

Section 02710**BASE COURSE FOR PAVEMENT****1.0 GENERAL****1.01 SECTION INCLUDES**

- A. Base course of crushed stone, recycled crushed concrete base, cement-stabilized crushed stone, cement-stabilized bank-run gravel, recycled crushed stone and hot mix asphalt base course.
- B. References to Technical Specifications:
 - 1. Section 01200 – Measurement and Payment Procedures
 - 2. Section 01350 - Submittals
 - 3. Section 01450 – Testing Laboratory Services
 - 4. Section 02742 – Prime Coat
- C. Referenced Standards:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM C 131, “Standard Test Methods for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine”
 - b. ASTM D 4318, “Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils”
 - c. ASTM C 150, “Standard Specification for Portland Cement”
 - d. ASTM C 33, “Standard Specification for Concrete Aggregates”
 - e. ASTM D 1557, “Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort”
 - f. ASTM D 1556, “Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method”
 - g. ASTM D 2922, “Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)”
 - h. ASTM D 3017, “Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)”
 - 2. Texas Department of Transportation (TxDOT)
 - a. Tex-101-E, “Preparing Soil and Flexible Base Materials for Testing”
 - b. Tex-110-E, “Particle Analysis of Soils”
 - c. Tex-120-E, “Soil-Cement Testing”
 - d. Tex-106-E, “Calculating the Plasticity Index of Soils”
 - e. Tex-203-F, “Sand Equivalent Test”

- f. Tex-126-E, “Molding, Testing, and Evaluating Bituminous Black Base Material”
- g. Tex-204-F, “Design of Bituminous Mixtures”
- h. Tex-208-F, “Test for Stabilometer Value of Bituminous Material”
- i. Tex-227-F, “Theoretical Maximum Specific Gravity of Bituminous Mixtures”
- j. Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, 2004 Adoption
 - 1) Item 340, “Dense-Graded Hot-Mix Asphalt (Method)”

1.02 MEASUREMENT AND PAYMENT

- A. Measurement for base course is on a square yard basis. Separate measurement will be made for each different required thickness of base course.
- B. When required by Section 01100 – Summary of Work, unit price adjustments shall be made for insufficient in-place depth determined by cores as follows:
 - 1. Adjusted unit price shall be reduced by a ratio of average thickness determined by cores to thickness bid upon, times unit price bid.
 - 2. Adjustment shall apply to lower limit of 90 percent of unit price bid.
- C. Refer to Section 01200 – Measurement and Payment Procedures.

1.03 SUBMITTALS

- A. Make Submittals required by this Section under the provisions of Section 01350 – Submittals.
- B. Submit samples of crushed stone, gravel, crushed concrete and soil binder for testing.
- C. Submit weight tickets, certified by supplier, with each bulk delivery of cement to work site.
- D. Submit manufacturer’s description and characteristics for pug mill and associated equipment, spreading machine, and compaction equipment for approval.
- E. Submit manufacturing description and characteristics of spreading and finishing machine for approval.

1.04 TESTING

- A. Testing and analysis of product quality, material sources, or field quality shall be performed by an independent testing laboratory provided by the Owner under the

provisions of Section 01450 – Testing Laboratory Services and as specified in this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stockpiles shall be made up of layers of processed aggregate materials. Load material by making successive vertical cuts through entire depth of stockpile. Comply with applicable requirements of Section 01600 – Material and Equipment and Section 02255 – Bedding, Backfill, and Embankment Material.

2.0 PRODUCTS

2.01 CRUSHED STONE FLEXIBLE BASE COURSE

- A. Crushed Stone: Material retained on the No. 40 Sieve meeting the following requirements:
1. Durable particles of crusher-run broken limestone, sandstone, gravel or granite obtained from an approved source.
 2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C 131.
- B. Soil Binder: Material passing the No. 40 Sieve meeting the following requirements when tested in accordance with ASTM D 4318:
1. Maximum Liquid Limit: 40.
 2. Maximum Plasticity Index: 12.
 3. Maximum Lineal Shrinkage: 7 (when calculated from volumetric shrinkage at liquid limit).
- C. Mixed Materials shall meet the following requirements:
1. Minimum compressive strength of 35 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure using triaxial testing procedures.
 2. Grading in accordance with Tex-101-E and Tex-110-E within the following limits:

SIEVE	PERCENT RETAINED
1 ¾-inch	0 to 10
No. 4	45 to 75
No. 40	60 to 85

2.02 CEMENT STABILIZED BASE COURSE

- A. Cement: ASTM C 150 Type I; bulk or sacked.
- B. Water: Clean; clear; and free from oil, acids, alkali, or vegetable matter.
- C. Crushed Stone: material retained on the No. 40 Sieve meeting the following requirements:
1. Durable particles of crusher-run broken limestone obtained from an approved source.
 2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C 131.
- D. Gravel: Durable particles of bank-run gravel or processed material.
- E. Soil Binder: Material passing the No. 40 Sieve meeting the following requirements when tested in accordance with ASTM D 4318:
1. Maximum Liquid limit: 35.
 2. Maximum Plasticity index: 10.
- F. Mixed aggregate and soil binder shall meet the following requirements:
1. Grading in accordance with Tex-101-E and Tex-110-E within the following limits:

SIEVE	PERCENT RETAINED			
	CRUSHED STONE	PROCESSED GR. 1	GRAVEL GR. 2	BANKRUN GRAVEL
1 ¾-inch	0 to 10	0 to 5	-	0 to 5
½-inch	-	-	0	-
No. 4	45 to 75	30 to 75	15 to 35	30 to 75
No. 40	55 to 80	60 to 85	55 to 85	65 to 85

2. Obtain prior permission from Engineer for use of additives to meet above requirements.
- G. Cut back asphalt: MC30 conforming to requirements of Section 02742 – Prime Coat.
- H. Emulsified petroleum resin: EPR-1 Prime conforming to requirements of Section 02742 – Prime Coat.

- I. Design mix for minimum average compressive strength of 200 psi at 48 hours using Tex-120-E unconfined compressive strength testing procedures. Provide minimum cement content of 1-1/2 sacks, weighing 94 pounds each, per ton of mix.
- J. Increase cement content if average compressive strength of tests on field samples fall below 200 psi. Refer to Part 3 concerning field samples and tests.
- K. Mix in stationary pug mill equipped with feeding and metering devices which shall add specified quantities of base material, cement, and water into mixer. Dry mix base material and cement sufficiently to prevent cement balls from forming when water is added.
- L. Resulting mixture shall be homogeneous and uniform in appearance.

2.03 CEMENT-STABILIZED RECYCLED CRUSHED CONCRETE BASE (RCCB) COURSE

- A. System Description: Provide RCCB with following performance:
 - 1. Minimum 5 percent cement.
 - 2. Minimum Compressive Strength: 650 psi at 7 days following TxDOT Tex-120-E.
 - 3. Prepare concrete product in an on- or off-site pug mill, or in an on- or off-site portable concrete mixer.
- B. Preliminary Design: Prepare preliminary mix for 4 cement ratios; 5, 6, 7 and 8 percent.
 - 1. Designate source of concrete for crushing.
 - 2. Results of compression tests will be used by Engineer to select the final mix design.
- C. Cement: ASTM C 150 Type I, II or III; bulk or sacked.
- D. Water: Potable.
- E. Aggregate: Recycled Crushed Concrete: Material retained on the No. 40 Sieve, and durable coarse particles of crusher-run reclaimed cured Portland cement concrete, obtained from an approved source. Organic material is prohibited.
- F. Soil Binder (classified below): Meeting the following requirements when tested following TxDOT Tex-106-E:
 - 1. Maximum Liquid Limit: 35
 - 2. Maximum Plasticity Index: 10

- G. Mixed Aggregate and Soil Binder: Grading following Tex-101-E and Tex-110-E within the following limits:

SIEVE	PERCENT RETAINED
1 ¾-inch	0 to 10
No. 4	45 to 75
No. 40	55 to 80; classified as "Soil Binder"

1. Obtain prior permission from Engineer for use of additives to meet above requirements.

- H. Asphaltic Seal Cure:

1. Use following as Contractor's option to curing by sprinkling, at no additional cost or time.
2. Cut-back asphalt: MC30 following Section 02742 – Prime Coat.
3. Emulsified petroleum resin: EPR-1 Prime following Section 02742 – Prime Coat.

- I. Material Mix and Mixing Equipment

1. Design mix for minimum compressive strength of 650 psi at 7 days following Tex-120-E unconfined compressive strength.
2. Cement Ratio: If compressive strength of field samples of installed products fails to meet strength requirements above, increase cement content in one percent increments up to a maximum of 8 percent.
3. Mix according to the requirements of this Section, 2.03A, with metering devices adding specified quantities of crushed concrete, cement, and water into mixer. Dry mix crushed concrete and cement to prevent cement balls from forming when water is added. Produce homogeneous and uniformly mixed product.

2.04 HOT MIX ASPHALT BASE COURSE (BLACK BASE)

- A. Coarse Aggregate: Gravel or crushed stone, or combination thereof that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic, or other injurious matter occurring either free or as coating on aggregate. Aggregate shall conform to ASTM C 33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.

- B. Fine Aggregate: Sand or stone screenings, or combination thereof, passing No. 10 sieve. Aggregate shall conform to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by Tex-106-E. Sand equivalent shall have a minimum value of 45 when tested by Tex-203-F.
- C. Composite Aggregate: Conform to the grading limits of TxDOT Item 340 for the paving type indicated on the Plans.
- D. Asphaltic Material: Moisture-free homogeneous material which will not foam when heated to 347° F, meeting the following requirements:

VISCOSITY GRADE				
TEST	AC-10		AC-20	
	min.	max.	min.	max.
Viscosity, 140° F stokes	1000	± 200	2000	± 400
Viscosity, 275° F stokes	1.9	-	2.5	-
Penetration, 77° F, 100 g, 5 sec.	85	-	55	-
Flash Point, C.E.C., F.	450	-	450	-
Solubility in trichloroethylene, percent	99.0	-	99.0	-
Tests on residues from thin film oven tests:				
Viscosity, 140° F stokes	-	3000	-	6000
Ductility, 77° F, 5 cms per min., cms	70	-	50	
Spot tests	Negative for all			

- 1. Material shall not be cracked.
- 2. Engineer will designate grade of asphalt to use after design tests have been made. Use only one grade of asphalt after grade is determined by test design for project.
- E. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuously mixtures meeting specifications. Plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:
 - 1. Cold aggregate bins and proportioning device
 - 2. Dryer
 - 3. Screens

4. Aggregate weight box and batching scales
 5. Mixer
 6. Asphalt storage and heating devices
 7. Asphalt measuring devices
 8. Truck scales
- F. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix.
- G. Mix: Employ and pay certified testing laboratory to prepare design mixes. Test in accordance with Tex-126-E, Tex-204-F, Tex-208-F, and Tex-227-F.
- H. Density and Stability Requirements:

PERCENT DENSITY		PERCENT OPTIMUM	HVEEM STABILITY PERCENT NOT LESS THAN
MIN	MAX		
95	99	97	35

- I. Proportions for Asphaltic Material: As specified in TxDOT Item 340 for the mix type shown on the Plans.

3.0 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is ready to support imposed loads.
- B. Verify lines and grades are correct.

3.02 PLACEMENT

- A. Do not mix and place cement stabilized base when temperature is below 40° F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35° F and rising.
- B. Place material on prepared subgrade in uniform layers to produce thickness indicated on Plans. Depth of layers shall not exceed 8 inches. Do not dump material in piles or windrows.
- C. Spread with approved spreading machine. Conduct spreading so as to eliminate planes of weakness or pockets of non-uniformly graded material resulting from hauling and dumping operations.

- D. Provide construction joints between new material and stabilized base that has been in place 4 hours or longer. Joints shall be approximately vertical. Form joint with a temporary header or make vertical cut of previous base immediately before placing subsequent base.
- E. Use only one longitudinal joint at center line under main lanes and shoulder. Do not use longitudinal joints under frontage roads and ramps.
- F. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Secure a firm bond between reinforcement and base.
- G. Do not place asphaltic base when air temperature is below 50 F and falling. Base may be placed when air temperature taken in shade and away from artificial heat is above 40 F and rising.
- H. Haul prepared and heated asphaltic concrete mixture to project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250° F and 325° F when laid.
- I. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type. Use track-mounted finish machine to place base course directly on earth subgrade.
- J. Place base courses 4 inches or greater in thickness in two or more layers, each having compacted thickness of not greater than 4 inches. Spread all lifts. Attain smooth course of uniform density to section, line and grades as indicated on Plans.
- K. Place courses as nearly continuously as possible. Pass roller over unprotected ends of freshly laid mixture only when mixture has become cooled. When work is resumed, cut back laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.
- L. When new asphalt/concrete is laid against existing asphalt, existing asphalt/concrete shall be saw cut full depth to provide straight smooth joint.
- M. In restricted areas where use of paver is impractical, spread and finish asphalt by mechanical compactor. Use wood or steel forms, rigidly supported to assure correct grade and cross section. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove any lumps that do not break down readily. Place asphalt courses in same sequence as if placed by machine.

3.03 COMPACTION

- A. Start compaction as soon as possible but not more than 60 minutes from start of moist mixing. Compact loose mixture with approved tamping rollers until entire depth is uniformly compacted. Do not allow stabilized base to mix with underlying material.

- B. Correct irregularities or weak spots immediately by replacing material and recompacting.
- C. Apply water to maintain moisture between optimum and 3 percent above optimum moisture as determined by ASTM D 1557. Mix in with a spiked tooth harrow or equal. Reshape surface and lightly scarify to loosen imprints made by equipment.
- D. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.
- E. Finish by blading surface to final grade after compacting final course. Seal with approved pneumatic tired rollers which are sufficiently light to prevent surface hair line cracking. Rework and recompact at areas where hair line cracking develops.
- F. Compact to minimum density of 95 percent of modified Proctor density at a moisture content of treated material between optimum and 3 percent above optimum as determined by ASTM D 1557, unless otherwise indicated on the Plans.
- G. Maintain surface to required lines and grades throughout operation.

3.04 CURING

- A. Moist cure for minimum of 7 days before adding pavement courses. Restrict traffic on base to local property access. Keep subgrade surface damp by sprinkling.
- B. If indicated on Plans, cover base surface with a curing membrane as soon as finishing operation is complete. Apply with approved self-propelled pressure distributor at following rates, or as indicated on Plans:
 - 1. MC30: 0.1 gallon per square yard.
 - 2. EPR-1 Prime: 0.15 gallon per square yard.
- C. Do not use cutback asphalt during the period of April 16 to September 15.

3.05 TOLERANCES

- A. Completed surface shall be smooth and conform to typical section and established lines and grades.
- B. Top surface of base course: Plus or minus 1/4 inch in cross section, or in 16 foot length.

3.06 FIELD QUALITY CONTROL

- A. At the direction of the Engineer, a minimum of one core will be taken at random locations per 1,000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.
- B. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.
- C. Compaction Testing will be performed in accordance with ASTM D 1556 or ASTM D 2922 and ASTM D 3017 at a random location near each depth determination core. Rework and recompact areas that do not conform to compaction requirements at no additional cost to the Owner.
- D. Fill cores and density test sections with new compacted cement stabilized base.

3.07 NONCONFORMING PAVEMENT

- A. Recompact pavement sections not meeting specified densities or replace them with new asphaltic concrete material. Replace with new material, sections of base course not meeting surface test requirements or having unacceptable surface texture. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute.
- B. Remove and replace areas of asphaltic concrete base course found by cores to be deficient in thickness by more than 10 percent at no cost to Owner. Use new asphaltic concrete base material of thickness shown on Plans.
- C. Areas of asphaltic concrete base course found by cores to be deficient in thickness by less than 10 percent shall be remedied at the Owner's direction by one of the following methods:
 - 1. Remove and replace using new asphaltic concrete base material of thickness shown on Plans and in accordance with the requirements of this Section at no cost to Owner.
 - 2. Reduce the Unit Price by the ratio of the average thickness (as determined by cores) to the thickness required.
- D. No adjustments will be made for excess thickness.

3.08 PROTECTION OF THE WORK

- A. Maintain stabilized base in good condition until completion of work. Repair defects immediately by replacing base to full depth.

- B. Protect the asphalt membrane, if used, from being picked up by traffic. The membrane may remain in place when proposed surface courses or other base courses are to be applied.

END OF SECTION