U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: Development of State Aviation Standards for Construction at Non-primary Public-use Airports and Use of State Highway Material Specifications for Individual Projects

Date: Draft
Initiated By: AAS-100

AC No: 150/5100-13C
Change:

1 Purpose.

This advisory circular (AC) provides guidelines for the Development of State Aviation Standards for Non-primary Public-use Airports as provided for in Title 49 United States Code (USC) § 47105(c).

This AC also provides guidelines for the use of a State Highway Material Specification for individual projects for airport pavement construction at non-primary public-use airports as provided for in Title 49 USC § 47114(d)(5).

2 Cancellation.

This AC cancels AC 150/5100-13B, *Development of State Standards for Non-Primary Airports*, dated 8/31/2011.

3 Scope.

This AC provides guidelines for 1) the Development of State Aviation Standards for Construction at Non-primary Public-use Airports and 2) the use of State Highway Material Specifications for individual projects for airport pavement construction at non-primary public-use airports.

State Aviation Standards for Construction at Non-primary Public-use Airports, upon approval by the Federal Aviation Administration (FAA), may apply instead of the comparable standards prescribed by the Secretary.

After the FAA has approved the use of a State Aviation Standards for Construction, they may be used for non-primary public-use airport development without a MOS within the state where the standard was approved.

The State Aviation Standards for Construction must be updated and submitted to the FAA for approval within one year of any revisions to AC 150/5370-10, *Standard Specifications for Construction of Airports*.

State specifications for projects developed in accordance with this AC for airports serving aircraft that do not exceed 60,000 pounds gross weight may be developed following state highway pavement specifications.

4 Application.

The FAA recommends the use of the guidelines and standards in this AC for the preparation and submission to the FAA for approval of State Aviation Standards for Construction at Non-primary Public-use Airports and for the use of State Highway Material Specifications for an individual airfield pavement construction project at non-primary public-use airports. In general, use of this AC is not mandatory. However, use of this AC is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and with revenue from the Passenger Facility Charges (PFC) Program. See Grant Assurance No. 34, *Policies, Standards, and Specifications*, and PFC Assurance No. 9, *Standards and Specifications*.

These standards primarily apply to airfield pavement development projects. For building construction, applicable laws and local building codes serve as construction standards acceptable to the FAA.

Standards for the geometric layout of airports are excluded from consideration for development of State Aviation Standards. FAA standards for the geometric layout of airports are minimum standards and it is not possible to establish adequacy of lesser standards.

5 Principal Changes.

The AC incorporates the following principal changes:

1. The title of the AC has been modified to clarify that the AC applies to two cases: 1) the development of State Aviation Standards for Construction at Non-primary Public-use Airports and 2) the use of State Highway Material Specifications for individual projects for airport pavement construction at non-primary public-use airports.
2. Chapter 1 covers the development of State Aviation Standards for Construction at Non-primary Public-use Airports within a state.
3. Chapter 2 covers the Use of State Highway Material Specifications for individual projects.
4. Appendix A includes information on recommended format and content for State Aviation Standards for Construction at Non-primary Public-use Airports.
5. Appendix B includes guidelines for the use of State Highway Material Specifications for construction of airport pavements serving aircraft.
6. Appendix C includes an example of asphalt mixture specification (P-405) incorporating State Highway Material Specifications.
7. Appendix D includes an example of a concrete specification (P-505) incorporating State Highway Materials Specifications.

8. The format of the AC has been updated and editorial changes have been made throughout the document.

6 Applicable Documents.

Consult the following FAA documents for related reading material:

AC 150/5300-13	*Airport Design*
AC 150/5320-6	*Airport Pavement Design and Evaluation*
AC 150/5370-10	*Standards for Specifying Construction of Airports*
FAA Order 5100.38	*Airport Improvement Program (AIP) Handbook*
FAA Order 5300.1	*Modifications to Agency Airport Design, Construction, and Equipment Standards*

7 Where to Find this AC.

You can view a list of all ACs at http://www.faa.gov/regulations_policies/advisory_circulars/.

Electronic copies of the Airports orders can be found at http://www.faa.gov/airports/resources/publications/orders/.

You can view the Federal Aviation Regulations at http://www.faa.gov/regulations_policies/faa_regulations/.

8 Feedback on this AC.

Use the Advisory Circular Feedback form at the end of this AC if you have suggestions for improving this AC.

John R. Dermody
Director of Airport Safety and Standards

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Chapter 1. Development of State Aviation Standards for Construction at Non-primary Public-use Airports

1.1 State Aviation Standards.

This chapter and Appendix A provides guidelines for the development of State Aviation Standards for Construction at Non-primary Public-use Airports as provided for in Title 49 USC § 47105(c). This permits the FAA to allow a state to develop state aviation standards for airport development within the state. If approved, such standards will be applicable in lieu of any comparable FAA standards within the state. The FAA limits consideration of state aviation standards to those detailed in paragraph 1.2 below.

The development of state aviation standards related to safety of airport approaches and airport geometric standards is not allowed. FAA standards must be used in these areas.

1.2 Applicable Standards.

Only standards for airport pavement construction specifications may be considered for state aviation standards.

1.2.1 Pavement Design.

FAA standards for airport pavement structural design are contained in AC 150/5320-6, *Airport Pavement Design and Evaluation.*

1.2.2 Construction Standards.

Construction standards relate primarily to materials and methods employed in the construction of airport improvements and are used in the preparation of contract specifications.

AC 150/5370-10, *Standard Specifications for Construction of Airports*, contains guidance to develop specifications. The format, language, and options of the FAA specifications must be used to the maximum extent possible in developing State Aviation Standards for Construction with any necessary modifications and/or changes to adjust to local conditions, policies, or available materials.

As stipulated in Title 49 USC § 47105(c) State Aviation Standards for Construction may only be for non-primary public-use airports in the state developing the standards.

1.3 FAA Approval of State Aviation Standard Specifications for Construction.

FAA Order 5300.1, *Modifications to Agency Airport Design, Construction, and Equipment Standards*, contains details on the process for approval of State Aviation Standards for Construction. A State may make an application for use of State Aviation Standards for Construction and must submit to the appropriate FAA Airports District or Regional Office. The submittal must contain relevant State Aviation Standards, and the rationale used to establish the State Aviation Standards.

Upon approval, the State Aviation Standards for Construction may be used on federally funded projects, at non-primary public-use airports within the State that developed the State Aviation Standards.

1.4 Revision of State Aviation Standards for Construction.

The State may submit revisions to approved State Aviation Standards for Construction when deemed necessary. Revision will be subject to the FAA approval process in accordance with FAA Order 5300.1.

1.5 Use of Approved State Aviation Standards for Construction.

Approved State Aviation Standards for Construction may be used at any non-primary public-use airport serving aircraft 60,000 pounds or less in the state where the standards were approved.

Chapter 2. Use of State Highway Material Specifications for Individual Airfield Pavement Projects

2.1 General.

This AC provides guidelines for the use of a State Highway Material Specification for individual projects for airport pavement construction at non-primary public-use airports as provided for in Title 49 USC § 47114(d)(5). Appendix B provides guidance in developing specifications for individual airport pavement project specifications.

Many aggregate subbases and bases that meet State Highway Material gradations have little or no significant variance from FAA gradations. State and local gradations can easily be incorporated into airport pavement projects by specifying these gradations in lieu of the FAA gradation. Appendix C and Appendix D provide examples of the use of State Materials for specifications for asphalt and concrete pavements respectively.

2.2 State Highway Material Specifications.

For state highway specifications to be used for construction of airport pavements, Title 49 USC § 47114 (d) (5) requires that the FAA determine that safety will not be negatively affected and the life of the pavement will not be shorter than it would be if constructed using FAA standard specifications. In general, an airport may not seek federal airport funds for runway rehabilitation or reconstruction of any airfield pavement constructed using State Highway Material Specifications for a period of 10 years after construction is completed.

2.3 FAA Approval of Use of State Highway Material Specifications for Individual Airfield Pavement Project.

FAA Order 5300.1 contains details on the process for approval of State Highway Material Specifications for airfield pavements. A request for use of State Highway Material Specifications must be submitted in accordance with FAA Order 5300.1.

A modification to standards for pavement specifications is not required for pavements serving aircraft with gross weights of 12,500 pounds and under.

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Appendix A. RECOMMENDED FORMAT AND CONTENT FOR STATE AVIATION STANDARDS FOR CONSTRUCTION OF NON-PRIMARY PUBLIC-USE AIRPORTS

A.1 Purpose.

This appendix presents information to facilitate an FAA review of a State's proposed use of State Aviation Standards for Construction of Non-primary Public-use Airports in lieu of FAA standards.

A.2 State Aviation Standards Approval Process.

Request to utilize State Aviation Standards for Construction of Non-primary Public-use Airports must be submitted to the FAA for approval in accordance with FAA Order 5300.1. The process to request approval is as follows:

1. The State must apply for approval to the FAA Airport District Office (ADO) or Regional Office for those Regions with no ADOs.
2. The request for approval must contain a red-lined version of all changes to AC 150/5370-10. The application must include justification for any changes to general provisions and procurement standards, materials, quality control, quality assurance, measurement and payment. Copies of all referenced State Material Specifications must be included in the submittal.
3. Revisions to a State's aviation standards must be re-submitted to the FAA for approval in accordance with FAA Order 5300.1, and within one year of any revisions to AC 150/5370-10.

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Appendix B. GUIDELINES FOR USE OF STATE HIGHWAY MATERIAL SPECIFICATIONS FOR INDIVIDUAL AIRFIELD PAVEMENT PROJECTS SERVING AIRCRAFT FOR NON-PRIMARY PUBLIC-USE AIRPORTS

B.1 Introduction.

Selection of the proper materials specification and criteria for airport pavements may require modifications to the state highway materials specification to ensure performance as an airport pavement. The use of State Highway Material Specifications, without modifications, may result in lower airport pavement performance than typically achieved using FAA criteria due to the differences between highway loadings and aircraft loadings.

Use this appendix as a guideline to modify State Highway Material Specifications to ensure that the critical elements in the pavement materials specifications are addressed when State Highway Material Specifications are used for construction at non-primary public-use airports.

B.2 Differences between Airport and Highway Pavements.

Airport pavements are fundamentally different from highway pavements.

Airport pavements are typically constructed to support a low volume of distributed, high load, high tire pressure traffic. Highway pavements are typically constructed to support a high volume of channelized automobile and truck traffic.

Foreign object debris (FOD) is a major issue on airport pavements and is not a significate issue for highway pavements. FOD can be ingested into jet engines and/or impact critical aircraft surfaces. Minimizing the potential of pavement FOD is one of the primary goals of airfield pavement design, construction, and maintenance.

Environmental distresses are the predominate distresses exhibited on airport pavements. Highway pavements are more prone to load associated distress types, such as rutting (permanent deformation) and fatigue cracking.

B.3 Critical Items to Address when Utilizing State Highway Material Specifications for Airfield Pavements.

Individual State Highway Material Specifications covering pavement generally have different titles, identification numbers, a range of criteria and requirements, and State-specific test methods which are based on local experience for material characteristics, environmental conditions, political considerations, etc. Due to the difference in how State Highway Material Specifications are organized, project material specifications must include copies of the relevant State Highway Material Specifications used to avoid confusion on which specifications to follow for the project being constructed.

As a minimum, the following critical items must be addressed to utilize State Highway Material Specifications for airport pavements: terminology, materials, quality control, quality assurance, measurement and payment.

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Appendix C. EXAMPLE ASPHALT STATE MIX SPECIFICATION

ITEM P- 405
ASPHALT STATE MIX

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The project specification must include copies of all state specifications that are referenced.

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DESCRIPTION

405-1.1 This work shall consist of pavement composed of a **[** surface / base / leveling **]** course composed of mineral aggregate and asphalt material mixed in a central mixing plant and placed on a prepared surface in accordance with these specifications. The pavement shall conform to the lines, grades, thickness, and typical cross section or elevations required by the plans and shall be rolled, finished and approved before the placement of the next course.

Except as modified herein the Asphalt Mix shall be in accordance with the **[** insert State DOT Name **]** specification sections: **[ ]**

If there is a conflict between this (the project) specification and the state specification the project specification shall govern.

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The Engineer must include the following information in the above paragraph:

List appropriate divisions and/or sections of state specification, which must be followed and include copies of all referenced specification sections. Check the State DOT web site to assure that the latest revisions to the state standards are utilized.

Indicate the specific state mix, maximum aggregate (or nominal) maximum aggregate size, grade of asphalt binder, acceptance criteria, and method of measurement and payment.

In addition, note any modifications to the State Highway Material Specification as appropriate, for example, reference city or airport in lieu of the State DOT. Note material / mix design approval will need to be by the airport owner as opposed to the State DOT.

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MODIFICATIONS TO ASPHALT STATE MIX SPECIFICATIONS

405-2.1 Definitions: Wherever the words "Secretary", "State" or "Department" are found, they shall mean the **[** City of _____, _____ Airport Authority **]**, (the airport owner), or its designated representative.

405-2.2 Asphalt binder. Asphalt binder shall conform to ASTM D6373 Performance Grade (PG) **[ ]**. A certificate of compliance from the manufacturer shall be included with the mix design submittal.

The supplier's certified test report with test data indicating grade certification for the asphalt binder shall be provided to the Resident Project Representative (RPR) for each load at the time of delivery to the mix plant. A certified test report with test data indicating grade certification for the asphalt binder shall also be provided to the RPR for any modification of the asphalt binder after delivery to the mix plant and before use in the asphalt. When an asphalt binder is modified, a PG Plus Test is required. Use the PG Plus Test found in the Asphalt Institute's State Binder Specification Database for the project location. When a State does not specify a PG Plus Test, use ASTM D6084 with a minimum elastic recovery of 70%.

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The Engineer should use the following guidance in selecting the asphalt binder PG to include in the above paragraph.

The initial PG asphalt binder should be consistent with the recommendations of the applicable State Department of Transportation requirements for pavement. The applicable state binder specification database can be found at http://www.asphaltinstitute.org/specification-databases/us-state-binder-specification-database/.

Using the initial PG selected, apply a 2 grade bump to the high temperature side which will determine the PG that will be inserted in the above paragraph.

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405-3.2 Job mix formula (JMF). The laboratory used to develop the JMF shall possess a current certificate of accreditation, in accordance with ASTM D3666 or qualified state DOT laboratory.

The asphalt shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. [Samples shall be prepared at various asphalt contents and compacted using a Marshall compactor in accordance with ASTM D6926. **] [** Samples shall be prepared at various asphalt contents and compacted using the gyratory compactor in accordance with ASTM D6925. **]**

The submitted JMF shall be stamped or sealed by the responsible professional Engineer of the laboratory. The JMF shall be submitted in writing by the Contractor at least **[** 30 **]** days prior to the start of paving operations. The JMF shall be developed or verified within the same construction season using aggregates currently being produced. No asphalt mix for payment shall be produced until a JMF has been approved in writing by the RPR.

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Select the method for mix design, Marshall Method, ASTM D6926 or Gyratory method, ASTM D6925.

The design criteria in Table 1 are target values necessary to meet the acceptance requirements contained in paragraph 405-3.2. The criteria is based on a production process which has a material variability with the following standard deviations Air Voids = 0.65%.

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For new job mix designs include the following items as a minimum:

a. Percent passing each sieve size for total combined gradation, individual gradation of all aggregate stockpiles and percent by weight of each stockpile used in the JMF.

b. Specific Gravity and absorption of each aggregate.

c. Percent natural sand.

d. Percent fractured faces.

e. Percent by weight of flat particles, elongated particles, and flat and elongated particles.

f. Percent of asphalt.

g. Asphalt binder performance, grade, and type of modifier if used.

- Certificate of compliance from the manufacturer indicating compliance with ASTM D6373.
- For plant modified asphalt binder, certified test report indicating grade certification of modified asphalt binder.

h. Number of blows or gyrations.

i. Laboratory mixing temperature.

j. Laboratory compaction temperature.

k. Supplier recommended mixing and compaction temperatures.

l. Plot of the combined gradation on the 0.45 power gradation curve.

m. Graphical plots of air voids, voids in the mineral aggregate, and unit weight versus asphalt content.

n. Tensile Strength Ratio (TSR).

o. Type and amount of Anti-strip agent when used.

p. Date the JMF was developed. Mix designs that are not dated or which are from a prior construction season shall not be accepted.

[q. Percentage and properties (asphalt content, asphalt binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph 405-3.3 if RAP is used. **]**

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Delete if RAP is not allowed per paragraph 405-3.3.

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For verification of new and state mix designs, the Contractor shall submit to the RPR the results of verification testing of three (3) asphalt samples prepared at the optimum asphalt content. The average of the results of this testing shall indicate conformance with the JMF requirements specified in Tables 1 and Table 2.

When the project requires asphalt mixtures of differing aggregate gradations, a separate JMF and the results of JMF verification testing shall be submitted for each mix.

Table 1. Asphalt Design Criteria

Test Property	Value	Test Method
Number of blows/gyrations	50	
Air voids (%)	3.5	ASTM D3203
Percent voids in mineral aggregate (VMA), minimum	See Table 2	ASTM D6995
TSR	not less than **[** 75 **] [** 80 **]** at a saturation of 70-80%[1]	ASTM D4867
Asphalt Pavement Analyzer (APA) [2]	Less than 10 mm @ 4000 passes	AASHTO T340 at 250 psi hose pressure at 64°C test temperature

[1]An anti-stripping agent shall be added to the asphalt, as necessary, to produce a TSR of not less than 75.
[2]AASHTO T340 at 100 psi hose pressure at 64°C test temperature may be used in the interim prior to publication of the next update. If this method is used the required Value shall be LESS THAN 5 mm @ 8000 passes

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Specify a TSR of not less than 80 in areas with aggregate that are prone to stripping at a TSR of 75.

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The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 2 when tested in accordance with ASTM C136 and ASTM C117.

The gradations in Table 2 represent the limits that shall determine the suitability of aggregate, be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa.

Table 2. Aggregate - Asphalt Pavements

Sieve Size	Percentage by Weight Passing Sieve
1 inch (25.0 mm)	*
3/4 inch (19.0 mm)	*
1/2 inch (12.5 mm)	*
3/8 inch (9.5 mm)	*
No. 4 (4.75 mm)	*
No. 8 (2.36 mm)	*
No. 16 (1.18 mm)	*
No. 30 (600 µm)	*
No. 50 (300 µm)	*
No. 100 (150 µm)	*
No. 200 (75 µm)	*
Voids in Mineral Aggregate (VMA)	*
Asphalt Percent:	
Stone or gravel	*
Slag	*
Minimum Construction Lift Thickness	*

The aggregate gradations shown are based on aggregates of uniform specific gravity. The percentages passing the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition.

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The Engineer must choose the aggregate gradation from the state highway material specification that most closely matches the gradations shown in the table below and insert into Table 2. Based on the aggregate gradation chosen, indicate the appropriate asphalt content and construction lift thickness. Asterisk's denote insertion points.

Aggregate - Asphalt Pavements

Sieve Size	Percentage by Weight Passing Sieves		
	Gradation 1	Gradation 2	Gradation 3
1 inch (25.0 mm)	100	--	--
3/4 inch (19.0 mm)	90-100	100	--
1/2 inch (12.5 mm)	68-88	90-100	100
3/8 inch (9.5 mm)	60-82	72-88	90-100
No. 4 (4.75 mm)	45-67	53-73	58-78
No. 8 (2.36 mm)	32-54	38-60	40-60
No. 16 (1.18 mm)	22-44	26-48	28-48
No. 30 (600 µm)	15-35	18-38	18-38
No. 50 (300 µm)	9-25	11-27	11-27
No. 100 (150 µm)	6-18	6-18	6-18
No. 200 (75 µm)	3-6	3-6	3-6
Voids in Mineral Aggregate (VMA)	14	15	16
Asphalt percent by total weight of mixture:			
Stone or gravel	4.5-7.0	5.0-7.5	5.5-8.0
Slag	5.0-7.5	6.5-9.5	7.0-10.5
Minimum Construction Lift Thickness	3 inch	2 inch	1 1/2 inch

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405-3.3 Reclaimed asphalt pavement (RAP). [Reclaimed asphalt pavement shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt. Recycled asphalt shingles (RAS) shall not be allowed. The use of RAP containing Coal Tar shall not be allowed. Coal Tar surface treatments must be removed prior to recycling underlying asphalt material.

The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP size shall not exceed 1-1/2 inches (38 mm). The reclaimed asphalt mix shall be designed using procedures contained in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D2172 using the appropriate dust correction procedure. RAP should only be used for shoulder surface course mixes and for any intermediate courses. The amount of RAP shall be limited to 30 percent. **]**

[RAP shall not be used. **]**

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Engineer will determine if RAP is/is not allowed and make appropriate selection.

RAP should not be used for surface mixes, except on shoulders. It can be used very effectively in lower layers or for shoulders. Engineer to specify the maximum percentage of reclaimed asphalt allowed in the mix. The amount of RAP shall be limited to 30%, as long as the resulting reclaimed mix meets all requirements that are specified for virgin mixtures. The Contractor may obtain the RAP from the job site or an existing source.

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405-3.4 Control section. [A control section is not required. **] [**The Contractor shall prepare and place a quantity of asphalt according to the JMF. Contractor will not be allowed to place the control section until the contractor quality control plan has been approved, in writing, by the RPR.

Produce 250 tons (227 metric tons) or 1/2 sublot, whichever is greater, to construct a control section. The control section shall be placed in two lanes at the same width to be used in production with a longitudinal cold joint, and shall be of the same depth specified for the construction of the course which it represents. The cold joint must be cut back using the same procedure that will be used during production. However, a cold joint for this control section is an exposed construction joint at least four (4) hours old or whose mat has cooled to less than 160°F (71°C). The underlying grade or pavement structure upon which the control section is to be constructed shall be the same as the remainder of the course represented by the control section. The equipment used in construction of the control section shall be the same type, configuration and weight to be used on the project.

The control section shall be evaluated for acceptance as a single lot in accordance with the acceptance criteria. The control section shall be divided into equal sublots. As a minimum, the control section shall consist of three (3) sublots.

The control section shall be considered acceptable if the average mat density of the control section cores is greater than or equal to 96% and the average joint density of the control section cores is greater than or equal to 94%.

If the initial control section should prove to be unacceptable, it shall be removed and the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second control section shall then be placed. If the second control section also does not meet specification requirements, it shall be removed at the Contractor's expense. Additional control sections, as required, shall be constructed and evaluated for conformance to the specifications. Any additional sections that are not acceptable shall be removed at the Contractor's expense. Full production shall not begin until an acceptable control section has been constructed and accepted in writing by the RPR.

Job mix control testing shall be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the JMF. Specimens shall be prepared and the optimum asphalt content determined in the same manner as for the original JMF tests. **]**

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For small projects, less than 3,000 tons (2722 metric tons), the Engineer will determine if a control section is required.

The control section should be a minimum of 250 feet (75 m) long and shall include demonstration of construction of a cold joint. The control section gives the Contractor and the Engineer an opportunity to evaluate the performance of the plant and laydown equipment as well as to determine the quality of the mixture in place.

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405-3.5 Diamond grinding. When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch (3-mm) wide and there shall be a minimum of 55 to 60 blades per 12 inches (300 mm) of cutting head width; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet (0.9 m) wide. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The surface of the ground pavement shall have a texture consisting of grooves between 0.090 and 0.130 inches (2 and 3.5 mm) wide. The peaks and ridges shall be approximately 1/32 inch (1 mm) higher than the bottom of the grooves. The pavement shall be left in a clean condition. The removal of all of the slurry resulting from the grinding operation shall be continuous. Control the grinding operation so the residue from the operation does not flow across other lanes of pavement. The Contractor shall apply a surface treatment per Item P-608 to all areas that have been subject to grinding.

405-3.6 Quality Control (QC) testing. The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to these specifications. The testing program shall include, but is not limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A QC Testing Plan shall be developed by the contractor and approved by the RPR.

a. Asphalt content. A minimum of two asphalt content tests shall be performed per lot in accordance with ASTM D6307 or ASTM D2172 if the correction factor in ASTM D6307 is greater than 1.0. The asphalt content for the lot will be determined by averaging the test results.

b. Gradation. Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D5444 and ASTM C136, and ASTM C117.

c. Moisture content of aggregate. The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C566.

d. Moisture content of asphalt. The moisture content of the asphalt shall be determined once per lot in accordance with ASTM D1461.

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ASTM D1461 may be replaced with AASHTO T329 when moisture content will be determined by conventional oven or microwave.

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e. Temperatures. Temperatures shall be checked, at least four times per lot, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the asphalt at the plant, and the asphalt at the job site.

f. In-place density monitoring. The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.

g. Smoothness.

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Note change in deviations on final surface course that require grinding, limited to deviations greater than 1/4 inch (6mm) that trap water. Intent here is to focus on areas that may cause issues with the safe operation of aircraft and to minimize grinding if it will not improve safety.

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The Contractor shall perform smoothness testing on each sublot to verify that the construction processes are producing pavement that meets the following guidelines. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the contractor before construction continues.

Smoothness shall be tested in both the transverse and longitudinal direction of each lot to identify areas that may be prone to ponding of water which could lead to hydroplaning of aircraft. The final surface shall be free from roller marks. After the final rolling, but not later than 24 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness. The contractor has the option of using either a 12-foot (3.7 m) straightedge and/or a rolling inclinometer meeting the requirements of ASTM E2133. Testing shall be continuous across all joints. Straightedge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. The contractor may choose to evaluate daily lot compliance with the 1/4-inch straightedge requirement using a rolling inclinometer. If the rolling inclinometer is used, the acquired data can be read into the FAA profile program, ProFAA, using the straightedge simulation function to assess the compliance with 1/4-inch (6mm) variance with a 12-foot straightedge. If the contractor opts to use a rolling inclinometer, the device shall be operated in accordance with ASTM E2133.

The final finished surface course of the pavement shall not vary more than 1/4 inch (6 mm) transversely. Smoothness readings will not be made across grade changes or cross slope

transitions. Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch (6 mm) will be corrected with diamond grinding per paragraph 405-3.5 or by removing and replacing the surface course to full depth. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. Areas that have been ground will be sealed with a surface treatment in accordance with Item P-608. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

1. Transverse measurements. Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet (15 m) or more often as determined by the RPR. The joint between lots shall be tested separately to facilitate smoothness between lots.

2. Longitudinal measurements. Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater.

If the contractor's machines and/or methods are producing significant areas that need corrective actions, then production should be stopped until corrective measures can be implemented. If corrective measures are not implemented and when directed by the RPR, production shall be stopped until corrective measures can be implemented.

h. Grade. Grade will be evaluated prior to the first day of placement and then as a minimum, prior to placement of the surface lift and after the placement of the surface lift to allow adjustments to paving operations if measurements do not meet specification requirements.

The Contractor shall submit the survey data to the RPR by the following day after measurements have been taken with measurements taken at appropriate grade lines (as a minimum at center and edges of paving lane) and 50-foot (15-m) longitudinal spacing on cross-sections verifying that project is in conformance with project plans and cross-sections. The final finished surface of the pavement of the completed project shall not vary from the grade line elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically **[** or 0.1 feet (30 mm) laterally **]**. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the RPR. The Contractor shall pay the cost of the surveying and level runs.

405-3.7 Quality Assurance (QA) Acceptance.

405-3.7.1 Lots.

a. Standard lot. A standard lot will be equal to one day's production. If the day's production exceeds 4000 tons (3628 metric tons), the lot size will be to 1/2 of the day's production. Each lot will be divided into approximately equal sublots with individual sublots between 400 to 600 tons. Where three sublots are produced, they will constitute a lot. Where one or two sublots are produced, they will be incorporated into the previous or next lot.

Where more than one plant is simultaneously producing asphalt for the job, the lot sizes will apply separately for each plant.

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For small projects with multiple small placements or if the total project size is less than 3000 tons (2722 metric tons), acceptable material will be paid for by the ton (metric ton) placed per day.

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b. Partial Lot. When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, or for overages or other minor tonnage placements to be considered as partial lots, the following procedure will be used to adjust the lot size. Where three sublots have been produced, they will constitute a lot. Where one or two sublots have been produced, they will be incorporated into the next lot or the previous lot.

405-3.7.2 Quality Assurance (QA) Acceptance Criteria.

a. Mat Density. Each lot shall be divided into equal sublots between 400 and 600 Tons. One 6-inch diameter core shall be taken for each sublot from the finished, compacted material. Sampling locations shall be determined by the RPR in accordance with random sampling procedures contained in ASTM D 3665. Pavement shall be compacted to 94.5 percent maximum theoretical density for maximum payment.

b. Joint Density. The joint lot size shall be the total length of longitudinal joints constructed by a lot as defined in paragraph 405-3.7.1. The joint lot shall be divided into the same number of sublots used for mat density. One 6-inch diameter core shall be taken centered on the joint for each sublot. Joints shall be compacted to 92.5 percent maximum theoretical density for maximum payment.

c. Air Voids (Total Mix). The lot will be acceptable if the average air voids of the lot are equal to or greater than 2% and equal to or less than 5%.

d. Grade. Grade shall be evaluated prior to the first day of placement and then as a minimum, prior to placement of the surface lift and after the placement of the surface lift to allow adjustments to paving operations if measurements do not meet specification requirements.

The Contractor must submit the survey data to the RPR by the following day after measurements have been taken with measurements taken at appropriate gradelines (as a minimum at center and edges of paving lane) and 50-foot longitudinal spacing on cross-sections verifying that project is in conformance with project plans and cross-sections.

The final finished surface of the pavement of the completed project shall not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically **[** or 0.1 feet (30 mm) laterally **]**. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the RPR. The contractor shall pay the cost of the surveying and level runs.

High points may be ground off if the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans.

405-3.8 Measurement. Plant mix asphalt pavement shall be measured by the number of **[** tons (kg) **] [** square yards (square meters) **]** of asphalt pavement used in the accepted work. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage.

405-3.9 Payment. Payment for an accepted lot of asphalt pavement shall be made at the contract unit price **[** per ton (kg) **] [** per square yard(square meter) **]**. Payment shall be compensation for furnishing all labor, materials, tools, equipment, and incidentals required to complete the work as specified herein and on the drawings,

405-3.9.1 Basis for Adjusted Payment. The pay factor for each individual lot shall be calculated in accordance with the following Price Adjustment Schedule. Note a pay factor shall be calculated for both mat and joint density. The lot pay factor shall be the average of these two values. The lot pay factor shall apply to both the mineral aggregate and the asphalt cement.

Price Adjustment Schedule		
Maximum Theoretical Density		
Mat	**Joint**	**Pay Factor**
94.5	92.5	100
93.8	91.8	95
93	91	90
92.5	90.5	80
< 92.5	< 90.5	Reject

Appendix D. EXAMPLE PCC STATE MIX SPECIFICTION

Item P-505 Concrete Pavement (PCC) State Mix

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The project specification must include copies of all state specifications that are referenced.

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505-1.1 General. This work shall consist of pavement composed of Portland cement concrete (PCC) constructed on a prepared surface in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross sections shown on the plans.

Except as modified herein the PCC shall be in accordance with the **[** enter State DOT Name **]** specification sections: **[ ]**

If there is a conflict between this (the project) specification and the state specification the project specification shall govern.

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List appropriate divisions and or sections of state specification, which must be followed and include copies of all referenced specification sections. Check the State DOT web site to assure that the latest revisions to the state standards are utilized.

Indicate the type of mix, maximum aggregate (or nominal) maximum aggregate size, type of cement and strength of mix.

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505-1.2 Definitions: Wherever the words “Secretary”, “State” or “Department” are found, they shall mean the **[** City of _____, _____ Airport Authority **]**, (the airport owner), or its designated representative.

505-2.1 Aggregates.

a. Reactivity. Fine and Coarse aggregates to be used in PCC on this project shall be tested and evaluated by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and ASTM C1567. Tests must be representative of aggregate sources which will be providing material for production. ASTM C1260 and ASTM C1567 tests may be run concurrently.

(1) Coarse and fine aggregate shall be tested separately in accordance with ASTM C1260, however, the length of test shall be extended to 28 days (30 days from casting). Tests must be completed within the last 6 months.

(2) Combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If the expansion does not

exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

(3) If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) Concrete Research Division (CRD) C662 in lieu of ASTM C1567. If lithium nitrate admixture is used, it shall be nominal 30% ±0.5% weight lithium nitrate in water. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

b. Fine aggregate. Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33. Fine aggregate material requirements and deleterious limits are shown in the table below.

Fine Aggregate Material Requirements (Portion Passing the 3/8 inch (9.5 mm) sieve and retained on the No. 200 (75 µm))		
Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Sand Equivalent	**[** 45 **]**	ASTM D2419
Fineness Modulus (FM)	2.50 ≤ FM ≤ 3.40	ASTM C136
Limits for Deleterious Substances in Fine Aggregate for Concrete		
Clay lumps and friable particles	1.0% maximum	ASTM C142
Coal and lignite	0.5% using a medium with a density of Sp. Gr. of 2.0	ASTM C123
Total Deleterious Material	1.0% maximum	

c. Coarse aggregate. The maximum size coarse aggregate shall be **[ ]**.

Aggregates delivered to the mixer shall be clean, hard, uncoated aggregates consisting of crushed stone, crushed or uncrushed gravel, air-cooled iron blast furnace slag, crushed recycled concrete pavement, or a combination. To the best of the aggregate producer's knowledge, the aggregates shall have no known history of detrimental pavement staining. Steel blast furnace slag shall not be permitted. The aggregate shall be composed of clean, hard, uncoated particles. Coarse aggregate material requirements and deleterious limits are shown in the table below.

Coarse Aggregate Material Requirements (Portion retained on the No. 4 (4.75 mm) sieve)		
Material Test	**Requirement**	**Standard**
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 for any size group coarser than 3/8 (9.5 mm) sieve [1]	ASTM D4791
Bulk density of slag [2]	Weigh not less than 70 pounds per cubic foot (1.12 Mg/cubic meter)	ASTM C29
[D-cracking (Freeze-Thaw)[3] **]**	Durability factor ≥ 95	ASTM C666]

[1] flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

[2]Only required if slag is specified.

[[3] Coarse aggregate may only be accepted from sources that have a 20-year service history for the same gradation to be supplied with no history of D-Cracking. Aggregates that do not have a 20 year record of service free from major repairs (less than 5% of slabs replaced) in similar conditions without D-cracking shall not be used unless the material currently being produced has a durability factor greater than or equal to 95 per ASTM C666 procedure B. The Contractor shall submit a current certification and test results to verify the aggregate acceptability. Test results will only be accepted from a State Department of Transportation (DOT) materials laboratory or an accredited laboratory. Certification and test results which are not dated or which are over one (1) year old or which are for different gradations will not be accepted. **]**

The amount of deleterious material in the coarse aggregate shall not exceed the following limits:

Limits for Deleterious Substances in Coarse Aggregate for Concrete

Deleterious material	**ASTM**	**Percentage by Mass**
Clay Lumps and friable particles	ASTM C142	1.0
Material finer than No. 200 sieve (75 µm)	ASTM C117	1.0[1]
Lightweight particles	ASTM C123 using a medium with a density of Sp. Gr. of 2.0	0.5
Chert (less than 2.40 Sp Gr.)	ASTM C123 using a medium with a density of Sp. Gr. of 2.40)	1.0[2]
Total of all deleterious Material		3.0[1]

[1] The limit for material finer than 75-µm is allowed to be increased to 1.5% for crushed aggregates consisting of dust of fracture that is essentially free from clay or shale (material finer than 2 µm). Test results supporting

acceptance of increasing limit to 1.5% with statement indicating material is dust of fracture must be submitted with Mix Design. Acceptable techniques to characterizing these fines include methylene blue adsorption, hydrometer analyses, or X-ray diffraction analysis. The total of all deleterious materials increases up to 3.5%.

[2] The limit for chert may be limited to 0.1 percent by mass in areas subject to severe freeze and thaw.

505-3 Mix Design [Select which state PCC mix to follow.]

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Insert the type or class of state PCC to be utilized. Choose a mix as close to P-501 as possible.

****

The Contractor shall provide a mix design to the Resident Project Representative (RPR) for approval at least **[** 28 **]** days prior to first placement of PCC. PCC shall be designed to achieve a 28-day **[** compressive strength of 4,400 psi (30 Mpa) or flexural strength of 625 psi (4.3 Mpa) **]**.

505-4 Control Section. The initial 250 feet (76 m) of pavement shall be considered the control section. The Contractor shall demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of the specification. Upon acceptance of the control section by the RPR, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the RPR.

505-5 Construction. In addition to construction requirements in state standards specifications include:

a. Temperature Management/Stress Management Program: Prior to the start of paving operations for each day of paving the contractor shall provide the RPR with a Temperature Management / Stress Management Program to assure that uncontrolled cracking is avoided. As a minimum the program should address:

1. Anticipated tensile strains in fresh concrete as related to heating and cooling of the concrete material.
2. Anticipated weather conditions including temperature, wind velocity, and relative humidity.
3. Anticipated timing of initial saw cut.
4. Anticipated number and type of saws to be utilized for saw cutting
5. Provisions for backup or additional equipment for saw cutting.

b. Placement: Backhoes and grading equipment shall not be utilized to distribute or manipulate PCC in front of paver.

505-6 Repair, removal, or replacement of slabs.

a. General. New pavement slabs that are broken or contain cracks or are otherwise defective or unacceptable as defined by the acceptance criteria in 505-8 shall be removed and replaced or repaired, as directed by the RPR and as specified hereinafter at no cost to the Owner. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of removal shall be normal to the paving lane and to each original transverse joint. The RPR will determine

whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be 2 inches (50 mm) to 4 inches (100 mm) diameter, shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with a bonding agent, using approved procedures. Drilling of cores and refilling holes shall be at no expense to the Owner. Repair of cracks as described in this section shall not be allowed if in the opinion of the RPR the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of cracks shall be allowed in any panel that demonstrates segregated aggregate with an absence of coarse aggregate in the upper 1/4 inch (6 mm) of the pavement surface.

b. Shrinkage cracks. Shrinkage cracks which do not exceed one-third of the pavement depth shall be cleaned and either high molecular weight methacrylate (HMWM) applied; or epoxy resin (Type IV, Grade 1) per ASTM C881, pressure injected using procedures recommended by the manufacturer and approved by the RPR. Sandblasting of the surface may be required following the application of HMWM to restore skid resistance. Care shall be taken to ensure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the RPR. Shrinkage cracks which exceed one-third the pavement depth shall be treated as full depth cracks.

c. Slabs with cracks through interior areas. Interior area is defined as that area more than 6 inches (150 mm) from either adjacent original transverse joint. The full slab shall be removed and replaced at no cost to the Owner, when there are any full depth cracks, or cracks greater than one-third the pavement depth, that extend into the interior area.

d. Cracks close to and parallel to joints. All cracks essentially parallel to original joints, extending full depth of the slab, and lying wholly within 6 inches (150 mm) either side of the joint shall be treated as specified here. Any crack extending more than 6 inches (150 mm) from the joint shall be treated as specified above in subparagraph c.

(1) Full depth cracks present, original joint not opened. When the original un-cracked joint has not opened, the crack shall be sawed and sealed, and the original joint filled with epoxy resin as specified below. The crack shall be sawed with equipment specially designed to follow random cracks. The reservoir for joint sealant in the crack shall be formed by sawing to a depth of 3/4 inches (19 mm), ±1/16 inch (2 mm), and to a width of 5/8 inch (16 mm), ±1/8 inch (3 mm). Any equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent such raveling or spalling. The joint sealant shall be a liquid sealant as specified. Installation of joint seal shall be as specified for sealing joints or as directed. If the joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, per ASTM C881, thoroughly tooled into the void using approved procedures.

If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, per ASTM C881, using approved procedures. If filler type material has been used to form a weakened plane in the transverse joint, it shall be completely sawed out and the saw cut pressure injected with epoxy resin, Type IV, Grade 1, per ASTM C881, using approved procedures. Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remainder of

the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.

(2) Full depth cracks present, original joint also cracked. At a joint, if there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced for the full lane width and length.

e. Removal and replacement of full slabs. Where it is necessary to remove full slabs, all edges of the slab shall be cut full depth with a concrete saw. All saw cuts shall be perpendicular to the slab surface

No mechanical impact breakers, prior to full depth saw cut around edges of removal area, shall be used for any removal of slabs. If under break between 1-1/2 and 4 inches (38 and 100 mm) deep occurs at any point along any edge, the area shall be repaired as directed before replacing the removed slab. Procedures directed will be similar to those specified for surface spalls, modified as necessary.

If under break over 4 inches (100 mm) deep occurs, the entire slab containing the under break shall be removed and replaced. Dowels or tie bars of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified. Original damaged dowels or tie bars shall be cut off flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All four (4) edges of the new slab shall contain dowels or tie bars.

Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material (unless it is stabilized) shall be re-compacted and shaped as specified in the appropriate section of these specifications. The surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels or tie bars. The resulting joints around the new slab shall be prepared and sealed as specified for original construction.

f. Repairing spalls along joints. Where directed, spalls along joints of new slabs, and spalls along parallel cracks used as replacement joints, shall be repaired by first making a vertical saw cut at least one inch (25 mm) outside the spalled area and to a depth of at least 2 inch (50 mm). Saw cuts shall be straight lines forming rectangular areas surrounding the spalled area. The concrete between the new saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete and at least 1/2 inch (12 mm) of visually sound concrete, do not remove over ½ of the slab depth or the entire slab must be replaced. The cavity thus formed shall be thoroughly cleaned with high-pressure water jets supplemented with compressed air as needed to remove all loose material. Immediately before filling the cavity, a prime coat of epoxy resin, Type III, Grade I, shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Pooling of the prime coat epoxy resin shall be avoided. The cavity shall be filled with low slump Portland cement concrete or mortar or with epoxy resin concrete or mortar. Concrete shall be used for larger spalls, generally those more than 1/2 cu. ft. (0.014 m^3) in size, and mortar shall be used for the smaller ones. Any spall less than 0.1 cu. ft. (0.003 m^3) shall be repaired only with epoxy resin mortar or a Grade III epoxy resin. Portland

cement concrete and mortar mixtures shall be proportioned as directed and shall be mixed, placed, consolidated, and cured as directed. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions and mixing and placing procedures as recommended by the manufacturer and approved by the RPR. The epoxy resin materials shall be placed in the cavity in layers not over 2 inches (50 mm) thick. The time interval between placement of additional layers shall be such that the temperature of the epoxy resin material does not exceed 140°F (60°C) at any time during hardening. Mechanical vibrators and hand tampers shall be used to consolidate the concrete or mortar. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints, or as required to be routed for cracks. The reservoir shall be thoroughly cleaned and sealed with the sealer specified for the joints. If any spall penetrates half the depth of the slab or more, the entire slab shall be removed and replaced as previously specified. If any spall would require over 25% of the length of any single joint to be repaired, the entire slab shall be removed and replaced. Repair of spalls as described in this section shall not be allowed if in the opinion of the RPR the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of spalls shall be allowed in any panel that demonstrates segregated aggregate with a significant absence of coarse aggregate in the upper one-eight (1/8th) inch of the pavement surface. Any slabs that have spall repairs will have a 5% reduction in payment, and may not receive more than 95% payment for that slab.

g. Diamond grinding of PCC surfaces. Diamond grinding of the hardened concrete with an approved diamond grinding machine should not be performed until the concrete is 14 days or more old and concrete has reached full minimum strength. When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch (3-mm) wide and there shall be a minimum of 55 to 60 blades per 12 inches (300 mm) of cutting head width; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet (0.9 m) wide. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The depth of diamond grinding shall not exceed 1/2 inch (13 mm) and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. All grinding shall be at the expense of the Contractor. All pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified above, may require removing and replacing in conformance with paragraph 505-6. Any sublots that have over 50% of the sublots with diamond grinding may not receive more than 95% payment for that sublot.

505-7 Contractor Quality Control (QC).

505-7.1 Contractor QC testing. The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to this specification. The testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content. A QC Testing Plan shall be developed by the contractor and approved by the RPR.

The RPR may at any time, notwithstanding previous plant acceptance, reject and require the contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the RPR, and if it can be demonstrated in the laboratory, in the presence of the RPR, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

a. Fine aggregate.

(1) Gradation. A sieve analysis shall be made at least twice daily in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C70 or ASTM C566.

(3) Deleterious substances. Fine aggregate as delivered to the mixer shall be tested for deleterious substances in fine aggregate for concrete as specified in paragraph 505-2.1b prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

b. Coarse Aggregate.

(1) Gradation. A sieve analysis shall be made at least twice daily for each size of aggregate. Tests shall be made in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C566.

(3) Deleterious substances. Coarse aggregate as delivered to the mixer shall be tested for deleterious substances in coarse aggregate for concrete as specified in paragraph 505-2.1c, prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

c. Slump. Four slump tests shall be performed for each lot of material produced in accordance with the lot size defined in paragraph 505-8.1. One test shall be made for each sublot. Slump tests shall be performed in accordance with ASTM C143 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

d. Air content. Four air content tests shall be performed for each lot of material produced in accordance with the lot size defined in paragraph 505-8.1. One test shall be made for each sublot. Air content tests shall be performed in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

e. Unit weight and Yield. Four unit weight and yield tests shall be made in accordance with the lot size defined in paragraph 505-5.1. One test shall be made for each sublot. Unit weight and yield tests shall be in accordance with ASTM C138. The samples shall be taken in accordance with ASTM C172 and at the same time as the air content tests.

f. Temperatures. Temperatures shall be checked at least four times per lot at the job site in accordance with ASTM C1064.

g. Smoothness.

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Note change in deviations on final surface course that require grinding, limited to deviations > 1/4 inch that trap water, intent here is to focus on areas that may cause issues with the safe operation of aircraft and to minimize grinding if it will not improve safety.

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The Contractor shall perform daily smoothness testing on each sublot to verify that the construction processes are producing pavement that meets the following guidelines. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the contractor before construction continues.

Smoothness shall be tested in both the transverse and longitudinal direction of each lot to identify areas that may be prone to ponding of water which could lead to hydroplaning of aircraft. The final surface shall be free from finishing marks. After the final finishing, but not later than 48 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness. The contractor has the option of using either a 12-foot (3.7 m) straightedge and/or a rolling inclinometer meeting the requirements of ASTM E2133. Testing shall be continuous across all joints. Straightedge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. The contractor may choose to evaluate daily lot compliance with the 1/4-inch straightedge requirement using a rolling inclinometer. If the rolling inclinometer is used, the acquired data can be read into the FAA profile program, ProFAA, using the straightedge simulation function to assess the compliance with 1/4-inch variance with a 12-foot straightedge. If the contractor opts to use a rolling inclinometer, the device shall be operated in accordance with ASTM E2133.

The final finished surface course of the pavement shall not vary more than 1/4 inch (6 mm) transversely. Smoothness readings will not be made across grade changes or cross slope transitions. Deviations on final surface course in either the transverse or longitudinal that will trap water > 1/4 inch (6 mm) will be corrected with diamond grinding per paragraph 505-6g or by removing and replacing the surface course to full depth. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which

diamond grinding has been performed will be subject to the final pavement thickness tolerances specified in paragraph 505-8.4.

(1) Transverse measurements. Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet (15 m) or more often as determined by the RPR. The joint between lots shall be tested separately to facilitate smoothness between lots.

(2) Longitudinal measurements. Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater.

If the contractor's machines and/or methods are producing significant areas that need corrective actions then production must be stopped until corrective measures can be implemented.

h. Grade. Grade will be evaluated prior to placement of the PCC surface and then, as a minimum, after placement of the PCC surface. The Contractor must submit the survey data to the RPR by the following day after measurements have been taken with measurements taken at appropriate gradelines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans verifying that the project is in conformance with project plans and cross-sections. The final finished surface of the pavement of the completed project will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically **[** or 0.1 feet (30 mm) laterally **]**. The documentation, stamped and signed by a licensed surveyor, will be provided by the Contractor to the RPR. The contractor will pay the cost of the surveying and level runs. Grinding will be in accordance with paragraph 505-6g.

505-7.2 Control charts. The Contractor shall maintain linear control charts for fine and coarse aggregate gradation, slump, moisture content and air content.

Control charts shall be posted in a location satisfactory to the RPR and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and suspension Limits, or Specification limits, applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a potential problem and the Contractor is not taking satisfactory corrective action, the RPR may halt production or acceptance of the material.

a. Fine and coarse aggregate gradation. The Contractor shall record the running average of the last five gradation tests for each control sieve on linear control charts. Superimposed on the control charts shall be the action and suspension limits. Gradation tests shall be performed by the Contractor per ASTMC136. The Contractor shall take at least **[** two **]** samples per lot to check the final gradation. Sampling shall be per ASTM D75 from the flowing aggregate stream or conveyor belt.

b. Slump and air content. The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest

measurements) for slump and air content in accordance with the following Action and Suspension Limits.

505-7.3 Corrective action at Suspension Limit. The quality control plan shall indicate that appropriate action shall be taken when the process is believed to be out of control. The quality control plan shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a minimum, a process shall be deemed out of control and corrective action taken if any one of the following conditions exists.

a. Fine and coarse aggregate gradation. When two consecutive averages of five tests are outside of the suspension limits, immediate steps, including a halt to production, shall be taken to correct the grading.

b. Fine and coarse aggregate moisture content. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5%, the scale settings for the aggregate batcher and water batcher shall be adjusted.

c. Slump. The Contractor shall halt production and make appropriate adjustments whenever:

(1) one point falls outside the Suspension Limit line for individual measurements

OR

(2) two points in a row fall outside the Action Limit line for individual measurements

d. Air content. The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:

(1) one point falls outside the Suspension Limit line for individual measurements

OR

(2) two points in a row fall outside the Action Limit line for individual measurements.

505-8 Quality Assurance (QA) Acceptance.

505-8.1. Lot size. Concrete will be accepted for strength and thickness on a lot basis. A lot will consist of a day's production not to exceed 2,000 cubic yards (1530 cubic meters) **[[ ]** square yards **([ ]** square meters) **]**. Each lot will be divided into approximately equal sublots with individual sublots between 400 to 600 cubic yards. Where three sublots are produced, they will constitute a lot. Where one or two sublots are produced, they will be incorporated into the previous or next lot. Where more than one plant is simultaneously producing concrete for the job, the lot sizes will apply separately for each plant.

505-8.2 Partial lots. When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot or for overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three sublots have been produced, they will constitute a lot. Where one or two sublots have been produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will be used in the acceptance criteria calculation, that is, n=5 or n=6.

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The Engineer will specify the lot size for a project based on the total quantity and the expected production rate. The lot size should not exceed 2,000 cubic

yards (1,530 cubic meters). For projects where basis of payment is square yards (square meters), the Engineer will convert the lot size to an equivalent area that contains 2,000 cubic yards (1,530 cubic meters) or less.

Concrete for each placement will be accepted on the basis of the strength specified in paragraph 505-5.3. The Engineer will make and test the concrete at no expense to the Contractor.

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505-8.3. Compressive Strength.

(a) Sampling. Each lot shall be divided into equal sublots. One sample shall be taken for each sublot from the plastic concrete delivered to the job site. Sampling locations shall be determined by the RPR in accordance with random sampling procedures contained in ASTM D 3665. The concrete shall be sampled in accordance with ASTM C 172. All cylinders for compressive strength testing shall be 6" x 12". Any pavement that does not meet the minimum strength specified in paragraph 505-3 shall be removed and replaced.

(b) Testing**.** Two (2) specimens shall be made from each sample. Specimens shall be made in accordance with ASTM C 31 and the compressive strength of each specimen shall be determined in accordance with ASTM C 39. The compressive strength for each sublot shall be computed by averaging the results of the two test specimens representing that sublot. Cylinders shall be 6" x 12."

(c) Curing. The Contractor shall provide adequate facilities for the initial curing of **[** cylinders/beams **]**. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60 to 80 degrees F (16 to 27 degrees C), and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather or in heavyweight closed plastic bags, or use other suitable methods, provided the temperature and moisture loss requirements are met.

505-8.4. Thickness. The sublot thickness shall not be less than 0.5 inches (12 mm) from plan thickness. One core shall be taken by the contractor for each sublot. Sampling locations shall be determined by the RPR in accordance with random sampling procedures contained in ASTM D 3665. Areas such as thickened edges with planned variable thickness shall be excluded from sample locations.

Cores shall be neatly cut with a core drill. The Contractor shall furnish all tools, labor, and materials for cutting samples and filling the cored hole. Core holes shall be filled by the Contractor with a non-shrink grout approved by the RPR within one day after sampling.

The thickness of the cores shall be determined by the RPR by the average caliper measurement method in accordance with ASTM C 174.

505-8.5. Grade. Grade will be evaluated prior to the first day of placement and then as a minimum, prior to placement of the surface lift and after the placement of the surface lift to allow adjustments to paving operations if measurements do not meet specification requirements. The Contractor must submit the survey data to the RPR by the following day after measurements have been taken with measurements taken at appropriate gradelines (as a minimum at center and edges of paving lane) and 50 foot longitudinal spacing on cross-sections verifying that project is

in conformance with project plans and cross-sections. The final finished surface of the pavement of the completed project will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically **[** or 0.1 feet (30 mm) laterally **]**. The documentation, stamped and signed by a licensed surveyor, will be provided by the Contractor to the RPR. The contractor will pay the cost of the surveying and level runs. Grinding will be in accordance with P-505-6g. High points may be ground off provided the course thickness after grinding is not more than ½ inch (12 mm) less than the thickness specified on the plans.

[505-8.6. Profilograph Smoothness. The final profilograph will be the full length of the project to facilitate testing of smoothness between lots. Profilograph testing will be performed by the **[** contractor, in the presence of the RPR **] [** RPR **]** using approved equipment and procedures as described as ASTM E1274. The pavement must have an average profile index less than 15 inches per mile per 1/10 mile. The equipment will utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2 inch (5 mm) blanking band. The bump template must span one inch (25 mm) with an offset of 0.4 inches (10 mm). The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilograms will be recorded on a longitudinal scale of one inch (25 mm) equals 25 feet (7.5 m) and a vertical scale of one inch (25 mm) equals one inch (25 mm). Profilograph will be performed one foot right and left of project centerline and 15 feet (4.5 m) right and left of project centerline. Any areas that indicate "must grind" will be corrected with diamond grinding per paragraph 505-6g or by removing and replacing full depth of surface course. as directed by the RPR. Where corrections are necessary, second profilograph runs will be performed to verify that the corrections produced an average profile index of 15 inches per mile per 1/10 mile or less **]**.

[505-8.7. Adjustments for repair. Panels with spall repairs, partial panel replacement or grinding over 50% of panel will be limited to no more than 95% payment. **]**

505-9 Measurement. Portland cement concrete pavement shall be measured by the number of **[** cubic yards (cubic meters) **] [** square yards (square meters) **]** of pavement as specified in-place, completed and accepted.

505-10 Payment.

a. Payment for **accepted** concrete pavement shall be made at the contract unit price **[** per cubic yard (per cubic meter) **] [** per square yard (square meter) **]**. Payment shall be compensation for all labor, materials, tools, equipment, and incidentals required to complete the work as specified herein and on the drawings.

b. Payment. Payment shall be made under:

Item P-505-10 Portland Cement Concrete Pavement. **[** per cubic yard (cubic meter) **] [** per square yard (square meter) **]**

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Advisory Circular Feedback

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by (1) mailing this form to Manager, Airport Engineering Division, Federal Aviation Administration ATTN: AAS-100, 800 Independence Avenue SW, Washington DC 20591 or (2) faxing it to the attention of the Office of Airport Safety and Standards at (202) 267-5383.

Subject: AC 150/5100-13C Date: _____

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐ Recommend paragraph _____ on page _____ be changed as follows:

_____
_____
_____

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

_____
_____
_____

☐ Other comments:

_____
_____
_____

☐ I would like to discuss the above. Please contact me at (phone number, email address).

_____
_____
_____

Submitted by: _____ Date: _____