

**MICHIGAN DEPARTMENT OF TRANSPORTATION  
BUREAU OF AERONAUTICS - STANDARD SPECIFICATION  
P-209  
Crushed Aggregate Base Course**

**DESCRIPTION**

**1.1** This item shall consist of a base course composed of crushed aggregates constructed on the prepared underlying course in accordance with these specifications and shall conform to the dimensions and typical cross section shown on the plans and with the lines and grades established by the Engineer.

**MATERIALS**

**2.1** **Aggregate.** Aggregates shall consist of clean, sound, durable particles of crushed stone, crushed gravel, or crushed slag and shall be free from coatings of clay, silt, vegetable matter, and other objectionable materials and shall contain no clay balls. Fine aggregate passing the number 4 (9.5 mm) sieve shall consist of fines from the operation of crushing the coarse aggregate. If necessary, fine aggregate may be added to produce the correct gradation. The fine aggregate shall be produced by crushing stone, gravel or slag that meet the requirements for wear and soundness specified for coarse aggregate.

The crushed slag shall be an air-cooled, blast furnace slag and shall have a unit weight of not less than 70 pounds per cubic foot (1.12 Mg/m<sup>3</sup>) when tested in accordance with ASTM C29.

The crushed aggregate portion which is retained on the number 4 sieve shall contain not more than 15 percent, by weight, of flat or elongated pieces as defined in ASTM D693 and shall have at least 90 percent by weight of particles with at least two fractured faces and 100 percent with at least one fractured face. The area of each face shall be equal to at least 75 percent of the smallest midsectional area of the piece. When two fractured faces are contiguous, the angle

between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

The percentage of wear shall not be greater than 45 percent when tested in accordance with ASTM C131. The sodium sulfate soundness loss shall not exceed 12 percent, after 5 cycles, when tested in accordance with ASTM C88.

The fraction passing the No. 40 (0.042 mm) sieve shall have a liquid limit no greater than 25 and a plasticity index of not more than 4 when tested in accordance with ASTM D4318. The fine aggregate shall have a minimum sand equivalent value of 35 when tested in accordance with ASTM D2419.

The Contractor shall make arrangements with an independent laboratory to perform the above tests prior to delivery of the aggregates to the jobsite. Samples shall be taken by the Contractor in accordance with ASTM D75. The Contractor shall pay all expenses for testing and related transport charges per the requirements of Section 60 of the General Provisions.

**2.2** **Gradation Requirements**

The requirements for gradation of the aggregate are listed in Table 1. The gradation of the mixture delivered for placement shall be continuously well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on an adjacent sieve or vice versa.

TABLE 1. REQUIREMENTS FOR GRADATION OF AGGREGATE

Sieve Size	Design Range Percentage by Weight Passing Sieves	Job Mix Tolerance Percent
2 inch (50.0 mm)	100	
1½ inch (37.0 mm)	95-100	± 5
1 inch (25.0 mm)	70-95	± 8
¾ inch (19.0 mm)	55-85	± 8
No. 4 (4.75 mm)	30-60	± 8
No. 30 (0.60 mm)	12-30	± 5
No. 200 (0.075 mm)	0-8	± 3

An independent laboratory shall test the aggregate for conformance with Table 1 requirements prior to delivery of the material to the job site. Samples shall be taken by the Contractor per ASTM D75 and tested in accordance with ASTM C117 and C136. Also, the material shall be tested in accordance with ASTM D422. The maximum percent of material by weight smaller than 0.02 mm shall be 3 percent. All costs related to these preliminary tests shall be paid by the Contractor.

Samples of the aggregates will be taken by the Engineer after the aggregates have been delivered to the job site, but prior to placement in the constructed base course. The aggregate samples will be taken in accordance with ASTM D75 and be tested for gradation in accordance with ASTM C117 and C136, and these tests shall be the basis of final acceptance. The Engineer will determine the frequency of sampling and shall advise the Contractor of the test results. Material which fails to meet specification requirements shall not be incorporated into the work.

The fraction of the final mixture that passes the No. 200 (0.075 mm) sieve shall not exceed 60 percent of the fraction passing the No. 30 (0.60 mm) sieve.

The job mix tolerances in Table 1 shall be applied to the job mix gradation to establish a job control grading band. The full tolerance still will apply, if application of the tolerances results in a job control grading band outside the design range.

### CONSTRUCTION METHODS

**3.1 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 at the Contractor's expense before the base course is placed thereon. Material shall not be placed on frozen subgrade.

**3.2 Mixing.** The aggregate shall be uniformly blended during crushing operations or mixed in a plant. The plant shall blend and mix

the materials to meet the specifications and to secure the proper moisture content for compaction.

**3.3 Placing.** The crushed aggregate base material shall be placed on the moistened subgrade in layers of uniform thickness with a mechanical spreader.

The maximum depth of a compacted layer shall be 6 inches (15.2 cm). If the total depth of the compacted material is more than 6 inches, it shall be constructed in two or more layers. In multi-layer construction, the base course shall be placed in approximately equal-depth layers.

The previously constructed layers should be cleaned of loose and foreign material prior to placing the next layer. The surface of the compacted material shall be kept moist until covered with the next layer.

**3.4 Compaction.** Immediately upon completion of the spreading operations, the crushed aggregate shall be thoroughly compacted. The number, type and weight of rollers shall be sufficient to compact the material to the required density.

The base material shall have a satisfactory moisture content when rolling is started, and maintained by sprinkling or aeration, if necessary.

During placing and spreading, the Contractor shall prevent the incorporation of subgrade, subbase or shoulder material in the base course mixture.

**3.5 Acceptance Sampling and Testing for Density.** Each layer of aggregate base course placed shall be accepted for density on a lot basis. A lot will consist of 2400 square yard (2000 square meters) increments for each layer placed.

Each lot shall be divided into two equal sublots and each tested for in-place field density in

accordance with ASTM D1556 or D2167. Sampling locations will be determined by the Engineer.

Each lot will be accepted for density when the field density is at least 100 percent of the maximum density determined in accordance with ASTM D1557, Method D [pavements designed for aircraft weights 60,000 lb. (27270 Kg) and greater] or D698, Method D [pavements designed for aircraft weights less than 60,000 lb. (27270 Kg)]. The Engineer shall designate the appropriate ASTM standard.

If the specified density is not attained, the entire sublot shall be reworked and/or recompacted until the specified density is reached. In lieu of the core method of field density determination, acceptance testing may be accomplished using a nuclear gauge in accordance with ASTM D2922. The gauge should be field calibrated in accordance with paragraph 4 of D2922. Calibration tests shall be conducted on the first lot of material placed that meets the density requirements.

Use of ASTM D2922 results in a wet unit weight, and when using this method, ASTM D3017 shall be used to determine the moisture content of the material. The calibration curves furnished with the moisture gauges shall be checked as described in paragraph 7 of D3017. The calibration checks of both the density and moisture gages shall be made at the beginning of a job and at intervals, as determined by the Engineer.

If a nuclear gauge is used for density determination, two readings shall be made in each sublot.

Tests for compaction of the aggregate shall be performed by the Engineer and are not a Contractor cost.

**3.6 Finishing.** The surface of the aggregate base course shall be finished by blading or with automated equipment especially designed for

this purpose.

In no case will the addition of thin layers of material be added to the top layer of base course to meet grade. If the elevation of the top layer is  $\frac{1}{2}$  inch (12 mm) or more below grade, the top layer of base shall be scarified to a depth of at least 3 inches (72 mm), new material added, and the layer shall be blended and recompact to bring it to grade. If the finished surface is above plan grade, it shall be cut back to grade and rerolled.

**3.7 Surface Test.** After the course has been completely compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified, reshaped, recompact, and otherwise manipulated at the Contractor's expense as the Engineer may direct until the required smoothness and accuracy are obtained. The finished surface shall not vary more than  $\frac{3}{8}$  inch (10 mm) from a 16-foot (5 m) straightedge when applied to the surface parallel with, and at right angles to, the centerline.

**3.8 Thickness.** The thickness of the completed base course material shall be determined by elevations taken to the nearest 0.01 foot (3 mm), at intervals not exceeding 50 feet (15 m), using the method of setting finished grades stakes.

The thickness shall be verified by the Contractor, at his expense, by the taking of cores or depth tests in the presence of the Engineer. Cores or depth test shall be taken at intervals of not less than one per 1200 square yards (1000 meters) of material placed. When deficiencies in excess of  $\frac{1}{2}$  inch (12 mm) are noted, the Contractor shall make such additional cores or depth tests, as required by the Engineer, to determine the extent of the deficiency. Replacement and compaction of base material removed for test purposes shall be accomplished by the Contractor, at his expense.

Deficiencies in thickness in excess of  $\frac{1}{2}$  inch (12 mm) of base material shall be corrected by the Contractor, at his expense, by scarifying, adding satisfactory mixture, rolling, sprinkling, reshaping and finishing in accordance with these specifications.

**3.9 Protection.** Work on the base course shall not be accomplished during freezing temperatures, nor when the subgrade is saturated. When the aggregates contain frozen materials or when the underlying course is frozen, the construction shall be stopped.

Hauling equipment may be routed over completed portions of the base course, provided no damage results and provided that such equipment is routed over the full width of the base course to avoid rutting or uneven compaction. However, the Engineer shall have full and specific authority to stop all hauling over completed or partially completed base course when, in his opinion, such hauling is causing damage. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at his own expense.

**3.10 Maintenance.** Following the completion of the base course, the Contractor shall perform all maintenance work necessary to keep the base course in a condition satisfactory for paving. The base course shall be properly drained at all times and free from foreign material. If cleaning is necessary, or if the prime coat becomes disturbed, any work or restitution necessary shall be performed at the expense of the Contractor.

## METHOD OF MEASUREMENT

**4.1** The quantity of crushed aggregated base course to be paid for shall be the number of cubic yards, compacted measure, of base course material placed, bonded, and accepted in the completed base course. The quantity of base course material shall be measured in final position, based on average end areas of the

completed work, computed from elevations to the nearest 0.01 foot. No payment will be made for material placed in excess of the specified depth or width. Base materials shall not be included in any other excavation quantities.

**BASIS OF PAYMENT**

**5.1** Payment shall be made at the contract unit price per cubic yard, compacted, measurement, for crushed aggregate base course. This price shall be full compensation for furnishing all materials and for all preparation, hauling and placing of these materials and for all labor, equipment, tools and incidentals necessary to complete this item.

Payment will be made under the nomenclature and seven digit item number specified in the plans and proposal for each type of crushed aggregate base course or crushed base course work required per cubic yard or per square yard, as applicable.

The first three digits of any item number for work included under this specification shall be 209, i.e., 209XXXX.

**TESTING AND MATERIAL REQUIREMENTS**

Test and Short Title

ASTM C29	Unit Weight of Aggregate
ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate of Magnesium Sulfate
ASTM C117	Materials Finer than 0.75 mm ( No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

ASTM C136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM D75	Sampling Aggregate
ASTM D693	Crushed Stone, Crushed Slag and Crushed Gravel for Dry-or-Water-Bound Macadam Base Courses and Bituminous Macadam Base and Surface Courses of Pavements
ASTM D698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb. (2.49 kg) Ramer and 12-in (305 mm) Drop
ASTM D1556	Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.5 kg) Ramer and 18 in (145 mm) Drop
ASTM D2167	Density of Soil in Place by the Rubber-Balloon Method
ASTM D2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D3017	Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D3665	Random Sampling of Paving Materials
ASTM D4318	Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D422	Particle Size Analysis of Soils

Material and Short Title

None