DIVISION 400

ROADWAY MAINTENANCE AND REHABILITATION

ITEM 401. CRACK SEALING

401.1. GENERAL

Crack sealing compound shall consist of hot poured polymer or ready-mixed cold-applied sealant, or other material approved by the CITY. It shall not crack or break when exposed to low temperatures. The cured sealant must not pick up or "track" at elevated road temperature.

401.2. MATERIALS

401.2.1. Hot Poured Polymer. The sealing compound shall meet the requirements of Item 303.2.14.1.1. Hot Poured Polymer.

401.2.2. Ready-Mixed Cold-Applied. This sealant shall meet the requirements of Item 303.2.14.1.2. Ready-Mixed Cold-Applied.

401.2.3. Thermoplastic Cold-Applied. If approved by the CITY, thermoplastic cold-applied jointing material may be used according to manufacturer's recommendations.

401.2.4. Rejection. Materials may be rejected for failure to meet any of the requirements of this specification.

401.3. METHODS

Routine pavement cracks shall be filled to a depth of 1½-in. (3.8cm). Materials shall generally be handled and applied according to the manufacturer's recommendations, with additional requirements as stated herein.

401.3.1. Hot Poured Polymer. The sealing compound shall be melted in an approved oil-batch kettle with continuous mechanical agitation. The kettle shall be equipped with temperature indicators. The CITY shall determine the optimum temperature for proper pouring fluidity, and the CONTRACTOR shall maintain the material within close range of optimum temperature. At no time shall the temperature exceed 450°F (232°C). The sealing compound shall not be poured at atmospheric temperatures below 32°F (0°C).

401.3.2. Ready-Mixed Cold-Applied. Permeation of cracks shall principally be achieved without the task of squeegeeing. However, squeegeeing is recommended to assist permeation and to allow sealant to become rapidly tack-free. Sealant shall "set" in a fixed position within 40-minutes after application, to where traffic may be restored to the pavement without the effects of "tracking." "Tracking" shall be averted without the use of topping materials such as sand.

ITEM 402. PAVEMENT CUT, EXCAVATION, AND REPAIR

402.1. GENERAL REQUIREMENTS

Also refer to Standard Drawing 3070 for more information.

402.1.1. Marking. All pavement cut repairs shall be marked with the CONTRACTOR'S name if required by the CITY.

402.1.2. Thoroughfares. No interference with traffic flow on the thoroughfares shall be permitted during the hours of 6:30 a.m. to 9:30 a.m. and 3:30 p.m. to 6:30 p.m., Monday through Friday, unless directed otherwise by the CITY. Emergency closures during these hours shall be with the approval of the CITY.

Streets shall be maintained in accordance with Item 203.2. Maintenance of Streets During Construction. When work is stopped for the day, all lanes of arterial or collector streets shall be opened to traffic in accordance with the traffic control plan. A traffic lane shall be considered satisfactorily open if it is paved with hot-mix or cold-mix asphalt paving, or paved with another suitable material approved by the CITY, or covered.

If the cut is to be covered, the CONTRACTOR shall use steel plates of sufficient strength and thickness to support all the traffic. A transition of hot-mix or cold-mix asphalt conforming to the requirements of Item 302. Asphalt Pavement shall be constructed from the top of the steel plate to the existing pavement to create a smooth riding surface.

Exceptions to these specifications must be approved by the CITY.

402.1.3. Minimum Size of Repair. Sidewalks shall be removed and replaced to the nearest existing joint. No horizontal dimension of any cut shall be less than 4-ft. in a paved street or alley. Except for sidewalks, where saw-cut locations coincide with or fall within 3-ft. (0.9m) of the present location of either dummy joints, cold joint, construction joints, expansion joints, or edge, breakout shall be to the existing joint or edge, there not being a requirement to cut an additional groove. For sidewalks, if a saw cut falls within 18-in. (0.46m) of a construction joint, cold joint, expansion joint or edge, the materials to be removed shall be removed to the joint or edge.

No sidewalk or driveway section to be replaced shall be smaller than 30-in. (0.75m) in either length or width unless otherwise approved by the CITY.

402.2. SAWING

402.2.1. Description. This Item shall apply in the removal of bituminous or concrete pavement, curb, gutter, sidewalk or driveways. This item shall also govern for the sawing of weakened plane joints (contraction joints). Sawing shall be in accordance with the requirements of this item unless otherwise shown on the plans or in the special provisions.

The removal and replacement of portions of permanent pavement (Portland cement concrete or hot-mix asphalt), drives, slabs, sidewalks, etc. shall require a breakout groove to be sawed by the use of an approved power-driven concrete saw in accordance with this specification or as directed by the CITY.

402.2.2. Equipment. The saw shall be suitable for the work to be performed including dust control and shall be maintained in good opertating condition.

Saw blades shall make a clean, smooth cut, producing a groove -in. (3mm) to ¼- in. (6mm) wide and to the full depth required by these specifications or as shown on the plans.

The saw, with its control devices, shall be mounted on a sturdy frame supported on rubber-tired wheels.

402.2.3. Construction Methods. Provide reasonable dust control based upon project location.

The edge of pavements, curb, gutter, sidewalk and/or driveways shall be neatly sawed. Saw cuts shall be made perpendicularly to the surface to a minimum depth of 1½-in. (38mm) or as directed by the CITY. The edges of pavement and appurtenances damaged subsequent to sawing shall again be saw cut to neat straight lines for the purpose of removing the damaged areas. Such saw cuts shall be parallel to the original saw cut.

Concrete sidewalk or driveway to be removed shall be neatly sawed in straight lines either parallel to the curb or at right angles to the alignment of the sidewalk.

402.3. REPLACING PAVED SURFACES

402.3.1. General. Repairs are to be made as rapidly as possible. Use of fast setting concrete and similar techniques are encouraged. Completion of the job, including replacement of pavement and cleanup, shall normally be accomplished within 10-working-days after the repair work involving the cut is made.

Removal of unsatisfactory work shall begin within 15-days and replacement shall be completed within 30-days of written notification by the CITY.

402.3.2. Temporary Pavement Repair. In the event it is necessary to place a temporary surface on any cut opening, it shall be composed of permanent type paving material, specifically excluding gravel or flexbase as the surface material, unless approved by the CITY. Temporary surfaces shall be adequately compacted and sealed to prevent degradation of the repair during the temporary period. Any temporary surface that fails to provide a nondegraded riding surface shall be removed and replaced at the CONTRACTOR'S expense.

402.3.3. Replacing Curb, Gutter, Sidewalks, Driveways, Etc. Curb, curb with gutter, sidewalks, drives, etc. shall be replaced with Class A or Class PA concrete as specified by the CITY, unless specified otherwise by the CITY.

402.3.3.1. Replacement of Curb, Gutter, Sidewalks, Driveways, Etc. The removal or replacement of curbs, curbs and gutters, sudewalks, driveways, etc. in excess of that specified or approved by the CITY shall be at the expense of the CONTRACTOR
approved by the CITY shall be at the expense of the CONTRACTOR.

402.3.4. Replacing Reinforced Concrete Pavement. The existing pavement shall be sawed in accordance with Item 402.2. Sawing and removed to a line 12-in. (30cm) back of the firm banks of the trench. The concrete replacement shall be reinforced with like-size bars as the existing pavement, #3 minimum, lapping 30 diameters on splices, and spaced on a minimum of 24-in. (61cm) centers each way. The replacement concrete shall match the thickness of the existing concrete pavement, minimum of 6-in. (15cm) thick.

The new concrete pavement shall be protected from vehicular traffic for a minimum of 7-days or until a minimum flexural strength of 500-psi (3450-kPa) is obtained or until a compressive strength of 3000-psi (20700 kPa) is obtained.

The concrete shall be Class A or Class PA as specified by the CITY, unless specified otherwise by the CITY.

If the limiting trench width occurs within 3-feet (0.9m) of an expansion joint, construction joint or dummy joint, the CITY may order the pavement removed and replaced to the existing joint.

402.3.5. Replacing full depth Hot-Mix Asphalt Pavement with a Concrete Base and Asphalt surface course. The existing pavement shall be removed to a neat line at least 12-in. (30cm) back of the firm banks of the trench. The asphalt surface course over the concrete base shall be hot-mix asphalt pavement of the type, thickness and class as indicated on the plans. The concrete base shall be of the class and thickness as specified on the plans.

402.3.6. Replacing full depth Hot-Mix Asphalt Pavement on a Natural Soil Base with same. Unless otherwise specified by the CITY, the existing hot-mix asphalt shall be cut back to produce a vertical edge for the full depth of the paving. The cut shall extend 12-in. (30cm) back of the firm banks of the trench.

The cut shall be replaced with a natural soil base compacted to 95% Standard Proctor density. All courses of hot-mix asphalt pavement shall be of the types and classes as indicated on the plans.

402.3.7. Replacing Hot-Mix Asphalt Pavement on a Flexible Base with same. Unless otherwise specified by the CITY, the existing hot-mix asphalt shall be sawed 12-in. (30cm) back from the firm banks of the trench. The cut shall be replaced with a compacted flexible base, as specified in Item 301.5. Flexible Subbase or Base (Crushed Stone/Concrete), to match the existing thickness of the base, 6-in. (15cm) minimum.

All courses of hot-mix asphalt pavement shall be of the types and classes as indicated on the plans.

402.3.8. Replacing One- or Two-Course Surface Treatment or Penetration Type Pavement. The pavement shall be replaced as specified by the CITY in accordance with Item 404. Surface Treatments.

402.3.9. Replacing Gravel Pavement on a Dirt Base. The existing gravel pavement shall be replaced with compacted flexible base, as specified in Item 301.5. Flexible Subbase or Base (Crushed Stone/Concrete). The minimum thickness of flexible base shall be 8-in. (20cm) unless otherwise specified by the CITY.

ITEM 403. ASPHALTIC PAVEMENT REPAIR

403.1. DESCRIPTION

Asphaltic Pavement Repair shall be used only for patching utility cuts, potholes and temporary pavement repairs.

403.2. MATERIALS AND MIXING

403.2.1. Performance Guaranty. The supplier of the material shall guarantee the performance of the patching mix to meet the following requirements:

(1) The material shall remain workable, in an uncovered stockpile, if applicable, for a period of not less than 12-months.
(2) Containerized material, if applicable, shall have a shelf life and remain workable for a period of not less than 12-months.
(3) Repaired potholes shall not show any significant signs of shoving, rutting, tracking, kick-up, or ravel-out within a period of 12-months from the time of repair.

403.2.2. Rejection. In the event a material furnished does not meet any of the specified requirements (regardless of weather, test's acceptability, methods of repair, or other conditions), the material shall be removed and replaced at no cost to the CITY.

The Engineer shall determine the quantity of unacceptable material and the supplier shall be required to deliver an equal quantity of acceptable material. The material shall be delivered to the location(s) designated by the Engineer within 14-days from the date of written notification from the Engineer.

In the event that the material supplier cannot provide acceptable material, the Engineer shall determine the quantity of the unacceptable material and the supplier shall reimburse the CITY based on the unit bid price. The reimbursement shall be submitted to the CITY in the form of a cashier 's check within 28-days from the date of written notification from CITY.

403.2.3. Hot-Mix, Cold-Laid Asphaltic Concrete (Cold Mix). Hot-Mix, Cold-Laid Asphaltic Concrete shall consist of surface mix.

403.2.3.1. Asphaltic Mixture. The asphaltic material shall form from 4% to 7.5% of the mixture by weight. Asphalt for the mixture shall be a bituminous material in accordance with Item 302.3. Bituminous Materials as determined by the mix manufacturer and CITY. The grade of asphalt to be used shall be determined by the CITY after design tests have been made using the mineral aggregate approved for use in the construction. The CONTRACTOR shall notify the CITY of asphaltic material source prior to production of the asphaltic mixture, and this source shall not be changed during the course of the project except by written permission of the CITY.

403.2.3.2. Tack Coat. The liquid asphalt material used for tack coat should be MS-2 or SS-1 in Item 302.3.4. Emulsified Asphalt, Restorative Seal in Item 302.3.6. Specialty Emulsions or one of the other various grades of materials (selected by the CITY) listed under Item 302.3.4. Emulsified Asphalt.

403.2.3.3. Primer. When approved by the Engineer, the use of an asphaltic primer will be permitted. When used, the primer shall be added as directed by the Engineer during the mixing.

403.2.3.4. Mineral Aggregate. The material shall be crushed and screened as necessary to meet the requirements hereinafter specified and shall consist of durable coarse aggregate particles mixed with approved binding materials.

Unless otherwise specified, the grading of mineral aggregate shall conform to the limitations as shown in Table 403.2.3.4.(a) Aggregate Grading for Cold Mix Asphalt Repair.

Table 403.2.3.4.(a) Aggregate Grading for Cold Mix Asphalt Repair

Sieve	% Aggregate by Weight
Passing -in. sieve	100%
Passing ¼-n. sieve	80 to 100%
Passing ¼-in. sieve, retained on No. 10 sieve	27 to 58%
Total retained on No. 10 sieve	42 to 58%
Passing No. 10 sieve, retained on No. 40 sieve	6 to 32%
Passing No. 40 sieve, retained on No. 80 sieve	4 to 32%
Passing No. 80 sieve, retained on No. 200 sieve	3 to 32%
Passing No. 200 sieve	1 to 8%

403.2.3.5. Water. Water in an amount not to exceed 3% by weight of the mixture, as determined by ASTM D1641 Practice for Conducting Outdoor Exposure Tests of Varnishes, may be used in preparing the mixture. In the event water is used in the mixing operation, adequate measuring devices as approved by the Engineer shall be used, and the water shall be administered to the mix through an approved spray bar.

When used, the water shall be added as directed by the Engineer during the mixing.

403.2.3.6. Mixture Preparation. The materials may be mixed on the job or at a central mixing plant and shipped ready for use. Mixtures that do not remain workable a sufficient period of time to permit unloading by normal means, proper spreading, blading and rolling shall not be acceptable.

Mixing Plants. Mixing plants may be either the weight-batching type plant, the continuous mixing type plant, or the drum mixing type plant as described in Item 302.9.5. Mixing Plants.

Equipment. Equipment for storage, weighing and heating of materials shall be as described in Item 302.9.4. Equipment.

403.2.4. High Performance Cold Mix Asphaltic Concrete. This specification shall govern for asphaltic concrete mixture intended primarily as a cool to cold wet-weather, high-performance, pothole-patching mix for maintenance. It is primarily crushed stone, asphaltic concrete with asphalt additives.

When shown on the plans or requisition, the mixture shall be provided in airtight, resealable plastic buckets of 4- to 5-gal. (15- to 19-L) capacities.

403.2.4.1. Mixture Performance Criteria. The patching mix shall not require the use of a tack coat or a primer for adherence to the patch area. The mix shall be capable of being placed in air temperatures from -15°F to 100°F (-26°C to 38°C) and shall maintain adhesive qualities in areas that are damp or wet at the time of application. The repaired areas shall remain flexible and cohesive to an air temperature of -15°F (-26 °C) and shall have the capability of immediately being opened to traffic with no kick-up or ravel-out.

403.2.4.2. Mixture Properties. The mixture shall comply with the following requirements.

403.2.4.2.1. Aggregate. Aggregate shall have a maximum particle size of ½-in. (12.7 mm).

403.2.4.2.2. Resistance to Water Damage. Tests shall be conducted according to TxDOT methods. The as-received mix shall be evaluated for resistance to water damage by soaking a 3.5-oz. (100-gram) representative sample of the total mixture in 7-fluid-ounces (200-milliliters) of distilled or deionized water at 140 ± 2°F (60 ± 1°C) for 24 ± 2 hours. The soaking test shall be accomplished in a glass beaker of approximately 14-fluid-ounces (400-milliliters). Upon completion of the 24-hour period, the mixture shall be evaluated while submerged in the testing water. The material shall show no visible evidence of stripping.

403.3. METHODS

If CITY requires base, subbase, and/or subgrade repair by a separate method than the asphaltic patch, the base, subbase, and/or subgrade shall be repaired as specified by the CITY. Otherwise, repair of the base, subbase, and/or subgrade may be accomplished using the asphaltic patch material when it is specifically designed to do so.

CONTRACTOR shall use all repair material(s) as instructed by its respective manufacturers.

ITEM 404. SURFACE TREATMENTS

404.1. DESCRIPTION

This Item provides specifications for the construction and quality control required for the proper application of pavement surface treatments.

404.2. GENERAL

404.2.1. Environmental Conditions. Surface treatments shall not be applied when the air temperature is below 60°F (16°C) and is falling but may be applied when the air temperature is above 50°F (10°C) and is rising, the air temperature being taken in the shade and away from artificial heat. If the air temperature does not meet these criteria, the CITY shall evaluate the asphaltic material for applicability. Surface treatments shall not be applied when the temperature of the surface to which the surface treatment is to be applied is below 60°F (16°C). When latex modified asphalt cement is specified, surface treatments shall not be applied when the air temperature is below 80°F (27°C) and is falling, but may be applied when the air temperature is above 70°F (21°C) and is rising and shall not be applied when the temperature of the surface on which the surface treatment is to be applied is below 70°F (21°C). Asphaltic material shall not be placed when, in the opinion of the CITY, general weather conditions are not suitable.

Slurry seal or micro-surfacing shall only be applied between March 1 and December 1. Neither treatment shall be applied under any of the following conditions:

(1) In the period following precipitation with water remaining on the surface to be coated
(2) In foggy conditions
(3) If there is a threat of rain before the treatment can fully cure
(4) If there is danger that the finished product will freeze within 24-hours of application
(5) If weather conditions could delay opening to traffic beyond the time specified by the Engineer.

404.2.2. Storage and Stockpiling. Precautions shall be taken to insure aggregate does not become contaminated with over-sized rock, clay, silt or excessive amounts of moisture during storage. The stockpile shall be kept in areas that have good drainage. Segregation of aggregates proposed for use and as supplied to the mixing plant shall be avoided.

The CONTRACTOR shall be required to provide a suitable storage facility for all equipment and materials needed to perform the work. This site should be located as close as possible to the area of work being done to reduce turn around time and insure an acceptable rate of work. The Engineer shall subject any site selected to final approval.

Temporary stockpiling of aggregates on the roadways shall be permitted, provided the stockpiles are spaced not less than 1,000-ft. (300m) apart and are so placed that they neither obstruct traffic nor interfere with roadway drainage. The CONTRACTOR shall be responsible for the proper preparation of all stockpile debris necessary for protection of the aggregate and to prevent any combination thereof.

404.3. SLURRY SEALS AND MICRO-(RE)SURFACING

The surface treatment shall consist of a mixture of an approved emulsified asphalt, mineral aggregate, mineral filler, water and specified additives, proportioned, mixed and uniformly spread over a properly prepared surface. The completed slurry seal shall leave a homogenous mat, adhere firmly to the prepared surface and have a skid resistant surface texture.

404.3.1. Laboratory Evaluation. Before work commences, the CONTRACTOR shall submit a signed original of a mix design containing the test results and proportioning of the specific materials to be used on the project. A qualified laboratory must have performed this design. Previous lab reports covering the exact materials to be used may be accepted provided they were made during the calendar year. This initial mix design shall be done at the CONTRACTOR'S expense. Upon receipt of the original mix design, an independent qualified laboratory selected by the CITY shall perform tests using the same materials as used in the initial mix design for verification of the results. This testing shall be done at the CITY'S expense. No work shall begin until all materials and/or mix design proportions have met the specifications as required. Once the materials are approved, no substitution shall be permitted unless first tested and approved by the methods stated above.

404.3.2. Materials.

404.3.2.1. Mineral Filler. Mineral filler shall be a recognized brand of non-air-entrained Type I or II Portland that meets the requirements of ASTM D242 Mineral Filler For Bituminous Paving Mixtures, if required by

the mix design. 0.5% to 2% by dry weight of aggregate shall be the range of mineral filler in the mix design. The mineral filler shall be considered as part of the dry aggregate.

404.3.2.2. Water. All water shall be potable and compatible with the slurry mix. The CONTRACTOR must insure compatibility. The percent of water in the mix design shall be as required to produce proper mix consistency.

404.3.2.3. Additives. The mix design laboratory as part of the mix design shall approve any additive used to accelerate or retard the break-set of the surface treatment materials. The amount and type of additive (if needed) shall be shown on the mix design.

404.3.2.4. Aggregate. The mineral aggregate shall consist of natural or manufactured crushed stone such as granite, slag, limestone or other high quality aggregates or a combination thereof that conforms to the quality requirement of ASTM D1073 Fine Aggregate for Bituminous Paving Mixtures, and shall be free of dirt, organic matter, clay balls, adherent films of clay, dust or other objectionable material. If the CITY accepts aggregate that is not free of dirt, organic matter, clay balls, adherent films of clay, or dust, the CITY shall have the option to evaluate and accept or reject chemical modifiers of the asphaltic material. The aggregate shall contain no free water. Smooth textured sands of less than 1.25-percent water absorption shall not exceed 50-percent (by weight) of the total aggregate blend. For heavy-duty surface requirements, 100% crushed material is required.

The aggregate shall meet the gradations as shown in the Table 404.3.2.4.(a) Slurry Seal Aggregate Requirements or Table 404.3.2.4.(b) Micro-Surface Aggregate Requirements, as appropriate, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieves or vice versa. The gradation type to be used shall be as designated by the Engineer.

Table 404.3.2.4.(a) Slurry Seal Aggregate Requirements

Sieve Size	Percent Passing
3/8	100
No. 4	70-90
No. 8	45-70
No. 16	28-50
No. 30	19-34
No. 50	12-25
No. 100	7-8
No. 200	5-15

Table 404.3.2.4.(b) Micro-Surface Aggregate Requirements

Sieve Size	Percent Passing
3/8	99-100
No. 4	86-94
No. 8	45-65
No. 16	25-46
No. 30	15-35
No. 50	10-25
No. 100	7-18
No. 200	5-15

404.3.2.5. Emulsified Asphalt. The asphalt emulsion shall be homogeneous and show no separation after mixing.

404.3.2.5.1. Slurry Seal. As directed by the Engineer, one of the following two grades of emulsion shall be selected. Grade CQS-1 h (Quick Set) shall be specified on streets where the amount of time the street can be closed is restricted.

Grade SS-1h: Conforming to the requirements specified in ASTM D977 for Emulsified Asphalt.

Grade CQS-1h:Conforming to the requirements specified in ASTM D2397 for Cationic Emulsions (Quick Set).

Any emulsion used for slurry will be with 4% polymer modifier content based on bitumen weight, certified by the emulsion supplier, which shall be milled into the emulsion or blended into the asphalt prior to the

emulsification process. It shall pass all applicable storage and settlement tests. The cement-mixing test shall be waived.

404.3.2.5.2. Micro-Surface. Emulsified asphalt for micro-surfacing shall be a quick-set polymer modified cationic type CSS-1 h emulsion and conform to the requirements specified in AASHTO M208 and ASTM D2397 Cationic Emulsified Asphalt. It shall pass all applicable storage and settlement tests. A minimum of 3% polymer modifier content based on bitumen weight content, certified by the emulsion supplier, along with special quick-setting emulsifier agents, shall be milled into the asphalt emulsion. The cement mixing test shall be waived. The emulsified asphalt shall be so formulated that when the paving moisture is applied with the relative humidity at no more than 50% and ambient air temperature of at least 75°F (24°C), it will cure sufficiently such that rolling traffic can be allowed in one-hour with no damage to the surface.

404.3.2.6. Mixture Tests. Mixures shall meet the requirements in Table 404.3.2.6.(a) Slurry Seal Mixture Requirements or Table 404.3.2.6.(b) Micro-Surface Mixture Requirements, as appropriate when tested by the given methods.

Table 404.3.2.6.(a) Slurry Seal Mixture Requirements

Characteristic	Test Method	Value
Consistency test	ASTM D3910 Standard Practices for Design, Testing, and Construction of Slurry Seal	2- to 3-cm Flow
Set time	ASTM D3910 (same as above)	12-hours maximum
Cure time	ASTM D3910 (same as above)	24-hours maximum
Wet stripping test	ISSA TB114	80%-coating minimum
Wet track abrasion test	ASTM D3910 (same as above)	75-g/ft^2 maximum

Table 404.3.2.6.(b) Micro-Surface Mixture Requirements

Characteristic	Test Method	Value
Set time	ASTM D6372 Standard Practice for Design, Testing, and Construction of Micro-Surfacing	12-hours maximum
Cure time	ASTM D6372 (same as above)	24-hours maximum
Wet stripping test	ISSA TB114	80%-coating minimum
Wet track abrasion test	ASTM D6372 (same as above)	75-g/ft^2 maximum
Marshall stability Flow units	ASTM D5581 Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen)	1800-lbs. minimum 6- to 16-units
Hveem stability, exceeding a height twice the maximum aggregate size	ASTM D1560 Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus	35 minimum
Set Time 30-minute Blotter test Displacement test Water resistance test @ 30-Minutes	ISSA TB102	 No Brown Stain No Displacement No Discoloration

404.3.3. Equipment. All methods and equipment employed in performing the work shall be subject to the approval of the Engineer before work is started and whenever found unsatisfactory they shall be changed and improved as required. All equipment must be maintained in a satisfactory condition.

The CONTRACTOR will provide suitable crack and pavement cleaning equipment, hand tools and any support equipment as necessary to perform the work.

404.3.3.1. Calibration. Each piece of equipment to be used shall be calibrated in the presence of the Engineer prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted provided they were made during the calendar year. No machine will be allowed to work on the project until the calibration has been completed and/or accepted.

404.3.3.2. Verification. Test strips shall be laid (location to be determined by the Engineer) before construction begins. The Engineer will observe the test strip for verification or rejection according to the specifications. Upon failure of any test, additional test strips will be laid at no cost to the CITY. The squareyards (m^2) of the first test strip will be measured and paid for at the contract unit price.

A field test shall be made to check consistency of the surface treatment. If a line made through the surface treatment fills up, the mixture is too wet, which the CONTRACTOR shall correct. If the line stays, the slurry has a proper consistency.

404.3.3.3. Mixing Equipment.

404.3.3.3.1. Slurry Seal. The slurry seal mixing equipment shall be continuous flow mixing unit as to give a uniform and complete circulation of the batch in the mixer, so as not to segregate the aggregates, but will provide a thorough and uniform free flowing mix with the asphalt and water. The units shall be equipped with a water pressure system and nozzle type spray bar adequate for completely fogging the surface with 0.05- to 0.15-gallons-per-square-yard (0.22- to 0.68-L/m^2) immediately ahead of the spreader box.

Application rate of aggregate, based on dry weight of aggregate, shall be 15- to 21-lbs-per-squareyard (8.1- to 11.4-kg/m^2) complete in place.

The residual asphalt content, based on % weight of dry aggregate, shall be 8% to 12%.

404.3.3.3.2. Micro-Surface Mixing Equipment. The material shall be mixed by a self-propelled micro-surfacing mixing machine which shall be a continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler and water to a revolving multi-blade mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler and water to maintain an adequate supply to the proportioning controls. The machine shall be equipped with self-loading devices which provide for the loading of all materials while continuing to lay micro-surfacing, thereby minimizing construction joints.

Individual volume or weight controls for proportioning each material to be added to the mix shall be provided. Each material control device shall be calibrated and properly marked.

The mixing machine shall be equipped with a water pressure system and nozzle type spray bar to provide a water spray immediately ahead of and outside the spreader box with 0.05- to 0.15-gallons-per-squareyard (0.22- to 0.68-L/m^2).

The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time. The mixing machine shall be equipped with an approved fines feeder that shall provide a uniform accurately metered, predetermined amount of the specified mineral filler. Application rate of aggregate, based on dry weight of aggregate, shall be 22- to 28-lbs-per-squareyard (11.9- to 15.2-kg/m^2) complete in place.

The emulsion pump shall be a positive displacement type and shall be equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time. The residual asphalt content, based on % weight of dry aggregate, shall be 6% to 11.5%.

404.3.3.4. Spreading Equipment.

404.3.3.4.1. Slurry Seal. The spreader box shall be equipped to prevent loss of slurry seal from all sides and with a flexible rear strike-off capable of being adjusted. It shall have suitable means for side tracking to compensate for deviations in pavement geometry. The box shall be kept free of built-up asphalt and aggregate. The strike-off drag shall be kept completely flexible at all times.

404.3.3.4.2. Micro-Surface. The surface mixture shall be spread uniformly by means of a mechanical type spreader box attached to the mixer, equipped with paddles to agitate and spread the materials throughout the box. A front seal shall be provided to insure no loss of the mixture at the road contact point. The rear seal shall act as final strike off and shall be adjustable. The mixture shall be spread to fill cracks and minor surface irregularities and leave a uniform skid resistant application of material on the pavement. The longitudinal joint where two passes join shall be neat appearing, uniform and lapped. All excess material shall be removed from the job site prior to opening the road. The spreader box shall have suitable means provided to side shift the box to compensate for variations in pavement geometry.

404.3.4. Preparation. Any breakdowns, base failures, or other defects shall be properly repaired by the CITY before application of the surface treatment. No work shall commence on any location until approval by the Engineer.

Immediately prior to applying the surface treatment, CONTRACTOR shall thoroughly clean the pavement of all loose materials, vegetation, soil and objectionable material. The CONTRACTOR shall cover manholes, valve boxes, raised pavement markers and other designated objects to insure their integrity. All pavement cleaning and covering of appurtenances shall be subject to the final approval and acceptance of the Engineer.

If required, the CONTRACTOR shall apply a tack coat or a second coverage of treatment on brick, concrete, or other highly absorbent or polished pavements. If a tack coat is required, a 1-part emulsion, 3-part water tack coat of the same asphalt emulsion type and grade as specified for the surface treatment is required. Rate of application of tack coat material shall be 0.05- to 0.10-gallons-per-square-yard (0.22- to 0.45-L/m^2). All debris and unused material shall be removed.

404.3.5. Surface Treatment Application. Surface treatments shall be placed on the location and within the time limit as specified by the Engineer.

404.3.5.1. Fogging. If conditions require, the pavement shall be pre-wetted by fogging ahead of the slurry/spreader box. Water used in fogging the surface shall be applied so that the entire surface is damp with no flowing water in front of the box. Rate of spray shall be 0.05- to 0.15-gallons-per-square-yard (0.22- to 0.68-L/m^2) or as directed by the Engineer. No streaks, lumps, balls or unmixed aggregated shall be permitted.

404.3.5.2. Mix Stability. The mix shall be sufficiently stable during the spreading period so that the emulsion does not break, there is no segregation of the fines from the coarser aggregate and the liquid of the mix does not float to the surface.

404.3.5.3. Lines and Joints. Straight lines along curb gutters and shoulder will be required. No runoff on these areas will be permitted. Lines at intersections must be kept straight to provide a good appearance. Surface treatment shall be placed at the lip of the gutter or at a distance from the face of the curb as directed by the Engineer.

No excessive buildup or unsightly appearance shall be permitted on longitudinal or transverse joint. An excessive overlap will not be permitted on longitudinal joints. The CONTRACTOR shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the project. Longitudinal joints shall be placed on lane lines when possible. If half passes are used, they shall not be the last passes on any paved area.

404.3.5.4. Rolling. If required, specified areas shall be rolled by a self-propelled 10-ton (9000- to 10,000-kg) pneumatic roller with tire pressure of 50-psi (3.5-kg/cm^2) and equipped with a water spray system. The slurried pavement shall be subjected to a minimum of 5 full coverages by the roller. Rolling should not commence until the slurry has cured enough so that it will not pick up on the tires. In areas of high traffic volume and subject to slow turning, e.g. major intersections, rolling may be feasible.

404.3.5.5. Hand Work. In areas where the spreader box cannot be used, hand squeegees to provide complete and uniform coverage shall apply the surface treatment. Any joint cracks not filled by the mix shall be corrected by use of hand squeegees. Handwork shall be completed during the machine applying process. Due to the difficulty in hand working micro-surfacing material because of the quick-set nature of the emulsion, hand work for micro-surface treatment shall be kept to a minimum.

404.3.5.6. Curing and Finishing. All traffic shall be kept off the treated area until it has cured to a firm condition that will prevent damage to the surface treatment. Any uncured areas damaged will be repaired satisfactory to the Engineer at the CONTRACTOR'S expense.

After completion of surface treatment placement, the CONTRACTOR shall remove covered objects (manhole covers, valve covers, raised traffic markers, etc.) so the object protected will remain fully functional. All objects not to have been covered shall be restored to original integrity. Any objects damaged by the CONTRACTOR'S work activities shall be repaired or replaced at no cost to the CITY.

Any work directed by the Engineer to correct any appearance defect shall be subject to the final approval of the Engineer.

The CONTRACTOR shall remove all unused material and debris from the site prior to final acceptance.

404.4. BITUMINOUS SURFACE TREATMENT (CHIP SEAL)

404.4.1. Description. This item shall consist of a wearing surface composed of one, two or three applications of asphaltic materials, each covered with aggregate, constructed on the prepared base course or surface in accordance with the requirements as shown on the plans and these specifications.

404.4.2. Materials.

404.4.2.1. Asphaltic Materials. The asphaltic materials used shall be of the type and grade as specified by the CITY and shall meet the requirements of Item 302.3. Bituminous Materials.

WARNING TO CONTRACTOR: Attention is called to the fact that asphaltic materials are highly flammable. The utmost care shall be taken to prevent open flames from coming in contact with the asphaltic materials or the gases of same. The CONTRACTOR shall be responsible for any fires or accidents that may result from heating the asphaltic materials.

404.4.2.2. Aggregate. Aggregate shall be composed of dry, sound, durable particles of processed stone or steel slag having a percent of wear of not more than 35 when tested in accordance with ASTM C131 Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine. Crushed gravel shall not be allowed. The aggregate shall be free from organic matter, clay, loam, or coated pebbles and shall contain not more than five-percent of slate, shale, schist, or soft particles.

The aggregate used shall be of the type and grade or types and grades selected from those prescribed in Item 301.5. Flexible Subbase or Base (Crushed Stone/Concrete). The particular type and grade or types and grades shall be as provided on the plans or as required by the CITY.

Aggregate when tested by standard laboratory methods shall meet the grading requirements in Table 404.4.2.2.(a) Chip Seal Aggregate Gradations. Prior to shipping aggregate to the project, the CONTRACTOR shall furnish the Engineer with samples of the proposed aggregate.

Table 404.4.2.2.(a) Chip Seal Aggregate Gradations

Sieve Size	% Retained, by weight	Sieve Size	% Retained, by weight
FIRST APPLICATION			
Small Aggregate "SB"		**Large Aggregate "LB"**	
5/8-in.	0%	1-in.	0%
1/2-in.	0 - 10%	3/4-in.	15 - 45%
1/4-in.	70 - 100%	1/2-in.	85 - 100%
No. 10	95 - 100%	1/4-in.	98 - 100%
SECOND APPLICATION			
Small Aggregate "ST"		**Large Aggregate "LT"**	
3/8-in.	0%	3/4-in.	0%
1/4-in.	2 - 20%	1/2-in.	0 - 10%
No. 10	70 - 100%	1/4-in.	65 - 85%
No. 20	95 - 100%	No. 10	90 - 100%
		No. 20	98 - 100%

404.4.2.2.1. Precoated Aggregate. The grade of aggregate specified shall meet all other requirements of Item 404.4.2.2. Aggregate prior to the application of precoat or fluxing material. Materials that are not uniformly and/or properly coated, in the opinion of the Engineer, shall not be accepted for use.

Precoated aggregate shall be aggregate of the type and grade specified, coated with 0.5- to 1.5-percent (by weight) of residual bitumen from a precoating material. When limestone rock asphalt is used, it shall be fluxed with 0.5- to 1.5-percent (by weight) of fluxing material. The materials may be mixed on the job or at a central mixing plant and shipped ready for use. Mixes that do not maintain flow qualities such that the precoated aggregate may be satisfactorily spread by approved mechanical spreading devices will not be acceptable.

Precoated aggregate will show no stripping when tested in accordance with TxDOT test method Tex-530-C Effect of Water on Bituminous Paving Mixtures. If antistripping additives are required to meet this requirement, they shall meet the requirements of TxDOT Item 301 Asphalt Antistripping Agents.

404.4.3. Construction Methods.

404.4.3.1. Equipment and Preparation. All storage tanks, piping, retorts, booster tanks, and distributors used in storing or handling asphalt shall be kept clean and in good operating condition at all times. They shall be operated in such a manner that there shall be no contamination of the asphalt with foreign material.

The area to be treated shall be cleaned of dirt, dust or other deleterious matter by sweeping or other approved methods. If it is found necessary by the CITY, the surface shall be lightly sprinkled just prior to the application of the asphaltic material.

404.4.3.2. Application of Asphalt. The CITY shall select the temperature of application based on the temperature-viscosity relationship that shall permit application of the asphalt with the limits recommended in Item 302.5. Storage, Heating and Application Temperature of Bituminous Materials. The CONTRACTOR shall apply the asphalt at a temperature within 15°F (8°C) of the temperature selected. It shall be the responsibility of the CONTRACTOR to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

Asphaltic material may be placed by preheating aggregate to 280°F (138°C) when the air temperature is 70°F (21 °C) and falling or when the air temperature is 50°F (10°C) and rising.

Asphaltic material of the type and grade shown on the plans shall be applied on the clean surface by an approved type of self-propelled pressure distributor so operated as to distribute the material in the quantity specified, evenly and smoothly, under a pressure necessary for proper distribution. The CONTRACTOR shall provide all necessary facilities for determining the temperature of the asphaltic materials in all of the heating equipment and in the distributor, for determining the rate at which they are applied, and for securing uniformity at the junction of two distributor loads. The distributor shall have been recently calibrated and the CITY shall be furnished an accurate and satisfactory record of such calibration. After beginning the work, should the yield on the asphaltic materials appear to be in error, the distributor shall be recalibrated in a manner satisfactory to the CITY before proceeding with the work.

Asphaltic materials for each course may be applied for the full width of the surface treatment in one application, unless the width exceeds 26-ft. (8m). No traffic or hauling shall be permitted over the freshly applied asphaltic materials. Asphaltic materials shall not be applied until immediate covering with aggregate is assured.

404.4.3.3. Application of Aggregate. Aggregate, of the type and grade shown on the plans for the first course, shall be immediately and uniformly applied and spread by approved calibrated mechanical spreaders, operated on the rear of the aggregate trucks or as a separate power-driving unit. These spreader units shall be approved by the CITY prior to the start of the work. The aggregate shall be applied at the approximate rates indicated on the plans, within the limits shown in Table 404.4.3.4.(a) Chip Seal Rates of Application, and as directed by the CITY. The entire surface shall then be broomed, bladed or raked as required by the CITY and shall be thoroughly rolled with both pneumatic tire and steel wheel (3- to 6-tons) (2,700-kg to 5,400-kg) rollers to insure proper embedding into the bitumen. The rolling shall be continued until no more aggregate can be worked into the surface. Rolling shall meet the governing specifications for Item 301.1.2. Rolling of Embankment, Subgrade or Flexible Base.

404.4.3.4. Rates of Application. The asphalt and aggregates shall be applied at the approximate rates indicated on the plans within the following limits, as directed by the Engineer. The rates of application and the estimated quantities of aggregate are based on the usual or average gradation of known materials. Prior to shipping aggregate to the project, the CONTRACTOR shall furnish the Engineer with samples of the proposed aggregate so that the gradation may be determined and rate of application changed if necessary.

Table 404.4.3.4.(a) Chip Seal Rates of Application

Application	Asphalt gal/yd^2 (L/m^2)		Aggregate yd^3 per yd ^{2} (m^3:m^2)	
	Minimum	**Maximum**	**Minimum**	**Maximum**
SMALLER AGGREGATE				
First, Aggregate “SB”	0.20(0.9)	0.30 (1.4)	1:100(0.9:100)	1:75(0.9:75)
Second, Aggregate “ST”	0.30(1.4)	0.40 (1.8)	1:200(0.9:200)	1:150(0.9:150)
LARGER AGGREGATE				
First, Aggregate “LB”	0.25(1.1)	0.35 (1.6)	1:75(0.9:75)	1:50(0.9:50)
Second, Aggregate “LT”	0.35(1.6)	0.45 (2.0)	1:150(0.9:150)	1:100(0.9:100)

404.4.3.5. Multiple Courses. Where double or triple surface courses are specified on the plans, each succeeding course shall be constructed by the procedures as prescribed for the first course. The rates of asphaltic material and aggregate for multiple-course construction shall be as shown on the plans within the limits shown in Table 404.4.3.4.(a) Chip Seal Rates of Application or as directed by the CITY.

404.4.3.6. Maintenance and Completion. The CONTRACTOR shall be responsible for the maintenance of the surface and distribution of the excess aggregate until final completion and acceptance of the entire project by the CITY. All holes or failures in the surface shall be repaired per each course by use of additional asphalt and aggregate. All fat or bleeding surfaces shall be covered with approved cover material per each course in such a manner that the asphaltic material will not adhere to or be picked up by the wheels of vehicles.

ITEM 405. ULTRA THIN CONCRETE PAVING (WHITETOPPING)

405.1. DESCRIPTION

This Item shall govern for a 2-inch thick (5cm) to 4-inch thick (10cm) bonded concrete overlay placed on an asphaltic surface in accordance with the details shown on the plans and the requirements of this Item.

405.2. MATERIALS

Unless otherwise shown on the plans or required herein, all materials shall conform to the requirements of Item 303. Portland Cement Concrete Pavement, except for the following:

(1) The concrete shall be designed to include seven (7) sacks of Type III cement.
(2) The maximum water cement ratio shall not exceed 5.5-gallons (20.8L) per sack.
(3) The fineness modulus of aggregate shall be 2.6 to 2.8 unless otherwise shown on the plans.
(4) An ASTM Type A water-reducing admixture and an ASTM Type C nonchloride set-accelerating admixture shall be used to achieve the earliest possible concrete-setting times.
(5) The use of a set-retarding admixture will not be permitted.
(6) The concrete will be designed to achieve a minimum flexural strength of 425 psi (29.9-kg/cm2). Aggregate size shall conform to size number 467 as shown in Table 303.2.1.3.2.(a) Grading Requirements for Coarse Aggregates.

The entrained air content of the fresh concrete shall be 4% with a tolerance of +/-1 % when tested in accordance with TxDOT Test Method Tex-416-A.

Reinforcing fibers in accordance with Item 303.2.6. Fibrous Reinforcement shall be of the type and amount shown on the plans, and shall be added to the mix in accordance with the manufacturer's recommendations.

Curing materials shall conform to Item 303.2.13. Curing Materials or as specified on the plans.

Equipment and forms shall comply with requirements as stated in Item Item 303. Portland Cement Concrete Pavement.

405.3. CONSTRUCTION METHODS

405.3.1. General. Loads on the milled area shall be kept to a minimum so not to cause failure to the underlying material. This may require using small loads of concrete or other than normal concrete delivery methods. Once the milled area has been cleaned, no traffic other than construction equipment for the overlay shall be permitted on any portion of the milled area. The thickness of the concrete overlay shall be as specified on the plans. The screed shall be adjusted to provide an approved grade line and sufficient thickness. To identify insufficient depth areas prior to concrete placement, the following procedures shall be used, unless other methods are approved by the CITY. To identify areas of insufficient depth, a filler block having a thickness ¼-inch (6mm)
less than the overlay thickness shall be attached to the bottom of the screed and the screed shall be passed over the area to be overlaid. Areas which have insufficient depths shall be corrected by adjustments of the screed and/or rail system, or by chipping or scarifying of the milled asphalt prior to the overlay as approved by the Engineer.

405.3.2. Preparation of Surface. Oil or other foreign material spilled or dripped onto the milled surface shall be removed by cleaning. Immediately before the concrete is placed, the asphalt surface shall be cleaned with a filtered air blast to remove windblown dust, dirt, debris, and standing water and then brought to a to a moist, approximately saturated surface dry condition. It is important that the milled surface be thoroughly clean so as to facilitate the bond between the asphaltic surface and the concrete.

405.3.3. Spreading and Finishing Concrete. The spreading and finishing of the concrete overlay shall be in accordance with Item 303. Portland Cement Concrete Pavement, including environmental constraints.

405.3.4. Transverse Construction Joints. When the placing of concrete is stopped, CONTRACTOR shall provide a bulkhead of sufficient cross sectional area to prevent deflection that is shaped accurately to the cross section of the pavement. The bulkhead shall be at right angles to the centerline of the pavement, perpendicular to the surface and at the required elevation. Intentional stoppage of the placing of the concrete shall be at either a construction joint or at a weakened plane joint. This joint shall be sawed and sealed using a joint sealant in accordance with Item 303. Portland Cement Concrete Pavement, type as indicated on the plans.

When an unintended stoppage occurs, the CONTRACTOR shall immediately install the above described bulkhead at a weakened plane joint. The available concrete should completely fill against the bulkhead and any concrete remaining on the subgrade ahead of the bulkhead shall be removed and disposed of as directed by the Engineer. This joint shall be sawed and sealed using a joint sealant in accordance with Item 303. Portland Cement Concrete Pavement, type as indicated on the plans.

All construction joints adjacent to existing concrete paving, curb, or curb and gutter shall be sawed and sealed using a joint sealant in accordance with Item 303. Portland Cement Concrete Pavement, type as indicated on the plans.

405.3.5. Initial Curing. Immediately after any section of pavement has been tined and the surface moisture has disappeared, the concrete surface shall be sprayed uniformly with a curing compound as specified in Item 303.5.7. Curing. Immediately after this curing compound has dried, the concrete surface shall be sprayed uniformly with a second application of curing compound in accordance with Item 303.5.7. Curing. Should the membrane be damaged from any cause, except for the sawing cutting, before the water cure is started, the damaged portions shall be repaired immediately with additional compound.

405.3.6. Saw Cutting Weakened Plane Joints. Unless otherwise shown on the plans, sawed joints shall be sawed to a minimum depth of one-third the thickness of the concrete overlay. The minimum saw cut depth for a dry, early saw cut shall be ¾-inch (2cm).

Saw cuts shall be perpendicular to the surface of the overlay. Unless otherwise shown on the plans, the saw cuts shall be in lines that are perpendicular and parallel to the centerline of the travel lanes and spaced at a maximum distance apart of 1-foot (30cm) for every inch (2.5cm) of design overlay depth. Saw joints for radii shall be as detailed in the plans. Chalk line, offset string line, sawing template or other approved methods shall be used to provide a true joint alignment. The saw cuts are not to be sealed, but shall be cleaned of all deleterious material after sawing.

Since the starting and ending times for sawing is the function of many variables within the mix, the weather, and the type and number of saws used, the CONTRACTOR is wholly responsible for the timing and order of the saw cutting. If excess spalling or raveling occurs at the top of the saw cuts or the intersection of saw cuts, or if uncontrolled full depth cracking occurs before traffic is allowed on that portion of the concrete, that portion of concrete which is bordered by existing saw cuts shall be entirely removed and replaced at the CONTRACTOR's expense.

405.3.7. Deficient Thickness. The pavement shall be tested for depth by direct measurement in accordance with TxDOT Test Method Tex-423-A at locations selected by the Engineer. If the thickness of the pavement indicated by the direct measurement depth test is deficient by more than ¼-inch (6mm) from the plan thickness, the CONTRACTOR may verify the thickness by cores taken in accordance with TxDOT Test Method Tex-424-A at the locations selected by the Engineer.

Any area of pavement deficient in thickness by more than ¼-inch (6mm) of plan thickness shall be removed and replaced. The deficient area along with the concrete within the same border of the existing saw cuts shall be entirely removed, the asphalt surface chipped or scarified as described above, and the concrete replaced, all at the CONTRACTOR's expense.

405.3.8. Opening to Traffic. Opening of the completed overlay to normal construction traffic and to the traveling public shall be after the concrete has obtained a flexural strength of 255-psi (18-kg/cm^2) or a compressive strength of 1800-psi (127-kg/cm^2).