

**MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF AERONAUTICS - STANDARD SPECIFICATION
P-304
Cement-Treated Base Course**

DESCRIPTION

1.1 This item shall consist of a base course composed of mineral aggregate and cement 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 plan. 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.

MATERIALS

2.1 Portland Cement. Portland cement shall conform to the requirements of ASTM C150, Type I.

2.2 Water. Water shall be clean, clear, and free from injurious amounts of sewage, oil, acid, strong alkalis, 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 selected 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.

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

TABLE 1.
AGGREGATE CEMENT TREATED BASE

Sieve	Percent Passing By Weight
2 in. (50 mm)	100*
No. 4 (4.75 mm)	45-100
No. 10 (1.80 mm)	37-80
No. 40 (0.450 mm)	15-50
No. 80 (0.210 mm)	0-25

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

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 (C°)
Cutback Asphalt	ASTM D2028	
RC-70		50-70
RC-250		70-95
Emulsified Asphalt		
RS-2, SS-1	ASTM D977	25-25
CRS-1	ASTM D2397	25-55

CEMENT CONTENT

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.

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.

The freeze-thaw weight loss shall not exceed 14 percent in accordance with ASTM D560.

CONSTRUCTION METHODS

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.

4.2 Operation at Pits. All work involves 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.

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.

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 maturing 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 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.

The cement-treated base course shall be accepted for density on a lot basis. A lot will consist of 1200 square yards and will be divided into four equal sublots. One test shall be made for each subplot. 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 finish finishing.

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 multi layer 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.

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 recompact to the required density.

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.

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.

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.

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

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.

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 [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 hundred weight.

BASIS OF PAYMENT

6.1 Payment shall be made at the contract unit price per square yard (square 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.

Each lot of cement-treated base course will be accepted for density at the full contract 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 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 hundred weight 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 incidentals necessary to complete the item.

AASHTO T26 Quality of Water to be Used in Concrete

Payment will be made under the nomenclature and seven digit item number specified in the plans and proposal for cement-treated base course required per square yard.

MATERIAL REQUIREMENTS

The first three digits of any item number for work included under this specification shall be 304, i.e. 304XXXX.

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

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