

**SECTION 32 01 13.68**  
**HIGH DENSITY MINERAL BOND SEAL**

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**PART 1 GENERAL**

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**1.1. SECTION INCLUDES**

- A. Application of an asphalt-aggregate *bond* seal coat as a high density roadway surface preservation treatment.

**1.2 REFERENCES**

A. AASHTO Standards:

T 59 Standard Method of Test for Emulsified Asphalts.

T 111 Standard Method of Test for Mineral Matter or Ash in Asphalt Materials.

B. ANSI Standards:

B74.8 Ball Mill Test for Friability of Abrasive Grain.

C. ASTM Standards:

C 128 Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.

C 170 Compressive Strength of Dimension Stone.

C 1326 Knoop Indentation Hardness of Advanced Ceramics.

D 1644 Nonvolatile Content (Solids by weight).

D 2172 Quantitative Extraction of Bitumen From Bituminous Paving Mixtures.

D 2196 Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) Viscometer.

D 2486 Determining Wear Resistance in Cycles.

D 2939 Emulsified Bitumens Used as Protective Coatings.

D 3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D 6937 Determining Density of Emulsified Asphalt.

D 3960 Determining Volatile Organic Compound Content of Paints and Related Coatings.

E 70 pH of Aqueous Solutions with the Glass Electrode.

**1.3 SUBMITTALS**

- A. Mix Design: Provide the following. Allow ENGINEER 10 days to evaluate the submittal.

1. Date of mix design. If older than 60 days from date of submission, recertify mix design.
2. Proportions of aggregate, filler, water, polymer, and emulsion in the mix.
3. Residual in-place bitumen content, in *pounds per square yard*.
4. Residual in-place aggregate or mineral solids content, in *pounds per square yard*.
5. Thickness target for each application coat, in *gallons per square yard*.
6. Total minimum thickness, in *gallons per square yard*.
7. Results of a wear resistance test current within one (1) calendar year of the

proposed mix design.

- B. Before Placement: Submit at least 48 hours before delivery.
  - 1. Traffic control plan, Section 01 55 26.
  - 2. List of construction equipment to be used.
  - 3. Certificate from emulsion supplier stating emulsion meets requirements in this section.
  - 4. Names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM standards.
  - 5. Warranty.
- C. Reports: If requested by ENGINEER, submit the following.
  - 1. List of five (5) projects that have successful product applications on bituminous surfaces. Provide names of project contacts.
  - 2. Source and field quality control testing reports performed by CONTRACTOR and Suppliers.

#### 1.4 **QUALITY ASSURANCE**

- A. Foreman of CONTRACTOR's crew or Supplier's representative has completed at least three (3) projects of similar scope. If crew foreman does not have such experience, Supplier must provide a full-time representative on site during application.
- B. Use a laboratory that complies with ASTM D 3740 and follows Section 01 45 00 requirements.
- C. Verify mixture delivered to site contains the same emulsion specified in the mix design.
- D. Do not change source of the asphalt emulsion or aggregate without supporting changes in the mix design.
- E. Reject product that does not meet requirements.

#### 1.5 **WEATHER**

- A. Temperature:
  - 1. Apply surface treatment material if air and pavement surface temperatures in the shade are 55 deg F. and rising.
  - 2. Cease application if air or pavement surface temperatures are projected to fall below 45 deg F. within 48 hours.
- B. Moisture and Wind:
  - 1. Do not apply surface treatment material to a wet surface (no visible standing water or high sheen), during rain, 24 hours prior to forecast rain, or in unsuitable windy weather.
  - 2. Cease work if weather or other conditions prolong opening pavement surface to traffic.

#### 1.6 **NOTICE**

- A. Follow Laws and Regulations concerning when and to whom notices are to be given at least three (3) days before applying surface treatment material.
- B. Indicate application time and when the surface can be used. If necessary, include a map showing closed-off areas.

- C. Provide phone numbers of at least two (2) individuals who represent the CONTRACTOR who can be reached at any time during the work.
- D. Warn of potential vehicle tow away and other construction issues affecting neighborhood.
- E. Should work not occur on specified day, issue an updated notice.

**1.7 ACCEPTANCE**

**A. General:**

- 1. Acceptance is by Lot.
- 2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.
- 3. Dispute resolution, Section 01 35 10.
- 4. Opening surface treatment to vehicular traffic does not constitute acceptance.
- 5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing, however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

**B. Asphalt Binder:**

- 1. Lot size is total contracted product placement. Sub-lot size is one (1) day's production.
- 2. Of all sub-lot samples collected, randomly select one and test it for the physical properties in this section. The lot is acceptable if this single test meets requirements. If the test does not meet requirements, continue testing other samples for compliance.
- 3. At ENGINEER's discretion, a lot with deficient sub-lot properties may be accepted if pay for the lot is reduced using one of the following applicable pay factors, or lot may be accepted at 50 percent pay if lot is in Reject.

<b>Pay Factor</b>	<b>Number of Non-complying Tests</b>
1.00	0
0.90	1
0.80	2
0.70	3
Reject	4

**C. Placement:**

- 1. Mat appearance.
  - a. No runoff onto concrete curbs, gutter pans, and shoulders.
  - b. No streaking, drilling, drag marks, or squeegee marks.
  - c. No light spots.
  - d. No de-bonding.
  - e. Straight longitudinal edges with proper joints.
- 2. Mat thickness, bitumen content and aggregate content.
  - a. Lot size is one (1) day's production. Sub-lot size is 0.5 lane mile.
  - b. Collect and test five (5) equally spaced samples from the initial sub-lot. Upon

review of the initial sub-lot test results and at ENGINEER's discretion, acceptance of subsequent sub-lots may be based upon one or less samples from each subsequent sub-lot.

3. Pay Adjustment: Not applicable. Correct mat deficiencies at no additional cost to OWNER.

**1.8 WARRANTY**

- A. Both the CONTRACTOR and Supplier shall provide a two (2) year minimum written warranty when the existing pavement is in an appropriate condition (CONTRACTOR and Supplier to determine condition). Warranty covers delaminating, peeling and premature surface wear.
  1. Before placement notify ENGINEER if pavement condition or application condition voids the warranty.
  2. ENGINEER may allow or cancel product application at no cost to OWNER if warranty cannot be given.
- B. Acceptable performance after two (2) year period is no delaminating, peeling, or inter-aggregate loss in surface wear. Mechanical disturbances by snow plow chatter, studded tires, etc. are excluded from warranty. Repair defective coverage at no additional cost to OWNER.

**PART 2 PRODUCTS**

**2.1 ASPHALT BINDER**

- A. Crack Pouring Asphalt: Rubberized asphalt or asphalt rubber hot pour, Section 32 01 17.
- B. Tack Coat: SS or CSS grade, Section 32 12 13.13. Use a tack coat that is compatible with seal coat application.
- C. Emulsified Asphalt: Inorganic, non-ionic, thixotropic mineral colloid at 25 deg C that meets the following requirements. Inorganic is defined as a non-carbon based emulsifier.

<b>Table 1 – Emulsion Properties</b>			
<b>Criterion</b>	<b>Standard</b>	<b>Min</b>	<b>Max</b>
Brookfield Viscosity at 77 deg F (Spindle 5, 20 rpm), cPs	ASTM D 2196	11,000	20,000
pH	ASTM E 70	5.0	7.5
Density, lbs/gal	AASHTO T 59	8.5	9.0
Asphalt Cement Content, percent by weight	ASTM D 2172	45	50
Solids Content, percent by weight	AASHTO T 59	50	54
Ash Content, percent by weight	AASHTO T 111	4.0	6.0

## 2.2 AGGREGATE

A. Clean and free from organic matter or other detrimental substances. Composed of sand, clay, slate and corundum. Properties of slate and corundum as follows.

1. Slate

Table 2 – Slate			
Physical Properties			
Criterion	ASTM	Min	Max
Specific gravity	C 128		2.7
Compression, psi	C 170	11,000	

2. Refined Corundum:

Table 3 – Corundum			
Physical Properties			
Criterion	Standard	Min	Max
Specific Gravity	ASTM C 128	3.9	
Knoop 100 Hardness	ASTM D 1326	2,000	
Ball Mill Friability (14 grit)	ANSI B74.8		50

## 2.3 ADDITIVES

A. Water is clean, non-detrimental, and free from salts and contaminant.

B. Polymers and other additives as necessary to achieve mix design performance.

## 2.4 MIX DESIGN

A. Completed high density mineral bond material, prior to being loaded for install, must meet the following requirements.

Table 4 – Mix Properties			
Criterion	Standard	Min	Max
Asphalt Content, percent by weight	ASTM D 2172	17	20
Solids Content, percent by weight	ASTM D 1644	55	63
Initial Brookfield Viscosity at 77°F (Spindle 4, 20 rpm), cPs	ASTM D 2196	5,500	9,000
Ash Content, percent by weight	AASHTO T 111	38	
Ash Content of Solids, percent by weight (a)	AASHTO T 111	65	
Density, lbs/gal	AASHTO T 59	11	
pH	ASTM E 70	6.0	8.0
Total Inorganic Aggregate Content, percent by weight (b)	AASHTO T 111	37	
Total Sand Content, percent by weight			6.0
Maximum VOC, g/L	ASTM D 3960		5
Resistance to Re-emulsification	ASTM D 2939	No re-emulsification	
Wear Resistance, percent loss by weight (c)	ASTM D 2486		4
NOTES:			
(a) Ash content as a percentage of solids content.			
(b) Ash content of completed mix minus ash content of base non-ionic emulsion.			
Total inorganic aggregate content is defined as slate, refined corundum, and			

sand.

(c) ASTM D 2486 (Modified): Prepare sample at 48 wet mils on glass panel. Dry at 77 deg F for three (3) days. Immerse in water for 24 hours at 77°F. Test scrub resistance with 1,000 gram brass brush for 12,000 cycles. Report percent of dry film lost.

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## **PART 3 EXECUTION**

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### **3.1 CONSTRUCTION EQUIPMENT**

- A. Paver: Use a continuous flow mixing unit.
1. Capable of applying at least 15,000 square yards of material per day.
  2. Equipped with full sweep agitation system to assure proper suspension of fine aggregates.
  3. Equipped with an operator control station that adjusts material spread rate in accordance with project calibration process.
  4. Equipped with a filtering system to catch particles that plug nozzles.
  5. Equipped with a retractable spray bar capable of applying mixture without drilling. The bar should be positioned to meet calibration requirements.
- B. Storage Tanks:
1. When delivering mix from the central mixing plant to a job site storage tank, use only storage tanks with a capacity to contain the entire transport load.
  2. Ensure that all site storage tanks have internal full sweep mixing mechanisms and mixing capability that can provide at any given point in the tank a homogenous mix.

### **3.2 PREPARATION**

- A. Paver Calibration: On a test strip at least 300 feet long, determine the correct pump settings, spray bar height, and ground speed for the application equipment. Apply material with pump settings at 80 percent of maximum output (plus or minus 5 percent) and a ground speed of 300 to 400 feet per minute.
1. Do not begin or continue application without ENGINEER's knowledge of the calibration process and equipment settings.
  2. Do not deviate from calibration settings without ENGINEER's knowledge.
- B. Surface Repair: Method of payment to be determined by ENGINEER if any of the following repairs are required.
1. Raising low areas to grade, lowering high areas to grade, hole patching, inlays.
  2. Providing tack coat on highly absorbent, polished, oxidized, or raveled asphalt surfaces or on brick and concrete surfaces.
  3. Crack sealing and crack repairing, Section 32 01 17.
  4. Pushing or shoving pavement repairs.
    - a. Mill damaged area at least three (3) inches below required surface elevation.
    - b. Install and compact three (3) inches of PG64-22-DM-3/4 asphalt concrete,

Section 32 12 16.19.

- C. Masking: Mask-off Street Fixtures, end of streets, intersections.
- D. Traffic Control:
  - 1. Implement traffic control plan requirements. Provide safe passage for pedestrians and vehicles. Do not proceed without flaggers if work requires maintaining two-way vehicular traffic.
  - 2. Grind off existing pavement markings and lane stripes. If existing markings and stripes are to be reestablished, use reflective tabs to mark existing locations before applying surface treatment material. Unless specified otherwise, cost is included in the work of this section.
- E. Cleaning:
  - 1. Remove loose material, mud spots, sand, dust, oil, vegetation and other objectionable material.
  - 2. Do not flush water, or apply pressurized water over cracked pavement unless ENGINEER allows its' use and a sufficient time is allowed for drying.

**3.3 PROTECTION**

- A. Trees, Plants, Ground Cover:
  - 1. Protect trees, plants and other ground cover from damage.
  - 2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.
- B. Protect structures, curb, gutter, sidewalks, guard rails, guide posts, etc. from physical damage.

**3.4 APPLICATION**

- A. General: Two separate applications coats are required. The first application must be thoroughly set and free of any damp areas before the second application begins.
- B. Spreading:
  - 1. Keep material delivery at a constant rate even if forward speed of lay-down machine varies.
  - 2. Do not reduce application rate along edges or around manhole covers.
  - 3. Apply both applications right to the edge of the pavement. Do not leave uncovered areas near curbs, Street Fixtures, or edges on either application.
  - 4. Make straight lines at all locations.
  - 5. Place product out to right-of-way line on side streets and intersections.
  - 6. Use hand squeegees to spread mix in areas that cannot be reached with distribution spray bar.
    - a. Provide complete and uniform coverage.
    - b. Avoid unsightly appearance from hand work.
- C. Joints:
  - 1. Make transverse joints straight-cut butt type, not over-lap type.
  - 2. Place longitudinal joints on lane lines. Limit overlap to three (3) inches maximum.
  - 3. Stop and correct paving operation if longitudinal or transverse joints have uncovered areas or unsightly appearance.

D. Lines:

1. Make straight lines along lip of gutters, shoulders, end of streets, and in street intersections. No runoff on these areas will be permitted.
2. Vary edge lines no more than one (1) inch per 100 feet.

**3.5 TOLERANCES**

- A. First application = *0.20 gallons per square yard minimum.*
- B. Second application = *0.16 gallons per square yard minimum.*

**3.6 FIELD QUALITY CONTROL**

- A. Emulsion density testing, AASHTO T 59. If testing shows material non-compliance, remove installed product and halt operations until new material is delivered and is known to be in compliance.
- B. Measure the total amounts of material installed, and verify it meets the application rate.

**3.7 AFTER APPLICATION**

- A. Raise reflective tabs that were covered over by application.
- B. Clean Street Fixtures.
- C. Do not apply permanent pavement markings or striping material until layout and method of payment has been determined by ENGINEER, and final application of surface treatment material has been in place at least 10 days, or as permitted by ENGINEER. Layout must be verified by ENGINEER prior to application.

**3.8 REPAIR**

- A. Remove delaminated or non-compliant product found after installation and apply acceptable product.
- B. Remove spatter, mar and overcoat from curb, gutter, sidewalk, guard rails, guide posts, etc.
- C. Remove overcoat from Street Fixtures.
- D. Make edge and end lines straight. Provide a good appearance.
- E. Leave no streaks, holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement.
- F. Repair collateral damage caused by construction.

**3.9 OPENING TO TRAFFIC**

- A. Cure time depends on type of asphalt, mixture characteristics and weather. Keep traffic off surface until material does not track out.

END OF SECTION