400 FLEXIBLE PAVEMENT

ITEM 417 - ASPHALT EMULSION SLURRY SEAL

417.01 Description. The slurry seal shall consist of a mixture of emulsified asphalt, mineral aggregate, and water; properly proportioned, mixed, and spread evenly on the surface as specified herein and as directed by the Engineer. The cured slurry shall have a homogeneous appearance, fill all cracks, adhere firmly to the surface and have a skid resistant texture.

417.02 Materials.

1. **Asphalt Emulsion.** The emulsified asphalt shall conform to AASHTO specifications for dense mixing grade SS-1h except that they shall be of the QUICK SET SLURRY SEAL EMULSION TYPE, either anionic or cationic, whichever in the opinion of the Engineer and laboratory is best suited to the aggregates and job conditions to be encountered. The following specifications will apply:

	Quick Set Anionic	**Quick Set Cationic**
Viscosity at 77° F (25° C), SSF, secs.	15-50	15-50
Residue from Distillation Weight, %	57% min.	57% min.
Sieve Test, Retained on 20 mesh, %	0.10 max.	0.10 max.
Particle Charge, Electroplate	Negative	Positive
Tests on Residue from Distillation:		
Penetration at 77° F (25° C), 100 G., 5 sec.	40-90	40-90
Solubility in CS2 or TCE	97.5 min.	97.5 min.
Ductility at 77° F (25° C), cm.	40 min.	40 min.
Tests on Job Design Slurry:		
Mixing Time Test Sec.	120 min.	120 min.
Set Time Blotter Test, 30 mins.	No brown stain or	No brown stain or

	displacement	displacement
Water Resistance Test, 30 mins.	No dis-coloration	No dis-coloration
Coating Test (3 min. in boiling water), %	90 min.	90 min.
Wet Track Abrasion Test, Loss in gms. per sq. ft.	75 max.	75 max.
Loaded Wheel Test, Sand Adhesion gms. per sq. ft.	60 max.	60 max.

2. **Aggregate.** The mineral aggregate shall consist of 100 percent crushed gravel, or slag, or approved limestone. The aggregate shall be clean and free from vegetable matter and other deleterious substances. When tested by AASHTO T176, the aggregate blend shall have a sand equivalent of not less than 45. When tested according to AASHTO T104, the aggregate shall show a loss of not more than 35 percent.

Mineral fillers such as Portland cement or limestone dust shall be considered as part of the blended aggregate and shall be used in minimum required amounts. They shall meet the gradation requirements of ASTM D242 (Dry). Mineral fillers shall only be used if needed to improve the workability of the mix or gradation of the aggregate.

The aggregates proposed for use in the work shall have a proven durability record for the conditions and traffic expected. The Engineer shall approve the aggregate source before work proceeds. The combined mineral aggregate shall conform to the following gradation when tested by the previously mentioned test:

Sieve Size	**Type I (Slurry Seal) Percent Passing**	**Type II (Slurry Seal) Percent Passing**	**Type III (Slurry Seal) Percent Passing**
3/8 (9.5 mm)	100	100	100
No. 4 (4.75 mm)	100	90-100	70-90
No. 8 (2.36 mm)	90-100	65-90	45-70
No. 16 (1.18 mm)	65-90	45-70	28-50
No. 30 (600µm)	40-60	30-50	19-34
No. 50 (300µm)	25-42	18-30	12-25
No. 100 (150µm)	15-30	10-21	7-18
No. 200 (75µm)	10-20	5-15	5-15

Sieve Size	Type I (Slurry Seal) Percent Passing	Type II (Slurry Seal) Percent Passing	Type III (Slurry Seal) Percent Passing
Theoretical Asphalt Content, (% Dry Aggregate) % Extracted from dry sample	10-16	7.5-13.5	6.5-12
Application Rate, Aggregate lbs./SY (kg/m^2), Dry	8+/-2 (4+/-1)	15+/-2 (8+/-1)	20+/-3 (10+/-1.5)

3. **Water.** All water used with the slurry mixture shall be potable and free from harmful soluble salts.

4. **Stockpiling of Aggregate.** Stockpiling at areas other than the quarry site to be approved by the Engineer. Segregation of the aggregate will not be permitted. Contamination of stockpile will not be permitted.

5. **Storage.** The Contractor shall provide suitable storage facilities for the asphalt emulsion. The container shall be equipped to prevent water from entering the emulsion. Suitable heat shall be provided if necessary to prevent freezing.

6. **Sampling.** Samples of materials and of the finished slurry surface shall be furnished by the Contractor as directed by the Engineer during progress of the work. Test reports may be requested from the Contractor as additional materials arrive.

7. **Design.** The bidder shall submit to the Engineer a complete laboratory design made in a qualified laboratory before the contract award is made. A complete analysis of the materials and Job Mix Formula proposed for use in the performance of the work shall be made in accordance with procedures outlined in the current issue of International Slurry Seal Association Technical Bulletin No. 111 as indicated by the Engineer. The Engineer will review and approve the bidder's selection of the optimum mix design from the material data presented.

8. **Submittals.** The bidder shall submit along with the required written materials analysis and proposed Job Mix Formula the following physical specimens:

   A. 11 lb (5 kg) of the proposed aggregate selected.

   B. 1 gal (4 liters) of the proposed emulsion selected.

   C. 1/2 kg. of the filler selected, if applicable.

D. 3 series of consistency tests at 100, 85 and 70 percent BR and at 2-3, 4-5, and 6-7 cm. consistencies.

E. 2 each of abraded Wet Tract Abrasion Test specimens at 100, 85 and 70% BR.

F. 2 each of sand adhered Loaded Wheel Test specimens at 100, 85 and 70% BR.

Each specimen shall be indelibly identified with the date and source.

The Engineer shall waive the design submittals provided the bidder has previously applied in this subdivision a satisfactorily designed and applied slurry with substantially the same materials proposed for this work. In any case, untried materials may not be introduced into this work without complete analysis and design of a Job Mix Formula for each new material and the approval of the Engineer.

417.03 Equipment. All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working order at all times. The Contractor will furnish proof by certification that the slurry machines to be used on the project have been calibrated within the past 2 months. Such certificate shall consist of a letter from a professional Engineer or an acceptable testing laboratory.

1. **Slurry Mixing Equipment.** The slurry mixing machine shall be a continuous flow mixing unit and be capable of delivering accurately a predetermined proportion of aggregate, water and asphalt emulsion to the mixing chamber and to discharge the thoroughly mixed product on the continuous basis. The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. No violent mixing shall be permitted. The mixing machine shall be equipped with an approved fines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed. The fines feeder shall be used whenever added mineral filler is a part of the aggregate blend.

   The mixing machine shall be equipped with a water pressure system and fog type spray bar adequate for completing fogging the surface preceding spreading equipment with a maximum application of 0.05 gallons per square yard (2 L/m^2). No free water shall be carried in front of the spreader. The emulsion tanks will be equipped with some type of measuring device, that will provide a quick reference to determine application rate - gallons of emulsion per square yard (liters per square meter). A minimum of two complete slurry machines of at least 10 tons (9 metric tons) aggregate capacity each shall be required to provide as nearly a continuous operation as possible.

2. **Slurry Spreading Equipment.** Attached to the mixing machine shall be a mechanical type squeegee distributor box equipped with flexible material to contact with the surface to prevent loss of slurry from the spreader box. It shall be maintained full to prevent the loss of slurry on varying grades and crowns by adjustment to assure a uniform spread.

   There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. The box shall be kept clean, and build-up of asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other drags shall be approved by the Engineer.

3. **Cleaning Equipment.** Power brooms, power blowers, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old surface. High pressure water (10 gal/m (38 L/m) at 1,000 psi (6.9 Mka)) shall be the only approved method for removal of mud and adhesive clays.

4. **Auxiliary Equipment.** Hand squeegees, shovels, and other equipment shall be provided as necessary to perform work.

417.04 Preparation of Surface. The Contractor will be responsible for sweeping, weed removal and final cleaning just before the machine. Any standard cleaning method used to clean pavements will be acceptable, except water flushing will not be permitted in areas where considerable cracks are present in the pavement surface. The Engineer shall give final approval of the surface.

If the slurry is being placed over a brick or concrete surface, highly absorbent asphalt surface, or over a surface where the aggregate has become exposed and is polished and slick, a one part emulsion, three parts water, tack coat of the same asphalt emulsion type and grade as specified for the slurry may be required. This mixture may be applied with the slurry machine spreader box. The normal application rate is 0.05 to 0.10 gallons (2 to 4 liters) of the diluted emulsion per square yard (square meter) of surface. The Engineer should give final approval.

417.05 Composition and Rate of Application of the Slurry Mix. The optimum Job Mix Formula as set forth in the materials Section (4G) of this specification shall be translated into job control quantities by the Contractor in accordance with ISSA TB #107. The rate of spread shall be determined in accordance with ISSA TB #112 by the Contractor.

The consistency of the mix shall be controlled within 2.5 and 3.5 cm. A complete load-by-load record of the quantities used as in ISSA TB #107 shall be kept by the Contractor and shall be made available to the Engineer or City representative upon request. Final payment for the work will not be made until all load tickets and inventories are verified to assure that specification quantities have been applied. In case of disputes, the Engineer's judgment shall be final.

417.06 Weather Limitations. The slurry seal surface shall not be applied if either the pavement or air temperature is 50° F (10° C) or below and falling, but may be applied when both the air and pavement temperature are 45° F (7° C) or above and rising. The mixture should not be applied if high relative humidity prolongs the curing beyond a reasonable time.

417.07 Traffic Control. Suitable methods such as pennants, barricades, flaggers, pilot cars, etc., shall be used to protect the uncured slurry surface from all types of traffic. Any damage to the uncured slurry will be the responsibility of the Contractor. The Engineer shall give final approval as to the method used. If damage occurs where suitable means have been made to protect the uncured slurry, violators will be prosecuted and the Contractor will be reimbursed for the amount of the damages. Residents affected by the work shall be notified by the Contractor in writing, *1 week* before the work is to be done. Posting of "No Parking" signs shall be done by the Contractor *3* working days before the work is to be done. Towing parked vehicles after *3* days of notification has been done, the Contractor is responsible and liable for the removal of these vehicles.

417.08 Application of the Slurry Surfaces.

1. **General.** The surface shall be fogged with water directly preceding the spreader. The slurry mixture shall be of the desired consistency when deposited on the surface and no additional elements shall be added. Total time of mixing shall not exceed 4 minutes. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that complete coverage is obtained. No lumping, balling, or unmixed aggregate shall be permitted. No excessive breaking of the emulsion will be allowed in the spreader box. No streaks such as caused by oversized aggregate will be left in the finished pavement.

2. **Test.** The Contractor will furnish the City a cone consistency test each morning for each slurry machine used on the job, see Technical Bulletin 106 attached.

3. **Joints.** No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints.

4. **Hand Work.** Approved squeegees shall be used only to spread slurry in inaccessible areas to the slurry mixer. Care shall be exercised in leaving no unsightly appearance from hand work. In areas with adjacent concrete curb or curb and gutter which are not to be treated, the Contractor shall use special care to avoid covering the concrete. If the Engineer determines that insufficient care is being taken to protect the concrete, masking with suitable material may be ordered by the Engineer at no additional cost to the City.

5. **Curing.** Treated areas will be allowed to cure until such time as the Engineer permits their opening to traffic.

6. **Structures.** All structures which may become marred by the slurry such as open gates, catch basins, manholes and valve boxes, shall be masked prior to the work with .006" (.15 mm) plastic or equal and attached so as not to be displaced by the operations and shall be removed after the slurry has cured. Care shall be taken at intersections to achieve a clean straight line as directed by the Engineer by use of 15 pound (6.8 kg) roofing felt or equal. All masking materials shall be removed at the completion of the work.

417.09 Method of Measurement. The slurry seal surface shall be measured and paid for by the square yards (square meter) of work completed and accepted as designated by the Engineer for each type applied. The City will require 1 test section per 1,000 square yards (836 m^2) completed, sections will be selected by the Engineer. At each location a 1 x 1-foot (0.3 x 0.3m) square area will be removed of the fresh dried slurry. A piece of steel bar stock will be laid across the removed section and the thickness measured daily. Acceptable minimum for each type is:

Type I	1/16 inch (1.6 mm)
Type II	3/16 inch (4.8 mm)
Type III	5/16 inch (8.0 mm)

A payment deduction will be applied if the average thickness is less than the acceptable minimum. The payment shall be paid for at the ratio of the average actual thickness to the acceptable minimum thickness applied to the unit bid for the item.

417.10 Basis of Payment. Payment for accepted quantities complete in place will be paid for at the contract unit price per square yard (square meter) which price and payment shall be full compensation for furnishing and placing all materials; provided, however, that the slurry seal found deficient in thickness only the reduced price stipulated in Section 417.09 shall be paid.

No additional payment over the unit contract bid price will be made for any slurry seal which has an average thickness in excess of that shown in Section 417.09.

Payment for accepted quantities complete in place, will be made at the contract price for:

Item	Unit	Description
417	Square Yard (Square Meter)	Asphalt Emulsion Slurry Seal, Type ____