

**SECTION 02715
HOT-MIX ASPHALT BASE COURSE**

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Foundation course of compacted mixture of coarse and fine aggregates and asphalt binder (Black Base).

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for hot-mix asphalt base is on a per ton basis.
2. Payment for hot-mix asphalt base for transitions and base repairs is on a per ton basis.
3. Payment for hot-mix asphaltic base for temporary driveway, roadway shoulders, etc., is on a per ton basis.
4. Measurement for utility projects:
 - a. Actual pavement replaced but not beyond the maximum pavement replacement limits shown on the Drawings.
 - b. Include installed hot-mix asphalt base course material that extends one foot (1 Ft) beyond outside edge of pavement to be replaced, except where proposed pavement section shares common edge with existing pavement section.
5. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum):

1. If Contract is Stipulated Price Contract, payment for Work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

A. AASHO – American Association of State Highway and Transportation Officials.

1. AASHTO T201 – Standard Specification for Kinematic Viscosity of Asphalts (Bitumens).
2. AASHTO T202 – Standard Specification for Viscosity of Asphalt by Vacuum Capillary Viscometer.

B. ASTM – American Society for Testing and Materials.

1. ASTM C33 – Standard Specifications for Concrete Aggregate.
2. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
3. ASTM C136 – Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
4. ASTM D4402 – Standard Test Method for Viscosity

02715-1

Determination of unfilled Asphalt Using the Broolfield Thermal Apparatus.

- C. CFTS – City of Friendswood Technical Specifications.
- D. TxDOT – Texas Department of Transportation.
 - 1. TxDOT Tex-106-E – Calculating the Plasticity Index of Soils.
 - 2. TxDOT Tex-126-E – Molding, Testing and Evaluating Bituminous Black Base Material.
 - 3. TxDOT Tex-200-F – Sieve Analysis of Fine and Coarse Aggregates.
 - 4. TxDOT Tex-203-F – Sand Equivalent Test.
 - 5. TxDOT Tex-204-F – Design of Bituminous Mixtures.
 - 6. TxDOT Tex-207-F – Determining Density of Compacted Bituminous Mixtures.
 - 7. TxDOT Tex-208-F – Test for Stabilometer Value of Bituminous Mixtures.
 - 8. TxDOT Tex-227-F – Theoretical Maximum Specific Gravity of Bituminous Mixtures.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit certificates that asphalt materials and aggregates meet requirements of Paragraph 2.1, Materials.
- C. Submit proposed mix and test data for each type of base course in Work.
- D. Submit manufacturer's description and characteristics of mixing plant for approval.
- E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

1.5 QUALITY ASSURANCE

- A. Provide manufacturer's affidavits that material was manufactured in compliance with standards referenced in this Section.

PART II: PRODUCTS

2.1 MATERIALS

- A. Coarse Aggregate:
 - 1. Use crushed gravel or crushed stone or combination retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic or other injurious material occurring either free or as coating on aggregate. Conform aggregate to ASTM C33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed forty percent (40%) by weight when tested in accordance with ASTM C131.
 - 2. Reclaimed asphalt pavement (RAP) or reclaimed Portland cement concrete pavement (RPCCP) are permitted as aggregates for hot-mix asphalt base course if combined

02715-2

aggregate criteria, gradation and mixture properties are met.

- B. Fine Aggregate: Sand or stone screenings or combination thereof, passing No. 10 sieve. Conform aggregate to ASTM C33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other deleterious 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 six (6) when tested by TxDOT Tex-106-E. Sand equivalent shall have a minimum value of forty-five (45) when tested by TxDOT Tex-203-F.
- C. Composite Aggregate: Conform to limits specified in TABLE 4.1 – GRADATION OF COMPOSITE AGGREGATE in this Section when graded in accordance with ASTM C136. Provide either coarse or fine aggregate where designated on the Drawings.
- D. Asphalt Binder: Moisture-free homogeneous material meeting requirements as specified in TABLE 4.2 – ASPHALT BINDERS in this Section.
- E. Reclaimed asphalt pavement (RAP) and reclaimed Portland cement concrete pavement (RPCCP) may be used at a rate no greater than twenty percent (20%).

2.2 EQUIPMENT

- A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuous mixtures meeting specifications. With exception of a drum mix plant, the plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins and dust collectors.
- B. 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.
- C. Bins: Separate aggregate into a minimum of four (4) bins to produce consistently uniform grading and asphalt content in completed mix. One (1) cold feet bin per stockpile is required.

2.3 MIXES

- A. Employ certified testing laboratory to prepare design mixes.
 - 1. Test in accordance with TxDOT Tex-126-E, TxDOT Tex-204-F, TxDOT Tex-208-F and TxDOT Tex-227-F.

2. Verify mixture design properties for plant-produced mixture. Demonstrate that asphalt plant is capable of producing mixture meeting design volumetric and stability requirements before placement begins.
- B. Density, Stability and Air Voids Requirements: Select asphalt binder content for base courses to result in three percent (3%) to five percent (5%) air voids in laboratory molded specimens, while meeting a minimum VMA requirement for selected mixture classification as specified in TABLE 4.3 – MINIMUM VMA REQUIREMENTS in this Section.

PART III: EXECUTION

3.1 PREPARATION

- A. Complete backfill of new utilities below future grade.
- B. Verify lines and grades are correct.
- C. Prepare subgrade in accordance with requirements of Section 02115 – Embankment and Section 02135 – Excavation for Roadway or Section 02720 – Lime-Stabilized Base Subgrade and Section 02725 – Portland Cement-Stabilized Base Subgrade. Subgrade preparation may also refer to Section 02145 – Cement-Stabilized Sand or Section 02705 – Crushed Concrete Base Course.
- D. Correct subgrade deviations in excess of plus or minus one-quarter inch (1/4 In) in cross section or in sixteen foot (16 Ft) length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

3.2 PLACEMENT

- A. Place base when the surface temperature taken in the shade and away from artificial heat is above forty degrees Fahrenheit (40° F) and rising. Do not place asphalt base when temperature of surface to receive base course is below fifty degrees Fahrenheit (50° F) and falling.
- B. Haul prepared and heated asphalt base mixture to project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between two hundred fifty degrees Fahrenheit (250° F) and three hundred thirty-five degrees Fahrenheit (325° F) when laid.
- C. Place hot-mix asphalt base course in compacted lifts no greater than four inches (4 In) thick, unless permitted by the Project Manager.
- D. Place courses as nearly continuously as possible: Place material with approved mechanical spreading and finishing machine of screeding or tamping type. Spread lifts to attain smooth course of uniform density to section, line and grades as indicated on the Drawings.
- E. In areas with limited space where use of paver or front-end loader is impractical, spread by hand and compact asphalt by mechanical means. Carefully place materials to avoid segregation of mix; do not broadcast material. Remove lumps that do not break down readily.

3.3 JOINTS

- A. Transverse Joints: Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back placed 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.
- B. Existing pavement: When new asphalt is laid against existing asphalt pavement, saw cut existing asphalt to full depth creating vertical face. Clean joint and apply tack coat before placement.

3.4 COMPACTION

- A. Construct test strip to identify correct type, number and sequence of rollers necessary to obtain specified in-place density or air-voids. Prepare test strip at least five hundred feet (500 Ft) in length, comparable to placement and compaction conditions for the Project.
- B. Begin rolling while pavement is still hot and as soon as it shall bear roller without undue displacement or hair line cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water; do not use petroleum by-products.
- C. Compact surface thoroughly and uniformly with power-driven equipment capable of obtaining required compaction. Ensure subsequent compaction by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half (1/2) width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compaction can be obtained and rolling marks are eliminated. Complete rolling before mat temperature drops below one hundred seventy-five degrees Fahrenheit (175° F).
- D. Along walls, curbs, headers, similar structures and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.
- E. Compact base course to a minimum density of ninety-one percent (91%) (TxDOT Tex-227-F).

3.5 TOLERANCES

- A. Furnish templates for checking surface of finished sections. Maximum deflection of templates, when supported at center, shall not exceed one-quarter inch (1/4 In).
- B. Completed surface, when tested with a ten foot (10 Ft) straight edge laid parallel to center line of pavement, shall show no deviation in excess of one-quarter inch (1/4 In) in ten feet (10 Ft). Correct surface not meeting this requirement.

3.6 FIELD QUALITY CONTROL

- A. Perform testing under provisions of Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures.
- B. For in-place depth and density, take a minimum of two (2) cores at random locations for each one thousand feet (1000 Ft) of single lane of

pavement. On a two (2) lane pavement, take cores at random every five hundred feet (500 Ft) from alternating lanes. Take cores for parking lots every five hundred square yards (500 Sy) of base to determine in-place depth and density. If cul-de-sac or streets are less than five hundred feet (500 Ft), a minimum of two (2) cores [one (1) per lane] shall be taken. On small projects, take a minimum of two (2) cores for each day's placement. For first days placement and prior to coring, a minimum of five (5) nuclear gauge readings shall be performed at each core location to establish correlation between nuclear gauge (wet density reading) and core (bulk density). This process shall continue for each day's placement until the Testing Laboratory's Engineer determines that a good basis has been established for the nuclear gauge.

- C. Determine in-place density in accordance with TxDOT Tex-207-F and Tex-227-F from cores or sections of asphaltic base located near each core. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by the Project Manager.
- D. Three (3) additional cores within a five foot (5 Ft) radius of core indicating nonconforming in-place depth may be requested by the Project Manager at no additional cost to the City. In-place depth at these locations shall be average depth of four (4) cores.
- E. Fill cores and density test sections with new compacted asphalt base or cold patch material.

3.7 NONCONFORMING PAVEMENT

- A. Re-compact and retest nonconforming street sections not meeting surface test requirements. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute. Retesting is at no cost to the City.
- B. Remove and replace areas of asphalt base found deficient in thickness by more than ten percent (10%). Remove and replace areas of asphalt base found deficient in density. Use new asphalt base of thickness shown on the Drawings.
- C. Replace or correct nonconforming pavement sections at no additional cost to the City.

3.8 PROTECTION

- A. Do not open base to traffic until at least twelve hours (12 Hrs) after completion of rolling or as noted on the Drawings.
- B. Maintain asphalt base in good condition until completion of the Work.
- C. Repair defects immediately by replacing base to full depth.

PART IV: TABLES

4.1 GRADATION OF COMPOSITE AGGREGATE

GRADATION OF COMPOSITE AGGREGATE Percent Passing by Weight or Volume		
Sieve Size	Type A Coarse Base	Type B Fine Base
1 1/2"	100	-
1 1/4"	95 to 100	-
1"	-	100
7/8"	70 to 90	95 to 100
5/8"	-	75 to 95
1/2"	50 to 70	-
3/8"	-	60 to 80
#4	30 to 50	40 to 60
#10	30 to 34	27 to 40
#40	5 to 20	10 to 25
#80	2 to 12	3 to 13
#200	1 to 6*	1 to 6*
VMA % Minimum	11	12
*2 to 8 when Test Method Tex-200-F, Part II (Washed Sieve Analysis) is used.		

4.2 ASPHALT BINDERS

SPECIFICATION	PG 64 – 22
Average 7-day Maximum Pavement Design Temperature, degrees C ^a	<64
Minimum Pavement Design Temperature, degrees C ^a	>-22
Original Binder	
Flash Point Temperature, T48, Minimum degrees C	230
Viscosity, ASTM D4402, ^b Maximum 3 Pa.s (3000cP), Test Temperature, degrees C	135
Dynamic Shear, TP5, ^c G*/sine[], Minimum, 1.00kPa Test Temperature @ 10rad/sec, degrees C	64
Rolling Thin Film Oven (T240) or Thin Film Oven (T179) Residue	
Mass Loss, Maximum, %	-1.00
Dynamic Shear T5; G*sine[], Minimum, 2.20 kPa Test Temperature @ 10 rad/sec, degrees C	64
Pressure Aging Vessel Residue (PPI)	
PAV Aging Temperature, degrees C ^d	100
Dynamic Shear, TP5; G*/sine[], Maximum 5000 kPa Test Temperature @ 10 rad/sec, degrees C	25
Physical Hardening ^e	Report
Creep Stiffness, TP1; ^f S, Maximum, 300 Mpa; m-value, Minimum, 0.300 Test Temperature @ 60 sec, degrees C	-12
Direct Tension, TP3; ^f Failure Strain, Minimum, 1.0%; Test Temperature @ 1.0 mm/min, degrees C	-12

NOTES:

- ^a Pavement temperature can be estimated from air temperature using algorithm contained in TxDOT testing procedures.
- ^b The requirement may be waived at the discretion of the Project Manager if supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet the applicable safety standards.
- ^c For quality control of unmodified asphalt cement production, measurement of viscosity of original asphalt cement may be substituted for dynamic shear measurements of G*/sine[] at test temperature where asphalt is Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometry (AASHTO T 201 or T 202).
- ^d The PAV aging temperature is based on simulated climatic conditions and is one of three (3) temperatures: ninety Centigrade (90° C), one hundred degrees Centigrade (100° C) or one hundred ten degrees Centigrade (110° C). The PAV aging temperature is one hundred

- degrees Centigrade (100° C) for PG64 and PG70.
- e Physical Hardening – TP 1 is performed on a set of asphalt beams according to Section 13.1, except conditioning time is extended to twenty-four hours (24 Hrs) plus or minus ten minutes (±10 Min) at ten degrees Centigrade (10° C) above minimum performance temperature. The twenty-four hour (24 Hr) stiffness and m-value are reported for information purposes only.
- f If creep stiffness is below three hundred Mega Paschals (300 MPa), the direct tension test is not required. If creep stiffness is between three hundred Mega Paschals (300 Mpa) and six hundred Mega Paschals (600 MPa) the direct tension failure strain requirement can be used in lieu of creep stiffness requirement. The m-value requirement must be satisfied in both cases.

4.3 MINIMUM VMA REQUIREMENTS

Percent Density		Percent Optimum	HVEEM Stability Percent Not Less Than	Percent Asphalt Content	
Min.	Max.			Min.	Max.
94.5	97.5	96	35	3.5	7

END OF SECTION