NOTICE TO CONTRACTOR – PAVEMENT REPAIR ITEMS

This Project includes the repair of flexible pavement structures using various items. Please refer to the Plans for exact limits of repair types, pavement structures, and depths.

1. Utilize Item No. 0409001 – "Fine Milling of Bituminous Concrete (0" to 4")" to remove the bituminous concrete overlay to the specified depth on the Plans.

2. Utilize Item No. 0409002 – "Coarse Milling of Bituminous Concrete (Greater Than 4" Up to 8")" to remove the bituminous concrete overlay to the specified depth on the Plans.

3. Utilize Item No. 0202000 – "Earth Excavation" for shoulder rehabilitation/reconstruction as specified on the Plans. Use Item No. 0209001 – "Formation of Subgrade" to prepare the remaining granular material prior to paving.

4. Patch areas in need of temporary repair with Item No. 0406124A – "Bituminous Concrete Surface Patching" to open the section of road to traffic prior to permanent patching in all locations of milling.

5. Perform permanent repairs to areas of deteriorated or delaminated bituminous concrete pavement with Item No. 0406125.20A – "Bituminous Concrete Patching – Partial Depth" in all flexible pavement areas. Item is intended for shallow 1.5"-2.5" repairs.

6. Utilize Item No. 0406195A – "Filling Joints and Cracks in Bituminous Concrete Pavement" to seal single cracks of appropriate width per the special provision. Item is intended for all flexible pavement areas.

7. Utilize Item No. 0406600 – "Material Transfer Vehicle" to reduce the chance of mixture segregation and allow for continuous paving when placing any pavement mixture specified for this project (PMA S1, PMA S0.5, PMA S0.375, and UTBO PMA) within the mainline and ramp areas.

ITEM #0406124A – BITUMINOUS CONCRETE SURFACE PATCHING

Description: This work shall consist of sweeping and cleaning areas of deteriorated pavement of all loose and delaminated pavement materials, disposing of deteriorated pavement materials, application of tack coat, and placement of Hot-Mix Asphalt (HMA) or an equivalent Polymer Modified Asphalt (PMA) to match the elevation of the surrounding pavement.

For road sections being milled and paved, all patching operations must be completed after milling is complete and before paving begins. All patching operations shall be completed within one working day following milling and shall be completed before traffic is permitted to resume on the exposed roadway.

Materials: Materials for this work shall meet the requirements of Section M.04 and shall consist of the following:

1. HMA S0.25, HMA S0.375, or an equivalent PMA. All HMA or PMA shall be Traffic Level 2 unless indicated otherwise on the plans.
2. Tack coat.

Construction Methods:
Equipment for this work shall include a sweeper capable of remove millings and loose debris, an air compressor capable of producing 100 psi oil free compressed air for cleaning the area to be patched, tools for the placement of bituminous concrete, and pavement compaction equipment to perform patching operations, such as a plate compactor.

1. The Engineer will mark out areas for patching that are broken, damaged, distorted, or delaminated in order to provide a suitable surface for placement of a layer of bituminous concrete. Examples of such areas to be patched include potholes, open longitudinal joints, ruts, and depressions.
2. Sweep and clean the areas to be patched in order to remove all loose and delaminated material to the satisfaction of the Engineer.
3. Clean off any residual dust or small debris using compressed air to the satisfaction of the Engineer, and allow area to fully dry.
4. A uniform application of tack coat meeting the requirements of Section 4.06 shall be applied prior to patching. It shall cover the entire surface area of the patch and be allowed to sufficiently cure or break.
5. Place and compact HMA S0.25, HMA S0.375, or an equivalent PMA by means acceptable to the Engineer and to the elevation meeting the surrounding pavement.

Method of Measurement: This work will be measured by the number of square yards of patched roadway completed and accepted.

Basis of Payment: This work will be paid for at the Contract unit price per square yard of "Bituminous Concrete Surface Patching." The price shall include all tools, materials, labor, equipment, disposing of deteriorated materials, sweeping and cleaning, tack coat application, and placement and compaction of HMA or PMA.

Pay Item	Pay Unit
Bituminous Concrete Surface Patching	s.y.

ITEM #0406125.20A – BITUMINOUS CONCRETE PATCHING – PARTIAL DEPTH

Description:
This work shall consist of milling out deteriorated bituminous concrete pavement to a depth between 1.5 to 2.5 inches, disposing of pavement millings, sweeping and cleaning, application of tack coat on all surfaces within the milled area, and placement of Hot-Mix Asphalt (HMA) or an equivalent Polymer Modified Asphalt (PMA) to match the elevation of the surrounding pavement.

For road sections being milled and paved, all patching operations must be completed after milling is complete and before paving begins. All patching operations shall be completed within one working day following milling and shall be completed before traffic is permitted to resume on the exposed roadway.

Materials:
Materials for this work shall meet the requirements of Section M.04 and shall consist of the following:

1. HMA S0.375 or an equivalent PMA. All HMA or PMA shall be Traffic Level 2 unless indicated otherwise on the plans.
2. Tack coat.

Construction Methods:
Equipment for this work shall include, but is not limited to, the following:

1. Milling machine: A milling machine designed and built for milling flexible pavements. It shall be self-propelled with sufficient power, traction, and stability to maintain depth and slope and shall be capable of removing the existing bituminous concrete pavement.

   The rotary drum of the machine shall use carbide or diamond tip tools spaced not more than 15 mm apart. The forward speed of the milling machine shall be a maximum of 45 feet/minute. The tools on the revolving cutting drum must be continually maintained and shall be replaced as warranted to provide a uniform pavement texture.

   The machine shall be equipped with an integral pickup and conveying device to immediately remove milled material from the surface of the roadway and discharge the millings into a truck in one operation. The machine shall also be equipped with a means of effectively limiting the amount of dust escaping from the milling and removal operation. When milling smaller areas or areas where it is impractical to use the above described equipment, the Contractor may be permitted to use a lesser equipped milling machine, if approved by the Engineer.

   The minimum milling width shall be 20 inches, making the minimum achievable patch size 20 inches by 20 inches, or 0.30 square yards.

2. 10-foot straight edge.

3. Sweeper: A sweeper, equipped with a water tank, capable of remove millings and loose debris.

4. Air compressor: An air compressor capable of producing 100 psi oil free compressed air for cleaning the milled pavement surface.

5. Hot air lance: A hot air lance that can deliver 100 psi oil free heated air to clean and dry the pavement surface. The compressed air emitted from the tip of the lance shall achieve a temperature of at least 1500°F.

6. Paving and compaction equipment: Paving and compaction equipment meeting the requirements of Section 4.06. It is expected that much of the placement will require hand work or a mixture of equipment and hand tools to achieve the required results. Smaller compaction equipment, including vibratory plate compactors, will be allowed by the Engineer to achieve the required results. At all times the Contractor is required to meet the density and compaction and all other requirements specified in Sections 4.06 and M.04.

7. Portable lighting equipment: If the work is performed at night a truck towed light tower and driver shall be provided for use by the Engineer for all marking, installation, and inspection of the patches.

8. Tack Coat Distributor: A minimum 150-gallon capacity tank that is trailer mounted or self-propelled and capable of applying tack coat meeting the requirements of Section 4.06.

The work shall include, but is not limited to, the following:

1. Demarcating: The Engineer will mark out areas for patching and will determine the appropriate milling depth between 1.5 inches and 2.5 inches. The minimum length and width dimensions of the patch shall be 20 inches. Any area to be patched shall completely encompass the entire distressed pavement area and extend at least 6 inches beyond into the surrounding pavement wherever possible.

2. Milling: Mill marked out areas to the specified depths.

3. Sweeping, Cleaning, and Drying: Sweep the milled surface clean, and allow milled areas to dry. Any moisture in or on the milled areas must be allowed to evaporate or be removed with the assistance of the hot air lance. When the milled area is dry to the satisfaction of the Engineer, it shall be blown clean of any residual dust or debris using compressed air.

4. Applying Tack Coat: Apply tack coat to the entire clean and dry milled area, including the sides/walls of the area to be patched, in accordance with the requirements of Section 4.06.

5. Placing Patch Material: After the tack coat has had sufficient time to cure or break, HMA S0.375 or equivalent PMA shall be placed and compacted to the requirements above and in Section 4.06. The Contractor shall confirm that the surface elevation of the finished patch matches the elevation of the surrounding pavement surface to within 1/4 inch using the 10-foot straightedge. The Contractor shall confirm that all patch material placed is uniform in appearance without segregation.

Method of Measurement:
This work will be measured by the number of square yards of patched bituminous concrete completed and accepted.

Basis of Payment:
This work will be paid for at the Contract unit price per square yard of "Bituminous Concrete Patching – Partial Depth." The price shall include all tools, materials, labor and equipment; milling, removing, and disposing of pavement millings; sweeping and cleaning of the milled area; drying the milled area; applying tack coat to the milled area; and placement and compaction of HMA or PMA.

Pay Item	Pay Unit
Bituminous Concrete Patching – Partial Depth	s.y.

ITEM #0406180A - HOT-MIX ASPHALT SMOOTHNESS ADJUSTMENT

Description: The Engineer will evaluate the final pavement surface for smoothness (rideability) to either pay a bonus or assess a penalty based on determination of smoothness of the surface lift. This item will apply to pavement construction included in the project requiring a minimum of two (2) lifts of bituminous concrete in which the combined total compacted depth of bituminous concrete placed is 2.5 inches or greater. All provisions and requirements of Section 4.06 Bituminous Concrete apply, unless specifically stated otherwise within this item.

Construction Methods:

Definitions:

Surface Lift: The uppermost lift of bituminous-concrete paving.

Roadway segment: A segment of highway designated to receive pavement rehabilitation that includes paving at least 2 lifts, the combined thickness of which is 2.5 inches or greater. A roadway segment contains 1 or 2 directions of travel, through lanes in each direction, and any additional shoulder area, paved median area, ramp(s), and/or auxiliary lanes designated to receive paving.

Lane: An area of pavement designated to carry traffic in a given direction.

Measured Lane: A lane subject to a hot-mix asphalt pavement smoothness adjustment as indicated in this item. Ramps, shoulders, and certain other features are excluded from the adjustment as described below.

Tenth Mile Segment: The subset of a measured lane that will be evaluated for smoothness and used as the basis for payment adjustments. Each measured lane shall be divided into tenth (0.1) mile segments. Some tenth mile segments may be less than a full tenth (0.1) mile because of a boundary such as the end of the lane or a bridge without an asphaltic plug joint. Payment adjustments shall be based on the smoothness and tonnage of the surface lift of each tenth (0.1) mile segment.

Lift Pay Thickness (inches): The thickness shown on the plans for the surface lift of the measured lane.

Tenth Mile Segment Pay Area (square yards): The area of the travelway of a tenth (0.1) mile segment as determined from the plans. If striping exists, measurement shall be the area bounded by the lane striping and beginning and ending termini of the tenth (0.1) mile segment. Where a segment's travelway width varies (for example, a low speed lane which narrows as it begins or terminates within the 0.1 mile), the Pay Area shall reflect the actual travelway area.

ARAN: Automatic Road Analyzer: A vehicle operated by the State that collects roadway profile data. It provides IRI data every 16.4 feet for both the right and left wheel paths.

IRI (inches/mile): International Roughness Index, developed by the World Bank to quantify roughness.

ProVAL: Free FHWA sponsored software that is used to analyze road roughness.

Average IRI (MRI) (inches/mile): The average of the right and left wheelpath IRIs for a tenth mile (528 foot) segment as computed by analyzing ARAN data with ProVAL software.

Hot-Mix Asphalt**:** Whenever reference is made to Hot-Mix Asphalt (HMA), the reference shall apply to HMA, PMA, UTB-PMA, and WMA unless otherwise noted.

This item will be applied separately to each roadway segment that is included in this Contract and designated to be measured for a Hot-Mix Asphalt smoothness adjustment as indicated in this item. The Engineer will calculate smoothness (as represented by ProVAL MRI) and cost adjustments separately for each tenth mile segment in each measured lane.

Evaluation Methods

Final evaluations for payment or penalty will measure all lanes of interest (as described below) in each direction of travel.

Data Collection and IRI Computation – The final pavement surface will be evaluated for smoothness using a State ARAN vehicle. The ARAN measures the IRI in each wheelpath (right and left) for each lane of travel over the Project. If a State ARAN vehicle is unavailable, the Engineer may substitute another suitable method of obtaining IRI values with a World Bank Class II profiler that allows calculation of smoothness adjustments as indicated in this item.

ProVAL will be used to calculate an MRI value for each tenth (0.1) mile segment.

The evaluation will be subject to the following:

1. Only mainline travel lanes will be evaluated. This will include climbing lanes, operational lanes, and turning roadways that are 0.4 miles (2,112 feet) or greater in length. For smoothness purposes, the length of a climbing lane includes where the lane is at least half of its full normal width. Likewise, the length of an acceleration lane is from the tip of the painted gore of the on ramp to where the lane width diminishes to half of its normal width. These climbing and acceleration lengths determine both whether a lane should be measured for smoothness and the section of the lane that will be measured for smoothness.

2. Data collection will start approximately 100 feet prior to, and end approximately 100 feet after the transverse construction joints at the Project limits. The pay area will be limited to the limits of the paving as defined by the transverse construction joints at the start and end of the Project.

3. Construction joints inside the Project will not be excluded from the area measured for smoothness.

4. Smoothness data and payment adjustments will not be computed for the following Project sections:

   - Ramps
   - Climbing lanes, operational lanes, acceleration lanes, deceleration lanes, and turning roadways less than 0.4 miles (2,112 feet) in length

- Shoulders and gore areas
- Pavement on horizontal curves which have a 900 foot or less centerline radius of curvature, and pavement within the super-elevation transition of these curves

5. Bridge decks will be included if they are paved as part of the Project, have 2 lifts totaling 2.5 inches of bituminous concrete, and have an asphaltic plug or similar product for bridge joints. Structures with exposed concrete, elastomeric concrete or steel joint systems will be excluded.

6. Transition sections of varying thickness of pavement (created by milling or paving) leading into or away from pavement changes such as bridge decks or underpasses or Project end points will be excluded if the deck or underpass is excluded. A length of 50 feet on either end of a transition will be excluded from measurement of IRI, but not from payment of an adjustment. The 50 foot length will have the same payment adjustment as the immediately adjacent tenth (0.1) mile section.

7. If a deck or underpass is excluded and there is no transition section adjoining it, then a length of 50 feet before and after the deck or underpass will be excluded for measurement, but included for payment similar to 6 above.

8. Data will be collected within 30 days of the completion of the entire surface lift of pavement, or within 30 days of the completion of any corrective work on the pavement. The Contractor, at its own expense, will be allowed to correct any areas prior to the collection of data. The Contractor shall notify the Engineer in writing of its intent to do so along with a proposed schedule for corrective work that includes an anticipated date that data collection can be performed. The completion of the entire final lift of pavement or any corrective work includes, but is not limited to, all associated work such as pavement markings, sawing and sealing of joints, and installation of bridge asphaltic plug joints.

   To minimize the number of times the ARAN van is needed, all final surface lift paving in both directions of travel must be completed before calling on the ARAN van to measure the smoothness. However, if final surface lift paving extends beyond a single paving season, then the ARAN van shall be used to measure the final surface lifts completed each paving season.

9. No testing will be conducted during rain or under other conditions deemed unacceptable by the Engineer. During testing, the roadway must be free of moisture and other deleterious materials which might affect the evaluation. Any work associated with preparing the roadway for the evaluation (for example, sweeping), will not be measured for payment.

10. The option on the State ARANs to apply the 250 mm (10 inch) filter, which represents the footprint length of a typical tire, will be NOT be selected, because a similar 12 inch filter is already pre-applied by the ARAN van when the data is collected.

11. Measurements and locations are understood to have an accuracy limited to what can be attained by reviewing data and photos collected by the ARAN van. The Department will not be required to conduct surveys in addition to the ARAN van measurements.

Method of Measurement: Rideability Adjustments (RA) for pavement smoothness will be applied to all bituminous concrete in the surface lift of all measured lanes in both directions, as specified herein. It will be computed and paid or a penalty will be assessed for each tenth (0.1) mile segment.

Tonnages for payment will be calculated based on the theoretical volume of bituminous concrete as determined by the typical sections and distances measured by the ARAN van and assuming a density of 0.048875 tons per SY per inch of bituminous concrete thickness. The quantity of bituminous concrete used to determine the RA <u>for each tenth (0.1) mile segment</u> will be calculated by using the equation below:

Segment Tons = HMA Lift Thickness x Tenth Mile Segment Pay Area x 0.048875
(tons) (inches) (s.y.) (tons/s.y.·inch)

Rideability Adjustment (RA) Percent (%) - The RA bonus or penalty and applicable pay factor percentage for each tenth (0.1) mile segment will be determined based on its MRI. Each tenth (0.1) mile segment MRI will be classified into one of the following MRI ranges shown in Table 1 and the applicable pay factor percentage for the segment derived.

Table 1: Rideability Pay Factor Schedule

MRI (inches per mile)	Pay Factor (%)	RA
Less than 50	+10	Bonus
50 to 60	+(60 – MRI)	Bonus
60 to 80	0	0
80 to 120	1.25 x (80 – MRI)	Penalty
over 120	- 50	Penalty

Basis of Payment: Bonuses or Penalties will be computed for each tenth (0.1) mile segment. For each segment, the HMA Pay Factor and tonnage of the surface lift will be determined as described above. The adjustment to the Estimated Cost will be determined by the following formula:

Smoothness Adjustment = Segment Tons x Pay Factor / 100 x HMA Unit Cost

For example, a 1.06 mile measured lane with surface lift thickness of 2 inches has 11 segments with lengths, average travelway widths, and MRI values as shown in Table 2 below. Assuming a unit cost bid price for HMA of $85 per ton, the smoothness adjustments for each segment would be as shown in Table 2. The unit cost used shall be the Contract bid price ($/ton) for the material used in the surface lift without Asphalt Adjustment Cost applied to it.

Table 2: HMA Smoothness Adjustment Example Calculations

Segment	Length (miles)	Average Width (ft)	Area (SY)	HMA Lift Thick-ness (inch)	HMA Computed Tons (Area x thickness x 0.0575)	MRI (in/ mile)	Pay Factor (%)	Adjust ($) (Tons x Pay Factor /100 x Unit cost)
1	0.1	4	235	2	26.99	72	0	0
2	0.1	9	528	2	60.72	50	10	516
3	0.1	12	704	2	80.96	40	10	688
4	0.1	12	704	2	80.96	90	-12.5	-860
5	0.1	12	704	2	80.96	100	-25	-1720
6	0.1	12	704	2	80.96	50	10	688
7	0.1	12	704	2	80.96	77	0	0
8	0.1	12	704	2	80.96	55	5	344
9	0.1	12	704	2	80.96	55	5	344
10	0.1	8	469	2	53.97	51	9	413
11	0.06	4	141	2	16.19	62	0	0
							Total:	413

For the surface lift in this measured lane, there would be a $413 bonus.

Adjustments for smoothness <u>will not be made</u> for areas the Engineer determines to be defective and require removal and replacement of the HMA.

Pay Item	Pay Unit
Hot Mix Asphalt Smoothness Adjustment (Estimated Cost)	est.

ITEM #0406192A – POLYMER MODIFIED ASPHALT EMULSION (TYPE 1)
ITEM #0406193A – ULTRA-THIN BONDED PMA PAVEMENT (TYPE B)
ITEM #0406600A – MATERIAL TRANSFER VEHICLE

Description: Work under these items shall include the production and placement of an Ultra-Thin Bonded Overlay, consisting of a polymer modified asphalt emulsion tack coat followed immediately by a 0.625-inch lift of "Type B" polymer modified asphalt (PMA) mixture.

Polymer Modified Asphalt Emulsion (Type 1) will be referred to herein as "asphalt emulsion" or "emulsion." Ultra-Thin Bonded PMA Pavement (Type B) will be referred to herein as "ultra-thin PMA" or "ultra-thin PMA material/mixture." PMA describes a bituminous concrete mixture containing a polymer modified asphalt binder using a qualified warm-mix technology.

These items shall be constructed in conformance with the lines, grades, thicknesses, and typical cross sections shown on the Plans or established by the Engineer.

Materials:

1. **Asphalt Emulsion:** This material shall meet the requirements of CRS-1P in accordance with AASHTO M 316 as shown in Table 1. The emulsion shall be tested by the supplier and shall be submitted to the Engineer with a Certified Test Report (CTR) for approval 30 days prior to the start of paving. Test results for all requirements listed below must be included with the provided CTR. The polymer modifier shall be milled or blended into the asphalt emulsion base or the emulsifying agent prior to the emulsification process.

Table 1: Emulsion Requirements (CRS-1P)

Property	Test Method	Minimum	Maximum
Polymer Content, % by Weight of Total Residue	AASHTO T 59	3.0	--
Viscosity, Saybolt Furol, 77ºF (25ºC), seconds	AASHTO T 59	20	100
Sieve Test, %	AASHTO T 59	--	0.10
Demulsibility, %	AASHTO T 59	40	--
Storage Stability Test, 1 Day (Difference in % Residue)	AASHTO T 59	--	1.0
Classification Test	AASHTO T 59	Passes	--
Particle Charge Test	AASHTO T 59	Positive(1)	--
Residue by Distillation, %(2)	AASHTO T 59	63	--
Oil Distillate, Volume of Total Emulsion, %	AASHTO T 59	--	3

Table 1: Emulsion Requirements (CRS-1P) (continued)

Property (Residue from Distillation)	Test Method	Minimum	Maximum
Penetration at 77ºF (25ºC), 100 g, 5 second	AASHTO T 49	60	150
Elastic Recovery w/ Ductilometer at 50ºF (10ºC), %	AASHTO T 301	60	--
Ash Content, %	AASHTO T 111	--	1

Notes:

(1) If the Particle Charge Test result is inconclusive, material having a minimum pH value of 6.7 will be acceptable.

(2) Perform according to AASHTO T 59 except as follows:

a) When the lower temperature reaches approximately 275ºF (135ºC), move the ring burner approximately level with the bottom of the still.

b) Increase the temperature to a maximum 350ºF ± 11ºF (177ºC ± 5.5ºC), maintaining this temperature for 15 minutes.

c) Use an ASTM 16C thermometer to monitor the temperature of the emulsion. Distillation on field samples shall show no more than trace amounts of oil.

2. **Ultra-Thin PMA:** The materials, facilities, mix design, Job Mix Formula (JMF), and production requirements of Section M.04 shall be followed for the ultra-thin PMA unless otherwise specified herein. The JMF shall also meet the requirements in Table 2 below, and shall be submitted to the Engineer for approval at least 30 days before production. Any JMF change must be submitted to the Engineer for approval at least 24 hours in advance of production.

Table 2: Ultra-Thin PMA Mixture Requirements (Type B)

Sieve Size (or Property)	Design Limits (% Passing)(1)	Production Tolerance (%)(1)
1/2 inch	100	
3/8 inch	85-100	± 5
No. 4	24-40	± 4
No. 8	21-32	± 4
No. 16	16-26	± 4
No. 30	12-20	± 3
No. 50	8-16	± 3
No. 100	5-10	± 2
No. 200	4.0-7.0	± 1.5
Binder Content (Pb)	4.8-5.4%	
Moisture Sensitivity, AASHTO T 283(2)	80% minimum	
Film Thickness(3)	0.35 mils (9.0 µm (microns)) minimum	
Draindown, AASHTO T 305	0.1% maximum	

Notes:

(1) All aggregate percentages are based on total mass of aggregate.

(2) Specimens for AASHTO T 283 testing shall be compacted using the Superpave gyratory compactor. The mixtures shall be compacted using 100 gyrations to produce specimens approximately 3.7 inches in height. Use mixture and compaction temperatures recommended by the binder supplier. When necessary, an anti-stripping agent shall be added to provide resistance to stripping.

(3) Film thickness shall be obtained using effective binder content. Surface area shall be calculated according to Asphalt Institute MS-2 methodology.

a. Asphalt Binder: A PG 64E-22 binder shall be used for the ultra-thin PMA mixture meeting the requirements of Section M.04. The binder shall incorporate warm-mix technology listed on the "Northeast Asphalt User-Producer Group (NEAUPG) Qualified Warm Mix Asphalt (WMA) Technologies" list at the time of bidding, available online at https://neaupg.engr.uconn.edu/. The selected technology must be listed under "Organic (Waxes) Additives" or "Chemical Additives" only.

The PG 64E-22 binder with warm-mix technology shall be selected to meet the mix application temperature of 300ºF – 350ºF and the compaction cessation temperature of 200ºF. The dosage of warm-mix additive shall be as recommended by the binder supplier and shall be submitted to the Engineer for approval with the JMF.

b. Coarse Aggregate: Coarse aggregates that are from more than one source, or of more than one type of material, shall have all constituents proportioned and blended to provide a uniform mixture. Crushed stone shall be used from an approved source meeting the following requirements of (i) or (ii), and the requirements listed in Table 3 below:

i. Sandstone, granite, chert, traprock, or other similar non-carbonate material.

ii. Gravel, or a natural or manufactured blend of limestone, dolomite, gravel, sandstone, granite, chert, traprock, or other similar materials meeting the following requirements:
- 1/2-inch Nominal Maximum Size Aggregate (NMAS) Mixes
  - A minimum of 20% of plus 3/8-inch particles must be non-carbonate.
- 3/8-inch Nominal Maximum Size Aggregate (NMAS) Mixes
  - A minimum of 20% of plus No. 4 sieve particles must be non-carbonate.

Note: Non-carbonate material shall have a minimum acid insoluble residue content of 80%.

Table 3: Coarse Aggregate Requirements

Property	Test Method	Requirement
LA Abrasion coefficient, maximum % loss	AASHTO T 96	30
Percent passing #200 sieve, maximum %	AASHTO T 11, T 27	2
Soundness, maximum % loss	AASHTO T 104	10
Fractured particles, %	AASHTO T 335	100

Table 4: Recommended Coarse Aggregate Gradation

Sieve Size	Percent Passing
3/4 inch	100
1/2 inch	100
3/8 inch	85-100
1/4 inch	0-15
No. 4	0-3
No. 8	0

c. **Fine Aggregate:** Fine aggregate shall be 100% crushed stone having a minimum sand equivalent value of 60%, as determined by AASHTO T 176.

Table 5: Recommended Fine Aggregate Gradation

Sieve Size	Percent Passing
No. 4	100
No. 8	90-100
No. 16	60-80
No. 30	45-60
No. 50	30-40
No. 100	20-30
No. 200	15-25

d. **Mineral Filler:** Mineral Filler shall meet the requirements of Article M.04.01.

3. **Sampling and Testing:** The Engineer will conduct acceptance sampling and testing of the ultra-thin PMA mixture at the production facility, in accordance with Section M.04, for gradation and binder content. The Engineer may allow the Contractor to conduct acceptance testing following the sampling and testing procedures herein. The Contractor shall retain a 2500-gram split sample and provide the sample to the Engineer for verification testing. The split sample shall be stored in an appropriate container, sealed, and labeled with the Project number, ultra-thin PMA plant name, date, time obtained, sequential truckload number, sublot, and name of the person obtaining the sample. Verification testing will be performed by the Engineer on the retained samples in accordance with the Department's current Quality Assurance (QA) Program for Materials. Should gradation or binder content exceed the specified tolerances, the Department will investigate to determine an assignable cause. Contractor test results for a subject sublot may be replaced with the Department's results. The sample will be stored and disposed of at the discretion of the Engineer following the completion of the Project.

   Passing Test: A "Passing Test" is defined as ultra-thin PMA material meeting all tolerances for gradation and binder content shown in Table 2.

Failing Test: A "Failing Test" is defined as ultra-thin PMA material exceeding one or more of the tolerances in gradation and binder content shown in Table 2.

Lot: For ultra-thin PMA mixture sampling and testing purposes, a lot is defined as one planned production run or 24-hour period, whichever is shorter. An additional lot shall be created every 24 hours of a multiple-day production run.

Sublot: Each lot shall be subdivided into equal sublots based on planned quantity of ultra-thin PMA mixture for the production run as outlined in Table 6.

Table 6: Minimum Sampling and Testing Schedule

Planned Production Run Quantity – Lot Size (tons)	Number of Sublots
1-400	1
401-800	2
801-1200	3
1201+	4

The Contractor shall submit to the Engineer the planned production quantity for a lot at least four (4) hours prior to commencement of production of the ultra-thin PMA mixture. The planned quantity of production for each sublot shall be converted to a sequential, number of truckloads (i.e., 1, 2, 3, etc.). For each lot, the first sublot shall be randomly selected from the first five (5) truckloads for testing. Each remaining sublot shall be randomly selected.

At any time, the Contractor may obtain additional samples for Quality Control (QC) purposes. The Contractor shall designate a sample as a QC sample prior to conducting its sampling. No QC samples will be included in the acceptance of the produced material.

4. **Documentation:** All vendors producing ultra-thin PMA shall have their truck-weighing scales, storage scales, and mixing plant automated to provide a delivery ticket. Delivery tickets must include the following information:

   a. State of Connecticut printed on ticket.
   b. Name of producer, identification of plant, and specific storage bin (silo) if used.
   c. Date and time of day.
   d. Net weight (tons) of material loaded into truck.
   e. Gross weight or tare weight of truck.
   f. Project number, purchase order number, name of Contractor (if other than producer).
   g. Sequential truck number for specific identification of truck. Sequential number shall use natural numbers and be ordered beginning with the first truck for a production lot based on time truck is loaded (i.e., 1, 2, 3, etc.).
   h. Individual aggregate and asphalt high/target/low weights shall be printed on batch plant tickets. For drum plants and silo loadings, the plant printouts shall be maintained by the vendor for a period of three (3) years after the completion of the Project.

The Contractor must notify the Engineer immediately if there is a malfunction of the recording system in the automated plant or truck-weighing scales during the production day. Manually written tickets containing all required information will be allowed for a maximum of one (1) hour, provided that each load is weighed on State-approved scales. At the Engineer's discretion, trucks may be approved to leave the plant if a State inspector is present to monitor weighing. If such a malfunction is not fixed within forty-eight (48) hours, material will not be approved to leave the plant until the system is fixed to the Engineer's satisfaction.

The State reserves the right to have an inspector present to monitor batching or weighing operations. No damages will be considered should the State be unable to provide an inspector at the plant.

Construction Methods:

1. **Equipment:**

   a. **Spray Paver:** The Contractor shall provide a self-priming spray paver capable of applying the asphalt emulsion, placing the ultra-thin PMA mixture, and smoothing the surface of the mat in one pass. The spray paver shall travel at a speed of at least 30 feet/minute but not more than 85 feet/minute. The spray paver shall be equipped with a receiving hopper, feed conveyor, emulsion storage tank, metered high-pressure emulsion spray bar(s), and a variable width, heated, extendable ironing-type vibratory screed. The spray bar system shall be capable of applying the emulsion across the entire width of the screed, including the full width of the variable screed extensions.

      The paver shall be equipped with a microprocessor and controls to regulate the flow of the asphalt emulsion. The paver must be capable of varying the spray to ensure a uniform application of emulsion at the approved rate ± 0.02 gal/s.y. based on speed and paving width. The paver shall be able to apply the specified emulsion rate at all speeds, including all stops and starts of the paver, uniformly across the full placement width. The screed shall have the ability to produce a crown at the center both positively and negatively. The screed shall be vertically adjustable and shall have horizontal extensions to accommodate the desired pavement profile.

      Each spray paver to be used shall be calibrated in accordance with ASTM D2995 in the presence of the Engineer prior to the start of paving to ensure accurate, continuous, and uniform application of the asphalt emulsion at the approved rate(s). If determined by the Engineer, previous calibration documentation may be acceptable provided that the calibration was performed within 180 days of the Notice to Proceed (NTP) date of the Contract. No machine will be allowed to work on the Project until the calibration has been completed and accepted. Any component replacement affecting material application shall require the machine to be recalibrated.

   b. **Rollers:** The Contractor shall furnish a minimum of three (3) rollers for each spray paver to properly seat the ultra-thin PMA. All rollers shall be self-propelled, ten (10) ton double

drum rollers designed for compaction of hot mix asphalt. The rollers shall only operate in the static mode. Additional rollers may be required to meet production needs.

c. **Infrared Thermometers:** The Contractor shall supply for the Engineer's use a minimum of two (2) new, unused handheld digital infrared laser sighted thermometers for the duration of the Project, which shall become the property of the State. The thermometers shall have a minimum distance-to-spot ratio of 50:1 and shall have adjustable emissivity control. The thermometers shall have a minimum accuracy value of ± 1% of reading or ± 2ºF, whichever is greater. The thermometers shall be used in accordance with the manufacturer's written directions. All thermometers supplied must be in agreement within 5ºF of each other at all times at any temperature between 0ºF and 500ºF. If at any time any of the thermometers supplied are found to be in noncompliance with any of the above criteria, the Contractor shall dispose of them and provide the Engineer with a minimum of two (2) new, unused thermometers meeting the above requirements.

d. **Material Transfer Vehicle (MTV):** An MTV shall be used when placing ultra-thin PMA material. The MTV must be a self-propelled vehicle, specifically designed for the purpose of delivering the bituminous concrete mixture from the delivery truck to the paver. The MTV must continuously remix the bituminous concrete mixture throughout the placement process. The use of an MTV will be subject to the requirements stated in Article 1.07.05. The Engineer may limit the use of the MTV if it is determined that its use may damage highway components, utilities, or bridges.

   The Contractor shall submit to the Engineer at the time of pre-construction the following information:

   i. The make and model of the MTV to be used.
   ii. The individual axle weights and axle spacing for each separate piece of paving equipment (haul vehicle, MTV, and paver).
   iii. A working drawing showing the axle spacing in combination with all pieces of equipment that will comprise the paving echelon.

e. **Power or Vacuum Broom/Sweeper:** A motorized or vacuum broom/sweeper shall be provided that is capable of cleaning the roadway surface prior to application of asphalt emulsion.

f. **10-foot Straightedge:** A Contractor-supplied straightedge shall be provided and made available to the Engineer during all paving operations, inspection, and testing per Section 4.06.

2. **Temperature Requirements:** The infrared thermometers will be used to determine all specified temperature requirements unless otherwise noted. Only one (1) thermometer will be used to determine and record a temperature. If there is any question about the accuracy of any recorded temperature, an additional Contractor-supplied infrared thermometer will be used to confirm the temperature. If two (2) or more thermometers are in agreement within 5ºF, the first temperature will be officially recorded by the Engineer. This temperature will be used to

enforce all specified temperature requirements, including rejection of materials and halting or shutdown of the work, as stated herein.

A probe type thermometer may be used only at the production plant to test the ultra-thin PMA. Probe type thermometers shall not be used in the field once the mix is delivered to the Site.

3. **Quality Control Plan:** The Contractor shall provide a Quality Control Plan (QCP) according to the requirements of Subarticle 4.06.03-8. The QCP shall be submitted at the preconstruction meeting or a minimum of 30 days prior to any paving activities.

4. **Weather Restrictions:** The pavement surface temperature shall be at least 50°F. The ambient temperature shall be at least 50ºF and rising. Artificial heating of the pavement surface is not allowed. The Contractor shall monitor the weather forecast prior to production and make a determination as to whether the treatment shall be applied. Weather conditions must not impede the ability for the asphalt emulsion to properly break.

5. **Surface Preparation:** The work to remove pavement markings, seal or fill cracks, and patch areas of distress shall be completed (under other items) prior to application of the asphalt emulsion and ultra-thin PMA. Immediately prior to the application of emulsion and ultra-thin PMA, the roadway surface shall be cleaned by the Contractor using a motorized broom or vacuum sweeper and any other equipment or means necessary to remove all foreign debris and material (leaves, branches, dirt, sand, garbage, etc.) from the pavement surface. All foreign debris and material shall be properly disposed of by the Contractor in accordance with Article 1.10.03.

   The Contractor shall protect all manhole covers, utility gate boxes, catch basins, and other structures with plastic or building felt, which shall be removed upon completion of the paving operation.

   The pavement surface shall be dry immediately prior to the application of the asphalt emulsion.

6. **Asphalt Emulsion Application:** The application temperature of the asphalt emulsion shall be 130°F – 190°F. The emulsion shall be uniformly applied at a rate of 0.15 to 0.22 gal./s.y. across the entire pavement width to be overlaid. The emulsion shall extend one (1) to two (2) inches beyond the longitudinal edge of the ultra-thin PMA. The Contractor shall submit the Project-specific rate(s) of application in writing to the Engineer for approval 30 days prior to commencement of the work under this item. The proposed application rate for the asphalt emulsion shall be determined based on the texture of the surface on which the emulsion is placed. Proposed emulsion rates shall be submitted for each individual roadway section included in the Contract (if more than one), and for each distinct surface type present. A "distinct area" shall have a minimum length of 100 feet and minimum width of eight (8) feet. The submittal shall include backup details to support the proposed emulsion rates. The Engineer may direct the Contractor to pre-apply additional emulsion to any area that requires a higher amount of liquid asphalt so that the proper application rate for each surface texture type can be achieved in a single paving pass.

The Contractor shall continuously monitor the asphalt emulsion spray rate. The actual emulsion rate as determined by the Engineer through material yield checks shall not exceed the submitted and approved application rate by ± 0.02%.

No equipment shall come in contact with the asphalt emulsion before the ultra-thin PMA is placed. The emulsion shall be covered immediately by the ultra-thin PMA before it breaks or migrates (runs) along the pavement surface. Emulsion that runs or washes out from under the mat of the ultra-thin PMA prior to breaking for any reason will be considered an improper application of the treatment. Prolonged stops of the paver are not permitted.

7. **Ultra-Thin PMA Application:** The ultra-thin PMA shall be placed across the full width of the asphalt emulsion at a temperature of 300°F – 350°F. The mix delivery temperature will be checked for conformance at the back of the haul truck. When checking the mix in the back of the haul truck, the Engineer will remove at least the top 6 inches of material from the surface of the load, or the load shall be allowed to "break" when beginning the dumping process. The Engineer may also check the mix delivery temperature in the hopper of the paver or the MTV machine. The Engineer will record the temperature of the mix in several areas and, if necessary, remove any mix from the surface to expose material that is representative of the overall temperature of the truck load. The Engineer will record the highest temperature found when multiple readings are taken in the hopper. Truckloads of ultra-thin PMA material not meeting the minimum temperature requirement will be rejected by the Engineer.

   The finished in-place ultra-thin PMA shall be a minimum thickness of 0.625 inches and a maximum thickness of 0.875 inches. In no case shall the ultra-thin PMA be placed in a permanent condition creating a drop-off or vertical deviation in the direction of travel. Transition requirements of Section 4.06.03-5 shall apply to areas in the direction of travel and will be paid for under separate items. In no case shall the ultra-thin PMA exceed a thickness of 0.75 inches along the longitudinal edge of the treatment at the shoulders.

8. **Compaction:** Compaction shall start immediately after placement of the ultra-thin PMA and be completed before the mix falls below the compaction cessation temperature of 200°F. Compaction shall be obtained by use of the paver screed and three (3) double drum rollers in static mode. A minimum of three (3) static roller passes must be made over any given area prior to cooling of the ultra-thin PMA material below 200°F. A "pass" is defined as one coverage of a roller over any given pavement surface area.

   Data collected and delivered to the Engineer as specified in Item No. 0406608A "Documentation of Uniform Placement of Bituminous Concrete (Paver)" and Item No. 0406609A "Documentation of Uniform Compaction of Bituminous Concrete (Roller)" of the Contract will be used to determine adherence to the roller coverage requirements of this specification.

9. **Texture and Smoothness:** The ultra-thin PMA mixture shall be placed and compacted to provide a continuous and smooth surface with uniform texture. The roller(s) shall not stop on the freshly placed ultra-thin PMA. The mat shall be protected from traffic until the rolling operation is complete and the material has cooled sufficiently to resist damage.

If milling is specified as part of the work, or in any other areas where the ultra-thin PMA is required to be placed flush with adjacent pavement surfaces, structures, or other surrounding appurtenances, the pavement surface will be tested with the Contractor-supplied straightedge to ensure that the pavement surface does not deviate by more than 1/4 inch in any direction. When matching irregular surfaces or structures, the Engineer will use discretion when enforcing this rule.

10. Corrective Work:

a. Conditions: Any portion of the completed work that the Engineer determines to not meet these specifications, or determines to be defective or non-uniform, shall be corrected at the Contractor's expense or will be subject to non-payment.

Any ultra-thin PMA material placed at less than 0.625 inches thick, or greater than 0.875 inches thick, shall be subject to removal and replacement as determined by the Engineer. The Engineer will measure the longitudinal edge by performing spot-checks every 100 feet to verify the tolerances listed. Any longitudinal edge or drop-off formed showing a thickness of greater than 0.75 inch for a length of 100 feet or greater will be marked out by the Engineer and shall be corrected by the Contractor using the procedure described below.

If the Engineer determines that any full width travel lane area, or full width shoulder area, that is at least 100 feet long contains any change or deviation in texture occurring in 1.5% (or greater) of the surface of the ultra-thin PMA, that area shall be replaced at the Contractor's expense. Any bleeding or flushing of the asphalt emulsion to the surface of the ultra-thin PMA material will be considered as a deviation in texture and treated according to the texture requirements herein.

Asphalt emulsion running out from under the mat of the ultra-thin PMA prior to breaking will be considered non-compliance and subject to corrective action.

b. Procedures: If pavement placed by the Contractor is determined to be unacceptable, and the Engineer requires its replacement or correction, the Contractor shall:

i. Propose a corrective procedure to the Engineer for review and approval prior to any corrective work commencing. The proposal shall include the following:

- Limits of pavement to be replaced or corrected, indicating mile points, stationing, or other landmarks.
- Anticipated schedule.
- Construction methods and sequence of operations.
- Proposed application rate for asphalt emulsion.
- Methods of maintenance and protection of traffic.
- Material sources.
- Names and telephone numbers of supervising personnel.

ii. Perform all corrective work in accordance with the Contract and the approved corrective procedure.

Unless otherwise stated herein or determined by the Engineer, all corrective work shall be done with the ultra-thin PMA material. Any corrective ultra-thin PMA placed shall be placed by the specified spray paver and shall be placed at a minimum width equal to the width of the main screed of the paver, for no less than 100 feet in length. Corrective work shall not be performed exclusively by hand with the ultra-thin PMA material. With the permission of the Engineer, small, isolated areas or defects may be repaired with material other than the ultra-thin PMA. "Small, isolated areas or defects" are defined as one area of 25 square feet or less per full width lane, or full width shoulder, for any given continuous 200-foot lane or shoulder section that was placed by the spray paver.

Longitudinal edges of treatment identified for corrective work shall be ground down to within allowable tolerance. This shall be done using equipment designed and built for milling bituminous concrete pavements. The miller shall be self-propelled with sufficient power, traction, and stability to maintain depth and slope, and shall be capable of removing the existing bituminous concrete pavement. The rotary drum of the milling machine shall have carbide or diamond-tipped teeth with a maximum spacing of 8 mm. The forward speed of the milling machine shall be limited to no more than 45 feet/minute. The teeth on the revolving cutting drum must be continually maintained and shall be replaced as warranted to provide a uniform pavement texture, free from gouges, longitudinal grooves and ridges, oil film, and other imperfections, that are a result of defective equipment, improper use of equipment, poor workmanship, or inadequate field verification. Any unsatisfactory surfaces caused by the removal operations are the Contractor's responsibility and shall be corrected at the Contractor's expense to the satisfaction of the Engineer. The milling process also shall not materially damage the surface of the pavement or result in complete removal of the overlay. The Contractor shall immediately collect all debris and dust resulting from the milling operation by cleaning the longitudinal treatment edge and adjacent pavement surface. All collected debris and any waste material shall be properly disposed of by the Contractor in accordance with Article 1.10.03. The work area shall be returned to a debris-free state prior to reopening to traffic.

11. Cessation of Supply: Under any of the following conditions, the Engineer will stop the entire paving operation, and the production plant providing ultra-thin PMA shall cease supplying materials to the Project. Supply of material to the Site shall not resume until the Contractor determines the cause for non-compliance, proposes corrective measures in a submittal to the Engineer for approval, and can demonstrate compliance with these specifications:

a. If at any time the Engineer determines that the asphalt emulsion or ultra-thin PMA materials supplied do not meet the specification requirements.
b. If the supplied ultra-thin PMA material exceeds one or more of the tolerances shown in Table 2 on two (2) samples out of the latest consecutive three (3) samples tested for gradation or binder content. Delivery shall not resume until a "Passing Test" is performed.
c. If the application rate of the asphalt emulsion is determined by the Engineer through material yield checks to fall outside the allowable tolerances.

d. If weather conditions impede the ability for the asphalt emulsion to properly break.
e. If emulsion runs or washes out from under the mat of the ultra-thin PMA prior to breaking.
f. If a prolonged stop results in improper application or breaking of the emulsion, or the inability to meet the ultra-thin compaction requirements stated herein.
g. If the final compacted thickness requirements and tolerances stated herein are not met.
h. If the compaction requirements stated herein are not met.
i. If the ultra-thin PMA surface texture fails to meet the specified requirements.

Cessation of Supply shall occur as many times as necessary until the Contractor completes the work properly according to all the requirements within this specification. In all cases, if the Contractor continues to place material unacceptable to the Engineer, the Engineer reserves the right to withhold payment for, or call for the removal and replacement of, all material placed in non-conformance with these specifications.

All asphalt emulsion and ultra-thin PMA material in non-conformance with this specification, as described above, which is not subject to non-payment or removal and replacement by the Engineer, shall be considered deficient material (DM).

Method of Measurement:

1. **Polymer Modified Asphalt Emulsion (Type 1):** This work will be measured for payment by the number of gallons of asphalt emulsion furnished and applied on the Project and accepted by the Engineer.

2. **Ultra-Thin Bonded PMA Pavement (Type B):** This work will be measured for payment by the number of square yards of ultra-thin PMA material placed at the thickness shown on the Plans and accepted by the Engineer, subject to the following adjustments:

   a. Material Deficiency Adjustment (MDA): An adjustment will be applied when ten percent (10%) of the total quantity of ultra-thin PMA material produced exceeds one or more of the tolerances shown in Table 2, as determined by the Engineer.

   For deficient material due to failing tests of the ultra-thin PMA mixture at the plant, the entire quantity of produced ultra-thin PMA in each of the two (2) failing sublots leading to each instance of Cessation of Supply delivered to the Site will be included in the DM term of the MDA calculation.

   The adjustment in square yards will be calculated as follows:

   *MDA in square yards (s.y.) = DM * 0.10*

   Where:
   DM = square yards (s.y.) of deficient ultra-thin PMA, calculated as follows:

   *DM = TA * (DW / TW)*

Where:
TA = Total documented area covered and measured in square yards (s.y.)
DW = Total weight of deficient ultra-thin PMA material exceeding one or more of the tolerances shown in Table 2, as determined by the Engineer from delivery tickets
TW = Total weight of ultra-thin PMA material determined by the Engineer from the delivery tickets

b. **Roller Coverage Adjustment (RCA):** An adjustment will be applied when less than 90% of the total area of placed ultra-thin PMA is covered by fewer than three (3) roller passes (as documented by the uniform compaction technology equipped to the rollers) within 10 minutes of being laid (as documented by the uniform placement technology equipped to the spray paver). Prior to the roller passes, the mat temperature as recorded by the paver-mounted temperature sensor must be a minimum of 280°F. If the temperature of the mat as recorded by the paver temperature sensor is less than 280°F at the time of placement, the roller pass(es) in the corresponding area will not be considered for the purposes of this adjustment. If a roller pass is made more than 10 minutes after the ultra-thin PMA material has been placed by the paver, the pass will not be considered for the purposes of this adjustment, regardless of the recorded placement temperature.

Ten percent (10%) of the daily completed and accepted square yards of ultra-thin PMA will be withheld from payment until the end of the Project subject to determination of the RCA.

The RCA will be defined as the percentage of the daily withheld area in square yards that is eligible for payment. The RCA will be determined in accordance with the schedule in Table 7.

Table 7: Roller Coverage Adjustment

Percent Area of Compaction Requirements Met	Roller Coverage Adjustment (RCA)
90% – 100%	100%
80% – 90%	50%
≤ 80%	0%

The percentage of area where compaction requirements are met will be determined utilizing the data collected and delivered to the Engineer via the on-board documentation system specified in Item No. 0406608A "Documentation of Uniform Placement of Bituminous Concrete (Paver)" and Item No. 0406609A "Documentation of Uniform Compaction of Bituminous Concrete (Roller)" included in the Contract. The Engineer will filter the data for extraneous travel within Veta data analysis software using centerline filtering. When Project-specific centerline survey is not available, an assumed lane centerline based on the State Linear Referencing System will be used.

In any cases where the "Percent Area of Compaction Requirements Met" is unable to be determined using the data provided by the Contractor, the Engineer will evaluate adherence to the roller coverage requirements of this specification through field inspection and

determine the RCA for the corresponding day of paving for the purposes of Item 0406193A payment. Items 0406608A and 0406609A will only be paid for acceptable documentation according to the Contract specification requirements.

The quantity of the withheld area (in square yards) eligible for payment will be calculated as follows:

QRC = RCA(W x TA)*

Where:
QRC = Quantity of withheld area in square yards to be paid (as a result of the roller coverage adjustment)
RCA = Roller coverage adjustment
W = Withheld portion of treatment area = 10%
TA = Documented area of ultra-thin PMA placed and measured in square yards

Example –

- TA = Area of ultra-thin PMA placed = 20,000 SY
- W = Withheld portion = 10%
- W x TA = 10% x 20,000 SY = 2,000 SY
- Percent area of compaction requirements met = 88% (from Veta analysis)
- RCA = 50% (using Table 7)
- QRC = Quantity eligible for payment = 50% x 2,000 SY = 1,000 SY

3. **Material Transfer Vehicle:** This work will be measured for payment based on the actual number of tons of ultra-thin PMA delivered to a paver using the MTV. The number of tons will be obtained from delivery tickets.

Basis of Payment:

1. **Polymer Modified Asphalt Emulsion (Type 1):** This work will be paid at the Contract unit price per gallon for "Polymer Modified Asphalt Emulsion (Type 1)."

2. **Ultra-Thin Bonded PMA Pavement (Type B):** This work will be paid at the Contract unit price per square yard for "Ultra-Thin Bonded PMA Pavement (Type B)."

   Any adjustments will be incorporated by construction order for material deficiency or roller coverage adjustments documented by the Engineer.

   a. **Material Deficiency Adjustment (MDA):** The quantity of MDA in square yards will be used to determine the adjustment value which will be deducted from the total Contract amount.

      MDA Adjustment = MDA (s.y.) X Contract price per square yard ($/s.y.)

b. **Roller Coverage Adjustment (RCA):** The RCA will be used to determine the eligible quantity of ultra-thin PMA in square yards (QRC) that will be paid from the 10% withheld area.

RCA Adjustment = QRC (s.y.) X Contract price per square yard ($/s.y.)

3. **Material Transfer Vehicle**: This work will be paid at the Contract unit price per ton for "Material Transfer Vehicle."

Payment will be for the items completed and accepted by the Engineer, the price of which shall include all labor, materials, and equipment incidentals thereto.

The cost for all equipment, tools, and work required to furnish, produce, place, and compact the asphalt emulsion and the ultra-thin PMA shall be included in the respective unit prices. These prices shall also include cleaning the existing pavement surface prior to placement of the asphalt emulsion and ultra-thin PMA material with power sweeping and vacuuming equipment if required, and the cost for providing lighting for the purpose of illuminating the work area and equipment during placement operations.

The work to remove pavement markings, seal or fill cracks, and patch areas of distress will be paid under other items.

No separate or additional payment will be made for any work related to the replacement or correction of defective pavement as determined by the Engineer. Related work includes, but is not limited to, items such as the removal and replacement of ultra-thin PMA, maintenance and protection of traffic, pavement repairs, replacement of bridge joints, pavement markings, and any other work that is deemed necessary by the Engineer to provide and produce acceptable corrective or replacement work to the pavement.

The cost to furnish, equip, and collect required data for Documentation of Uniform Placement and Compaction of Bituminous Concrete (Paver/Roller) will be paid under separate items.

Pay Item	Pay Unit
Polymer Modified Asphalt Emulsion (Type 1)	gal.
Ultra-Thin Bonded PMA Pavement (Type B)	s.y.
Material Transfer Vehicle	ton

ITEM #0406195A – FILLING JOINTS AND CRACKS IN BITUMINOUS CONCRETE PAVEMENT (LF)

Description: This work consists of furnishing and applying a hot-applied mixture of Performance Graded (PG) asphalt binder and polyester fibers into bituminous concrete pavement joints and cracks. It shall be constructed in close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer. Filling Joints and Cracks in Bituminous Concrete Pavement may be used in conjunction with other repair treatments including joint and crack sealing or patching, in which case the sequence of treatments will be provided in the Plans or directed by the Engineer.

For the purposes of this document, the word "crack" includes all longitudinal (along the direction of travel) and transverse (perpendicular to the direction of travel) cracks and joints. All work specified for "crack(s)" herein shall apply to all types of cracks and joints unless otherwise specified.

Materials: The hot-applied crack filling material shall be composed of a mixture of Performance Graded Asphalt Binder and polyester fibers blended to provide 3%-5% ± 0.5% fibers by weight. No field mixing of the fibers is allowed. The crack filling material (with fibers) shall be prepackaged, labeled, and arrive on Site ready to be placed in the melter applicator. The component materials shall meet the following requirements:

1. Polyester Fibers: A Materials Certificate shall be provided by the manufacturer for this material. The polyester fibers must meet the following requirements:

Property	Test Method	Requirement
Length	N/A	0.25 inch ± 2 mils (6.4mm ± 0.05mm)
Crimps	ASTM D3937	None
Tensile Strength*	ASTM D2256	69,600 psi (480 MPa), minimum
Denier*	ASTM D1577	3.0 – 6.0
Specific Gravity	N/A	1.32 – 1.40
Melting Temperature	N/A	473ºF (245ºC), minimum
Ignition Temperature	N/A	1000ºF (540ºC), minimum

* This data must be obtained prior to cutting the fibers.

2. Performance Graded (PG) Asphalt Binder: The Performance Graded (PG) Asphalt Binder shall be PG 64E-22 (PG 76-22) and shall meet the requirements of AASHTO M 332 and AASHTO R 29. The Contractor shall submit a Certified Test Report and bill of lading representing each delivery in accordance with AASHTO R 26(M). The Certified Test Report must also indicate the asphalt binder specific gravity at 77°F, rotational viscosity at 275°F and 329°F, and a mixing and compaction viscosity-temperature chart as if the asphalt binder were to be used as binder for the construction of hot mix asphalt. The blending of PG asphalt binder from different suppliers is strictly prohibited. Contractors who blend PG asphalt binders will be classified as

a "Supplier" and will be required to certify the asphalt binder in accordance with AASHTO R 26(M).

3. Optional Barrier Material - Clean, Dry Sand: Sand shall conform to the requirements of Standard Specification Article M.01.03, Fine Aggregates, except that the gradation requirements shall be replaced with the following:

Square Mesh Sieve	Percent Passing by Weight
No. 8	100
No. 50	10 – 40
No. 100	0 – 10
No. 200	0 – 3

The Contractor must submit to the Engineer all Material Safety Data Sheet documents from the material manufacturer(s) prior to the commencement of work. During work progress, the Contractor must submit to the Engineer the manufacturer's Materials Certificate and a Certified Test Report showing conformance to applicable specifications for each batch or lot of material used on the Contract in accordance with Section 1.06.07.

Construction Methods: The crack filling operation shall proceed in accordance with the requirements of the "Maintenance and Protection of Traffic" and "Prosecution and Progress" specifications.

1. Equipment: The equipment used by the Contractor shall include, but not be limited to, the following:

    a. Melter Applicator: The unit shall consist of a boiler kettle equipped with pressure pump, hose, and applicator wand; the boiler kettle may be a combination melter and pressurized applicator of a double-boiler type with space between the inner and outer shells filled with heat transfer oil. Heat transfer oil shall have a flash point of not less than 600°F. The kettle shall include a temperature control indicator. The kettle shall be capable of maintaining the crack fill material at the manufacturer's specified application temperature range. The kettle shall include an insulated applicator hose and application wand. The hose shall be equipped with a shutoff control. The kettle shall include a mechanical fullsweep agitator to provide continuous blending. The unit shall be equipped with thermometers to monitor the material temperature and the heating oil temperature. The unit shall be equipped with thermostatic controls that allow the operator to regulate material temperature up to at least 425°F.

    b. Application Wand and Squeegee Applicator: The material shall be applied with a wand followed by a squeegee applicator. The squeegee applicator shall be of commercial/industrial quality designed with a "U" shaped configuration. It shall be of a size adequate to strike off, flush with the surrounding pavement surface and without overflow around the sides, all crack fill material placed. This tool shall be either attached to the applicator wand or used separately as its own long handled tool.

c. Hot Air Lance: The unit shall be designed for cleaning and drying the pavement surface cracks. Minimum compressed air capacity shall be 100 psi. The compressed air emitted from the tip of the lance shall be capable of achieving a temperature of at least 1500°F.

d. Vertically Mounted Power Driven Wire Brush: This tool shall be used to remove any dirt, debris, or vegetation to the depths specified that cannot be removed by the hot air lance. It shall be of adequate size and power to remove all material from cracks as specified.

2. Weather Requirements: Work shall not be performed unless the pavement is dry. No frost, snow, ice, or standing water may be present on the roadway surface or within the cracks. The ambient temperature must be 40°F and rising during field application operations for work to proceed.

3. Material Mixing Procedure: The prepackaged material shall be added to the melter applicator in the presence of the Engineer. It shall then be mixed and heated to the recommended application temperature. The crack fill material shall never exceed 400°F.

4. Determination of Cracks to be Filled: The width and depth requirements for cracks to be filled are as follows:

   All crack width determinations shall be made by measuring the crack width flush at the surface of the pavement prior to being filled. A straightedge shall be used whenever necessary to establish the location or limits of the flush surface of the pavement.

   All cracks from ¼ inch up to 1.5 inches wide shall be prepared and filled as stated below. Cracks that are between ¼ inch and 1.5 inches wide, but eventually taper in width below the minimum ¼ inch, shall also be prepared and filled as stated below. Only cracks that are less than ¼ inch wide throughout their entire length shall be excluded.

   Transverse cracks, where a portion of the crack (50% or less) exceeds a width of 1.5 inches, up to 2 inches, shall also be prepared and filled as stated below.

   All joints to be filled that are raveled (loss of the pavement surface material) shall be at least ½ inch in depth at the joint's deepest point. The minimum width of a raveled joint must be ½ inch. The maximum width of a raveled joint to be filled is 3 inches.

   Any cracks exceeding the width and depth requirements specified above shall be repaired using separate items.

5. Crack Preparation: Cracks to be filled shall be treated with a hot air lance prior to application of the crack fill material. Two (2) passes minimum shall be made with the hot air lance. The hot air lance operation shall proceed at a rate no greater than 120 feet per minute. There shall be no more than 10 minutes between the second hot air lance treatment and the material

application. Should this time be exceeded, additional pass(es) shall be made with the hot air lance.

The use of the hot air lance is not intended to heat the crack. It is to be used to blow all debris from the crack to the depths specified below and to remove any latent moisture from the crack until the inside of the crack is completely dry as determined by the Engineer. "Moisture" does not include standing water. The hot air lance is not to be used to boil off or blow standing water from the bottom of a crack. If standing water is present in the bottom of any crack, the filling operation shall be postponed until such time that the standing water evaporates naturally. The Contractor may use compressed, oil-free air (not heated) to blow standing water from a crack to help accelerate the natural evaporation process. If standing water remains after using compressed air, the crack shall be allowed to dry naturally until remaining standing water evaporates. The hot air lance may be used after visible water has evaporated. If a crack is already completely dry as determined by the Engineer, the hot air lance shall be operated at its lowest temperature possible.

The hot air lance shall be used to blow all debris from cracks (not including raveled joints) to a depth of at least ¾ inch for cracks between ¼ inch and ¾ inch wide, and to a depth of 1.25 inches for cracks between ¾ inch and 2 inches wide. The hot air lance shall be used to blow all debris from raveled joints to a depth of 1 inch or the full depth of the joint, whichever is smaller.

In the event that cracks are packed tightly with debris, dirt, vegetation, or other material, except previously placed sealant or filler, the Contractor shall use a vertically mounted power driven wire brush to remove all material and burnish the sides of the crack to the depths specified above. Cracks treated with the power driven wire brush shall subsequently be treated with a hot air lance as described in this section. The use of both the power driven wire brush and the hot air lance shall result in the complete removal of all material in the crack (except previously placed sealant or filler) to the depths specified above such that the sides of the crack are completely free and clean of any debris and moisture.

In the event that cracks have depths greater than 2 inches below the pavement surface, the Contractor may place a barrier composed of clean, dry sand as specified herein. The barrier material shall be placed in a manner leaving 1.25 inches below the elevation of the pavement surface for crack filling material. A barrier will not be allowed for cracks wider than 1.5 inches or less than ½ inch wide.

6. Crack Filling: As soon as cracks have been prepared, they shall be filled to refusal along their entire length. The treatment material shall be maintained at the manufacturer's specified/recommended application temperature range at all times. The filling operation shall be suspended if the temperature of the crack filling material falls outside the specified temperature range and shall remain suspended until the crack filling material is brought within the specified temperature range. Filled cracks are to be squeegeed immediately following application of the crack filling material, striking excess filler flat to the adjacent pavement surface. There shall be no build-up of treatment material above or adjacent to the crack at any

time. If the initial application of crack fill material fails to fill the crack or shrinks upon cooling such that there is a depression formed of at least ¼ inch or greater, a second application of filler shall be placed over the first application.

7. Protection of Filled Cracks: Traffic shall not be permitted on the pavement until the crack fill material is set so that the material does not track and is not deformed or pulled out by tires. If the work under this item is being performed prior to placing a hot mix overlay or other surface treatment, a detackifier or blotting agent will not be allowed. If work under this item is not followed by placement of an overlay of any kind, a detackifier or blotting agent may be used. If a detackifier or blotting agent is used, it shall be one recommended by the supplier of the crack filling material and shall be used as recommended by the supplier, except that no paper, cotton, or other organic materials shall be allowed. Information on the type and usage of a detackifier or blotting agent shall be presented to the Engineer for their written acceptance prior to use.

8. Removal and Disposal of Material: All debris generated from the operations described above shall be removed from the roadway by the Contractor.

   Treatment material remaining in the Contractor's kettle at the close of the daily work session shall be discarded. At no time shall treatment material be re-heated for use in subsequent crack filling applications unless permitted by the Engineer following a review of specific circumstances.

   All debris and surplus treatment material shall be properly disposed in accordance with Article 1.10.03 and State of Connecticut law.

9. Acceptance of Work: When the work is complete, an inspection shall be scheduled with the Engineer. The Engineer will note all deficiencies including, but not limited to, areas exhibiting adhesion failure, cohesion failure, tracking of filler material, and missed cracks. Work identified by the Engineer as not acceptable shall be repaired at the Contractor's expense. The Contractor shall notify the Engineer upon completion of any corrective work performed.

Method of Measurement: This work will be measured by the total number of linear feet of cracks filled, or by the Project area in square yards of bituminous concrete roadway surface, as indicated in the Contract plans and as measured, verified, and accepted by the Engineer.

Basis of Payment: This work will be paid for at the Contract unit price per linear foot for "Filling Joints and Cracks in Bituminous Concrete Pavement" or per square yard for "Joint and Crack Filling of Bituminous Concrete Pavement" complete and accepted in place. The price shall include all submittals, materials, equipment, tools, and labor incidental thereto. No payment will be made to the Contractor prior to submittal of required documents.

Pay Item	Pay Unit
Filling Joints and Cracks in Bituminous Concrete Pavement	l.f.

ITEM #0406238A – NON-TRACKING ASPHALT TACK COAT

Description: This item shall consist of furnishing and applying Non-Tracking Asphalt Tack Coat.

Non-Tracking Asphalt Tack Coat shall not adhere to tires, tracks, or other parts of paving equipment or vehicles. The Non-Tracking Asphalt Tack Coat shall meet the relevant provisions of the Standard Specifications, including Materials Section M.04.01-5 where applicable, and supplemented as follows.

Materials: The emulsified asphalt used for the Non-Tracking Asphalt Tack Coat shall meet the following requirements:

Table 1: Asphalt Emulsion for Non-Tracking Asphalt Tack Coat

Property	Specification	Test Procedure
Viscosity, SFS, 77°F	20-100	AASHTO T 72
Sieve, %	0.3 maximum	AASHTO T 59
Asphalt Residue, %	50 minimum	AASHTO T 59
Oil Distillate, %	1.0 maximum	AASHTO T 59
Residue Penetration, at 77°F	10-40	AASHTO T 49
Original Dynamic Shear (G*/sin δ), kPa at 70°C (Base Asphalt)	1.0 minimum	AASHTO T 315
Solubility, %	97.5 minimum	AASHTO T 44

General:

i. The Non-Tracking Asphalt Tack Coat shall be undiluted and free of contaminants such as fuel oils and other solvents.
ii. The blending of Non-Tracking Asphalt Tack Coats from different suppliers at the mixing Plant is prohibited.

Basis of Approval:

i. The request for approval of the source of supply shall list the location where the material is manufactured, the handling and storage methods, and certifications in accordance with AASHTO R 77. Only suppliers that have an approved "Quality Control Plan for Non-Tracking Asphalt Tack Coat" formatted in accordance with AASHTO R 77 and that submit monthly split samples per grade to the Engineer may supply Non-Tracking Asphalt Tack Coat to Department projects.
ii. Each shipment of Non-Tracking Asphalt Tack Coat delivered to the Project site shall be accompanied with the corresponding Certified Test Report listing all properties shown in Table 1, weight per gallon at 77°F, recommended application temperature range, and a Materials Certificate in accordance with 1.06.07.

Project Site Sampling and Testing: The Contractor shall obtain two (2) 1-quart samples of the heated material for the Engineer. The sample shall be obtained while the material is within the manufacturer's recommended application temperature range. The sample shall be delivered to the Division of Materials Testing central office within 7 days. Project site sampling frequency

shall be in accordance with the Minimum Schedule for Acceptance Testing for emulsified asphalt.

Construction Methods:

Surface Preparation: Prior to the application of the Non-Tracking Asphalt Tack Coat, the Contractor shall ensure that the pavement surface is thoroughly dry and free from dust, standing water, or any other foreign material that would inhibit adhesion. The Contractor shall clean the surface by scraping, sweeping, and the use of compressed air and ensure this preparation process occurs shortly before application to prevent the return of debris on the pavement. The Contractor shall not apply tack coat if rain is expected within one hour after application.

Equipment: The Contractor shall provide a distributor truck capable of heating, circulating, and spraying the tack coat at the required application temperature range per the manufacturer's recommendations. The temperature of the tack coat shall not exceed 180°F and shall be circulated while heating. If the particle charge of the Non-Tracking Asphalt Tack Coat is different from the particle charge of the emulsion that was previously used, the tank shall be thoroughly cleaned prior to use.

The spray bar shall maintain a constant height above the pavement under variable load conditions. The distributor shall include a tachometer, pressure gauges, and an accurate volume measuring device or a calibrated tank. All applicator trucks shall have calibrations certified in accordance with ASTM D2995.

The Contractor shall submit delivery tickets at the end of each production day for all Non-Tracking Asphalt Tack Coat material used. The quantity and temperature of the material shall be recorded at the beginning and end of each production day from the distributor truck. Tack coat material shall not be removed from the distributor truck until the initial quantity and temperature measurements have been recorded. The tack coat supplier shall provide the weight per gallon of the material.

Tack Coat Application: The roadway temperature shall be a minimum of 40°F and rising during the application of the Non-Tracking Asphalt Tack Coat. The material shall not be applied if the existing surface is wet or frozen or it will not "break" within 30 minutes. Do not place any asphalt mixture until the tack coat has sufficiently cured. Prior to applying the tack coat, demonstrate competence in applying the tack coat to the satisfaction of the Engineer. The tack coat shall be heated in the distributor to within the recommended application temperature range provided by the manufacturer. Any material applied outside the manufacturer's recommended temperature range is subject to rejection.

The distributor spray bars shall be adjusted to uniformly coat the entire surface at the directed application rate. A hand hose attachment shall be used only on irregular areas and areas inaccessible to the spray bar and shall be coated uniformly and completely.

Tack coat shall be applied as directed by and in the presence of the Engineer to all exposed transverse and longitudinal edges of each course before mixture is placed against such surfaces. The tack coat shall be applied to contact surfaces of curbs, gutters, manholes, and vertical faces of existing pavements.

The Contractor shall protect bridge decks, curb reveals, handrails of structures, and all other appurtenances from tracking or splattering of tack coat material.

Full Production Application Rate: Full coverage of this material on the pavement surface is critical. If full coverage is not achieved, the material application rate shall be increased as required by the Engineer (see Table 2 below for in-place residual application rates) to ensure full coverage. The paving shall proceed only after the Non-Tracking Asphalt Tack Coat has cured (broken and set) to the satisfaction of the Engineer.

Table 2: Residual Application Rates for Non-Tracking Asphalt Tack Coat Emulsions

Non-Tracking Asphalt Tack Coat Uses	Minimum Residual (gal/s.y.)	Maximum Residual (gal/s.y.)
New AC Pavement to New AC Pavement or Thin Lift Leveling	0.04	0.06
New AC Pavement (≤ 20 % RAP) to Aged Existing Pavement or Milled Surface	0.05	0.08
New AC Pavement (> 25 % RAP) to Aged Existing Pavement or Milled Surface	0.06	0.10
New AC Pavement to PCC or Milled PCC Surface	0.04	0.08

Method of Measurement: The quantity of Non-Tracking Asphalt Tack Coat will be measured by the number of gallons furnished and applied on the Project and accepted by the Engineer. The application rate shall be established to meet the minimum residual asphalt application rate in Table 2.

The Engineer shall calculate the residual application rate of the in-place Non-Tracking Asphalt Tack Coat based on the applied emulsion quantity and the percent dilution at 77°F (i.e. 100 gallons of emulsion at 55% asphalt content applied on 900 s.y. therefore, the Residual Asphalt Application Rate = (0.55 x 100)/900 = 0.061 gallons/s.y.). Any amount of material more than 10% over the application rate specified, will not be included. Measured quantities in gallons of Non-Tracking Asphalt Tack Coat at 77°F can be determined using one of the following methods.

i. Measured by Weight: The number of gallons furnished will be determined by weighing the material on calibrated scales furnished by the Contractor. To convert weight to gallons, one of the following formulas will be used:
   Tack Coat (gallons at 77°F) = Measured Weight (pounds) / Weight per gallon at 77°F
ii. Measured by automated metering system on the delivery vehicle:
   Tack Coat (gallons at 77°F) = 0.976 x Measured Volume (gallons).

Basis of Payment: This work will be paid for at the Contract unit price per gallon for "Non-Tracking Asphalt Tack Coat," complete and accepted in place, which price shall include furnishing and applying materials, surface preparation, equipment, tools, labor and work incidental thereto.

Pay Item	Pay Unit
Non-Tracking Asphalt Tack Coat	gal.

ITEM #0406608A - DOCUMENTATION OF UNIFORM PLACEMENT OF BITUMINOUS CONCRETE (PAVER)

ITEM #0406609A - DOCUMENTATION OF UNIFORM COMPACTION OF BITUMINOUS CONCRETE (ROLLER)

Description: This item shall consist of tracking and recording the continuous real-time location of all placement (pavers) and compaction (rollers) equipment using Global Positioning System (GPS) technology during the application of Ultra-Thin Bonded PMA Pavement (Type B) mixtures within the limits of the work as described in the Plans. The continuous real-time temperature of the pavement under the rollers and immediately behind the paver(s) shall also be measured and recorded. In addition, the continuous real-time speed of the paver(s) shall be measured and recorded. "Ultra-Thin Bonded PMA Pavement (Type B)" will be referred to herein as "Ultra-Thin Bonded PMA" or "Ultra-Thin Bonded PMA, material/mixture."

The following GPS-related definitions in AASHTO PP 81 are applicable to this specification:

GPS: A space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth to determine the location in geodetic coordinates. In this specification, GPS refer to all GPS-related signals including US GPS and other Global Navigation Satellite Systems (GNSS).
Hand-Held GPS Rover: A portable GPS radio/receiver for in-situ point measurements.
GPS Base Station: A single ground-based system consisting of a GPS receiver, GPS antenna, radio and radio antenna to provide L1/L2 differential GPS correction signals to other GPS receivers within a range limited by radio, typically 3 miles in radius without repeaters.
Network RTK: Network RTK is a system that uses multiple bases in real-time to provide high-accuracy GPS positioning within the coverage area that is generally larger than that covered by a ground-based GPS base station (e.g., VRS™).
GPS Correction Service Subscription: A paid service that can receive VRS signals in order to achieve higher accuracy GPS positioning, normally via cellular wireless data services without the need for a ground-based base station. Examples of GPS Correction Service Subscriptions are as follows: Trimble VRS™, Trimble VRS NOW™, and OmniSTAR.
ECEF XYZ: Earth-Centered, Earth-Fixed Cartesian X, Y, Z coordinates.
Grid: Referred to as ECEF XYZ in this specification.
GUI Display: Graphical User Interface Display.

Construction Methods:

A. Equipment:

1. Rollers/Pavers: All rollers used for breakdown, intermediate, and finish rolling, and pavers used to place Ultra-Thin Bonded PMA within the project limits shall be equipped as follows:

   a. GPS radio and receiver units shall be mounted on each roller and paver to monitor the speed and location of such equipment during the entire paving operation.
   b. The equipment shall include an integrated on-board documentation system that is capable of displaying real-time, color-coded maps of location, number of passes, pavement surface temperatures, and speeds.
   c. The integrated on-board documentation system mounted on the paver(s) shall display, record, and report the speed of the paver(s) in units of feet per minute (fpm).
   d. The display unit shall be capable of transferring the data by means of a USB port or other methods acceptable to the Engineer.

2. Global Positioning System (GPS): The Contractor shall provide GPS technology to achieve accurate and consistent GPS measurements among all GPS equipped devices on the Project.

   All GPS devices for this Project shall be set to the same consistent coordinate datum/system no matter whether GPS or Grid data are originally recorded. The Connecticut State Plane Coordinate System shall be used. The records shall be in U.S. Survey Feet. Ad-hoc local coordinate systems will not be allowed.

3. GPS System and Reference System Combination: The Contractor shall provide the GPS system (including GPS receivers on equipment and hand-held GPS receivers (rovers)) that makes use of the same reference system that can be a ground-based base station or network-RTK, to achieve RTK-GPS accuracy. Examples of combinations are as follows:

   a. GPS receivers on equipment and hand-held GPS rovers referenced to the same on-ground base station.
   b. GPS receiver on equipment and hand-held GPS rovers referenced to the same network RTK.

4. GPS Data Records and Formats: The recorded GPS data, whether from the equipment or hand-held GPS rovers, shall be in accordance with AASHTO PP 81 Table 1.

   Coordinates shall be in feet with at least 3 digits of significance (0.003 ft or 0.036 inch) When importing data into the data analysis software, the GPS data and associated measurements shall be stored with minimum data conversions and minimum loss of precision. Users can then select unit of preference to allow real time unit conversion for

the GUI display.

5. Data Analysis Software: Standardized data analysis software (Veta) to be used for this Project is available on the website http://www.intelligentcompaction.com. At a minimum, the following Essential Data Information and Data Elements shall be included in each data file or section:

Table 1 – Essential Data Information

Item	Description	Item	Description
1	Section Title	6	Drum Diameter (ft) (roller only)
2	Machine Manufacturer	7	Machine Weight (ton)
3	Machine Type	8	CSPC Zone
4	Machine Model	9	Offset to UTC (hrs)
5	Drum/Screed Width (ft)	10	Number of Data Points

Table 2 – Essential Data Elements for each Data Point

Item	Data Field Name	Example of Data
1	Date Stamp (YYYYMMDD)	20220105
2	Time Stamp (HHMMSS.SS – military format)	090504.00 (9 hr. 5 min. 4.00 sec.)
3	Longitude (decimal degrees)	94.85920403
4	Latitude (decimal degrees)	45.22777335
5	Easting (US survey foot)	613315.604
6	Northing (US survey foot)	812317.831
7	Height (feet)	120.866
8	Pass number (rollers only)	2
9	Direction index	1 forward, 2 reverse
10	Speed (mph) (rollers)	4.0
11	Speed (fpm) (pavers)	70
12	Vibration on	1 for yes, 2 for no
13	Frequency (vpm)	3500.0
14	Amplitude (mils)	23.62
15	Surface temperature (°F)	250

In Table 2, Items 3 and 4 can be exchanged with Items 5 and 6, and vice versa.

The size of data mesh after post-processing shall be less than 18 inches by 18 inches in the X and Y directions.

6. Trained Equipment Operators: The Contractor shall provide equipment operator(s) trained to accomplish work under these items. Sufficient training for the operator(s) shall be supplied by a representative of the manufacturer of the equipment prior to

commencement of the work.

7. Equipment Information: Prior to commencement of the work, the Contractor shall supply the Engineer with equipment information, to include at a minimum the supplier, make, model, unique identifier, and GPS system supplier to be utilized.

B. Quality Control: In addition to any other QC responsibilities, the Contractor shall be responsible for the following:

1. Daily GPS check testing for the equipment and rover(s).
2. Routine checks of paver(s) speed ensuring paver placement of Ultra-Thin Bonded PMA does not exceed the maximum speed of 85 feet per minute (fpm).
3. Quality control testing to monitor the Ultra-Thin Bonded PMA temperature.
4. Ensuring complete roller coverage of all Ultra-Thin Bonded PMA material placed, as specified in Item #0406193A of the Contract.
5. Monitoring the equipment location during paving operations and the operation of the entire GPS system on the Project site.
6. Daily check of the temperature accuracy following AASHTO PP 81 Section X3.4.
7. Daily download and analysis of the data from the paver and roller(s).
8. Printing of equipment reports at the end of each shift and providing a copy these summary reports to the Engineer.
9. Daily set-up, take down, and secure storage of GPS and equipment components.

C. Data Sampling Requirements: The minimum frequency of obtaining the data from the equipment shall be 2 times per day of Ultra-Thin Bonded PMA placement and compaction operations. The data shall be date and time stamped which allows for subsequent external evaluation. Data reports shall be submitted to the Engineer at the end of each work shift, which shall the identity of the equipment used, the date of measurements, construction area being mapped, and percentage of the construction area mapped.

The raw data and results from the analysis software shall be made available to the Engineer within 24 hours of obtaining the data.

D. Post-Process GPS Check: The Contractor shall follow the vendor-specific instructions to export data from the equipment to Veta-compatible formats. For each data export, the Contractor shall import the equipment data into Veta and enter GPS point measurements from the rover and visually inspect the map and point measurements on the Veta display screen for consistency.

E. GPS Setup: Prior to the start of production, the Contractor and representatives of the GPS and equipment manufacturer shall conduct a check of the setup of the GPS, equipment, and the rover(s) using the same datum, as follows:

1. On a location nearby or within the project limits, the GPS base station (if required by the

GPS) shall be established and the equipment and the GPS rover tied into the same base station.

2. Verification that the equipment and rover are working properly and that there is a connection with the base station.
3. There are two (2) options for comparing the equipment and rover coordinates. Production shall not begin until proper GPS verification has been obtained. The vendor's recommended verification process can be used to augment either of the following options:
   a. GPS verification measurements shall be conducted while the equipment is stationary. The GPS coordinates from the equipment on-board display shall be recorded ensuring that the distance offsets are applied correctly to the center of the front drum (e.g., the measurement is at the equipment GPS receiver position). Place the hand-held GPS receiver on top of the GPS receiver mounted on the equipment and record the coordinates from the hand-held receiver display. The differences of the coordinates between the equipment GPS receiver and hand-held GPS receiver shall be within 12 inches in both the horizontal axes (X and Y). A vertical axis check is not required.
   b. A reference location on the Project site shall be selected and marked by the Contractor. The equipment shall be placed so that the center of the roller's front drum or paver hopper is on top of the reference location, and the location measurement shall be recorded. After moving the equipment from the marked location, a hand-held rover shall be used to locate the reference location. The differences of the coordinates in grid shall be within 12 inches in both the horizontal axes (X and Y). The GPS location measurements from the equipment must be used to determine any offsets that are required so that the GPS coordinate of the equipment is at the center of the front drum or hopper. On some systems, distance offsets are applied to the roller/paver GPS measurements from the on-board display and the coordinates may be on the left or right side of the drum or hopper. In those cases, the equipment must be moved so that the left or right side of the front drum axle or hopper is flush with the reference location. The hand-held rover shall be placed on the marked location and the difference of both coordinate records checked. The final GPS coordinate for each data point recorded in data files must be at the center of the front drum or hopper.
4. The Project plan file provided by the Department shall be uploaded into the data analysis software and, depending on the equipment manufacture, the on-board system.
5. GPS setup shall be conducted daily during production operations to ensure consistency and accuracy of measurements for all GPS devices prior to the paving and compaction operations.

F. <u>Documentation:</u> In addition to any data documentation requirements listed elsewhere in this specification, the following minimum documentation regarding all phases of data collection, processing, and reporting shall be provided to the Engineer:

1. Equipment: Documentation of the manufacturer, model, type of paver, and rollers used each day of paving. The relative positioning of the equipment in the paving operations shall be noted.

2. Initial Data: At a minimum, the electronic data from equipment and the data analysis software shall be provided to the Engineer upon the completion of the first day of paving.
3. Production Roller/Paver Data: The Contractor shall export from the vendor's software all data daily.

The Contractor shall analyze the equipment data for coverage area and uniformity and shall submit the results to the Engineer within 24 hours of completion of each day of paving operations.

A summary of all equipment data shall be submitted to the Department at the completion of the Project.

G. Assistance and Training:

1. Technical Assistance: The Contractor shall coordinate on-site technical assistance with the equipment representative(s) during the initial 7 days of production and as needed during the remaining operations. The equipment representative shall be present during the initial setup and verification testing of the equipment. The equipment representative shall assist the Contractor with data management using the data analysis software including data input and processing.
2. On-Site Training: The Contractor shall coordinate on-site training for Contractor and Department Project personnel related to operation of the technology. The Contractor's personnel shall include the paving superintendent, QC technician(s), and equipment operator(s). Minimum training topics shall include the following:
   a. Background information for the specific system(s) to be used.
   b. Setup and checks for system(s), GPS receiver, base-station, and hand-held rovers.
   c. Operation of the system(s) on the equipment: setup data collection, start/stop of data recording, and on-board display options.
   d. Transferring raw data from the equipment (via USB connections, cloud upload, or other means acceptable to the Engineer).
   e. Operation of vendor's software to open and view raw data files and exporting all-passes and proofing data files in Veta-compatible format.
   f. Operation of Veta software to import the exported all-passes and proofing data files, inspection of maps, input point test data, perform statistics analysis, and produce reports for Project requirements.
   g. Coverage and uniformity requirements.

Method of Measurement: These items will be measured by the number of square yards of "Ultra-Thin Bonded PMA Pavement (Type B)" for the Project placed by a paver and compacted by the roller(s), in accordance with these specifications. The number of square yards eligible for payment will be equal to the number of square yards of "Ultra-Thin Bonded PMA Pavement (Type B)" delivered to the Project during the period of acceptable documentation for the equipment.

For these Contract items, acceptable documentation is considered a continuous period(s) of data collection of 100% of the Essential Data Information and Data Elements for no less than 90% of the time material is being placed by the paver or compacted by the roller(s) as appropriate for the item.

Pro-rated measurements of material under this item will not be made.

Basis of Payment: These items will be paid at the Contract unit price per square yard for "Documentation of Uniform Placement of Bituminous Concrete (Paver)" and at the Contract unit price per square yard per roller for "Documentation of Uniform Compaction of Bituminous Concrete (Roller)" which prices shall include all submittals, technical assistance, materials, equipment, tools, and labor incidental thereto.

Pay Item	Pay Unit
Documentation of Uniform Placement of Bituminous Concrete (Paver)	s.y.
Documentation of Uniform Compaction of Bituminous Concrete (Roller)	s.y.

ITEM #0406999A - ASPHALT ADJUSTMENT COST

Description: The Asphalt Adjustment Cost will be based on the variance in price for the performance-graded binder component of the following:

I. Hot Mix Asphalt (HMA) and Polymer Modified Asphalt (PMA),
II. Ultra-Thin Bonded HMA (UTB-HMA) and Ultra-Thin Bonded PMA (UTB-PMA),
III. Thin Friction Wearing Course (TFWC),
IV. Binder Rich Intermediate Courses (BRIC) and Stone Matrix Asphalt (SMA), and
V. Asphalt Rubber Chip Seal (ARCS) treatments completed and accepted during the Contract.

The Asphalt Price is available on the Department of Transportation website at:
http://www.ct.gov/dot/asphaltadjustment

Construction Methods:

An asphalt adjustment will be applied only if all the following conditions are met per mixture:

I. For HMA, PMA, TFWC, BRIC, and SMA mixtures:
   a. The HMA, PMA, TFWC, BRIC, or SMA mixture for which the adjustment would be applied is listed as a Contract item with a pay unit of tons.
   b. ***The total quantity for all HMA, PMA, TFWC, BRIC, and SMA mixtures in the Contract or individual purchase order (Department of Administrative Service contract awards) exceeds 1000 tons or the Project duration is greater than 6 months.***
   c. The difference between the posted *Asphalt Base Price* and *Asphalt Period Price* varies by more than $5.00 per ton.

II. For UTB-HMA and UTB-PMA mixtures:
   a. The UTB-HMA or UTB-PMA mixture for which the adjustment would be applied is listed as a Contract item.
   b. ***The total quantity for the UTB-HMA or UTB-PMA mixture in the Contract exceeds:***
      i. 800 tons if the UTB-HMA or UTB-PMA item has a pay unit of tons,
      ii. 30,000 square yards if the UTB-HMA or UTB-PMA item has a pay unit of square yards, or
      iii. the Project duration is greater than 6 months.
      Note: The quantity of UTB-HMA or UTB-PMA measured in tons shall be determined from the material documentation requirements set forth in the UTB-HMA or UTB-PMA item specification.
   c. The difference between the posted *Asphalt Base Price* and *Asphalt Period Price* varies by more than $5.00 per ton.
   d. No Asphalt Adjustment Cost will be applied to the liquid emulsion that is specified as part of the UTB-HMA or UTB-PMA mixture system.

III. For Asphalt Rubber Chip Seal (ARCS) treatments:
   a. The ARCS treatment for which the adjustment would be applied is listed as a Contract item.

b. ***The total quantity for the ARCS treatment in the Contract exceeds 30,000 square yards or the Project duration is greater than 6 months.***

Note: The quantity of asphalt binder measured in tons used for the Asphalt Rubber Chip Seal treatment shall be determined from the material documentation requirements set forth in the ARCS item specification. The Asphalt Adjustment Cost will also be applied to the asphalt binder used to pre-coat the cover aggregate as part of the ARCS and will be considered as a portion of the total tons of binder for the treatment. The additional quantity of binder measured in tons will be determined based on a percentage of the cover aggregate weight per the requirements set forth in the ARCS item specification.

c. The difference between the posted *Asphalt Base Price* and *Asphalt Period Price* varies by more than $5.00 per ton.

Regardless of the binder used in all mixtures or treatments, the Asphalt Adjustment Cost will be based on PG 64-22.

The Connecticut Department of Transportation (CTDOT) will post on its website, the average per ton selling price (asphalt price) of the performance-graded binder. The average is based on the high and low selling price published in the most recent available issue of the **Asphalt Weekly Monitor®** furnished by Poten & Partners, Inc. under the "East Coast Market – New England, New Haven, Connecticut area," F.O.B. manufacturer's terminal.

The selling price furnished from the Asphalt Weekly Monitor ® is based on United States dollars per standard ton (US$/ST).

Method of Measurement:

A.

Formula A: HMA x [PG%/100] x [(*Period Price - Base Price*)] = $ ____

Where:

- **HMA:**
  1. For HMA, PMA, UTB-HMA, UTB-PMA, TFWC, BRIC, and SMA mixtures with pay units of tons:
     The quantity in tons of accepted HMA, PMA, UTB-HMA, UTB-PMA, TFWC, BRIC, or SMA mixture measured and accepted for payment.
  2. For UTB-HMA and UTB-PMA mixtures with pay units of square yards:
     The quantity of UTB-HMA and UTB-PMA mixture delivered, placed, and accepted for payment, calculated in tons as reported according to the Material Documentation provision of the UTB-HMA and UTB-PMA specification.
- ***Asphalt Base Price***: The asphalt price posted on the CTDOT website 28 days before the actual bid opening posted.
- ***Asphalt Period Price***: The asphalt price posted on the CTDOT website during the period the HMA, PMA, UTB-HMA, UTB-PMA, TFWC, BRIC, or SMA mixture was placed.
- **PG%** (Performance-Graded Binder percentage):
  1. For HMA or PMA mixes:
     - PG% = 4.5 for HMA S1 and PMA S1

- PG% = 5.0 for HMA S0.5 and PMA S0.5
- PG% = 6.0 for HMA S0.375, PMA S0.375, HMA S0.25 and PMA S0.25

2. For UTB-HMA, UTB-PMA, TFWC, BRIC, and SMA mixes:
   - PG% = Design % PGB (Performance Graded Binder) in the approved job mix formula, expressed as a percentage to the tenth place (e.g. 5.1%)

B. For Asphalt Rubber Chip Seal:

Formula B: Total Tons x [(*Period Price - Base Price*)] = $ ____

Where:

- ***Total tons:*** The tons of asphalt binder for each lot of asphalt rubber produced, as reported according to the Testing and Certification article of the specification for Asphalt Rubber Chip Seal, and the tonnage of binder used to coat the cover aggregate calculated as follows: 0.6% x tons of cover aggregate.
- ***Asphalt Base Price***: The asphalt price posted on the CTDOT website 28 days before the actual bid opening posted.
- ***Asphalt Period Price***: The asphalt price posted on the CTDOT website during the period the Asphalt Rubber Chip Seal mixture was placed.

The Asphalt Adjustment Cost shall not be considered as a changed condition in the Contract as result of this provision since all bidders are notified before submission of bids.

Basis of Payment: The "Asphalt Adjustment Cost" will be calculated using the applicable formula(s) indicated above. A payment will be made for an increase in costs. A deduction from monies due the Contractor will be made for a decrease in costs.

The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this item will be considered the bid price although the adjustment will be made as described above. The estimated cost figure is not to be altered in any manner by the bidder. If the bidder should alter the amount shown, the altered figure will be disregarded and the original cost figure will be used to determine the amount of the bid for the Contract.

Pay Item	Pay Unit
Asphalt Adjustment Cost	est.

ITEM #0917010A - REPAIR GUIDERAIL

Description: Work under this item shall consist of the repair of newly installed guiderail. It shall be repaired in the locations originally installed and fabricated in conformity with the lines, designations, dimensions, and details shown on the plans or as ordered by the Engineer.

Materials: The material for guiderail shall meet the requirements as specified within the original applicable contract items.

When repairing guiderail, the Contractor shall reuse any undamaged existing guiderail elements, timber rail, wire rope, appropriate posts, delineators, lap bolts, and other hardware within the project limits as approved by the Engineer to repair the guiderail. The Contractor shall use new materials when any components of the existing railing are damaged or missing and cannot be obtained from other guiderail systems being removed or converted within the Project limits.

Construction Methods: The repair of guiderail shall be in accordance with contraction methods as specified within the original applicable contract items.

Guiderail, including end anchors, which has been installed in final condition and accepted by the Engineer, shall be eligible for reimbursement for repairs subject to the conditions described below. If multiple runs are to be installed in a single stage as indicated in the contract documents, determination for reimbursement shall be made when all runs within the stage are complete and accepted as previously described. On projects without designated stages, guiderail installations must be complete and serving the intended function as determined by the Engineer.

When newly installed guiderail is damaged by public traffic, the following conditions must be satisfied prior to reimbursement for payment;

1. The damage must have been caused solely by the traveling public.

2. The contractor shall provide satisfactory evidence that such damage was caused by public traffic. Such as accident reports obtained from the Connecticut Department of Public Safety, police agencies or insurance companies; statements by reliable, unbiased eyewitnesses; or identification of the vehicle involved in the accident.

3. The contractor shall attempt to collect the costs from the person or persons responsible for the damage and provide documentation of those efforts to the satisfaction of the Engineer.

4. If such evidence cannot be obtained, the Engineer may determine that the damage was not caused by the Contractor and reimbursement for payment is warranted.

This repair provision does not relieve the Contractor of the requirements of Section 1.07, any other contractual requirements for maintenance and protection of traffic and final acceptance and relief of responsibility for the project.

The contractor shall remain responsible for the safety and integrity of the guiderail system for the duration of the project. In the event the guiderail is damaged, the Contractor shall provide sufficient cones, drums and other traffic control devices to provide safe passage by the public. When ordered by the Engineer, the Contractor shall furnish replacement parts and immediately repair the guiderail, but in no case more than 24 hours after notification from the Engineer. In non-emergency situations, the guiderail shall be repaired within 72 hours. The repaired guiderail or anchorages, when completed, shall conform to these specifications for a new system. The Contractor shall be responsible for the removal and the proper disposal of all damaged material and debris.

Method of Measurement: Guiderail damaged solely by the traveling public will be measured for payment. Damage caused by the Contractor's equipment or operations will not be measured for payment.

The sum of money shown on the estimate and in the itemized proposal as "Estimated Cost" for repair of guiderail will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount bid for the contract.

Basis of Payment: Repair of guiderail will be paid for in accordance with Article 1.09.04 as required to restore the rail to its full working condition in conformance with these specifications for a new system. There will be no payment for maintenance and protection of traffic for work associated with this item unless, in the opinion of the Engineer, the sole purpose of the maintenance and protection of traffic is for repair of the guiderail.

Pay Item	Pay Unit
Repair Guiderail	est. (est.)

ITEM #0969064A - CONSTRUCTION FIELD OFFICE, LARGE

Description: Under the item included in the bid document, adequate weatherproof office quarters with related furnishings, materials, equipment, and other services, shall be provided by the Contractor for the duration of the work, and if necessary, for a close-out period determined by the Engineer. The office, furnishings, materials, equipment, and services are for the exclusive use of CTDOT forces and others who may be engaged to augment CTDOT forces with relation to the Contract. The office quarters shall be located convenient to the work site and installed in accordance with Article 1.08.02. This office shall be separated from any office occupied by the Contractor. Ownership and liability of the office quarters shall remain with the Contractor.

Furnishings/Materials/Supplies/Equipment: All furnishings, materials, equipment, and supplies shall be in like new condition for the purpose intended and require approval of the Engineer.

Office Requirements: The Contractor shall furnish the office quarters and equipment as described below:

Description \ Office Size	Small	Med.	Large	Extra Large
Minimum Sq. Ft. of floor space with a minimum ceiling height of 7 ft.	400	720	1400	2800
Minimum number of exterior entrances.	2	2	2	2
Minimum number of parking spaces.	7	7	10	15

Office Layout: The office shall have a minimum square footage as indicated in the table above and shall be partitioned as shown on the building floor plan as provided by the Engineer.

Unless otherwise approved by the Engineer, office space shall be partitioned into segregated work areas for each user as follows:

- Each work area (or cubicle) shall be a minimum of 8 feet × 8 feet, with full height walls or tall cubicle partitions (minimum 6 feet high), placed to provide a minimum of 6 feet walking space around and between each user work area (for social distancing).
- Only one user (workstation/desk) per work area.
- Desks, tables, and other work surfaces shall be arranged so that adjacent users do not face each other.

Tie-downs and Skirting: Modular offices shall be tied-down and fully skirted to ground level.

Lavatory Facilities: For field offices sizes Small and Medium the Contractor shall furnish a toilet facility at a location convenient to the field office for use by CTDOT personnel and such assistants as they may engage; and for field offices sizes Large and Extra Large the Contractor shall furnish two (2) separate lavatories with toilet (men and women), in separately enclosed rooms that are properly ventilated and comply with applicable sanitary codes. Each lavatory shall have hot and cold running water and flush-type toilets. For all facilities the Contractor shall supply lavatory and sanitary supplies as required.

Windows and Entrances: The windows shall be of a type that will open and close conveniently, shall be sufficient in number and size to provide adequate light and ventilation, and shall be fitted with locking devices, blinds, and screens. The entrances shall be secure, screened, and fitted with a lock for which four keys shall be furnished. All keys to the construction field office shall be furnished to the CTDOT and will be kept in their possession while State personnel are using the office. Any access to the entrance ways shall meet applicable building codes, with appropriate handrails. Stairways shall be ADA/ABA compliant and have non-skid tread surfaces. An ADA/ABA compliant ramp with non-skid surface shall be provided with the Extra-Large field office.

Lighting: The Contractor shall equip the office interior with electric lighting that provides a minimum illumination level of 100 foot-candles at desk level height, and electric outlets for each desk and drafting table. The Contractor shall also provide exterior lighting that provides a minimum illumination level of 2 foot-candles throughout the parking area and for a minimum distance of 10 ft. on each side of the field office.

Parking Facility: The Contractor shall provide a parking area, adjacent to the field office, of sufficient size to accommodate the number of vehicles indicated in the table above. If a paved parking area is not readily available, the Contractor shall construct a parking area and driveway consisting of a minimum of 6 inches of processed aggregate base graded to drain. The base material will be extended to the office entrance.

Field Office Security: Physical Barrier Devices - This shall consist of physical means to prevent entry, such as: 1) All windows shall be barred, or security screens installed; 2) All field office doors shall be equipped with dead bolt locks and regular day operated door locks; and 3) Other devices as directed by the Engineer to suit existing conditions.

Electric Service: The field office shall be equipped with an electric service panel, wiring, outlets, etc., to serve the electrical requirements of the field office, including lighting, general outlets, computer outlets, electronics, etc., and meet the following minimum specifications:

A. 120/240 volt, 1 phase, 3 wire
B. Ampacity necessary to serve all equipment. Service shall be a minimum 100 amp dedicated to the construction field office.
C. The electrical panel shall include a main circuit breaker and branch circuit breakers of the size and quantity required.
D. Additional 120-volt, single phase, 20-amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed at each desk and personal computer table (workstation) location.
E. Additional 120-volt, single phase, 20-amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed, for use by the Telephone Company.
F. Additional 120-volt circuits and duplex outlets as required meeting National Electric Code requirements.

G. One exterior (outside) wall mounted GFI receptacle, duplex, isolated ground, 120-volt, straight blade.
H. After work is complete and prior to energizing, the State's CTDOT electrical inspector, must be contacted at 860-594-2240. (Do Not Call Local Town Officials)
I. Prior to field office removal, the CTDOT Office of Information Systems (CTDOT OIS) must be notified to deactivate the communications equipment.

Heating, Ventilation and Air Conditioning (HVAC): The field office shall be equipped with sufficient and properly operating, heating, air conditioning, and ventilation equipment to maintain a temperature range of 68°-80° Fahrenheit within the field office. The Contractor shall increase ventilation rates and increase the percentage of outdoor air that circulates into the system where possible.

Telephone Service: The Contractor shall provide telephone service with unlimited nation-wide calling plan. For a Small, Medium, and Large field office this shall consist of the installation of one (1) telephone line for phone/voice service. For an Extra-Large field office this shall consist of three (3) telephone lines for phone/voice service. The Contractor shall pay all charges.

Data Communications Facility Wiring: Contractor shall install a Category 6 568B patch panel in a central wiring location and Cat 6 cable from the patch panel to each PC station, Smart Board location, Multifunction Laser Printer/Copier/Scanner, terminating in a (Category 6 568B) wall or surface mount data jack. The central wiring location shall also house either the data circuit with appropriate power requirements or a Category 6 cable run to the location of the installed data circuit. The central wiring location will be determined by the CTDOT OIS staff in coordination with the designated field office personnel for CTDOT employee staffed field offices as soon as the facility is in place and requested by the Contractor. The central wiring location will be determined with designated CTDOT District staff as soon as the facility is in place and requested by the Contractor.

The Contractor shall provide LAN switches and patch panels as needed to provide the data speeds and connections specified. The contractor shall run a CAT 6 LAN cable from each workstation and networked device (including Multi-Function Laser Printer/Copier/Scanner, printers, and docking stations) to the contractor supplied patch panel/LAN switch area leaving an additional 10 feet of cable length on each side with terminated RJ45 connectors. The Contractor shall install patch panel and LAN switch in data circuit area. Each run / jack shall be clearly labeled with an identifying Jack Number.

The Contractor shall supply cables to connect all devices to the Contractor supplied internet router, switches, and RJ45 connections as needed. These cables shall be separate from the LAN cables and data Jacks detailed above for the CTDOT network.

The number of networked devices anticipated shall be at least equal to the number of personal computer tables, Multi-Function Laser Printer/Copier/Scanner, contractor supplied devices, and smartboards listed below.

In addition to the contractor supplied internet service, the additional installation of a data communication circuit between the field office and the CTDOT OIS in Newington (will only apply to projects staffed with CTDOT employees) will be coordinated between the CTDOT District staff, CTDOT OIS staff and the local utility company once the Contractor supplies the field office phone numbers and anticipated installation date. The Contractor shall provide the field office telephone number(s) to the CTDOT Project Engineer within 10 calendar days after the signing of the Contract as required by Article 1.08.02. This is required to facilitate data line and computer installations.

Additional Equipment, Facilities and Services: The Contractor shall provide at the field Office at least the following to the satisfaction of the Engineer:

Furnishing Description	Office Size			
	Small	Med.	Large	Extra Large
	Quantity			
Office desk (2.5 ft. x 5 ft.) with drawers, locks, and matching desk chair that have pneumatic seat height adjustment and dual wheel casters on the base.	1	3	5	8
Standard secretarial type desk and matching desk chair that has pneumatic seat height adjustment and dual wheel casters on the base.	-	-	-	1
Personal computer tables (4 ft. x 2.5 ft.).	2	3	5	8
Drafting type tables (3 ft. x 6 ft.) and supported by wall brackets and legs; and matching drafter's stool that have pneumatic seat height adjustment, seat back and dual wheel casters on the base.	1	1	1	2
Conference table, 3 ft. x 12 ft.	-	-	-	1
Table – 3 ft. x 6 ft.	-	-	-	1
Office Chairs.	2	4	8	20
Mail slot bin – legal size.	-	-	1	1
Non-fire-resistant cabinet.	-	-	2	4
Fire resistant cabinet (legal size/4 drawer), locking.	1	1	2	3
Storage racks to hold 3 ft. x 5 ft. display charts.	-	-	1	2
Vertical plan racks for 2 sets of 2 ft. x 3 ft. plans for each rack.	1	1	2	2
Double door supply cabinet with 4 shelves and a lock – 6 ft. x 4 ft.	-	-	1	2
Case of cardboard banker boxes (Min 10 boxes/case)	1	1	2	3
Open bookcase – 3 shelves – 3 ft. long.	-	-	2	2

White Dry-Erase Board, 36” x 48” min. with markers and eraser.	1	1	1	1
Interior partitions – 6 ft. x 6 ft., soundproof type, portable and freestanding.	-	-	6	6
Coat rack with 20 coat capacity.	-	-	-	1
Wastebaskets - 30 gal., including plastic waste bags.	1	1	1	2
Wastebaskets - 5 gal., including plastic waste bags.	1	3	6	10
Electric wall clock.	-	-	-	2
Electronic Level	1	1	1	2
Furnishing Description	Office Size			
	Small	Med.	Large	Extra Large
	Quantity			
Telephone.	1	2	3	-
Full size stapler 20 (sheet capacity, with staples)	1	2	5	8
Desktop tape dispensers (with Tape)	1	2	5	8
8 Outlet Power Strip with Surge Protection	3	4	6	9
Rain Gauge	1	1	1	1
Business telephone system for three lines with ten handsets, intercom capability, and one speaker phone for conference table.	-	-	-	1
Mini refrigerator - 3.2 c.f. min.	1	1	1	1
Hot and cold-water dispensing unit. Disposable cups and bottled water shall be supplied by the Contractor for the duration of the project.	1	1	1	1
Microwave, 1.2 c.f., 1000W min.	1	1	1	1
Fire extinguishers - provide and install type and *number to meet applicable State and local codes for size of office indicated, including a fire extinguisher suitable for use on a computer terminal fire.	*	*	*	*
Electric pencil sharpeners.	1	2	2	2
Multi-Function Laser Printer/Copier/Scanner combination unit, network capable, as specified below under Field Office Technology	1	1	1	1
Field Office Wi-Fi Connection as specified below under Field Office Technology	1	1	1	1
Wi-Fi Printer as specified below under Field Office Technology	1	1	1	1
Digital Camera as specified below under Field Office Technology	1	1	3	3
Teleconferencing Equipment as specified below under Field Office Technology	-	-	-	-
Infrared Thermometer, including annual third-party certified calibration, case, and cleaning wipes.	1	1	1	2

Concrete Curing Box as specified below under Concrete Testing Equipment.	1	1	1	1
Concrete Air Meter and accessories as specified below under Concrete Testing Equipment as specified below. Contractor shall provide third party calibration on a quarterly basis.	1	1	1	1
Concrete Slump Cone and accessories as specified below under Concrete Testing Equipment.	1	1	1	1
First Aid Kit	1	1	1	1
T-handle concrete cylinder mold splitter as specified below under Concrete Testing Equipment	1	1	1	1
Smart Phones as specified under Computer Related Hardware and Software.	-	-	-	-

The furnishings and equipment required herein shall remain the property of the Contractor. Any supplies required to maintain or operate the above listed equipment or furnishings shall be provided by the Contractor for the duration of the project.

Field Office Technology:

The Contractor shall supply the Field Office Wi-Fi Connection, Wi-Fi Printer, Digital Camera(s), Smart Phones, Multifunction Laser Printer/Copier/Scanner, Conference Room Teleconferencing Equipment, as well as associated hardware and software, meeting the requirements of this specification as well as the latest minimum specifications posted, as of the project advertising date, at CTDOTs web site https://portal.ct.gov/dot/office-of-construction/construction-field-office-technology

Within 10 calendar days after the signing of the Contract but before ordering/purchasing the Wi-Fi Printer (separate from the Multifunction Laser Printer/Copier/Scanner), Field Office Wi-Fi, Digital Camera(s), Smart Phones, Multifunction Laser Printer/Copier/Scanner, Teleconferencing Equipment, as well as associated hardware, the Contractor must submit a copy of their proposed order(s) with catalog cuts and specifications to the Administering CTDOT District for review and approval. The Wi-Fi Printer, Wi-Fi Router, digital cameras, smart phones, and Teleconferencing Equipment will be reviewed by CTDOT District personnel. The Multifunction Laser Printer/Copier/Scanner will be reviewed by the CTDOT OIS. The Contractor shall not purchase the hardware, software, or services until the Administering CTDOT District informs them that the proposed equipment, software, and services are approved. The Contractor will be solely responsible for the costs of any hardware, software, or services purchased without approval.

The Contractor and/or their internet service provider shall be responsible for the installation and setup of the field office Wi-Fi/internet service, Wi-Fi printer, and the configuration of the wireless router as directed by the CTDOT. Installation will be coordinated with CTDOT District and Project personnel.

After the approval of the hardware and software, the Contractor shall contact the designated representatives of the CTDOT administering District, a minimum of 2 working days in advance of

the proposed delivery or installation of the Field Office Wi-Fi Connection, Wi-Fi Printer, Digital Camera(s), Smart Phones, Multifunction Laser Printer/Copier/Scanner, Teleconferencing Equipment, as well as associated hardware, software, supplies, and support documentation.

The Contractor shall provide all supplies, paper, maintenance, service, and repairs (including labor and parts) for the Wi-Fi printers, copiers, field office Wi-Fi/internet service, and other equipment and facilities required by this specification for the duration of the Contract. All repairs must be performed with-in 48 hours. If the repairs require more than 48 hours, then an equal or better replacement must be provided.

Once the Contract has been completed, the hardware and software will remain the property of the Contractor.

First Aid Kit: The Contractor shall supply a first aid kit adequate for the number of personnel expected based on the size of the field office specified and shall keep the first aid kit stocked for the duration that the field office is in service.

Rain Gauge: The Contractor shall supply install and maintain a rain gauge for the duration of the project, meeting these minimum requirements. The rain gauge shall be installed on the top of a post such that the opening of the rain gauge is above the top of the post an adequate distance to avoid splashing of rainwater from the top of the post into the rain gauge. The location of the rain gauge and post shall be approved by the Engineer. The rain gauge shall be made of a durable material and have graduations of 0.1 inches or less with a minimum total column height of 5 inches. If the rain gauge is damaged the Contractor shall replace it prior to the next forecasted storm event at no additional cost.

Electronic Level: The Contractor shall supply and maintain in working order, for the duration of the Contract, the number of electronic levels, identified in the Additional Equipment, Facilities and Services table of this specification. The electronic levels shall meet the following requirements:

A. 48-inch length, box beam type
B. IP65 water and dust proof
C. 0.1-degree accuracy
D. Backlit display
E. Carrying case included
F. New or like new condition

Concrete Testing Equipment: If the Contract includes items that require compressive strength cylinders for concrete, in accordance with the Schedule of Minimum Testing Requirements for Sampling Materials for Test, the Contractor shall provide the following equipment.

A. Concrete Cylinder Curing Box – meeting the requirements of Section 6.12 of the Standard Specifications.
B. Air Meter – The air meter provided shall be in good working order and meet the requirements of AASHTO T 152.
C. Slump Cone Mold – Slump cone, base plate, and tamping rod shall be provided in like-new condition and meet the requirements of AASHTO T119, Standard Test Method for Slump of Hydraulic-Cement Concrete.
D. T-handle concrete cylinder mold splitter.

All testing equipment will remain the property of the Contractor at the completion of the project.

Insurance Policy: The Contractor shall provide a separate insurance policy, with no deductible, in the minimum amount of five thousand dollars ($5,000) to insure all State-owned data equipment and supplies used in the office against all losses. The Contractor shall be named insured on that policy, and the CTDOT shall be an additional named insured on the policy. These losses shall include, but not be limited to theft, fire, and physical damage. The CTDOT will be responsible for all maintenance costs of CTDOT owned computer hardware. In the event of loss, the Contractor shall provide replacement equipment in accordance with current CTDOT equipment specifications, within seven days of notice of the loss. If the Contractor is unable to provide the required replacement equipment within seven days, the CTDOT may provide replacement equipment and deduct the cost of the equipment from monies due or which may become due the Contractor under the Contract or under any other contract. The Contractor's financial liability under this paragraph shall be limited to the amount of the insurance coverage required by this paragraph. If the cost of equipment replacement required by this paragraph should exceed the required amount of the insurance coverage, the CTDOT will reimburse the Contractor for replacement costs exceeding the amount of the required coverage.

Maintenance: During the occupancy by the CTDOT, the Contractor shall maintain all facilities and furnishings provided under the above requirements, and shall maintain and keep the office quarters clean through the use of professional cleaning including vacuuming carpet, washing & waxing floors, cleaning restrooms, removal of trash, general cleaning, etc.

Exterior areas shall be mowed and clean of debris. A trash receptacle (dumpster) with weekly pickup (trash removal) shall be provided. Snow removal, sanding and salting of all parking, walkway, and entrance ways areas shall be accomplished during a storm if on a workday during work hours, immediately after a storm and prior to the start of a workday. If snow removal, salting and sanding are not completed by the specified time, the State will provide the service and all costs incurred will be deducted from the next payment estimate.

Method of Measurement: The furnishing and maintenance of the construction field office will be measured for payment by the number of calendar months that the office is in place and in operation, rounded up to the nearest month.

There will not be any price adjustment due to any change in the minimum computer related hardware and software requirements.

Basis of Payment: The furnishing and maintenance of the Construction Field Office will be paid for at the Contract unit price per month for "Construction Field Office, (Type)," which price shall include all material, equipment, labor, service contracts, licenses, software, repair or replacement of hardware and software, related supplies, utility services, parking area, external illumination, trash removal, snow and ice removal, and work incidental thereto, as well as any other costs to provide requirements specified herein.

Pay Item	Pay Unit
Construction Field Office, (Type)	Month