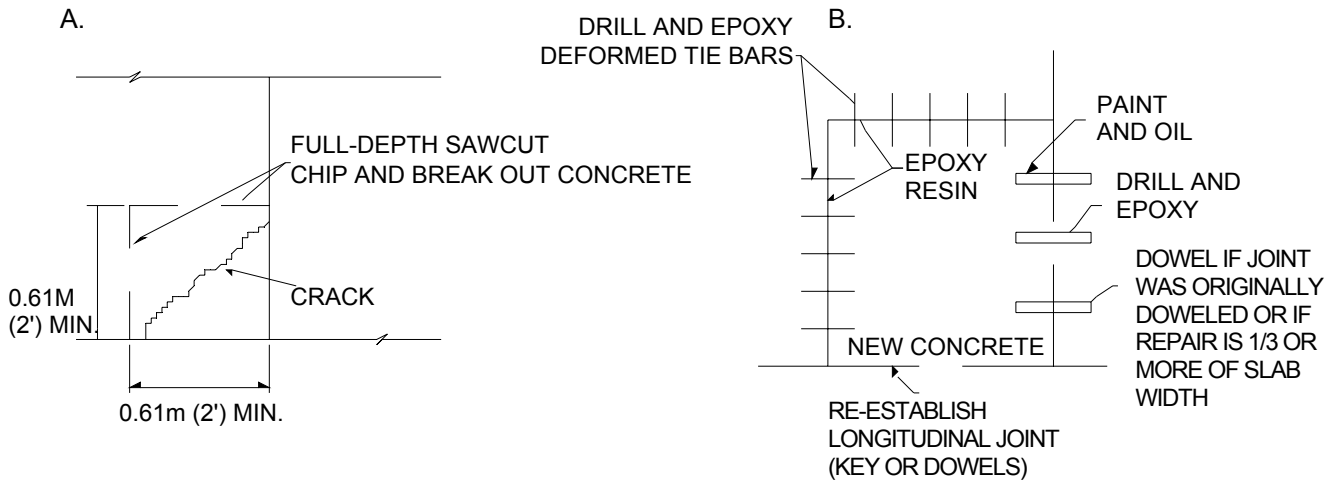
B.



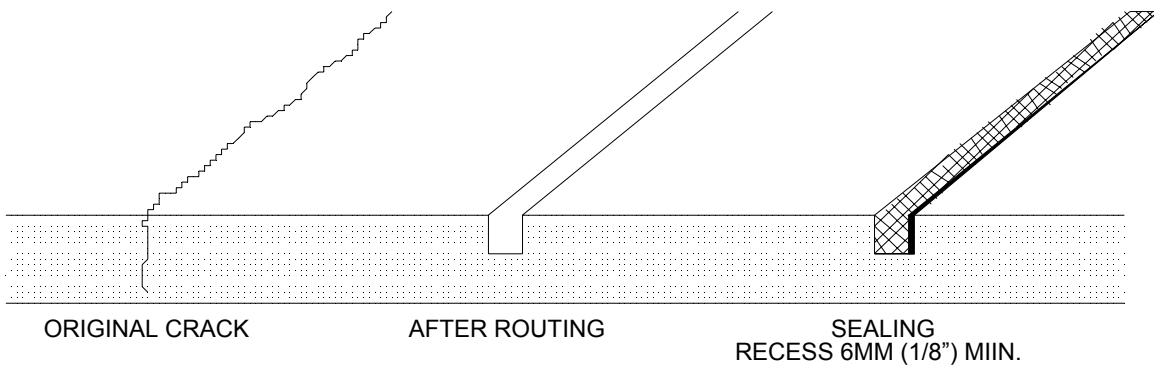
FORM AND PLACE CONCRETE IN ONE REPAIR SECTION AT A TIME

**Figure A3c. Repair of Concrete Pavements (Full Depth).**

**Note:** Refer to AFM 88-6CH3 for dowel and tiebar size and spacing; refer to ACI 503R-89 for guidance on bonding unhardened concrete to hardened concrete.



**Figure A3d. Repair of Concrete Pavements (Full Depth).**



THE VARIABLE WIDTH AND AMOUNT OF SPALLING FOUND IN CRACKS  
NECESSITATES DIFFERENT PROCEDURES FOR REPAIR.

**Figure A3e. Repair of Concrete Pavements (Crack).**

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