

**MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF AERONAUTICS -- STANDARD SPECIFICATION
P-208
Aggregate Base Course**

DESCRIPTION

1.1 This item shall consist of a base course composed of a partially crushed and uncrushed coarse aggregate combined with natural fine aggregates (sand) and soil. It shall be constructed on a 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. The aggregates shall consist of a combination of both fine and coarse fragments of hard crushed stone, crushed slag, crushed or uncrushed gravel mixed or blended with natural sand, crusher screenings, or other similar, approved materials. The crushed stone shall consist of hard, durable particles or fragments of stone and shall be free from excess flat, elongated, soft or disintegrated pieces, dirt, or other objectionable matter.

Crushed slag, if used, shall be air-cooled, blast-furnace slag and shall consist of angular fragments reasonably uniform in density and quality and shall be reasonably free from thin, elongated or soft pieces, dirt, and other objectionable matter. It shall weigh not less than 70 pounds per cubic foot, as determined by ASTM C29.

The crushed gravel shall consist of hard durable stones, rock and boulders crushed to specified size and shall be free from excess flat, elongated, soft or disintegrated pieces, dirt or other objectionable matter. The method used in production of crushed gravel shall produce a finished product as constant and uniform as practicable.

The percentage of crushed material having one or more fractured faces **shall be the minimum specified within the plans.** If not specified there, the Table 1 minimums will apply for crushed content, percent by weight. Determination of crushed content shall be done on a sample taken of the base material. The minimum percentage applies to the portion that is retained on a No. 4 mesh sieve. If necessary, to meet

the minimum crushed aggregate percentage or to eliminate an excess of fine, uncrushed particles, gravel may be screened before crushing. All stones, rocks, and boulders of inferior quality in the pit shall be wasted.

The coarse aggregate (crushed and uncrushed) shall have a percent of wear not more than 50 at 500 revolutions, as determined by ASTM C131.

All material passing the No. 4 mesh sieve produced in the crushing operation of either stone, slag, or gravel shall be incorporated in the base material to the extent permitted by the gradation requirements.

2.2 Gradation. The plans designate the base course material type to be provided by the contractor. Unless otherwise noted, it shall meet the applicable gradations listed within the following table when tested in accordance with ASTM 117, ASTM C136 and ASTM D422.

TABLE 1. REQUIREMENTS FOR GRADATION OF AGGREGATE

Sieve designation (square openings)	Percentage by weight passing sieves		
	A 2" maximum	B 1½" maximum	C 1" maximum MDOT 22A
2 inch	100	-	-
1 ½ inch	70-100	100	-
1 inch	55-85	70-95	100
¾ inch	50-80	55-85	90-100
⅜ inch	-	-	65-85
No. 8	-	-	30-50
No. 4	30-60	30-60	-
No. 40	10-30	10-30	-
No. 200	4-8*	4-8*	4-8 *
Minimum Crushed (%)	25	25	25

When aggregate base material is produced entirely by crushing rock, boulders, cobbles, slag or concrete, loss by washing must not exceed 10 percent (significant to the nearest whole percent). For aggregates produced from sources in Berrien County, the loss by washing must not exceed 8 percent and the sum of loss by washing and shale particles must not exceed 10 percent.

The gradations in the table represent the limits that 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 course to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieves, or vice versa.

The amount of the fraction of material passing the No. 200 mesh (0.075mm) sieve shall not exceed one-half the fraction passing the No. 40 mesh (0.45 mm) sieve. The aggregate blend shall not contain more than 3 percent material finer than 0.02 mm unless all materials are produced from crushed stone.

The portion of the filler and binder, including any blended material, passing the No. 40 (0.45 mm) mesh sieve shall have a liquid limit not more than 25 and a plasticity index not more than 6, when tested in accordance with ASTM D4318.

The selection of any of the gradations shown in the table shall be such that the maximum-size aggregate used in any course shall be not more than two-thirds the thickness of the layer of the course being constructed.

2.3 Filler for Blending. If filler, in addition to that naturally present in the base course material, is necessary for satisfactory bonding of the material, for changing the soil constants of the material passing the No. 40 (0.45 mm) mesh sieve, or for correcting the gradation to the limitations of the specified gradation, it shall be uniformly blended with the base course material at the crushing plant or at the mixing plant. The material for such purpose shall be obtained from sources approved by the Engineer and shall be of a gradation necessary to accomplish the specified gradation in the final processed material.

The additional filler may be composed of sand, but the amount of sand shall not exceed 20 percent by weight of the total combined base aggregate. All the sand shall pass a No. 4 (4.75mm) mesh sieve, and not more than 5 percent by weight shall pass a No. 200 (0.075mm) mesh sieve.

CONSTRUCTION METHOD

3.1 Operations in Pits and Quarries. All work involved in clearing and stripping pits and quarries,

including handling of unsuitable material, shall be performed by the Contractor. All material shall be handled in a manner that shall secure a uniform and satisfactory base product. The base course material shall be obtained from sources that have been approved.

3.2 Equipment. All equipment necessary for the proper construction of this work shall be on the project site, in first-class working condition and approved by the Engineer before construction is permitted to start.

3.3 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 due to improper drainage conditions, hauling, or any other cause, shall be corrected and rolled to the required density before the base course is placed thereon.

Grade control between the edges of the pavement shall be accomplished by grade stakes, steel pins, or forms placed in lanes parallel to the centerline of the pavement at intervals sufficiently close that string lines or check boards may be placed between stakes, pins or forms.

To protect the underlying course and to ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

3.4 Methods of Production.

(a) **Plant Mix.** When provided in the proposal, or when selected by the Contractor and approved by the Engineer, the base material shall be uniformly blended or mixed in any approved plant. The mixing plant shall include bins for storage and batching of the aggregate, pump and tanks for water, and batch mixers of either the pugmill or drum type. All mineral aggregates shall be batched into the mixer by weight. The agitation shall be such that a thorough dispersion of moisture is obtained. The size of the batch and the time of mixing shall be fixed by the Engineer and shall produce the results and requirements specified. The base course material produced by combining two or more materials from different sources shall be mixed in a mixing plant described herein. The mixture material shall be at a satisfactory moisture content to obtain maximum density.

The base material shall be stockpiled, either at the plant or on the worksite, prior to placing and spreading on the prepared underlying course.

(b) Materials of Proper Gradation. When the entire base course material from coarse to fine is secured in a uniform and well-graded condition and contains approximately the proper moisture, such approved material may be handled directly to the spreading equipment. The material may be obtained from gravel pits, stockpiles, or produced from a crushing and screening plant with the proper blending. The materials from these sources shall meet the requirements for gradation, quality, and consistency. The intent of this section of specifications is to secure materials that will not require further mixing. The base material shall be at a satisfactory moisture content to obtain maximum density. Any minor deficiency or excess of moisture may be corrected by surface sprinkling or by aeration. In such instances some mixing or manipulation may be required immediately preceding the rolling to obtain the required moisture content. The final operation shall be blading or dragging, if necessary, to obtain a smooth, uniform surface true to line and grade.

The base material shall be stockpiled, either at the plant or on the worksite, prior to placing and spreading on the prepared underlying course.

3.5 Methods of Placement

(a) The aggregate base material that is correctly proportioned or has been processed in a plant shall be placed on the prepared underlying course and compacted in layers of the thickness shown on the plans. The depositing and spreading of the material shall commence where designated and shall progress continuously without breaks. The material shall be deposited and spread in lanes in a uniform layer and without segregation of the size to such loose depth that, when compacted, the layer shall have the required thickness. The base aggregate shall be spread by spreader boxes or other approved devices having positive thickness controls that shall spread the aggregate in the required amount to avoid or minimize the need for hand manipulation. Dumping from vehicles in piles which require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

(b) The aggregate base material that has been processed in a traveling plant, or mixed and blended in-place, shall be spread in a uniform layer of required depth and width and to the typical cross-section. The spreading shall be by a self-powered blade grader, mechanical spreader, or other approved method. In spreading, care shall be taken to prevent cutting into the underlying layer. The material shall be bladed until a smooth, uniform surface is obtained, true to line and grade.

(c) The base course shall be constructed in layers not less than 3 inches or more than 6 inches of compacted thickness. The aggregate as spread shall be of uniform grading with no pockets of fine or coarse materials. The aggregate, unless otherwise permitted by the Engineer, shall not be spread more than 2,000 square yards in advance of the rolling. Any necessary sprinkling shall be kept within these limits. No material shall be placed in snow or on a soft, muddy, or frozen course.

When more than one layer is required, the construction procedure described herein shall apply similarly to each layer.

The Engineer shall make quality assurance tests to determine density and moisture content of the completed base material, and this information will be available to the Contractor. The Contractor shall provide for quality control testing during placement and rolling operations. The Contractor shall maintain the base material to a satisfactory moisture content when rolling is started, and any minor variation prior to or during rolling shall be corrected by sprinkling or by aeration, if necessary. A satisfactory moisture content is considered to be within 2 percentage points of the base material optimum moisture content determined by the moisture/density standards contained in section 3.6.

During the mixing and spreading process, sufficient caution shall be exercised to prevent the incorporation of subgrade, subbase, or shoulder material in the base course mixture.

3.6 Finishing and Compacting. Rolling shall continue until the base material has been compacted to not less than 100 percent Density of Compaction Control Standard ASTM D698 (aircraft weight designs to 60,000 pounds or less) or ASTM D1557 (aircraft weight designs greater than 60,000 pounds).

Field testing for in-place density control may be done by ASTM method D1556 (sand cone method), ASTM D2167 (balloon method) or D2922/D3017 (nuclear method/moisture content by nuclear method).

Grading and rolling shall be done alternately to obtain a smooth, even, and uniformly compacted base. In areas inaccessible to rollers, the base course material shall be compacted with an appropriate mechanical compactor so that the entire base course has achieved 100 percent density.

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, recompacted, and otherwise manipulated as the Engineer may direct until the required smoothness and accuracy are obtained. The finished surface shall not vary more than 3/8-inch from a 16-foot straight edge 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, at intervals not exceeding 50 feet, using the method of setting finished grade 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 tests shall be taken at intervals of not less than one per 3000 square yards of material placed. When deficiencies in excess of 1/2-inch 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 1/2-inch 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. Should frozen material be found in the base course or the

underlying course, construction shall be stopped until such conditions are no longer present.

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 in charge 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 at the Contractor's expense.

3.10 Maintenance. The Contractor is responsible to maintain adequate surface drainage over the work area during construction to prevent surface ponding or erosion. The Contractor shall take corrective action if the subgrade or the base course contains excessive moisture which results in the continued yielding of the surface during hauling, grading and compaction operations. The Contractor shall continue to maintain the completed base course until placement of the surface course.

Prior to the application of a surface course, the base course shall be allowed to partially dry to a moisture content below 80 percent of its optimum moisture content. The drying shall not continue to the extent that the surface of the base becomes dusty with consequent loss of binder. If the base course dries too fast, it shall be kept moist by sprinkling in order to maintain stability prior to placement of the final asphalt or concrete surface material.

METHOD OF MEASUREMENT

4.1 The quantity of aggregate 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 on 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 plan cross-section width or depth. Base materials shall not be included in any other excavation quantities.

BASIS OF PAYMENT

ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

5.1 Payment shall be made at the contract unit price per cubic yard, compacted measurement, for 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 aggregate base course or 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 208; i.e., 208XXXX

TESTING REQUIREMENTS

- ASTM C29 Unit Weight of Aggregate
- ASTM C117 Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C131 Resistance to Abrasion of Small Size Course Aggregate by Use of the Los Angeles Machine
- ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
- ASTM D422 Particle-Size Analysis of Soils
- ASTM D698 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb Rammer @ 12-inch Drop
- ASTM D1556 Density of Soil in Place by the Sand-Cone Method
- ASTM D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort
- ASTM D2167 Density of Soil in Place by the Rubber Balloon Method