M-494.4

AC 150/5370-10

CHANGE 13

DATE 4/21/81

ADVISORY CIRCULAR

CHANGE

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

Subject: Change 13 to STANDARDS FOR SPECIFYING CONSTRUCTION OF AIRPORTS--Rewritten in Guide Specification Format

1. PURPOSE. Item P-304, Cement-Treated Base Course, has been rewritten in guide specification format. The procedure for determining the cement content has been clarified and statistical acceptance of the material for density has been added as an option.

The Change number and date of changed material is carried at the top of each page.

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
241-264	10/24/74	241-264	4/21/81

Leonard E. Mudd
LEONARD E. MUDD
Acting Associate Administrator for Airports

Suggest filing this transmittal at the back of the AC. It will provide a reference authority for changes, a method of determining that all Changes have been received, and a check for determining if the AC contains the proper pages.

Initiated by: AAS-200

ITEM P-304 CEMENT-TREATED BASE COURSE

1. DESCRIPTION

1.1 This item shall consist of a base course composed of mineral aggregate and cement uniformly blended and mixed with water. The mixed material shall be spread, shaped, and compacted in accordance with these specifications and in conformity to the lines, grades, dimensions, and typical cross sections shown on the plans. Runway, taxiway, or apron pavements shall be built in a series of parallel lanes using a plan of processing that reduces longitudinal and transverse joints to a minimum.

2. MATERIALS

2.1 PORTLAND CEMENT. Portland cement shall conform to the requirements of ASTM [**_____.]

****

The Engineer shall specify ASTM C150 Type I, II, III, IV, or V or ASTM C595 Type IS, IS-A, IP, IP-A, P, or PA. Lean porous concretes such as cement-treated base courses are more susceptible to sulfate attack than are structural and pavement concretes. Consideration should be given to possible detrimental sulfate effects from the presence of pyrites, gypsum, or other sulfates in subgrade soils, ground water, or aggregates. Sulfate-resistant cements should be specified when dangerous quantities of sulfates are likely to be present.

****

2.2 WATER. Water shall be clean, clear, and free from injurious amounts of sewage, oil, acid, strong alkalies, or vegetable matter, and it shall be free from clay or silt. If the water is of questionable quality, it shall be tested in accordance with the requirements of AASHTO T26.

2.3 AGGREGATE. The aggregate shall be select granular materials meeting the gradation requirements given in Table 1. The material shall be free of roots, sod, and weeds. The crushed or uncrushed aggregate shall consist of hard, durable particles of accepted quality, free from an excess of flat, elongated, soft, or disintegrated pieces, or objectionable matter. The method used in producing the aggregate shall be such that the finished product shall be as consistent as practicable. All stones and rocks of inferior quality shall be wasted.

Aggregates suspected of containing injurious quantities of sulfates shall be examined petrographically in accordance with ASTM C295.

ITEM P-304 CEMENT-TREATED BASE COURSE

****

While not wholly conclusive, petrographic examination will provide a valuable indicator of any substances that may be deleteriously reactive with the alkalies in the cement in an amount sufficient to cause expansion in the cement-treated base course.

****

The aggregate shall conform to the gradation shown in Table 1 when tested in accordance with ASTM C136.

TABLE 1. AGGREGATE CEMENT-TREATED BASE COURSE

Sieve Size	Percentage by Weight Passing Sieves
2 in. (50 mm)	*
No. 4 (4.75 mm)	*
No. 10 (1.80 mm)	*
No. 40 (450 micro-m)	*
No. 80 (210 micro-m)	*

****

The aggregate gradation band applicable to a project shall be specified by the Engineer from the gradations shown in this note. The gradation shall be inserted in Table 1. Insert points are denoted by asterisks.

Sieve Size	Percentage by Weight Passing Sieves A	B
2 in. (50 mm)	100 1/	100 1/
No. 4 (4.75 mm)	45-100	55-100
No. 10 (1.80 mm)	37-80	45-100
No. 40 (450 micro-m)	15-50	25-80
No. 80 (210 micro-m)	0-25	10-35

1/ Maximum size of aggregate is 1 inch (25 mm) when used as a base course under Item P-501, Portland Cement Concrete Pavement.

ITEM P-304 CEMENT-TREATED BASE COURSE

Where locally available aggregates cannot be economically blended to meet the grading requirements of the gradations shown, the gradations may be modified to fit the characteristics of such local aggregates. The modified gradation must produce a mixture that meets the compressive strength requirements of Paragraph 304-3.1. State highway department gradations can frequently be used to meet the requirements of this standard.

****

The gradations in the table represent the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradations decided on, within the limits designated in the table, shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on adjacent sieves, or vice versa. The portion of the base aggregate, including any blended material, passing the No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 6 when tested in accordance with ASTM D423 and D424.

All aggregate samples required for testing shall be furnished by the Contractor at the expense of the Contractor. Sampling shall be in accordance with ASTM D75 and will be observed by the Engineer. No aggregate shall be used in production of mixtures without prior approval.

2.4 BITUMINOUS MATERIAL. The types, grades, and controlling specifications and application temperatures for the bituminous material are given in Table 2.

The Engineer shall specify the type and grade of bituminous material to be used.

TABLE 2. BITUMINOUS MATERIAL

Type and Grade	Specification	Application Temperature Deg. F	Deg. C
Cutback Asphalt			
RC-70	ASTM D2028	120-160	50-70
RC-250		160-200	70-95
Emulsified Asphalt			
RS-1, SS-1	ASTM D977	75-130	25-55
CRS-1	ASTM D2397	75-130	25-55

ITEM P-304 CEMENT-TREATED BASE COURSE 1.5 1.6

3. CEMENT CONTENT 176

3.1 Prior to start of work, laboratory tests of materials submitted by the Contractor shall be made to determine the quantity of cement required in the mix. 179 180 180

The cement content for construction shall be that at which the mix develops a 7-day compressive strength of at least 750 psi (5 170 Kpa). The testing procedure shall be as follows: mold and cure specimens in accordance with ASTM D560; soak specimens in water for 4 hours; cap and break specimens in compression in accordance with ASTM D1633. 182 183 184 186 187 187

********** 188.4.

In areas subject to considerable freeze-thaw cycles, the Engineer may also specify that the freeze-thaw weight loss shall not exceed 14 percent when tested in accordance with ASTM D560. 190 190 191 191

An estimated cement content may be determined from Table 1, Chapter 2, of the Soil-Cement Laboratory Handbook, published by the Portland Cement Association. Cement contents above and below that estimated should be used in determining the quantity of cement needed to achieve the required strength. 193 196 197 198 198

********** 199.1.

4. CONSTRUCTION METHODS 201

4.1 WEATHER LIMITATIONS. The cement-treated base shall not be mixed or placed while the atmospheric temperature is below 40 degrees F (4 degrees C) or when conditions indicate that the temperature may fall below 35 degrees F (2 degrees C) within 24 hours or when the weather is rainy. Cement-treated base shall not be placed on frozen subgrade or mixed when aggregate is frozen. 204 205 206 207 208 209 209

4.2 OPERATION AT PITS. All work involved in clearing and stripping pits, including handling unsuitable material, shall be performed by the Contractor. The Contractor shall notify the Engineer sufficiently in advance of opening of any designated pit to permit staking of boundaries at the site, to take elevations and measurements of the ground surface before material is produced, to permit the Engineer to take samples of the material for tests to determine its quality and gradation, and to prepare a preliminary design of base mixture. 212 214 215 216 217 218 219 221 221

The pits, as utilized, shall be opened immediately to expose vertical faces of the various strata of acceptable material and, unless otherwise directed, the material shall be secured in successive vertical cuts extending through all the exposed strata in order to secure a uniform material. 225 226 228 229 229

ITEM P-304 CEMENT-TREATED BASE COURSE 1.5
1.6

4.3 PREPARING UNDERLYING COURSE. The underlying course shall be checked and accepted by the Engineer before placing and spreading operations are started. Any ruts or soft yielding places caused by improper drainage conditions, hauling, or any other cause shall be corrected before the base course is placed thereon.

4.4 MIXING. The aggregate shall be proportioned and mixed with cement and water in a central mixing plant. The plant shall be equipped with feeding and metering devices which will introduce the cement, aggregate, and water into the mixer in the quantities specified. Mixing shall continue until a thorough and uniform mixture has been obtained.

4.5 PLACING. The mixture shall be transported to the job site in suitable vehicles and shall be deposited on the moistened subbase in uniform layers by means of approved mechanical spreaders. Not more than 60 minutes shall elapse between the start of moist mixing and the start of compaction of the cement-treated mixture on the prepared subgrade.

4.6 COMPACTION. Immediately upon completion of the spreading operations, the mixture shall be thoroughly compacted. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density.

The field density of the compacted mixture shall be at least 98 percent of the maximum density of laboratory specimens prepared from samples of the cement-treated base material taken from the material in place. The specimens shall be compacted and tested in accordance with ASTM D558. The in-place field density shall be determined in accordance with ASTM D1556 or ASTM D2167. Any mixture that has not been compacted shall not be left undisturbed for more than 30 minutes. The moisture content of the mixture at the start of compaction shall not be below nor more than 2 percentage points above the optimum moisture content. The optimum moisture content shall be determined in accordance with ASTM D558 and shall be less than that amount which will cause the mixture to become unstable during compaction and finishing.

****
The following optional paragraph applies when cement-treated base course is to be accepted for density on a statistical basis. Delete the paragraph below if not applicable. If applicable, substitute for Paragraph 4.6.
****

ACCEPTANCE SAMPLING AND TESTING OF CEMENT-TREATED BASE COURSE (COMPACTION). Immediately upon completion of the spreading operations, the mixture shall be thoroughly compacted. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density.

ITEM P-304 CEMENT-TREATED BASE COURSE

The cement-treated base course shall be accepted for density on a lot basis. A lot will consist of [**_____] and will be divided into four equal sublots. One test shall be made for each sublot. Sampling locations will be determined by the Engineer on a random basis in accordance with statistical procedures contained in ASTM D3665.

Each lot of compacted material will be accepted, with respect to density, when the average field density is equal to or greater than 98 percent of the maximum density of laboratory specimens prepared from samples of cement-treated base course taken from the material in place.

The laboratory specimens shall be compacted and tested in accordance with ASTM D558. The in-place field density shall be determined in accordance with ASTM D1556 or ASTM D2167.

The lot will be accepted without adjustment in payment if the average density, based on four acceptance tests of the lot, is greater than or equal to 98 percent. If the average density does not meet this requirement, the Contractor may elect to leave the lot in place at a reduced unit price determined in accordance with Table 3.

TABLE 3. SLIDING SCALE PAY FACTORS

Average Percent Density	Recommended Percent Payment
98.0 and greater	100
97.0-97.9	95
96.0-96.9	90
95.0-95.9	75
less than 95.0	reject

Any mixture that has not been compacted shall not be left undisturbed for more than 30 minutes. The moisture content of the mixture at the start of compaction shall not be below nor more than 2 percentage points above the optimum moisture content. The optimum moisture content shall be determined in accordance with ASTM D558 and shall be less than that amount which will cause the mixture to become unstable during compaction and finishing.

ITEM P-304 CEMENT-TREATED BASE COURSE 1.5
1.6

****
A lot is the quantity of material to be controlled. The lot size, to be specified by the Engineer, should not exceed 1200 square yards (1 003 square meters) or 200 cubic yards (153 cubic meters). One day's production may be specified as the lot size where it is not expected to exceed 1200 square yards (1 003 square meters) or 200 cubic yards (153 cubic meters).
********** 335.4.1 337 339 339 340 341 341 341 342.1.2

4.7 LAYER THICKNESS. The maximum depth of a compacted layer shall be 6 inches (15.2 cm), except where that total depth of the compacted base course is required to be greater than 6 inches (15.2 cm), no layer shall be in excess of 8 inches (20.3 cm) or less than 4 inches (10.2 cm) when compacted. In multilayer construction, the surface of the compacted material shall be kept moist until covered with the next layer. Successive layers shall be placed and compacted so that the required total depth of the base course is completed the same day. 345 346 347 348 350 351 352 353 353

4.8 FINISHING. Finishing operations shall be completed during daylight hours, and the completed base course shall conform to the required lines, grades, and cross section. If necessary, the surface shall be lightly scarified to eliminate any imprints made by the compacting or shaping equipment. The surface shall then be recompacted to the required density. 356 357 361 361 363 363

The compaction and finishing operations shall be completed within 2 hours of the time water is added to the mixture and shall produce a smooth, dense surface that is free of surface checking, ridges, or loose material. 365 366 367 369

4.9 SURFACE TOLERANCE. The finished surface shall not vary more than 3/8 inch (10 mm) when tested with a 16-foot (5 m) straightedge applied parallel with, or at right angles to, the centerline of the stabilized area. Any deviation in excess of this amount shall be corrected by the Contractor at the Contractor's expense. 372 373 376 377 378 378

4.10 CONSTRUCTION JOINTS. At the end of each day's construction, a transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true vertical face free of loose material. 381 382 383 383

Longitudinal joints shall be formed by cutting back into the compacted material to form a true vertical edge. 385 386

ITEM P-304 CEMENT-TREATED BASE COURSE 1.5
1.6

4.11 PROTECTION AND CURING. The completed cement-treated base shall be cured with a bituminous curing seal applied as soon as possible, and in no case later than 24 hours after completion of the finishing operations. The surface of the base course shall be kept moist until the bituminous material is applied.

Bituminous material shall be uniformly applied at a rate of between 0.10 and 0.25 gallons per square yard (0.47 and 1.20 liters per square meter) of surface. The rate of application shall be approved by the Engineer.

The curing seal shall be maintained and protected for 7 days.

Finished portions of the base course that are used by equipment in the construction of an adjoining section shall be protected to prevent marring or damaging the completed work. The stabilized area shall be protected from freezing during the curing period.

5. METHOD OF MEASUREMENT

5.1 The quantity of cement-treated base to be paid for will be determined by measurement of the number of [square yards (square meters)] [cubic yards (cubic meters)] of base actually constructed and accepted by the Engineer as complying with the plans and specifications.

5.2 Portland cement will be measured by the hundredweight.

6. BASIS OF PAYMENT

6.1 Payment shall be made at the contract unit price per [square yard (square meter)] [cubic yard (cubic meter)] for cement-treated base course. This price shall be full compensation for furnishing all materials, except portland cement; for all preparation, manipulation, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

****
The following optional paragraph applies when cement-treated base course is accepted for density as described under notes in Paragraph 304-4.6. Delete the paragraph below if not applicable.
****

Each lot of cement-treated base course will be accepted for density at the full contract unit price when the results of four density tests indicate that the average density is equal to or greater than 98 percent as determined by Paragraph 304-4.6. Each

ITEM P-304 CEMENT-TREATED BASE COURSE 1.5 1.6

lot not meeting this requirement will be accepted at an adjusted contract unit price in accordance with Table 3.

6.2 Payment shall be made at the contract unit price per hundredweight for portland cement. This price shall be full compensation for furnishing this material; for all delivery, placing, and incorporation of this material; and for all labor, equipment, tools, and indicentals necessary to complete the item.

Payment will be made under:

Item P-304-6.1	Cement-Treated Base Course - per [square yard (square meter)] [cubic yard (cubic meter)]
Item P-304-6.2	Portland Cement - per hundredweight

7. TESTING REQUIREMENTS

ASTM C136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM C295	Petrographic Examination of Aggregates for Concrete
ASTM D75	Sampling Aggregates
ASTM D423	Liquid Limit of Soils
ASTM D424	Plastic Limit and Plasticity Index of Soils
ASTM D558	Moisture-Density Relations of Soil-Cement Mixtures
ASTM D560	Freezing-and-Thawing Tests of Compacted Soil-Cement Mixtures
ASTM D1556	Density of Soil in Place by the Sand-Cone Method
ASTM D1633	Compressive Strength of Molded Soil-Cement Cylinders
ASTM D2167	Density of Soil in Place by the Rubber-Balloon Method
ASTM D3665	Random Sampling of Paving Materials
AASHTO T26	Quality of Water to be Used in Concrete

ITEM P-304 CEMENT-TREATED BASE COURSE 1.5
1.6

8. MATERIAL REQUIREMENTS 501

ASTM C150	Portland Cement	504
ASTM C595	Blended Hydraulic Cements	507
ASTM D977	Emulsified Asphalt	510
ASTM D2028	Liquid Asphalt (Rapid Curing Type)	513
ASTM D2397	Cationic Emulsified Asphalt	516

+ + END OF ITEM P-304 + + 517.3

U.S. Department of Transportation
Federal Aviation Administration

800 Independence Ave., S.W.
Washington, D.C. 20591

Official Business
Penalty for Private Use $300

PRESORTED FIRST-CLASS MAIL
POSTAGE & FEES PAID
FEDERAL AVIATION ADMINISTRATION
PERMIT NO. G-44

☆ U.S. GOVERNMENT PRINTING OFFICE: 1981 — 728-077/1769 REGION 3-1