

SECTION 32 11 23

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- AASHTO T 180 (2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
- AASHTO T 224 (2001; R 2004) Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

- ASTM C 117 (2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 127 (2004) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
- ASTM C 128 (2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- ASTM C 131 (2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- ASTM C 136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- ASTM C 88 (2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- ASTM D 1557 (2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
- ASTM D 2487 (2006) Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2007a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 75	(2003) Standard Practice for Sampling Aggregates
ASTM E 11	(2004) Wire Cloth and Sieves for Testing Purposes

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Graded-Crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

1.2.3 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in [ASTM D 1557](#) abbreviated as a percent of laboratory maximum dry density. Since [ASTM D 1557](#) applies only to soils that have 30 percent or less by weight of their particles retained on the $3/4$ inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the $3/4$ inch sieve shall be expressed as a percentage of the laboratory maximum dry density in accordance with [AASHTO T 180](#) Method D and corrected with [AASHTO T 224](#).

1.3 PAYMENT FOR STABILIZATION OF UNDERLYING COURSE

Stabilization of cohesionless subgrade or subbase courses, as specified in paragraph PREPARATION OF UNDERLYING COURSE, shall be included in the lump sum bid item for the project.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submitted the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

[SD-03 Product Data](#)

[Plant, Equipment, and Tools](#)

List of proposed equipment to be used in performance of construction work, including descriptive data.

Waybills and Delivery Tickets

Copies of waybills and delivery tickets during the progress of the work.

SD-06 Test Reports

Sampling and Testing; G
Field Density Tests; G

Certified copies of test results for approval not less than 30 days before material is required for the work.

Calibration curves and related test results prior to using the device or equipment being calibrated.

Copies of field test results within 24 hours after the tests are performed.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with [ASTM D 75](#). When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with [ASTM C 117](#) and [ASTM C 136](#). Sieves shall conform to [ASTM E 11](#).

1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with [ASTM D 4318](#).

1.5.2.3 Moisture-Density Determinations

The laboratory maximum dry density and optimum moisture content shall be determined in accordance with [ASTM D 1557](#).

1.5.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 6938.

1.5.2.5 Wear Test

Wear tests shall be made on GCA course material in conformance with ASTM C 131.

1.5.2.6 Soundness

Soundness tests shall be made on GCA in accordance with ASTM C 88.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis.
- b. Liquid limit and plasticity index.
- c. Moisture-density relationship.
- d. Wear.
- e. Soundness.

1.5.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted ABC. Samples shall be taken and tested at the rates indicated.

- a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.
- b. Sieve Analysis shall be performed on every lift of material placed and at a frequency of one sieve analysis for every 500 square yards, or portion thereof, of material placed.
- c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.
- d. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

1.5.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will

be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted course(s).

1.6 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work shall be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.7 WAYBILLS AND DELIVERY TICKETS

Before the final statement is allowed, the Contractor shall file certified waybills and certified delivery tickets for all aggregates actually used, as specified in the Submittals paragraph.

PART 2 PRODUCTS

2.1 AGGREGATES

The GCA shall consist of clean, sound, durable particles of crushed stone, crushed gravel, angular sand, or other approved material. GCA shall be free of silt and clay, as defined by [ASTM D 2487](#), organic matter and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

2.1.2 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to [ASTM E 11](#).

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 3
-----	-----
2 inch	----
1-1/2 inch	----
1 inch	100
1/2 inch	40-70
No. 4	20-50
No. 10	15-40
No. 40	5-25
No. 200	-8

NOTE 1: Particles having diameters less than No. 635 shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.2 LIQUID LIMIT AND PLASTICITY INDEX

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the GCA is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall be operated to produce the quantity and quality of materials meeting these specifications requirements in the specified time limit. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the base course(s), the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the base course(s), the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 31 00 00 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the base course(s). Stabilization shall be accomplished by mixing GCA into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the base course is placed.

3.4 INSTALLATION

3.4.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification. Adjustments to the Job Mix Formula shall be limited to plus or minus 8 percent on the 1 inch to No. 4 sieves; plus or minus 5 percent on the No. 30 sieve, and plus or minus 3 percent on the No. 200 sieve. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 2; this is acceptable.

3.4.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall be thicker than 6 inches or thinner than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

3.4.3 Grade Control

The finished and completed base course shall conform to the lines, grades,

and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required base course thickness so that the finished base course and the subsequent surface course will meet the designated grades.

3.4.4 Edges of Base Course

The base course(s) shall be placed so that the completed section will be a minimum of 2 feet wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of the base course in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of base course. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.4.5 Compaction

Each layer of the base course shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.4.6 Thickness

Compacted thickness of the base course shall be as indicated. No individual layer shall be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. The total compacted thickness of the base course(s) shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

3.4.7 Finishing

The surface of the top layer of base course shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of base course is $1/4$ inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.4.8 Smoothness

The surface of the top layer shall show no deviations in excess of $1/4$ inch when tested with a 12 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.5 TRAFFIC

Completed portions of the base course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

3.6 MAINTENANCE

The base course shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.7 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed. No additional payments will be made for materials that must be replaced.

-- End of Section --