CHAPTER 400 – GENERAL REQUIREMENTS FOR SURFACES

SECTION 401 – GENERAL REQUIREMENTS FOR SURFACES

401.01 GENERAL

This work consists of all types of surface construction and this section covers the general requirements which pertain to each type, unless otherwise stated in another relevant section.

401.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Distinguish the various surfacing pay items included in the Contract.
- Review special provisions included in the Contract for surfacing pay items (smoothness, electronic tickets, optimized gradation, etc.).
- Proposed sources of material and material requirements.
- Mix designs and verify plants have a current certification, when applicable.
- Acceptable tolerances for elevation, smoothness, width and thickness.
- Methods and equipment to be used.
- Subgrade requirements prior to and during construction.
- Contractor's schedule/plan for the work.

B. Acceptance of Materials

Review the Plans and distinguish the surfacing pay items included in the contract. Review the material requirements in the relevant surface construction sections or the sections of Chapter 700, "Materials" of the Standard Specifications that pertain to the type of surface construction performed. Review the Standard Specifications, Special Provisions and Plan Notes for applicable material requirements.

The Resident Engineer must review for acceptance the Contractor's proposed mix designs, plants and sources of materials. Resolve any questions or concerns with the submitted mix designs, plants and sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials and plants must be sent to the Contractor and kept in the project file.

1. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use as further described in the relevant sections of this Manual and as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

2. Contractor Proposed Asphalt and Concrete Plants

Ideally, the Contractor will submit their proposed asphalt and concrete plant locations in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt or concrete plants submitted by the Contractor have a current ODOT certification. The plants must be reviewed for acceptance by the Resident Engineer based on the criteria of the type of plant as further described in the relevant sections of this Manual and as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases. When a plant is being installed to produce for a Project in your Residency notify:

Oklahoma Department of Environmental Quality
Air Quality Division
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: (405) 702-4100
Fax: (405) 702-4101

and

Oklahoma Department of Transportation
Materials Division
Independent Assurance Branch
5201 N.E. 122nd Street
Building 4011
Edmond, OK 73013
Phone: (405) 521-2677

In the notice, list the project number and the location and type of plant (concrete or asphalt).

3. Sources of Materials

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on those items. The Residency will verify that the proposed sources of materials submitted by the Contractor for the products required on the project are on the ODOT Materials Division Qualified Products List (QPL) or Approved Rock, Stone, & Sand Sources lists. If a proposed source is not on the QPL or approved aggregate source list, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL or approved aggregate source list due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

C. Preparatory Work and Contractor Work Plans

Consider the following before surface construction work begins.

1. Contract Plans and Specifications

Review the Plans and distinguish the pay items included in the contract. Review the Standard Specifications, Special Provisions and Plan Notes.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing, ensure the Contractor or their designated subcontractor is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every delivery vehicle.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria.

2. Subgrade and Subbase Inspection

Ensure that the cross slope, elevation, and alignment are correct and the subgrade or subbase is processed and compacted in accordance with relevant sections of the Standard Specifications. Visually inspect the subgrade for soft spots, ruts, and grade deficiencies. Ensure that the subgrade or subbase is prepared within allowable tolerance to properly receive the required thickness of base course material. The Resident Engineer must notify the Contractor of any concerns so that a resolution can be determined prior to proceeding with the surface construction.

3. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

(a) Asphalt Mix Designs

The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation. Resolve any questions or concerns with the submitted mix designs with the Contractor in a timely manner. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

(b) Concrete Mix Designs

The Residency is responsible for reviewing and approving the proposed concrete mix designs submitted by the Contractor. Section 701.01.C prescribes the information that must be included in each concrete mix design. If the proposed concrete mix design fails to include any of the information listed, it should be returned in writing to the Contractor with a list of deficiencies needing to be included for resubmission.

Most of the criteria for the basis of acceptance of concrete mix designs can be found in Section 701.01 of the Standard Specifications. Additional criteria for work specific to a mix design may be found in Special Provisions in the Contract (such as SP 701-14 "Optimized Gradation for PC Concrete Pavement) or relevant sections of the Standard Specifications (such as Section 516.02.B for Class AA Concrete for Drilled Shafts).

The Residency will verify that the proposed sources of materials listed in the concrete mix designs submitted by the Contractor are on the Materials Division Qualified Product List (QPL). If a proposed source is not on the QPL, contact Materials Division for input or source approval. A written response approving the mix designs must be sent to the Contractor and kept in the project file.

4. Contractor Proposed Asphalt and Concrete Plants

Ideally, the Contractor will submit their proposed asphalt and concrete plants in time for the Preconstruction Conference. If they are not submitted at that time,

emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt or concrete plants submitted by the Contractor have a current ODOT certification.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

(a) Asphalt Plant Inspection and Scale Certification

The ODOT Materials Division – Independent Assurance (IA) Branch is responsible for inspecting asphalt plants each year and verifying that plant scales are certified every six months. The Hot Mix Asphalt (HMA) Plant List is maintained and posted on the Materials Division website that indicates the inspection status and scale certification status of all plants that may be used on ODOT construction projects.

The Residency will verify that the proposed asphalt plants submitted by the Contractor are on the Materials Division list of Hot Mix Asphalt (HMA) Plant List and that the inspection status and scale certification status are both listed as "current". If a proposed asphalt plant is not listed on this report or the plant status is not "current", contact Materials Division – Independent Assurance (IA) Branch for their input and recommendation. Resolve any questions or concerns with the submitted asphalt plants with the Contractor in a timely manner.

(b) Concrete Plant Inspection

Concrete plant inspections are the responsibility of the residency or consultant engineering firm acting as a residency as stated in the ODOT Concrete Plant Inspection Policy found on the Materials Division website. Inspection requirements can be found in Section 414.03 of the Standard Specifications. Plants must be inspected every 6 months or after every relocation of a portable plant.

Concrete plants must be inspected to ensure compliance with the referenced specifications prior to accepting plant produced concrete material on an ODOT construction project. The ODOT Inspection Form 414-IF must be used to document the plant inspection. The completed inspection form along with a copy of the current scale certification needs to be submitted to the Materials Division – Independent Assurance (IA) Branch for their use to update the database. The residency may decide not to perform the plant inspection if they verify on the Hydraulic Cement Concrete Plant List that

a recent inspection has been performed and the inspection status is "current".

5. Contractor Proposed Equipment

The Contractor may include the equipment needed to place the surface materials in their submittals prior to beginning construction. The various pieces of equipment required may include the following:

- Distributors,
- Trucks and transport units,
- Pavers,
- Milling machines,
- Material Transfer Vehicles, and/or
- Compactors.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and the relevant sections of this Manual.

D. Safety and Environmental Issues

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste concrete or materials. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

401.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the Plans and distinguish the surfacing pay items included in the contract. Review the material requirements in the relevant surface construction sections or the sections of Chapter 700, "Materials" of the Standard Specifications that pertain to the type of surface construction performed. Review the Standard Specifications, Special Provisions and Plan Notes for applicable material requirements.

The Contractor should submit its proposed mix designs, plants and sources of materials at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on those items. The Resident Engineer must review for acceptance the Contractor's proposed mix designs, plants and sources of materials. Resolve any questions or concerns with the submitted mix designs, plants and sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials and plants must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted and accepted sources of materials and mix designs are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product or mix designs approval.

1. Contractor Proposed Mix Designs

Ensure the Contractor has submitted its proposed asphalt and concrete mix designs in advance of any work beginning on those items. The Residency will verify that the proposed sources of materials submitted by the Contractor on their concrete mix designs are on the ODOT Materials Division Qualified Products List (QPL) or Approved Rock, Stone, & Sand Sources lists. If a proposed source is not on the QPL or approved aggregate source list, contact Materials Division to confirm the status of the source/product approval.

Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

2. Contractor Proposed Asphalt and Concrete Plants

Ensure the Contractor has submitted its proposed asphalt and concrete plants in advance of any work beginning on those items.

The Residency will verify that the proposed asphalt or concrete plants submitted by the Contractor have a current ODOT certification as further described in Section 401.02.C.4 and the relevant sections of this Manual for the type of surface being

used. A written response accepting the plants must be sent to the Contractor and kept in the project file.

3. Materials

Ensure the Contractor has submitted its proposed sources of materials in advance of any work beginning on those items. The Residency will verify that the proposed sources of materials submitted by the Contractor for the products required on the project are on the ODOT Materials Division Qualified Products List (QPL) or Approved Rock, Stone, & Sand Sources lists. If a proposed source is not on the QPL or approved aggregate source list, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL or approved aggregate source list due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Sampling and testing of the materials for acceptance will be based on the criteria of the material and its intended use as further described in the relevant sections of this Manual for the type of surface being used. The Residency will conduct the sampling and testing in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, visual appearance (yellow concrete, segregation, etc.), or other special provision requirements where Contractor tests are used for acceptance purposes.

Document the test results for acceptance in accordance with the requirements for the specific material as further described in the relevant sections of this Manual. If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

B. Equipment and Methods

Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing. Additionally, review the equipment requirements in the relevant surface sections or special provisions that pertain to the type of surface construction performed on the project. Some types of surfacing have stringent specific requirements for the equipment required to perform the work.

Verify the Contractor's equipment meets the requirements of Section 401.03 of the Standard Specifications as follows.

1. Distributors and Supply Tanks

Ensure the Contractor provides distributors and supply tanks capable of uniformly applying bituminous material in accordance with the following:

- At the temperatures specified in the relevant specification sections;
- On variable widths of surface not to exceed 26 ft;
- At rates from 0.010 gal/yd² to 1.000 gal/yd²; and
- With constant pressure and uniform temperature.

Ensure the distributor can apply material to vertical faces of asphalt pavement at the joints between paving operations.

Ensure the Contractor provides a distributor equipped with the following:

- A tachometer,
- Pressure gauges,
- Volume metering devices or a calibrated tank,
- A thermometer for measuring temperatures of tank contents,
- A power unit for the pump,
- Full circulation spray bars adjustable vertically and laterally,
- A positive shut off valve, and
- Fittings that prevent bituminous material from dripping.

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to ensure uniform distribution of the bituminous material. If clogging or streaking of the applied bituminous material occurs, stop the operation and correct the problems creating these conditions before resuming distribution. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

2. Compactors

Ensure the Contractor provides self-propelled rollers of the following types:

- Vibratory steel wheel,

- Non-vibratory steel wheel,
- Pneumatic tire, or
- A combination of the three types.

Ensure rollers are in good condition, capable of reversing without backlash, and operating at speeds that do not displace the bituminous mixture. Rollers must have properly working spray bars and nozzles along with scraper bars or brushes to ensure the mixture does not build up on the wheels during the compaction operation.

Vibratory rollers must be equipped with working amplitude controls or frequency controls designed specifically for the compaction of the specified bituminous material.

Ensure the steel wheeled compactors weigh at least 10 tons.

Pneumatic tired compactors must have at least seven pneumatic tires of equal size and diameter. Ensure the total weight of the tires produces an operating weight of at least 3,500 lbs per tire. The tires must be inflated to at least 90 percent of the maximum pressure recommended by the tire manufacturer. The tire pressure must be maintained for at least 1 hr after the start of operations and the variation in the range in pressure among the tires must not exceed 10 psi.

The Contractor must use the number of rollers of proper type and weight to complete the compaction of the bituminous material before its temperature drops below the specified minimum.

Equipment that crushes the aggregate in the bituminous material should not be used.

C. Construction Operations

Section 401.04.A of the Standard Specifications contains general requirements for various types of surfaces. Additionally, review requirements in the relevant surface sections or special provisions that pertain to the type of surface construction performed on the project.

Verify the Contractor meets the requirements of 401.04 of the Standard Specifications as follows.

1. Tolerances

Ensure the Contractor provides the required surface construction in accordance with the following:

(a) Surface Elevation and Smoothness

The surface elevations for new pavement construction and overlays must be within 1/2 in of the elevations shown on the Plans. If the Plans do not show

the elevations for overlays, provide a finished surface in accordance with the surface smoothness tolerances.

Ensure the surface smoothness is within 1/8 inch in 10 ft. Test for surface smoothness by placing a straightedge between two contacts on the finished surface and measuring the distance from the surface to the straightedge.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

(b) Width

Verify the Contractor obtains the width shown on the Plans. If the planned width is not being achieved, stop the operation and correct the problems creating the incorrect dimension before resuming the paving operation.

2. Corrections

The Contractor must correct material and dimension deficiencies that exceed specified tolerances using methods approved by the Resident Engineer, at no additional cost to the Department. The Resident Engineer may at their discretion accept out of specification work in accordance with Section 105.03 of the Standard Specifications as a reduced cost.

3. Surface Protection

The Contractor must submit a plan to the Resident Engineer to protect the pavement from damage by the paving operations before starting paving operations. If paving operations spall, crack, chip, rut, or deface the pavement, repair the pavement at no additional cost to the Department.

D. Safety and Environmental Considerations

When the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal

joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Monitor the Contractor's conformance with its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste concrete or materials. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Review the documentation requirements in the "Daily Work Report" portion of the relevant surface sections in this manual that pertain to the type of surface construction performed on the project.

2. Measurement and Payment

Review the documentation requirements in the "Measurement and Payment" portion of the relevant surface sections in this manual that pertain to the type of surface construction performed on the project.

401.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously submitted and accepted sources of materials and mix designs were used by the Contractor. If there were any substitutions used by the Contractor, ensure that the substituted material is acceptable before final payment and acceptance of the work.

B. Audit Requirements

Review the documentation requirements in the "Audit Requirements" portion of the relevant surface sections in this manual that pertain to the type of surface construction performed on the project.

C. Protection of the Work

The Contractor must protect the pavement from damage. If construction operations spall, crack, chip, rut, or deface the pavement, the Contractor must repair the pavement in a manner approved by the Resident Engineer at no additional cost to the Department.

401 CHECKLIST – GENERAL REQUIREMENTS FOR SURFACES

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the special provisions included in the contract for surfacing pay items been reviewed (smoothness, optimized gradation, etc.)?					
Have the proposed sources of materials been submitted by the Contractor and reviewed for acceptance?					
Have the proposed mix designs been submitted by the Contractor and reviewed for acceptance?					
Have the proposed asphalt and concrete plants been submitted by the Contractor and reviewed for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the sources of material, mix designs and plants?					
Review additional requirements in the "Preconstruction Considerations" portion of the relevant surface sections in this manual that pertain to the type of surface construction performed on the project.					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the Residency verified that the previously submitted and accepted sources of materials and mix designs are being used by the Contractor?					
Is the subgrade or subbase processed and compacted in accordance with relevant sections of the Standard Specifications?					
Has the cross slope, elevations and alignment of the subgrade or subbase been verified to be in accordance with the Plans?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the Contractor's equipment (distributors and compactors) conform to the requirements in Section 401.03 of the Standard Specifications?					
Is the Contractor meeting the tolerance requirements in Section 401.03 of the Standard Specifications for smoothness, grade and width?					
Review additional requirements in the "Inspection Guidelines During Construction" portion of the relevant surface sections in this manual that pertain to the type of surface construction performed on the project.					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Verify that the previously submitted and accepted sources of materials and mix designs were used by the Contractor.					
Has the Contractor taken adequate precautions to protect the pavement from damage?					

SECTION 402 – TRAFFIC-BOUND SURFACE COURSE

402.01 GENERAL

This work consists of constructing a surface course of hard and durable particles of sand, gravel, mine chats, crushed stone, or disintegrated granite and placing the surface course material on a prepared subgrade.

402.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Methods and equipment to be used.
- Information required on truck delivery tickets necessary to evaluate overloaded trucks.
- Subgrade requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Communicating and coordinating with property owners.
- Maintenance of traffic during construction.
- Shaping and compaction requirements.
- Maintenance of TBSC on temporary driveways and street returns.

B. Acceptance of Materials

Review the material requirements in Section 703.05, "Aggregates for Traffic Bound Surface Course" of the Standard Specifications that pertain to the type of TBSC required in the Plans.

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the TBSC item. The Residency will verify that the proposed sources of materials submitted by the Contractor are on the Materials Division Approved Rock, Stone & Sand Sources list (Aggregate for Miscellaneous Uses – Approved Sources). If a proposed source is not on the Approved Sources list, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the approved aggregate source list due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

C. Preparatory Work and Contractor Work Plans

Consider the following before surface construction work begins.

1. Subgrade and Subbase Inspection

Ensure that the cross slope, elevation, and alignment are correct and the subgrade is processed and compacted in accordance with relevant sections of the Standard Specifications. Visually inspect the subgrade for soft spots, ruts, and grade deficiencies. Ensure that the subgrade is prepared within allowable tolerance to properly receive the required thickness of TBSC material.

2. Traffic Control

Unless otherwise specified in the Plans, the Contractor must avoid closing the road, street returns or driveways to traffic during the placement of the TBSC. Discuss with the Contractor how they plan to minimize interference with traffic and coordinate with property owners that will be affected during the placement of TBSC on private drives or street returns.

D. Safety and Environmental Issues

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials. (Do not allow the Contractor to place surplus materials near or in streams or waterways.)

402.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements in Section 703.05, "Aggregates for Traffic Bound Surface Course" of the Standard Specifications that pertain to the type of TBSC required in the Plans.

Ensure that the proposed sources of materials are submitted by the Contractor in advance of any work beginning on the TBSC item. The Residency will verify that the proposed sources of materials submitted by the Contractor are on the Materials Division Approved Rock, Stone & Sand Sources list (Aggregate for Miscellaneous Uses – Approved Sources). If a proposed source is not on the Approved Sources list, contact Materials Division to

confirm the status of the source/product approval. Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL or approved aggregate source list due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Verify the proposed source of materials for the TBSC is on the Materials Division Approved Rock, Stone & Sand Sources list. [Document in Template AM5001]
    - TBSC - (Aggregate for Miscellaneous Uses – Approved Sources)
- Verify the TBSC material complies with the requirements of Table 703:7 of the Standard Specifications:
    - Gradation - AASHTO T 27
    - Liquid and Plastic Limits - AASHTO T 89 and T 90

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.). When using an approved quarry, notify Materials Division Aggregate Branch Manager if the material consistently fails to meet gradation or limits requirements.

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product approval.

B. Equipment and Methods

The Contractor must have the equipment on-site to ensure that the TBSC material is spread and compacted uniformly to the specified thickness as shown in the Plans. The surface of the TBSC must be shaped free of irregularities such as holes, ruts, waves, and undulations. Typical equipment used for the spreading of the TBSC to achieve the desired surface is a motor grader. Compaction may be achieved by use of a roller or adequate coverage of the equipment used for spreading the aggregate, such as a motor grader.

C. Construction Operations

1. Preparation of Subgrade

Ensure that the cross slope, elevation, and alignment are correct and the subgrade is processed and compacted in accordance with the requirements of Section 310.04.A, "Subgrade Method A for Traffic-Bound Surface Course" or Section 202, "Earthwork" of the Standard Specifications. Visually inspect the subgrade for soft spots, ruts, and grade deficiencies. Ensure that the subgrade is prepared within allowable tolerance to properly receive the required thickness of TBSC material. If unstable areas are identified, the Resident Engineer should evaluate those areas with the Contractor to evaluate options to remedy any unstable subgrade prior to beginning the placement of the TBSC.

2. Shaping and Maintenance

Ensure that the TBSC is placed in the locations and at the proper thickness as required in the Plans or as directed by the Resident Engineer.

Any irregularities in the surface, such as holes, ruts, waves, and undulations, must be corrected. The Contractor must continue shaping the surface material until it is compacted and free of irregularities. Verify the TBSC surface course material is placed to the elevations and dimensions shown on the Plans.

Although there are no specific percent of maximum density or percent compaction requirements, there are multiple references in Section 401.04 of the Standard Specifications to compacting the TBSC. Ensure the Contractor uses adequate equipment and effort to achieve a compacted surface that resists aggregate being displaced when sustaining traffic.

TBSC used to maintain access on driveways and street returns will likely require maintenance until the permanent pavement is placed. Obtain the approval of the Resident Engineer prior to placing additional TBSC material in areas for maintenance purpose.

3. Traffic Control

Unless otherwise specified in the Plans, the Contractor must avoid closing the road, street returns or driveways to traffic during the placement of the TBSC. Ensure the Contractor has an acceptable plan to minimize interference with traffic. Verify the Contractor has discussed their schedule for placement of TBSC with property owners that will be affected during the placement of TBSC on private drives or street returns.

D. Safety and Environmental Considerations

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials. (Do not allow the Contractor to place surplus materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents), thickness and length & width of area of TBSC placed.
- Receipt of haul tickets of Type of TBSC and quantity placed.
- Receipt of materials certifications and scale or weigher certification.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Construction Control Directive No. 20020213, delivery tickets received on a project and used to support payment of those contract items paid by delivery weight must be checked for overload delivery trucks. State statute requires that no payment will be made for any material that exceeds the legal weight limit.

Ensure that the delivery tickets include the information necessary to evaluate for overloaded trucks. Perform an analysis and omit payment for any amount of material that exceeds the allowable gross vehicle weight for a load. Written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

Documentation of the TBSC pay item paid by the Ton will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate field, enter the descriptive location (i.e., street return names, station location of drives, etc.) or the station to station extents and location.

c. In the Placed Quantity field enter the tons of TBSC complete in place as determined from haul tickets. This quantity may require adjustment after

the overload analysis is performed as required in Construction Control Directive No. 20020213.

d. In the Remarks bubble enter the Book/Folder/Envelope # to provide the location of the documentation for the calculations (i.e., ticket audit spreadsheet, truck load tickets, etc.) and/or explain how the quantity was derived (i.e., reduction due to truck being returned, audit adjustment, certified truck load weight, etc.).

e. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

402.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials which were submitted by the Contractor were utilized on the project. Ensure that the source of materials by the Contractor are on the Materials Division Approved Rock, Stone & Sand Sources list (Aggregate for Miscellaneous Uses – Approved Sources). If a proposed source is not on the Approved Sources list, contact Materials Division to confirm the status of the source/product approval. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

Verify the TBSC aggregate material complies with the requirements of Table 703:7 of the Standard Specifications for gradation and liquid/plastic limits. Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

Ensure that an analysis was performed on the delivery tickets and that payment was deducted for any amount of material that exceeds the allowable gross vehicle weight for a load. Written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

C. Protection of the Work

Check that the TBSC is satisfactorily maintained until the project is completed and or the permanent pavement is ready to be placed.

402 CHECKLIST – TRAFFIC-BOUND SURFACE COURSE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed source of TBSC materials been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the source of TBSC material?					
Has the Contractor been notified of the information necessary on the haul tickets to enable the evaluation of overload deliveries?					
Does the Contractor have a plan to maintain traffic and coordinate with property owners during the placement of the TBSC?					
Is the subgrade processed and compacted in accordance with relevant sections of the Standard Specifications?					
Is the subgrade at the proper cross slope, elevation and alignment?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proposed sources of materials for TBSC been submitted by the Contractor and reviewed/accepted by the Resident Engineer prior to its use?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the sources of materials?					
Has the Residency verified that the previously submitted and accepted source of TBSC material is being used by the Contractor?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the subgrade processed and compacted in accordance with relevant sections of the Standard Specifications?					
Has the cross slope, elevations and alignment of the subgrade been verified to be in accordance with the Plans?					
Is the TBSC being sampled at the frequency required in the FAST Guide for acceptance testing required in Table 703:7 of the Standard Specifications?					
Have all of the test results and confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Is the Contractor's equipment capable of shaping and compacting the TBSC uniformly?					
Is the Contractor placing TBSC materials to the correct thickness, cross section, and dimensions?					
Is the Contractor shaping the TBSC surface material until it is compacted and free of irregularities?					
Is the Contractor coordinating their work on driveways and street returns with property owners?					
Is the Contractor maintaining a safe work zone for their employees and the traffic?					
Are the truck delivery haul tickets being evaluated for overloads in accordance with CCD No. 20020213?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor use the source of materials for TBSC reviewed/accepted by the Resident Engineer?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Do the final sections conform to the lines and grades shown on the Plans?					
Has the Contractor taken adequate precautions to protect the completed TBSC from damage?					
Is the Contractor adequately maintaining TBSC to the finished section and grade?					
Was the TBSC sampled at the frequency required in the FAST Guide for acceptance testing?					
Were the truck delivery haul tickets evaluated for overloads in accordance with CCD No. 20020213 and deductions of quantity made if needed?					

SECTION 403 – CHIP SEAL

403.01 GENERAL

This work consists of constructing a single or double surface treatment of aggregates and bituminous materials.

403.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Type of chip seal required by the Plans; single or double treatment.
- Type of cover aggregate required in the Plans.
- Type of bituminous binder required in the Plans.
- Methods and equipment to be used.
- Weather limitations for construction.
- Subgrade/base or surface preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Staging areas for stockpiled aggregate and equipment.
- Maintenance and protection of traffic during construction.
- Application and coverage rates for bituminous material and aggregate.
- Rolling requirements.
- Maintenance of chip seal surface.

B. Acceptance of Materials

Review the material requirements in Sections 703.04, "Cover Aggregates for Bituminous Surface Treatments" and 708.03, "Asphalt Materials" of the Standard Specifications that pertain to the type of cover aggregate and bituminous binder required in the Plans. When precoated cover aggregate is specified, ensure compliance with Section 703.04.D of the Standard Specifications.

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the chip seal item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

The Residency will verify that the proposed sources of materials for the cover aggregate submitted by the Contractor are on the Materials Division Approved Rock, Stone & Sand Sources list (Aggregate for Miscellaneous Uses – Approved Sources). Ensure the source is shown in the section "Aggregates for Miscellaneous Use". If a proposed source is not on the QPL or Approved Sources list, contact Materials Division to confirm the status of the source/product approval.

The Residency will verify that the proposed sources of materials for the bituminous binder submitted by the Contractor are on the Qualified Products List (QPL-Bituminous Materials). Ensure the product name and manufacturer is shown in the Asphalt Cement list or in the Emulsified Asphalt list (whichever is required in the Plans) on the QPL. If a proposed source is not on the QPL or Approved Sources list, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL or approved aggregate source list due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

C. Preparatory Work and Contractor Work Plans

Consider the following before surface construction work begins.

1. Weather and Seasonal Limitations

Ensure that the seasonal limitations for the type of bituminous binder (cutback, asphalt cement or emulsified asphalt) being used falls within the allowable construction period provided in Table 403:1 of the Standard Specifications.

Ensure that the temperature and weather limitations for the type of bituminous binder (cutback, asphalt cement or emulsified asphalt) meets the minimum temperatures and surface condition provided in Table 403:2 of the Standard Specifications. Work must be suspended if the temperature forecast is predicted to fall below the minimum temperature within 72 hours or if adverse weather conditions (wind chill, rain, fog, high humidity) occur.

2. Traffic Control

Discuss with the Contractor how they plan to minimize delays to the traveling public but also protect vehicles and the newly applied chip seal from damage. The Plans should have notes and possibly pay items to facilitate the management of the work zone such as limitations on the length of the lane closure, flaggers, pilot cars, temporary signals, etc. Ensure that the Contractor complies with any plan notes regarding their operations and traffic control.

3. General Application Requirements

Discuss the application rates for the types of bituminous binder and cover aggregate required in the Plans. There may be application rates specified in the Plans. If not, the application rates for various types of binder and aggregate can be found in Section 403.04.H(3) of the Standard Specifications. It is critical that the Contractor and the Resident Engineer are in agreement with the application rates prior to beginning the chip seal operation. Adjustments to the application rates can be agreed to once the operation begins and the performance of the chip seal can be evaluated such as determining there is excess or insufficient binder or aggregates.

D. Safety and Environmental Issues

For storage of aggregates in a staging area near the project, stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. Additionally in Section 106.08, at the Contractor's request, the Department may allow the use of approved portions of the right-of-way for storing materials and staging their equipment. As part of the request for use of the site, the Contractor must provide the Resident Engineer with written documentation of the location of the proposed site, access and egress points, a proposed erosion control plan, a proposed traffic control plan, and any other information required by the Resident Engineer relevant to use of the site for materials and equipment storage. For controlled access facilities, the approval from the Resident Engineer is subject to the approval of FHWA, prior to altering, severing or removing any right-of-way fences. Prior written permission of the owner or lessee is required for the use of private property and copies of such written permission must be provided upon request to the Resident Engineer.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to ensure no risk to health, safety and property damage,
- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and chip seal surface from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

403.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements in Sections 703.04, "Cover Aggregates for Bituminous Surface Treatments" and 708.03, "Asphalt Materials" of the Standard Specifications that pertain to the type of cover aggregate and bituminous binder required in the Plans. When

precoated cover aggregate is specified, ensure compliance with Section 703.04.D of the Standard Specifications.

Ensure that the proposed sources of materials are submitted by the Contractor in advance of any work beginning on the chip seal item.

The Residency will verify that the proposed sources of materials for the cover aggregate submitted by the Contractor are on the Materials Division Approved Rock, Stone & Sand Sources list (Aggregate for Miscellaneous Uses – Approved Sources). Ensure the source is shown in the section "Asphalt Concrete Aggregates, Coarse". If a proposed source is not on the QPL or Approved Sources list, contact Materials Division to confirm the status of the source/product approval.

The Residency will verify that the proposed sources of materials for the bituminous binder submitted by the Contractor are on the Qualified Products List (QPL-Bituminous Materials). Ensure the product name and manufacturer is shown in the Asphalt Cement list or in the Emulsified Asphalt list (whichever is required in the Plans) on the QPL. If a proposed source is not on the QPL or Approved Sources list, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL or approved aggregate source list due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Verify the proposed source of materials for the cover aggregate is on the Materials Division Approved Rock, Stone & Sand Sources list. [Document in Template AM5001]
    - Cover aggregate - (Asphalt Concrete Aggregates, Coarse)
- Verify the cover aggregate material complies with the requirements of Table 703:6 in Section 703.04 of the Standard Specifications and is on the Approved Rock, Stone & Sand Sources list (Aggregate for Miscellaneous Uses – Approved Sources):
    - Gradation - AASHTO T 27 [Document in Template T27]
    - Dust Coating – OHD L-48

- Verify the type of bituminous binder complies with the Plans and the requirements of Section 708.03 of the Standard Specifications and is on the Qualified Products List [Document in Template AM5001]:
    - Bituminous binder (specify type) - (QPL-Bituminous Materials)
- Obtain a sample of the bituminous binder to submit to the ODOT Materials Division for acceptance. [Document in appropriate Template C91006-Emulsified Asphalt or C91018-Asphaltic Cement]
    - Sample liquid asphalt materials in accordance with AASHTO R66. Use appropriate sample containers; plastic jugs for Emulsified Asphalt and tin cans for Asphaltic Cement Binders.

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product approval.

B. Equipment and Methods

The Contractor must have the equipment on-site to ensure that the chip seal bituminous binder and cover aggregate material is spread uniformly to the application rates included in Section 403.04.H(3) of the Standard Specifications or as shown in the Plans.

Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing including distributors and compactors. Additionally, Section 403.03 of the Standard Specifications contains requirements for self-propelled spreaders for the uniform distribution of the cover aggregate.

Verify the Contractor's equipment meets the requirements of Sections 401.03 and 403.03 of the Standard Specifications as follows.

1. Distributors and Supply Tanks

Ensure the Contractor provides distributors and supply tanks capable of uniformly applying bituminous material in accordance with the following:

- At the temperatures specified in the relevant specification sections;
- On variable widths of surface not to exceed 26 ft;
- At rates from 0.010 gal/yd² to 1.000 gal/yd²; and
- With constant pressure and uniform temperature.

Ensure the distributor can apply material to vertical faces of asphalt pavement at the joints between paving operations.

Ensure the Contractor provides a distributor equipped with the following:

- A tachometer,
- Pressure gauges,
- Volume metering devices or a calibrated tank,
- A thermometer for measuring temperatures of tank contents,
- A power unit for the pump,
- Full circulation spray bars adjustable vertically and laterally,
- A positive shut off valve, and
- Fittings that prevent bituminous material from dripping.

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to ensure uniform distribution of the bituminous material. If clogging or streaking of the applied bituminous material occurs, stop the operation and correct the problems creating these conditions before resuming distribution. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

2. Compactors

Ensure the Contractor provides self-propelled rollers of the following types:

- Vibratory steel wheel,
- Non-vibratory steel wheel,
- Pneumatic tire, or
- A combination of the three types.

Pneumatic tire rollers are typically used on a chip seal. Ensure rollers are in good condition, capable of reversing without backlash, and operating at speeds that do not displace the cover aggregate. Rollers must have properly working spray bars and nozzles along with scraper bars or brushes to ensure the mixture does not build up on the wheels during the compaction operation.

Pneumatic tired compactors must have at least seven pneumatic tires of equal size and diameter. Ensure the total weight of the tires produces an operating weight of at least 3,500 lbs per tire. The tires must be inflated to at least 90 percent of the

maximum pressure recommended by the tire manufacturer. The tire pressure must be maintained for at least 1 hr after the start of operations and the variation in the range in pressure among the tires must not exceed 10 psi.

The Contractor must use the number of rollers of proper type and weight to complete the final rolling prior to the bituminous binder losing its ability to properly imbed the cover aggregate.

Equipment that crushes the aggregate in the bituminous material should not be used.

3. Self-propelled Spreaders

Ensure the Contractor provides self-propelled mechanical spreaders mounted on pneumatic tired traction wheels capable of the following:

- Operating independently of supply trucks;
- Receiving the aggregate from the supply truck directly into the hopper and then into the spreader box;
- Controlling the spreading of aggregate to a rate of 10 lb/yd^2 to 45 lb/yd^2;
- Spreading the aggregate from 3 ft to 12 ft wide; and
- Spreading the aggregate up to 24 ft wide, if required by the Contract.

C. Construction Operations

The Pavement Preservation & Recycling Alliance (PPRA) has developed a website that provides a resource to owners, designers, and construction inspection personnel on the effective use of asphalt pavement preventive maintenance treatments (roadresource.org-treatment resource center) including chip seal treatments. You may visit their site to learn more about construction and quality assurance of chip seal treatments by selecting from the index on the left side of their site (roadresource.org-chip seal). One example of their guidance found under the chip seal's Preparation link is, "*Any leveling that is needed should be done before construction and remove all excess asphalt on patches and joints.*"

To successfully apply a chip seal, it is critical that the Contractor have experience performing this type of work. A poorly applied chip seal can result in premature loss of aggregate that causes chipped windshields or excessive bleeding of the bituminous binder that tracks onto the vehicles. Care must be taken to adhere to seasonal and weather limitations along with using the necessary application rates for the materials. Adjustments may need to be considered to accommodate the conditions incurred on the project; surface being sealed, traffic volumes, material characteristics, etc.

The timely delivery of the cover aggregate to the project is critical to the placement onto the bituminous binder. Typically, the Contractor will stockpile the cover aggregate near the project site to ensure timely delivery. Stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. The area where aggregate is stockpiled must be prepared to preserve the quality and gradation of the material.

The completed sections of chip seal should be opened to traffic in accordance with Section 105.15, "Opening Sections of Project to Traffic" and as directed by the Resident Engineer. Care must be taken to ensure that the cover aggregate is properly imbedded into the bituminous binder and any excess aggregate is removed prior to putting traffic onto it.

Review all aspects of Section 403.04 of the Standard Specifications prior to beginning the chip seal operation, including the following:

1. Weather and Seasonal Limitations

Care must be taken to adhere to seasonal and weather limitations to reduce the risk of failure of the chip seal. Ensure that the seasonal limitations for the type of bituminous binder (cutback, asphalt cement or emulsified asphalt) being used falls within the allowable construction period provided in Table 403:1 found in Section 403.04.A(2) in the Standard Specifications.

Table 403:1
Construction Seasonal Limitations

Asphalt Type	Construction Period
Cutback Asphalt	April 1 through Nov. 15
Asphalt Cement	May 1 through Sept. 30
Emulsified Asphalt	May 15 through Sept. 15

Ensure that the temperature and weather limitations for the type of bituminous binder (cutback, asphalt cement or emulsified asphalt) meets the minimum temperatures and surface condition provided in Table 403:2 found in Section 403.04.A(3) in the Standard Specifications. Work must be suspended if the temperature forecast is predicted to fall below the minimum temperature within 72 hours or if adverse weather conditions (wind chill, rain, fog, high humidity) occur.

Table 403:2
Temperature and Weather Limitations

Asphalt Type	Minimum Temperature, °F			Base or Pavement Surface Condition Due to Weather
	Ambient	Surface	Aggregate	
Cutback Asphalt	50	60	40	Dry
Emulsified Asphalt	60	70	50	No visible free moisture present
Asphalt Cement	60	70	50	Dry

2. Maintenance of Traffic

Ensure the Contractor minimizes delays to the traveling public and protects vehicles and the newly applied chip seal from damage. The Plans should have notes and possibly pay items to facilitate the management of the work zone such as limitations on the length of the lane closure, flaggers, pilot cars, temporary signals, etc. Ensure that the Contractor complies with any plan notes regarding their operations and traffic control.

The Contractors traffic control must accomplish the following as required in Section 403.04.B of the Standard Specifications:

- No vehicles travel on the surface treatment before the application and stabilization of cover aggregate material;
- Construction operations pose no risk to the health, safety, or property of the traveling public; and
- No unnecessary delay to the traveling public.

3. Preparation of Base or Pavement Surface

When the chip seal is being applied to a subgrade or base, ensure the Contractor has prepared the area as required by the Contract (i.e., Section 307-Subgrade Treatment, Section 311-Processing Existing Base and Surface, etc.) before applying the chip seal bituminous surface treatment. When required by the Contract, ensure the tack coat or prime coat is applied in accordance with Sections 407, "Fog Seal and Tack Coat" and 408, "Prime Coat" in the Standard Specifications. The subgrade or base must be cleaned of foreign material before placing the tack coat or prime coat. If the base was previously sealed or patched with bituminous materials, ensure the Contractor removes areas with excess bituminous materials from the base course surface before applying the bituminous binder.

When the chip seal is being applied to an existing surface, clear vegetation, loose aggregate, and soil from the roadway surface. If the pavement has been previously sealed or patched with bituminous materials, ensure the Contractor removes areas with excess bituminous materials from the pavement surface before applying the bituminous binder.

4. Application of Bituminous Binder and Cover Aggregate

Discuss the application and coverage rates for the types of bituminous binder and cover aggregate required in the Plans. There may be application rates specified in the Plans. If not, the application rates for various types of binder and aggregate can be found in Section 403.04.H(3) of the Standard Specifications. It is critical that the Contractor and the Resident Engineer are in agreement with the application rates prior to beginning the chip seal operation. Since the chip seal pay item is paid by the square yard, it will be critical to monitor the Contractor's application rates

(yield) on a daily basis to ensure that ODOT is getting what they are paying for. Adjustments to the application rates can be agreed to once the operation begins and the performance of the chip seal can be evaluated, such as determining if there is excess or insufficient binder or aggregates.

Before placing the first application of bituminous binder, allow the prime coat to penetrate and harden when prime coat is included in the contract. Ensure the Contractor cleans the primed base of dirt and loose material.

Ensure an adequate quantity of the cover aggregate and all necessary equipment for spreading and rolling aggregate is immediately available before starting the application of bituminous binder.

(a) Bituminous Binder

Ensure the Contractor uses the type of bituminous binder specified in the Plans. The bituminous material must be heated uniformly and consistently, using an effective and positive control method. Heat bituminous material in accordance with Section 708.03, "Asphalt Materials" of the Standard Specifications that pertain to the type of bituminous binder required in the Plans. Ensure the fluidity of the heated bituminous material and prevent damage due to overheating. The Department will reject overheated or damaged bituminous material.

The bituminous binder must be applied at temperatures in accordance with Table 708:4, "Temperature Ranges for Use of Asphalt Materials" in Section 708.03 of the Standard Specifications for the type or grade of binder specified in the Plans.

The Contractor must uniformly apply the bituminous binder. One edge of the bituminous surfacing should be delineated before the first application of bituminous binder to ensure straight lines or uniform curves. At transverse joints, to prevent double or no bituminous binder application created by operation starts and stops, the Contractor should spread building paper over the treated surface before the joint to ensure the specified distribution of bituminous binder at the nozzles when they reach the untreated surface. The paper must be removed and disposed of after starting or restarting the bituminous material application.

The Contractor needs to apply bituminous material to the full width in one pass for each application if the roadway is closed to traffic and the surface width does not exceed 24 ft. Or, if the roadway is not closed to traffic and traffic is maintained on one-half of the width, the bituminous material will be applied on the closed half of the roadway width. During the bituminous material application on the second half of the roadway, ensure that the distributor nozzle nearest the center of the roadway overlaps the previous bituminous application from half to the full width of the nozzle spray.

(b) Cover Aggregate

Ensure the Contractor uses the type of cover aggregate at the application and coverage rates specified in the Plans must be uniformly spread immediately after applying the bituminous binder. If the application rates are not specified in the Plans, ensure the rates comply with Table 403:3, "Approximate Single Treatment Application Rates," and Table 403:4, "Approximate Double Treatment Application Rates" of the Standard Specifications. The coverage rate should be used to estimate the quantity of aggregate needed to cover the area of bituminous binder applied.

Provide self-propelled mechanical spreaders mounted on pneumatic tired traction wheels capable of receiving the aggregate from a supply truck and uniformly spreading the aggregate at the desired coverage rate. The Department will allow hand-spreading in areas inaccessible to mechanical spreaders.

It is critical that the cover aggregate is clean with minimal dust coating to ensure a proper bond with the bituminous binder. Ensure that the Contractor maintains good stockpiling practices to eliminate the contamination of the aggregate. Stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. The area where aggregate is stockpiled must be prepared to preserve the quality and gradation of the material. The Contractor may elect to water the stockpiled aggregate to reduce any potential dust coating that may have developed while the aggregate material was stored.

(c) General Application Requirements

Use the distribution and coverage rates shown on the Plans to estimate quantities of aggregate and bituminous binder. If no rates are provided in the Plans, use the rates found in Table 403:3, "Approximate Single Treatment Application Rates," and Table 403:4, "Approximate Double Treatment Application Rates," of the Standard Specifications. Since the chip seal pay item is paid by the square yard, it will be critical to monitor the Contractor's application rates (yield) on a daily basis to ensure that ODOT is getting what they are paying for. Adjustments to the application rates can be agreed to once the operation begins and the performance of the chip seal can be evaluated, such as determining if there is excess or insufficient binder or aggregates.

Ensure the Contractor prevents overlaps, streaks, or gaps in the application of bituminous binder and cover aggregate. Any overlaps, streaks, and gaps must be corrected as approved by the Resident Engineer, at no additional cost to the Department. Ensure the finished surface is free of the following:

- Bleeding,

- Loose chips, and
- Loss of imbedded aggregates.

For the *Chip Seal (Single Treatment)* pay item, the Contractor will apply the bituminous binder followed immediately with the cover aggregate. The type/grade of bituminous binder, the type of cover aggregate and the application and coverage rates should all be specified in the Plans.

For the *Chip Seal (Double Treatment)* pay item, the following additional details and steps are included as specified in Section 403.04.H(3)(b):

- For the first application, apply bituminous binder and spread No. 1 cover aggregate over the surface at the rates shown on the Plans.
- For the second application, apply bituminous binder on the surface of the No. 1 cover material, and spread the first application of No. 2 cover aggregate (first increment) over the surface at the rates shown on the Plans.
- For the third application, apply bituminous binder on the surface of the No. 2 cover material (first increment), and spread the second application of No. 2 cover aggregate (second increment) over the surface at the rates shown on the Plans.

5. Rolling

Ensure the Contractor rolls the entire surface after each application of cover aggregate and ensure it is firmly imbedded into the bituminous binder. The Contractor must hand-spread additional aggregate to fill irregularities and cover bare spots to prevent tracking bituminous binder during rolling.

The Contractor must perform final rolling of the surface with at least four passes over the entire surface with a pneumatic-type roller in accordance with Section 401.03.B, "Compactors" of the Standard Specifications. The roller must not exceed 7 mph during the final rolling. Care should be taken to roll the aggregate soon enough to properly imbed the aggregate into the bituminous binder while allowing enough time for the binder to cool enough that the aggregate will not become dislodged (pulled) during the final rolling.

6. Maintenance

The Contractor must remove unsatisfactory material or aggregate that has become dislodged and make repairs with bituminous binder and aggregate, to establish a uniformly dense treatment with maximum retention of the cover aggregate. Maintain until project completion is accomplished in accordance with Section 105.17, "Project Completion and Acceptance" of the Standard Specifications. Areas with irregularities that are repaired with additional bituminous binder and aggregate must be completed at no additional cost to the Department.

The Contractor should apply a sandy blotting material free of clay, silt, loam, or other foreign matter for excessive bleeding as directed by the Resident Engineer. And any excess aggregate that was not properly imbedded in the bituminous binder should be swept, gathered, and disposed of by the Contractor.

D. Safety and Environmental Considerations

For storage of aggregates in a staging area near the project, stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. Additionally in Section 106.08, at the Contractor's request, the Department may allow the use of approved portions of the right-of-way for storing materials and staging their equipment. As part of the request for use of the site, the Contractor must provide the Resident Engineer with written documentation of the location of the proposed site, access and egress points, a proposed erosion control plan, a proposed traffic control plan, and any other information required by the Resident Engineer relevant to use of the site for materials and equipment storage. For controlled access facilities, the approval from the Resident Engineer is subject to the approval of FHWA, prior to altering, severing or removing any right-of-way fences. Prior written permission of the owner or lessee is required for the use of private property and copies of such written permission must be provided upon request to the Resident Engineer.

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should effectively address the following:

- Providing traffic control during construction to ensure no risk to health, safety and property damage,
- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and chip seal surface from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Receipt of haul tickets of tons and type of cover aggregate stockpiled on project for future use and location of stockpile.
- Locations (station extents and lane direction of travel), length & width of area of chip seal placed.

- Receipt of haul tickets of tons and type of cover aggregate placed and resulting coverage rate.
- Shot record of gallons and type of bituminous binder placed and resulting application rate.
- Any conditions and locations (station) requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

The final quantity for these pay items will be determined by the method defined in Section 403.05 of the Standard Specifications. The length of the completed processing of base will be measured along the centerline to the nearest foot as shown on the Plans.

(a) Square Yard Unit of Measure Pay Items

Documentation of these Square Yard items will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate item from the list of contract pay items.
2. In the appropriate fields, enter both a descriptive location and the station-to-station extents.
3. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

(b) Linear Foot Unit of Measure Pay Items

Documentation of these Linear Foot items will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate pay item from the list of contract pay items.
2. In the appropriate fields, enter both a descriptive location and the station-to-station extents.
3. In the Placed Quantity field, enter the quantity (LF) of the item completed.

4. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

403.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials which were submitted by the Contractor were utilized on the project. The Residency will verify that the sources of materials used by the Contractor are on the Materials Division Approved Rock, Stone & Sand Sources list (Aggregate for Miscellaneous Uses – Approved Sources) and Qualified Products List (QPL-Bituminous Materials). If a proposed source is not on the QPL or Approved Sources list, contact Materials Division to confirm the status of the source/product approval. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

Verify the cover aggregate material complies with the requirements of Section 703.04 of the Standard Specifications for physical properties and gradation. Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Check that the Chip Seal is satisfactorily maintained until the project is completed and any corrective action or blotting material has been successfully remedied to the satisfaction of the Resident Engineer.

403 CHECKLIST – CHIP SEAL

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed sources of bituminous binder and cover aggregate materials been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the proposed sources of materials?					
Has the Contractor provided a detail of their proposed equipment? Does the proposed equipment meet the specification requirements?					
Does the Contractor have an acceptable plan to maintain traffic and minimize delays during the placement of the chip seal?					
Does the Contractor have an acceptable plan to protect traffic and the chip seal surface after opening sections to traffic after the chip seal is placed?					
Does the Contractor's schedule to perform the work fall within the seasonal limitations required for the type of asphalt binder being used?					
Does the Contractor have enough cover aggregate available to immediately spread onto the bituminous binder when applied?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the Residency verified that the previously submitted and accepted sources of materials is being used by the Contractor?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the sources of materials?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the seasonal limitation being met for the type of asphalt binder being used?					
Are the minimum temperature requirements being met to proceed with the work for the type of asphalt binder being used on the project?					
Has the weather forecast been evaluated to ensure the 72 hour forecast does not fall below the minimum temperature required for the type of asphalt binder being used on the project?					
Is the subgrade/base or existing pavement surface processed, compacted, and prepared for binder application in accordance with relevant sections of the Standard Specifications?					
Is the cover aggregate being sampled at the frequency required in the FAST Guide for acceptance testing required in Section 703.04 of the Standard Specifications?					
Have all of the test results and confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Is the Contractor successfully applying binder and spreading aggregate uniformly and at the specified application and coverage rates?					
Is the Contractor effectively rolling the chip seal resulting in a surface free of irregularities?					
Is the Contractor managing the traffic control to minimize delays to the travelers and protect the vehicles and chip seal surface from damage?					

Part 3:Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor use the products and sources of materials reviewed/accepted by the Resident Engineer?					

Part 3:Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the Contractor taken adequate precautions to protect the completed chip seal from damage?					
Is the Contractor adequately maintaining the chip seal surface from excessive bleeding or aggregate?					
Were the materials sampled at the frequency required in the FAST Guide for acceptance testing?					

SECTION 404 – ULTRA-THIN BONDED WEARING COURSE

404.01 GENERAL

This work consists of constructing an Ultra-Thin Bonded Wearing Course (UTBWC), which is a mixture of gap-graded aggregate and polymerized Performance Grade binder, that is mixed at an asphalt plant and delivered to the Project and laid over a rapid setting polymer modified emulsion membrane sprayed within seconds of the laying the mixture.

404.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Review special provisions included in the Contract for surfacing pay items (i.e., material requirements, electronic ticketing, smoothness, etc.).
- Proposed mix designs and certified plants.
- Methods and equipment to be used.
- Information required on truck delivery tickets necessary to evaluate overloaded trucks.
- Weather limitations for construction.
- Surface preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Maintenance of traffic during construction.
- Compaction and rolling requirements.
- Traffic control during construction and opening UTBWC to traffic.

B. Acceptance of Materials

Review the material requirements in Section 707, "Thin Surface Courses" of the Standard Specifications that pertain to the type of UTBWC required in the Plans.

The polymer modified asphalt emulsion membrane must be the rapid-setting PMCRS-1s in accordance with Section 707.01.C of the Standard Specifications unless otherwise specified in the special provisions or plans.

The type of aggregate (Type A, B or C mixture) is designated by the pay item shown in the Contract and must meet the gradation requirements shown on the approved Job Mix Formula and the sand equivalent requirements found in Table 707:1 from Section 707.01.B of the Standard Specifications.

The mineral filler for the UTBWC can be rock dust, hydrated lime, fly ash or Type I portland cement if needed to meet the gradation requirements of the Job Mix Formula in

accordance with Section 707.01.E of the Standard Specifications. Ensure the mineral fillers, if needed, have 100 percent passing the No. 30 sieve and at least 75 percent passing the No. 200 sieve.

The Contractor should submit its proposed sources of materials, mix designs and plant locations at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the UTBWC item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials, mix designs and plant locations. Resolve any questions or concerns with the submitted sources of materials, mix designs and plant locations with the Contractor in a timely manner. A written response accepting the proposed sources of materials, mix designs and plant locations must be sent to the Contractor and kept in the project file.

1. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt mix design submitted by the Contractor is on the Materials Division list of "Asphalt Mix Designs Approved for Use". Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

2. Contractor Proposed Asphalt Plants

Ideally, the Contractor will submit their proposed asphalt plant locations in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt plants submitted by the Contractor have a current ODOT certification. The plants must be reviewed for acceptance by the Resident Engineer based on the criteria of the type of plant as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases. When a plant is being installed to produce for a Project in your Residency notify:

Oklahoma Department of Environmental Quality
Air Quality Division
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: (405) 702-4100
Fax: (405) 702-4101

and

Oklahoma Department of Transportation
Materials Division
Independent Assurance Branch
5201 N.E. 122nd Street
Building 4011
Edmond, OK 73013
Phone: (405) 521-2677

In the notice, list the project number and the location and type of plant (concrete or asphalt).

3. Sources of Materials

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on those items.

The sources of materials for UTBWC mixes will be indicated on the approved Job Mix Formula (asphalt cement, aggregates, anti-stripping agents, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

The Residency will verify that the proposed source of materials for the polymer modified asphalt emulsion membrane submitted by the Contractor is on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name (PMCRS-1s unless otherwise specified in the Plans) and manufacturer is shown in the Section 708.03 – Emulsified Asphalt list on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

C. Preparatory Work and Contractor Work Plans

Consider the following before surface construction work begins.

1. Contract Plans and Specifications

Review the Plans and distinguish the pay items included in the contract and which type of UTBWC is listed. Review the Standard Specifications, Special Provisions and Plan Notes and determine the types of UTBWC and polymer modified asphalt emulsion membrane that is required. The polymer modified asphalt emulsion membrane must be the rapid-setting PMCRS-1s in accordance with Section 707.01.C of the Standard Specifications unless otherwise specified in the special provisions or plans.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing, ensure the Contractor or their designated subcontractor is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every delivery vehicle.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for UTBWC. The paver requirements for UTBWC are more stringent than the typical asphalt paver and it is critical to use the proper paver to successfully place this type of surface.

2. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum surface temperature (at least 55 °F) and weather conditions required to proceed with the placement of the UTBWC.

Ensure that the cross slope, elevation, and alignment are correct and the base courses are processed and compacted in accordance with relevant sections of the Standard Specifications. Visually inspect the bases courses for any unacceptable areas of raveling, cracking or other deficiencies. Ensure the base courses are prepared within allowable tolerance to properly receive the required thickness of

UTBWC material. The Resident Engineer must notify the Contractor of any concerns so that a resolution can be determined prior to proceeding with the surface construction.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the UTBWC. There are acceptable temperature ranges in Section 404.04 of the Standard Specifications for the Polymer Modified Emulsion Membrane and the UTBWC mix that should be discussed to ensure that the Contractor complies with these criteria that are essential to the successful completion of the work.

3. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

(a) Asphalt Mix Designs

The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation. Resolve any questions or concerns with the submitted mix designs with the Contractor in a timely manner. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

4. Contractor Proposed Asphalt Plants

Ideally, the Contractor will submit their proposed asphalt plants in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt plant submitted by the Contractor has a current ODOT certification.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

(a) Asphalt Plant Inspection and Scale Certification

The ODOT Materials Division – Independent Assurance (IA) Branch is responsible for inspecting asphalt plants each year and verifying that plant scales are certified every six months. The Hot Mix Asphalt (HMA) Plant List is maintained and posted on the Materials Division website that indicates the inspection status and scale certification status of all plants that may be used on ODOT construction projects.

The Residency will verify that the proposed asphalt plants submitted by the Contractor are on the Materials Division list of Hot Mix Asphalt (HMA) Plant List and that the inspection status and scale certification status are both listed as "current". If a proposed asphalt plant is not listed on this report or the plant status is not "current", contact Materials Division – Independent Assurance (IA) Branch for their input and recommendation. Resolve any questions or concerns with the submitted asphalt plants with the Contractor in a timely manner.

5. Contractor Proposed Equipment

The Contractor may include the equipment needed to place the UTBWC in their submittals prior to beginning construction. The various pieces of equipment required include the following:

- Trucks and transport units,
- Pavers,
- Material Transfer Vehicles, and
- Compactors.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 404.03.B of this Manual below.

D. Safety and Environmental Issues

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory

Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

404.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements in Section 707, "Thin Surface Courses" of the Standard Specifications that pertain to the type of UTBWC required in the Plans. The polymer modified asphalt emulsion membrane must be the rapid-setting PMCRS-1s in accordance with Section 707.01.C of the Standard Specifications unless otherwise specified in the special provisions or plans.

The Contractor should submit its proposed mix designs, plants and sources of materials at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on the UTBWC pay item. The Resident Engineer must review for acceptance the Contractor's proposed mix designs, plants and sources of materials. Resolve any questions or concerns with the submitted mix designs, plants and sources of materials with the Contractor in a timely manner and prior to placing any UTBWC on the project. A written response accepting the proposed sources of materials and plants must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted and accepted mix designs, plants and sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

1. Contractor Proposed Mix Designs

Ensure the Contractor has submitted its proposed asphalt mix designs in advance of any work beginning on the UTBWC pay item. The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation.

Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

2. Contractor Proposed Asphalt Plants

Ensure the Contractor has submitted its proposed asphalt plant in advance of any work beginning on the UTBWC pay item.

The Residency will verify that the proposed asphalt plants submitted by the Contractor have a current ODOT certification as further described in Section 404.02.C.4 of this Manual. A written response accepting the plants must be sent to the Contractor and kept in the project file.

3. Acceptance of Materials

Ensure the Contractor has submitted its proposed sources of materials in advance of any work beginning on the UTBWC pay item.

The sources of materials for UTBWC mixes will be indicated on the approved Job Mix Formula (asphalt cement, aggregates, anti-stripping agents, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

The mineral filler for the UTBWC can be rock dust, hydrated lime, fly ash or Type I portland cement if needed to meet the gradation requirements of the Job Mix Formula in accordance with Section 707.01.E of the Standard Specifications. Ensure the mineral fillers, if needed, have 100 percent passing the No. 30 sieve and at least 75 percent passing the No. 200 sieve.

The Residency will verify that the proposed source of materials for the polymer modified asphalt emulsion membrane submitted by the Contractor is on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name (PMCRS-1s unless otherwise specified in the Plans) and manufacturer is shown in the Section 708.03 – Emulsified Asphalt list on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, visual appearance (excessive or insufficient asphalt binder, segregation, etc.), or other special provision requirements where Contractor tests are used for acceptance purposes.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Verify the polymer modified asphalt emulsion membrane, rapid-setting PMCRS-1s (unless otherwise required in the special provisions or plans) is on the Qualified Products List [Document in Template AM5001]
    - Bituminous Materials (QPL-Bituminous Materials).
- Obtain a sample of the polymer modified asphalt emulsion membrane to submit to the ODOT Materials Division for acceptance. [Document in Template C91006]
    - Sample liquid asphalt materials in accordance with AASHTO R66. Use appropriate sample containers; plastic jugs for Emulsified Asphalt and tin cans for Asphaltic Cement Binders.
- Obtain a sample of the asphalt cement binder used in the UTBWC mix from the asphalt plant to submit to the ODOT Materials Division for acceptance. [Document in Template C91018]
    - Sample liquid asphalt materials in accordance with AASHTO R66. Use appropriate sample containers; plastic jugs for Emulsified Asphalt and tin cans for Asphaltic Cement Binders.
- Verify the UTBWC mixture complies with the requirements of the approved Job Mix Formula and applicable tolerances:
    - Gradation; Mechanical Analysis of Extracted Aggregate - AASHTO T 30 [Document in Template T30]
    - Asphalt Binder Content by Ignition – OHD L-26 [Document in Template C93013]
- Verify the aggregate used in the UTBWC mixture complies with the requirements of Table 707.1 of the Standard Specifications:
    - Sand Equivalent – AASHTO T 176 [Document in Template C93004]

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be

handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product or mix design approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing. Additionally, review the equipment requirements for pavers in Section 404.03 of the Standard Specifications. Review any special provisions that pertain to the UTBWC.

Ensure the Contractor's proposed equipment complies with the requirements for UTBWC. An MTV is required when placing the UTBWC mixture. The paver requirements for UTBWC are more stringent than the typical asphalt paver and it is critical to use the proper paver to successfully place this type of surface.

Verify the Contractor's equipment meets the requirements of Sections 401.03, 404.03 and 411.03 of the Standard Specifications as follows.

1. Distributors and Supply Tanks

Ensure the Contractor provides distributors and supply tanks capable of uniformly applying bituminous material in accordance with the following:

- At the temperatures specified in the relevant specification sections;
- On variable widths of surface not to exceed 26 ft;
- At rates from 0.010 gal/yd² to 1.000 gal/yd²; and
- With constant pressure and uniform temperature.

Ensure the distributor can apply material to vertical faces of asphalt pavement at the joints between paving operations.

Ensure the Contractor provides a distributor equipped with the following:

- A tachometer,
- Pressure gauges,
- Volume metering devices or a calibrated tank,
- A thermometer for measuring temperatures of tank contents,
- A power unit for the pump,

- Full circulation spray bars adjustable vertically and laterally,
- A positive shut off valve, and
- Fittings that prevent bituminous material from dripping.

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to ensure uniform distribution of the bituminous material. If clogging or streaking of the applied bituminous material occurs, stop the operation and correct the problems creating these conditions before resuming distribution. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

2. Mixing Plants

The Contractor must provide asphalt preparation plants in accordance with AASHTO M 156 and the Department's plant certification requirements.

Reclaimed asphalt paving (RAP) material must not be exposed directly to the burner flame or high temperature combustion gases. Ensure plants modified for this purpose meet the manufacturer's requirements for the specific modifications. **Note**: RAP is not allowed to be included in ultra-thin bonded wearing course (UTBWC).

Plants must include a closed system for storing and feeding mixtures with mineral fillers that maintains a constant material supply with minimal loss throughout the mix production system. Ensure the mineral filler measuring device provides a consistent percentage of filler. The plant must provide a system that includes flow indicators or sensing devices to automatically stop mix production if mineral filler introduction ceases. The Resident Engineer must be allowed access to the mineral filler feeder systems for approval before use, if requested.

The Department will inspect plants every six months, or after every move.

3. Compactors

Ensure the Contractor provides self-propelled rollers of the following types:

- Vibratory double-drum steel wheel, or
- Non-vibratory double-drum steel wheel,

Ensure rollers are in good condition, capable of reversing without backlash, and operating at speeds that do not displace the bituminous mixture.

Ensure the steel wheeled compactors weigh at least 10 tons. Rollers must have properly working spray bars and nozzles along with scraper bars or brushes to ensure the mixture does not build up on the wheels during the compaction operation.

For the compaction of the UTBWC, vibratory rollers will be operated in non-vibratory mode as specified in Section 404.04.B(2) of the Standard Specifications.

The Contractor must use the number of rollers of proper type and weight to complete the compaction of the bituminous material before its temperature drops below the specified minimum.

Equipment that crushes the aggregate in the bituminous material should not be used.

4. Pavers

The Contractor must provide self-contained, self-propelled asphalt pavers equipped with an activated heated screed, and an automatic control device for placing the mixture to the slopes and grades shown on the Plans. Ensure the pavers can spread and finish asphalt courses on lanes, shoulders, and similar construction to the widths and thicknesses shown on the Plans.

The paver must be equipped with a receiving hopper and a distribution system to uniformly place and spread the asphalt in front of the screed without causing asphalt segregation. The Department will not allow equipment designed to pick up asphalt from windrows and must be used in conjunction with a material transfer devise for the placement of the UTBWC.

Ensure the paver can operate at forward speeds to place the mixture in a uniform manner at a consistent speed.

The paver must include a heated strike off assembly to produce a finished surface that meets the specified evenness and uniform texture without tearing, shoving, or gouging the mixture or causing asphalt segregation.

Ensure the Contractor provides a paver approved by the Resident Engineer that has the following additional features required for the placement of UTBWC:

- A receiving hopper for hot mix asphalt;
- A feed conveyor;
- An asphalt emulsion storage tank;
- A system for measuring the Polymer Modified Asphalt Emulsion Membrane volume;
- A spray bar; and
- A heated, variable width, vibratory or combination vibratory-tamping bar screed.

Ensure the paver is capable of the following additional features required for the placement of UTBWC:

- Spraying the Polymer Modified Asphalt Emulsion Membrane;
- Applying the hot mix asphalt overlay;
- Leveling the surface of the mat in one pass;
- Placing the hot mix asphalt within 5 seconds after the application of the Polymer Modified Asphalt Emulsion Membrane; and
- Paving at a controlled speed from 30 ft/min to 90 ft/min.

The paver wheels and other parts of the paving machine must be capable of avoiding contact with the Polymer Modified Emulsion Membrane before the UTWBC mix is applied. The paving machine must be equipped with a screed that is capable of crowning the pavement at the center and adjusting the extensions vertically to accommodate the pavement profile.

(a) Safety Edge Attachment

A safety edge must be constructed when called for in the typical sections in the Plans. See Section 440 of the Standard Specifications and this Construction Manual for additional details.

Verify that the equipment used produces the safety edge to the specified slope and dimensions required in the Standard Specifications, Plans and ODOT Standard Drawings. In accordance with ODOT Standard Drawing PSE-2 (Note 5), all safety edges must meet the approval of the Resident Engineer. The Resident Engineer may require proof that the system proposed by the Contractor has been used on previous projects with acceptable results or may require that a test section be constructed prior to the beginning of work to demonstrate that the edge shape and compaction is to the satisfaction of the Resident Engineer.

The Contractor must equip the paver to ensure a 30 ± 5 degree wedge along the outside edge(s) of the roadway (measured from the horizontal plane) is in place after final compaction of the final surface course. The Contractor must use an approved mechanical edging device that will:

- apply compactive effort to the asphalt mixture to eliminate objectionable voids as the mixture passes through the wedge device, and
- produce a wedge with a uniform texture, shape, and density while automatically adjusting to varying heights encountered along the roadway shoulder.

5. Trucks and Transports

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for UTBWC, ensure the Contractor or their designated subcontractor/supplier is prepared to comply with the terms of the provision. That includes placing an identifying vehicle number on the driver side and the passenger or rear sides of every vehicle delivering UTBWC mix to the project.

Ensure trucks hauling asphalt mix comply with legal load limits and have tight, clean, smooth metal beds thinly coated with a minimum amount of soap solution, lime solution, or other material that prevents the mixture from adhering to the beds as approved by the Resident Engineer. The Contractor must prevent ponds of anti-adhesive solutions from forming in truck beds.

Solutions that contain diesel fuel or other contaminating solvents must not be used by the Contractor during material delivery.

Trucks hauling asphalt mix must have a canvas cover or other material large enough to protect the asphalt from the weather. If necessary, during cooler weather conditions or when longer hauls from the asphalt plant are necessary to a project, the Contractor should consider using insulated truck beds and fasten the covers so that the mixture remains at the specified temperature until delivery.

6. Material Transfer Vehicle (MTV)

A Material Transfer Vehicle (MTV) is the piece of equipment that transfers asphalt mix from the trucks to the paving machine. The MTV is required for the following reasons:

- Minimize aggregate segregation in the asphalt mix and improve the longevity of the asphalt pavement by having a more uniform asphalt layer being placed,
- Eliminate the truck bumping into the paver when positioning to unload the asphalt mix which will improve the smoothness of the asphalt pavement, and
- Minimize temperature variation of the asphalt mix and improve the longevity of the asphalt pavement by having a more uniform compaction of the asphalt layer being placed.

An MTV is required when placing the UTBWC mixture. The Resident Engineer may exempt use of the MTV from portions of a project due to small quantities, short isolated areas, poor condition of the pavement to be surfaced, proximity to bridge structures, etc.

The MTV must be equipped with remixing augers or paddles to continuously remix asphalt in the transfer device. This improves the uniformity of the aggregate distribution throughout the mix as well as providing a uniform temperature throughout the mix.

C. Construction Operations

The Pavement Preservation & Recycling Alliance (PPRA) has developed a website that provides a resource to owners, designers, and construction inspection personnel on the effective use of asphalt pavement preventive maintenance treatments (roadresource.org-treatment resource center) including UTBWC. You may visit their site to learn more about construction and quality assurance of these surface treatments by selecting from the index on the left side of their site (roadresource.org-ultra thin lift HMA). One example of their guidance found under the ultra-thin lift hot mix asphalt pavement's Preparation link is, "*Ensure crack sealing material applied prior to ultra-thin application is not excessive and is applied flush with the existing pavement.*"

The Contractor must construct a finished pavement surface as shown on the Plans and in accordance with Section 401.04.A(1), "Surface Elevation and Smoothness." The surface elevations for new pavement construction and overlays must be within 1/2 in of the elevations shown on the Plans. Ensure the surface smoothness is within 1/8 inch in 10 ft. Test for surface smoothness by placing a straightedge between two contacts on the finished surface and measuring the distance from the surface to the straightedge.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

Ensure the finished pavement structure is constructed in conformance to the widths and thicknesses of individual layers and the total thicknesses of asphalt shown on the Plans or directed by the Resident Engineer. If the planned width is not being achieved, stop the operation and correct the problems creating the incorrect dimension before resuming the paving operation.

The Contractor must correct material and dimension deficiencies that exceed specified tolerances using methods approved by the Resident Engineer, at no additional cost to the Department. The Resident Engineer may at their discretion accept out of specification work in accordance with Section 105.03 of the Standard Specifications as a reduced cost.

Verify the following complies with Section 404.04 of the Standard Specifications when constructing the UTBWC:

1. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. To enable the successful placement of the Polymer Modified Emulsion Membrane and the UTBWC mix, ensure the Contractor does not schedule the placement of the UTBWC until the weather conditions meet the following:

- minimum roadway surface temperature of at least 55 °F,
- weather conditions are clear of fog and no anticipated rain.

Ensure that the cross slope, elevation, and alignment are correct and the base courses are processed and compacted in accordance with relevant sections of the Standard Specifications. Visually inspect the bases courses for any unacceptable areas of raveling, cracking or other deficiencies. Ensure the base courses are prepared within allowable tolerance to properly receive the required thickness of UTBWC material. The Resident Engineer must notify the Contractor of any concerns so that a resolution can be determined prior to proceeding with the surface construction.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the UTBWC. The existing roadway surface must be cleared of vegetation, loose aggregate, soil and any debris before the Contractor commences with the placement of the UTBWC.

2. Application and Placement

Ensure the Contractor complies with the application requirements and rates for the Polymer Modified Emulsion Membrane and UTBWC as specified in the plans, special provisions and specifications, unless they are modified by the Resident Engineer.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for UTBWC, ensure the Contractor or their designated subcontractor/supplier is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every vehicle delivering UTBWC mix to the project.

Residency project inspector will utilize HaulHub similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each UTBWC load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

The longitudinal joint for the UTBWC surface must be placed at the lane lines. Allowing the surface course longitudinal joint to meander across the driving lane will introduce additional stress to the pavement surface and result in a shorter longevity of the pavement surface due to raveling. The UTBWC longitudinal joint must also be offset from the underlying longitudinal joint by at least 3 inches. Ensure all joints are tight, smooth, butt-type joints.

(a) Polymer Modified Emulsion Membrane

The Polymer Modified Emulsion Membrane will be polymer modified cationic rapid set type 1s (PMCRS-1s) in accordance with Section 707.01.C of the Standard Specifications unless otherwise specified in the Plans or special provisions in the contract. The application rate for placing the PMCRS-1s is typically established for the Project by plan note found in the Plans. A common application rate is 0.20 gal/SY.

The PMCRS-1s must be applied at a temperature from 120 °F to 180 °F using a metered mechanical pressure spray bar that is incorporated as part of the paver. The application temperature may be changed by recommendation of the emulsion material supplier. Ensure the sprayer accurately and continuously monitors the spray rate and applies the membrane uniformly across the width of the overlay. The Resident Engineer may adjust the spray application rate based on the pavement surface conditions and the recommendations of the emulsion material supplier.

The cost of the PMCRS-1s is typically included in the price per ton of the UTBWC and not measured separately for payment, unless otherwise specified in the contract and Plans. Therefore, it is critical to ensure that the Contractor complies with the specified application spray rate as they may have monetary motivation to save cost by reducing the quantity of the PMCRS-1s used which could also jeopardize the long-term performance of the UTBWC.

(b) Ultra-Thin Bonded Wearing Course (UTBWC)

Ensure the Contractor places the UTBWC mixture immediately after applying the Polymer Modified Emulsion Membrane. The spray bar for the application of the Polymer Modified Emulsion Membrane being incorporated as part of the paver ensures the timely placement of the UTBWC mixture.

The UTBWC mixture must be placed at a temperature ranging from 290 °F to 330 °F and must be placed over the full width of Polymer Modified Emulsion Membrane. Record temperature readings taken of the mix throughout the day's paving operation on the Daily Report for Laying of Asphalt Mixture (Laydown Report). It is critical to monitor the temperature of the mixture to ensure it is consistently within the acceptable temperature range. An example of the Laydown Report may be found in the Appendix of this chapter of the Manual. Temperatures outside the acceptable ranges will likely result in:

- Too cold. The mixture will be difficult to achieve adequate compaction and will shorten the life of the UTBWC surface due to the

premature raveling, stripping of the asphalt binder from the aggregates or rutting.

- Too hot. Overheating of the mixture will cause the asphalt cement binder to become over-oxidized and will shorten the life of the UTBWC surface due to premature raveling.
- Inconsistent temperatures. Inconsistent temperatures will result in thermal segregation which will adversely affect the unform compaction of the surface and result in irregularities in the smoothness of the surface. Inadequate compaction will shorten the life of the UTBWC surface due to the premature raveling, stripping of the asphalt binder from the aggregates or rutting.

Ensure the paver includes a heated vibratory or combination vibratory tamping bar screed for the UTBWC placement. The Contractor should strive to pave at a uniform and continuous speed to reduce surface imperfections. Ensure the paving operation provides a continuous, uniform, segregation-free flow of material during the HMA placement. To avoid stopping and restarting the paving operation between truck delivering the HMA, the Contractor must coordinate the following to the maximum extent possible:

- The number of haul units needed to maintain a consistent operation,
- The speed of the paver (and MTV when required),
- Roller train capability to ensure adequate compaction,
- The plant production rate, and
- The speed MTV.

If the Resident Engineer determines that sporadic material delivery is adversely affecting the mat quality, the Resident Engineer may direct paving operations to suspend until the Contractor makes appropriate adjustments.

The application target rate for placing the UTBWC is typically established for the Project by plan note found in the Plans. The Resident Engineer may adjust the UTBWC thickness and rate to minimize fractures in the top size aggregate in the finished pavement surface and at the paving edges for tapering or for other reasons.

Ensure the compacted thickness of the finished UTBWC is at least 1/2 in for Type A, 5/8 in for Type B, and 3/4 in for Type C.

3. Compaction

Thin lifts of UTBWC cool very rapidly and need to be compacted more quickly than typical thicker lifts of hot mix asphalt. Immediately after placing the UTBWC, ensure the Contractor performs uniform compaction by completing two to three

passes over the entire surface with approved steel, double-drum asphalt rollers (in non-vibratory mode) of at least 10 ton. The Contractor must use enough roller units to finish compacting the material before the temperature falls below 195 °F. Ensure that rollers do not stop on the freshly placed UTBWC, until the mat temperature falls below 180 °F. The rollers must be equipped with a water system and scrapers to prevent the fresh mix from adhering to the roller drums. If a water system is not sufficient to avoid pulling aggregate from the UTBWC surface, a release agent approved by the Resident Engineer should be added by the Contractor to the rollers.

The UTBWC is intended to be permeable to reduce splash and spray from vehicles during rain events. To prevent permeability reduction and aggregate degradation, avoid excessively rolling UTBWC in the driving lanes. The Resident Engineer will determine the acceptable extent of fracturing at the edge of the pavement due to rolling operations. Do not allow traffic on the new pavement until the rolling operation is complete and the material temperature is below 160 °F.

The typical compaction requirements associated with hot/warm mix asphalt pavements are not required in Section 404 of the Standard Specification for UTBWC. Establishing a rolling pattern to optimize compaction or performing roadway density tests or are not required.

4. Acceptance

The Residency will sample and test the UTBWC on a lot-by-lot basis for acceptance. A lot will consist of one day's run, or a maximum of 500 tons.

The Resident Engineer will perform the following tasks to determine the acceptability of the UTBWC:

- Take the first sample of the UTBWC mixture after the hot mix plant start-up from the third, fourth, or fifth production truck loads;
- Sample the UTBWC mixture at the hot mix plant from the transport truck;
- Randomly select the sample locations/truck load within each lot,
- Verify the daily application rate of the Polymer Modified Emulsion Membrane by dividing the volume used by the area paved each day;
- Test asphalt content in accordance with OHD L-26; and
- Test aggregate gradation in accordance with AASHTO T 30.

If the daily application rate of the Polymer Modified Emulsion Membrane is determined to be less than the application rate required in the Plans, the Resident Engineer must evaluate the situation with the Contractor before proceeding with the operation. The Resident Engineer may adjust the spray application rate based on the pavement surface conditions and the recommendations of the emulsion material supplier.

Stop production if the running average of three consecutive gradation and asphalt content test results varies from the Job-Mix Formula (JMF) by more than the quality control tolerances specified in Section 707.03, "Tolerances" in the Standard Specifications as directed by the Resident Engineer. Identify the cause of the discrepancies, adjust the JMF, and document the corrective actions. If the adjusted JMF meets the mixture requirements of the Contract and the Resident Engineer approves, replace the current JMF with the adjusted JMF and continue production.

The Contractor may be directed by the Resident Engineer to remove defective areas and replace with acceptable material at no additional cost to the Department.

D. Safety and Environmental Considerations

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents), thickness and length & width of area of UTBWC placed.

- Daily application rate (yield rate) of UTBWC placed.
- Shot record of gallons and type of bituminous binder placed and resulting application rate.
- Temperatures of the UTBWC mixture taken throughout the day (recorded in the Daily Laydown Report).
- Receipt of haul tickets (electronic tickets) of Type of UTBWC and quantity placed.
- Receipt of materials certifications and scale or weigher certification.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 404.05 and 404.06 of the Standard Specifications, the cost of the Polymer Modified Emulsion Membrane will be included in the cost per Ton of the relevant UTBWC pay item and will not be measured separately. Do not include the weight of the asphalt emulsion in the measurement of the weight of the relevant UTBWC pay item. Verify that your project's Contract does not include a separate pay item for the asphalt emulsion (PMCRS-1s). Some contracts may include a separate pay item to be measured and paid for by the Gallon or Ton.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for UTBWC, the residency project inspector will utilize the Department's Electronic Ticketing Portal system (HaulHub) similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each UTBWC load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

In accordance with Construction Control Directive No. 20020213, delivery tickets received on a project and used to support payment of those contract items paid by delivery weight must be checked for overload delivery trucks. State statute requires that no payment will be made for any material that exceeds the legal weight limit.

Ensure that the delivery tickets or electronic tickets include the information necessary to evaluate for overloaded trucks. Perform an analysis and omit payment for any amount of material that exceeds the allowable gross vehicle weight for a load. The HaulHub app should be used daily to generate a report that verifies the evaluation of overloaded vehicles. The report should be kept in the project records. Otherwise, written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

As stated in Section 404.06 of the Standard Specifications, the Department will adjust payment for the asphalt binder used in the UTBWC mix in accordance with Section 411.06.B of the Standard Specifications. SiteManager will automatically calculate and place a Line Item Adjustment on the progressive estimate for the amount of asphalt binder price adjustment that is warranted. The adjustment is calculated from the Asphalt Binder Price Index difference from the month that bids are received for the Project to the price index for the month the UTBWC is placed and paid for. It is critical to pay for the UTBWC placed in a timely manner on the progressive estimate to reflect an accurate binder adjustment is calculated.

Documentation of the UTBWC pay item paid by the Ton will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate field, enter the descriptive location or the station to station extents and location (i.e., direction, station extents, lane designation, etc.).

c. In the Placed Quantity field enter the tons of UTBWC complete in place as determined from haul tickets. This quantity may require adjustment after the overload analysis is performed as required in Construction Control Directive No. 20020213.

d. In the Remarks bubble enter the Book/Folder/Envelope # to provide the location of the documentation for the calculations (i.e., ticket audit spreadsheet, truck load tickets, etc.) and/or explain how the quantity was derived (i.e., reduction due to truck being returned, audit adjustment, certified truck load weight, etc.). Note in the project documentation any reductions to the quantity from the overload analysis.

e. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

404.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials and mix designs which were submitted by the Contractor were utilized on the project. Ensure the polymer modified asphalt emulsion membrane, rapid-setting PMCRS-1s (unless otherwise required in the special provisions or plans) is on the QPL list for Bituminous Materials (QPL-Bituminous Materials). Ensure the proposed asphalt mix designs for the UTBWC mixture submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. If the previously accepted proposed sources of materials and mix designs which were submitted by the Contractor were not utilized on the project are not on the QPL or Approved Sources list, contact Materials Division to confirm the status of source/product and mix design approvals. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional

sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

If your Contract includes the special provision for electronic ticketing for UTBWC, the residency project inspector will utilize the Department's Electronic Ticketing Portal system (HaulHub) similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each UTBWC load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

Ensure an analysis was performed and payment omitted for any amount of material that exceeds the allowable gross vehicle weight for a load. The HaulHub app should be used daily to generate a report that verifies the evaluation of overloaded vehicles. The report should be kept in the project records. Otherwise, written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

The Department will adjust payment for the asphalt binder used in the UTBWC mix in accordance with Section 411.06.B of the Standard Specifications. SiteManager will automatically calculate and place a Line Item Adjustment on the progressive estimate for the amount of asphalt binder price adjustment that is warranted. No further audit requirements should be necessary if the UTBWC is paid for in a timely manner on the progressive estimates.

C. Protection of the Work

Check that the UTBWC is satisfactorily maintained until the project is completed and any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

404 CHECKLIST – ULTRA-THIN BONDED WEARING COURSE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed mix design for the UTBWC been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the proposed asphalt plant for the production of the UTBWC been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the proposed source of asphalt emulsion material been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix design and source of asphalt emulsion?					
Has the Contractor been notified of the information necessary on the haul tickets (or electronic tickets) to enable the evaluation of overload deliveries?					
Has the Contractor submitted the equipment list (including the MTV) for the proper placement and compaction of the UTBWC?					
Have the minimum surface temperature requirements stated in the Standard Specifications been discussed with the Contractor?					
Have the acceptable mix temperature ranges for the application of the asphalt emulsion and UTBWC mixture been discussed?					
Have the application rates for the asphalt emulsion and UTBWC specified in the Plans been discussed?					
Does the Contractor have a plan to coordinate the number of haul trucks, speed of the MTV/paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Does the Contractor have a plan for maintenance of traffic and protection of the UTBWC during its placement and opening to traffic?					

Are there special provisions included in the contract for UTBWC surfacing that need to be discussed with the Contractor? Such as smoothness, electronic ticketing, etc.					
Are there bridges within the project which require attention for the MTV to cross the structure without causing damage to the bridge?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed mix design for the UTBWC been submitted by the Contractor and reviewed by the Resident Engineer and accepted?					
Does the proposed asphalt plant for the production of the UTBWC have a current certification and has been accepted by the Resident Engineer?					
Has the proposed source of asphalt emulsion material been submitted by the Contractor and reviewed by the Resident Engineer and accepted?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix design, plant and source of asphalt emulsion?					
Is the Contractor using the mix design and source of asphalt emulsion that has been accepted by the Resident Engineer?					
Does the Contractor's haul tickets (or electronic tickets) include the information necessary to enable the evaluation of overload deliveries?					
Does the Contractor's paver, MTV and rollers meet the specification requirements for the proper placement and compaction of the UTBWC?					
Does the surface temperature meet the minimum requirements of at least 55 °F prior to the placement of the UTBWC?					
Are the weather conditions clear of fog with no anticipated rain during the placement of the UTBWC?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Are the acceptable temperature ranges for the application of the asphalt emulsion (120-180 °F) and UTBWC mixture (290-330 °F) being achieved and recorded in the laydown report?					
Are the application rates for the asphalt emulsion and UTBWC in compliance with the rates specified in the Plans?					
Are the paver wheels and other parts of the paving machine avoiding contact with the asphalt emulsion during placement of the UTBWC mixture?					
Is the MTV being used to place the UTBWC mix into the paving machine?					
Has the Contractor complied with not raising (dumping) the wings of the paver's receiving hopper during the paving operations?					
Are bridges within the project being adequately protected from the MTV crossing the structure?					
Is the Contractor placing the asphalt emulsion and UTBWC to the width specified on the Plans?					
Are the longitudinal joints for the UTBWC being placed at the lane lines and offset from the underlying longitudinal joint by at least 3"?					
Is the Contractor sufficiently maintaining traffic and protecting the UTBWC during its placement?					
Is the Contractor coordinating the number of haul trucks, speed of the MTV/paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Is the Contractor complying with the compaction requirements using at least 2-3 uniform passes with double steel-wheel rollers prior to the UTBWC surface temperature falling below 195 °F?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the rolling operation been completed and the UTBWC surface temperature fallen below 160 °F prior to opening the completed UTBWC to traffic?					
Has a sample of the asphalt emulsion been taken and submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					
Has a sample of the asphalt cement binder used in the UTBWC mix been taken from the asphalt plant and submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					
Have samples of the UTBWC aggregate been taken and tested for sand equivalent results at the frequencies in accordance with the FAST Guide?					
Have samples of the UTBWC mixture been taken and tested at the frequencies in accordance with the FAST Guide?					
Have all of the test results and confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Has the Residency evaluated the acceptance of the UTBWC in accordance with Section 404.04.B(3)?					
Has the Contractor properly disposed of waste materials, asphalt emulsion, etc.?					
Are the truck delivery haul tickets (or electronic tickets) being evaluated for overloads in accordance with CCD No. 20020213?					

Part 3:Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor use the products and sources of materials reviewed/accepted by the Resident Engineer?					

Part 3:Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the UTBWC been placed to the thickness and width as shown on the Plans?					
Has the Contractor taken adequate precautions to protect the completed UTBWC from damage?					
Were any conditions requiring corrective action or maintenance addressed sufficiently by the Contractor?					
Was a sample of the asphalt cement binder used in the UTBWC mix submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					
Was the UTBWC mixture sampled at the frequency required in the FAST Guide for acceptance testing?					
Were the truck delivery haul tickets (or electronic tickets) evaluated for overloads in accordance with CCD No. 20020213 and deductions of quantity made if needed?					

SECTION 405 – PERMEABLE FRICTION COURSE

405.01 GENERAL

This work consists of constructing a Permeable Friction Course (PFC), which is a mixture of aggregate, bituminous material and fibers, that is mixed at an asphalt plant and delivered to the Project and laid as the surface course of a pavement.

405.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Review special provisions included in the Contract for surfacing pay items (i.e., material requirements, electronic ticketing, smoothness, etc.).
- Proposed mix designs and certified plants.
- Methods and equipment to be used.
- Information required on truck delivery tickets necessary to evaluate overloaded trucks.
- Weather limitations for construction.
- Surface preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Maintenance of traffic during construction.
- Compaction and rolling requirements.
- Traffic control during construction and opening PFC to traffic.
- Limitation of payment of PFC based on daily calculation of theoretical tons required.

B. Acceptance of Materials

Review the material requirements in Section 708, "Plant Mix Bituminous Bases and Surfaces" of the Standard Specifications that pertain to the Permeable Friction Course (PFC) required in the Plans.

The Contractor should submit its proposed sources of materials, mix designs and plant locations at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the PFC pay item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials, mix designs and plant locations. Resolve any questions or concerns with the submitted sources of materials, mix designs and plant locations with the Contractor in a timely manner. A written response accepting the proposed sources of materials, mix designs and plant locations must be sent to the Contractor and kept in the project file.

1. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt mix design submitted by the Contractor is on the Materials Division list of "Asphalt Mix Designs Approved for Use". Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

2. Contractor Proposed Asphalt Plants

Ideally, the Contractor will submit their proposed asphalt plant locations in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt plants submitted by the Contractor have a current ODOT certification. The plants must be reviewed for acceptance by the Resident Engineer based on the criteria of the type of plant as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases. When a plant is being installed to produce for a Project in your Residency notify:

Oklahoma Department of Environmental Quality
Air Quality Division
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: (405) 702-4100
Fax: (405) 702-4101

and

Oklahoma Department of Transportation
Materials Division
Independent Assurance Branch
5201 N.E. 122nd Street, Building 4011
Edmond, OK 73013
Phone: (405) 521-2677

In the notice, list the project number and the location and type of plant (concrete or asphalt).

3. Sources of Materials

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on those items.

The sources of materials for PFC mixes will be indicated on the approved Job Mix Formula (asphalt cement, aggregates, anti-stripping agents, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

C. Preparatory Work and Contractor Work Plans

Consider the following before surface construction work begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions and Plan Notes and determine any specific requirements that pertain to the Permeable Friction Course (PFC) on your project.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing, ensure the Contractor or their designated subcontractor is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every delivery vehicle.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for PFC. The PFC is a unique surface course, and its handling, placement and compaction requirements are more stringent than the typical asphalt mixture and it is critical to use the proper techniques to successfully place this type of surface course.

2. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum

surface temperature (at least 60 °F) and weather conditions required to proceed with the placement of the PFC.

Ensure that the cross slope, elevation, and alignment are correct and the base courses are processed and compacted in accordance with relevant sections of the Standard Specifications. Visually inspect the bases courses for any unacceptable areas of raveling, cracking or other deficiencies. Ensure the base courses are prepared within allowable tolerance to properly receive the required thickness of PFC material. The Resident Engineer must notify the Contractor of any concerns so that a resolution can be determined prior to proceeding with the surface construction.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the PFC. There are acceptable temperature ranges in Section 405.04 of the Standard Specifications for the PFC mix that should be discussed to ensure that the Contractor complies with these criteria that are essential to the successful completion of the work.

3. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

(a) Asphalt Mix Designs

The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation. Resolve any questions or concerns with the submitted mix designs with the Contractor in a timely manner. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

4. Contractor Proposed Asphalt Plants

Ideally, the Contractor will submit their proposed asphalt plants in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt plant submitted by the Contractor has a current ODOT certification.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

(a) Asphalt Plant Inspection and Scale Certification

The ODOT Materials Division – Independent Assurance (IA) Branch is responsible for inspecting asphalt plants each year and verifying that plant scales are certified every six months. The Hot Mix Asphalt (HMA) Plant List is maintained and posted on the Materials Division website that indicates the inspection status and scale certification status of all plants that may be used on ODOT construction projects.

The Residency will verify that the proposed asphalt plants submitted by the Contractor are on the Materials Division list of Hot Mix Asphalt (HMA) Plant List and that the inspection status and scale certification status are both listed as "current". If a proposed asphalt plant is not listed on this report or the plant status is not "current", contact Materials Division – Independent Assurance (IA) Branch for their input and recommendation. Resolve any questions or concerns with the submitted asphalt plants with the Contractor in a timely manner.

5. Contractor Proposed Equipment

The Contractor may include the equipment needed to place the PFC in their submittals prior to beginning construction. The various pieces of equipment required include the following:

- Trucks and transport units,
- Pavers,
- Material Transfer Vehicles, and
- Compactors.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 405.03.B of this Manual below.

D. Safety and Environmental Issues

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

405.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements in Section 708, "Plant Mix Bituminous Bases and Surfaces" of the Standard Specifications that pertain to the Permeable Friction Course (PFC) required in the Plans.

The Contractor should submit its proposed mix designs, plants and sources of materials at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on the PFC pay item. The Resident Engineer must review for acceptance the Contractor's proposed mix designs, plants and sources of materials. Resolve any questions or concerns with the submitted mix designs, plants and sources of materials with the Contractor in a timely manner and prior to placing any PFC on the project. A written response accepting the proposed sources of materials and plants must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted and accepted mix designs, plants and sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

1. Contractor Proposed Mix Designs

Ensure the Contractor has submitted its proposed asphalt mix designs in advance of any work beginning on the PFC pay item. The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation.

Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

2. Contractor Proposed Asphalt Plants

Ensure the Contractor has submitted its proposed asphalt plant in advance of any work beginning on the PFC pay item.

The Residency will verify that the proposed asphalt plants submitted by the Contractor have a current ODOT certification as further described in Section 405.02.C.4 of this Manual. A written response accepting the plants must be sent to the Contractor and kept in the project file.

3. Acceptance of Materials

Ensure the Contractor has submitted its proposed sources of materials in advance of any work beginning on the PFC pay item.

The sources of materials for PFC mixes will be indicated on the approved Job Mix Formula (asphalt cement, aggregates, anti-stripping agents, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, visual appearance (excessive or insufficient asphalt binder, segregation, etc.), or other special provision requirements where Contractor tests are used for acceptance purposes.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Obtain a sample of the asphalt cement binder from the asphalt plant to submit to the ODOT Materials Division for acceptance [Document in Template C91018]
    - Sample liquid asphalt materials in accordance with AASHTO R66. Use appropriate sample containers; plastic jugs for Emulsified Asphalt and tin cans for Asphaltic Cement Binders.
- Verify the PFC mixture complies with the requirements of the approved Job Mix Formula and applicable tolerances [Document in Template C93015]:
    - Gradation; Mechanical Analysis of Extracted Aggregate - AASHTO T 30 [Document in Template C93015]

- Asphalt Binder Content by Ignition – OHD L-26 [Document in Template C93015]
- Percent density of compacted asphalt specimen (lab molded density) – OHD L-14 [Document in Template C93015]

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product or mix design approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing. Additionally, review the equipment requirements for PFC in Sections 405.03 and 411.03 of the Standard Specifications. Review any special provisions that pertain to the PFC.

Ensure the Contractor's proposed equipment complies with the requirements for PFC. An MTV is required when placing the PFC mixture. The PFC is a unique surface course, and its handling, placement and compaction requirements are more stringent than the typical asphalt mixture and it is critical to use the proper techniques to successfully place this type of surface course.

Verify the Contractor's equipment meets the requirements of Sections 401.03, 405.03 and 411.03 of the Standard Specifications as follows.

1. Distributors and Supply Tanks

Ensure the Contractor provides distributors and supply tanks capable of uniformly applying bituminous material in accordance with the following:

- At the temperatures specified in the relevant specification sections;
- On variable widths of surface not to exceed 26 ft;
- At rates from 0.010 gal/yd² to 1.000 gal/yd²; and
- With constant pressure and uniform temperature.

Ensure the distributor can apply material to vertical faces of asphalt pavement at the joints between paving operations.

Ensure the Contractor provides a distributor equipped with the following:

- A tachometer,
- Pressure gauges,
- Volume metering devices or a calibrated tank,
- A thermometer for measuring temperatures of tank contents,
- A power unit for the pump,
- Full circulation spray bars adjustable vertically and laterally,
- A positive shut off valve, and
- Fittings that prevent bituminous material from dripping.

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to ensure uniform distribution of the bituminous material. If clogging or streaking of the applied bituminous material occurs, stop the operation and correct the problems creating these conditions before resuming distribution. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

2. Mixing Plants

The Contractor must provide asphalt preparation plants in accordance with AASHTO M 156 and the Department's plant certification requirements.

Reclaimed asphalt paving (RAP) material must not be exposed directly to the burner flame or high temperature combustion gases. Ensure plants modified for this purpose meet the manufacturer's requirements for the specific modifications. **Note**: RAP is not allowed to be included in permeable friction course (PFC).

Plants must include a closed system for storing and feeding mixtures with mineral fillers that maintains a constant material supply with minimal loss throughout the mix production system. Ensure the mineral filler measuring device provides a consistent percentage of filler. The plant must provide a system that includes flow indicators or sensing devices to automatically stop mix production if mineral filler introduction ceases. The Resident Engineer must be allowed access to the mineral filler feeder systems for approval before use, if requested.

Plants must provide a separate system for mixtures with cellulose fibers to feed fibers into the mixture to obtain a uniform distribution into the PFC mix. Ensure the fiber supply system has the following characteristics:

- Low level and no-flow indicators,
- A printout or data file that records the feed rate, and
- A section of transparent pipe that allows observation of flow and feed consistency.

The Department will inspect plants every six months, or after every move.

3. Compactors

Ensure the Contractor provides self-propelled rollers of the following types:

- Vibratory double-drum steel wheel, or
- Non-vibratory double-drum steel wheel,

Ensure rollers are in good condition, capable of reversing without backlash, and operating at speeds that do not displace the bituminous mixture. Rollers must have properly working spray bars and nozzles along with scraper bars or brushes to ensure the mixture does not build up on the wheels during the compaction operation.

Ensure the steel wheeled compactors weigh at least 10 tons.

For compaction of the PFC, vibratory rollers will be operated in non-vibratory mode as specified in Section 405.04.I of the Standard Specifications. Pneumatic rollers must not be used on the PFC for achieving compaction.

The Contractor must use the number of rollers of proper type and weight to complete the compaction of the bituminous material before its temperature drops below the specified minimum.

Equipment that crushes the aggregate in the bituminous material should not be used.

4. Pavers

The Contractor must provide self-contained, self-propelled asphalt pavers equipped with an activated heated screed, and an automatic control device for placing the mixture to the slopes and grades shown on the Plans. Ensure the pavers can spread and finish asphalt courses on lanes, shoulders, and similar construction to the widths and thicknesses shown on the Plans.

The paver must be equipped with a receiving hopper and a distribution system to uniformly place and spread the asphalt in front of the screed without causing asphalt segregation. The Department will not allow equipment designed to pick up asphalt from windrows and must be used in conjunction with a material transfer devise for the placement of the PFC.

Ensure the paver can operate at forward speeds to place the mixture in a uniform manner at a consistent speed.

The paver must include a heated strike off assembly to produce a finished surface that meets the specified evenness and uniform texture without tearing, shoving, or gouging the mixture or causing asphalt segregation.

(a) Safety Edge Attachment

A safety edge must be constructed when called for in the typical sections in the Plans. See Section 440 of the Standard Specifications and this Construction Manual for additional details.

Verify that the equipment used produces the safety edge to the specified slope and dimensions required in the Standard Specifications, Plans and ODOT Standard Drawings. In accordance with ODOT Standard Drawing PSE-2 (Note 5), all safety edges must meet the approval of the Resident Engineer. The Resident Engineer may require proof that the system proposed by the Contractor has been used on previous projects with acceptable results or may require that a test section be constructed prior to the beginning of work to demonstrate that the edge shape and compaction is to the satisfaction of the Resident Engineer.

The Contractor must equip the paver to ensure a 30 ± 5 degree wedge along the outside edge(s) of the roadway (measured from the horizontal plane) is in place after final compaction of the final surface course. The Contractor must use an approved mechanical edging device that will:

- apply compactive effort to the asphalt mixture to eliminate objectionable voids as the mixture passes through the wedge device, and
- produce a wedge with a uniform texture, shape, and density while automatically adjusting to varying heights encountered along the roadway shoulder.

5. Trucks and Transports

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for PFC, ensure the Contractor or their designated subcontractor/supplier is prepared to comply with the terms of the provision. That includes placing an identifying vehicle number on the driver side and the passenger or rear sides of every vehicle delivering PFC mix to the project.

Ensure trucks hauling asphalt mix comply with legal load limits and have tight, clean, smooth metal beds thinly coated with a minimum amount of soap solution, lime solution, or other material that prevents the mixture from adhering to the beds

as approved by the Resident Engineer. The Contractor must prevent ponds of anti-adhesive solutions from forming in truck beds.

Solutions that contain diesel fuel or other contaminating solvents must not be used by the Contractor during material delivery.

Trucks hauling asphalt mix must have a canvas cover or other material large enough to protect the asphalt from the weather. If necessary, during cooler weather conditions or when longer hauls from the asphalt plant are necessary to a project, the Contractor should consider using insulated truck beds and fasten the covers so that the mixture remains at the specified temperature until delivery.

6. Material Transfer Vehicle (MTV)

A Material Transfer Vehicle (MTV) is the piece of equipment that transfers asphalt mix from the trucks to the paving machine. The MTV is required for the following reasons:

- Minimize aggregate segregation in the asphalt mix and improve the longevity of the asphalt pavement by having a more uniform asphalt layer being placed,
- Eliminate the truck bumping into the paver when positioning to unload the asphalt mix which will improve the smoothness of the asphalt pavement, and
- Minimize temperature variation of the asphalt mix and improve the longevity of the asphalt pavement by having a more uniform compaction of the asphalt layer being placed.

An MTV is required when placing the PFC mixture. The Resident Engineer may exempt use of the MTV from portions of a project due to small quantities, short isolated areas, poor condition of the pavement to be surfaced, proximity to bridge structures, etc.

The MTV must be equipped with remixing augers or paddles to continuously remix asphalt in the transfer device. This improves the uniformity of the aggregate distribution throughout the mix as well as providing a uniform temperature throughout the mix.

C. Construction Operations

The Pavement Preservation & Recycling Alliance (PPRA) has developed a website that provides a resource to owners, designers, and construction inspection personnel on the effective use of asphalt pavement preventive maintenance treatments (roadresource.org-treatment resource center) including PFC. You may visit their site to learn more about construction and quality assurance of these surface treatments by selecting from the index on the left side of their site (roadresource.org-ultra thin lift HMA). One example of their guidance found under the ultra-thin lift hot mix asphalt pavement's Preparation link is, "*Ensure crack sealing material applied prior to ultra-thin application is not excessive and is applied flush with the existing pavement.*"

The Contractor must construct a finished pavement surface as shown on the Plans and in accordance with Section 401.04.A(1), "Surface Elevation and Smoothness." The surface elevations for new pavement construction and overlays must be within 1/2 in of the elevations shown on the Plans. Ensure the surface smoothness is within 1/8 inch in 10 ft. Test for surface smoothness by placing a straightedge between two contacts on the finished surface and measuring the distance from the surface to the straightedge.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

Ensure the finished pavement structure is constructed in conformance to the widths and thicknesses of individual layers and the total thicknesses of asphalt shown on the Plans or directed by the Resident Engineer. If the planned width is not being achieved, stop the operation and correct the problems creating the incorrect dimension before resuming the paving operation.

The Contractor must correct material and dimension deficiencies that exceed specified tolerances using methods approved by the Resident Engineer, at no additional cost to the Department. The Resident Engineer may at their discretion accept out of specification work in accordance with Section 105.03 of the Standard Specifications as a reduced cost.

Verify the following complies with Section 405.04 of the Standard Specifications when constructing the Permeable Friction Course (PFC):

1. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. To enable the successful placement of the PFC mix, ensure the Contractor does not schedule the placement of the PFC until the weather conditions meet the following:

- minimum roadway surface temperature of at least 60 °F,
- dry pavement surface, and
- weather conditions are clear of fog and no anticipated rain.

Ensure that the cross slope, elevation, and alignment are correct and the base courses are processed and compacted in accordance with relevant sections of the Standard Specifications. Visually inspect the bases courses for any unacceptable areas of raveling, cracking or other deficiencies. Ensure the base courses are prepared within allowable tolerance to properly receive the required thickness of PFC material. The Resident Engineer must notify the Contractor of any concerns so that a resolution can be determined prior to proceeding with the surface construction.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the PFC. The existing roadway surface must be cleared of vegetation, loose aggregate, soil and any debris before the Contractor commences with the placement of the PFC.

The Contractor must apply a tack coat or NT tack material in accordance with Section 407 of the Standard Specifications. The type and application rate for the tack coat will be specified in the Plans. Ensure the Contractor applies the proper type at the specified rate, unless otherwise agreed to by the Resident Engineer.

2. Spreading and Finishing

Ensure the Contractor complies with the required thickness, width and rates for the placement of the PFC mix as specified in the plans, special provisions and specifications, unless they are modified by the Resident Engineer.

(a) Loading and Hauling

Coordinate loading and hauling of the PFC with laydown operations to:

- Ensure the PFC mixture is placed at a temperature ranging from 275 °F to 325 °F,
- Verify there is no separation of the bituminous material from the aggregate in the PFC., and
- Trucks hauling PFC mix must have a canvas cover or other material large enough to protect the asphalt from the weather and excessive cooling of the mix while it is being transported to the project site.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for PFC, ensure the Contractor or their designated subcontractor/supplier is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every vehicle delivering PFC mix to the project.

Residency project inspector will utilize HaulHub similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each PFC load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

(b) Paver Operation and Joints

The PFC mix must be placed with a paver in conjunction with a material transfer vehicle (MTV) as specified in Section 405 of the Standard Specifications. Do not allow the Contractor to raise (dump) the wings of the paver's receiving hopper during the paving operations. Raising the paver wings will increase the potential for a segregated pavement surface (both mixture aggregate and thermal segregation). Do not allow the Contractor to windrow the PFC mix before spreading and finishing.

Prior to placing the PFC mix, ensure the Contractor has applied a tack coat or NT tack material in accordance with Section 407 of the Standard Specifications. The type and application rate for the tack coat will be specified in the Plans. Ensure the Contractor applies the proper type at the specified rate, unless otherwise agreed to by the Resident Engineer.

The PFC mixture must be placed at a temperature ranging from 275 °F to 325 °F. Ensure the paver includes a heated vibratory or combination vibratory tamping bar screed for the PFC placement. Record temperature readings taken of the mix throughout the day's paving operation on the Daily Report for Laying of Asphalt Mixture (Laydown Report). It is critical to monitor the temperature of the mixture to ensure it is consistently within the acceptable temperature range. An example of the Laydown Report may be found in the Appendix of this chapter of the Manual. Temperatures outside the acceptable ranges will likely result in:

- Too cold. The mixture will be difficult to achieve adequate compaction and will shorten the life of the PFC surface due to the premature raveling, stripping of the asphalt binder from the aggregates or rutting.
- Too hot. Overheating of the mixture will cause the asphalt cement binder to become over-oxidized and will shorten the life of the PFC surface due to premature raveling.
- Inconsistent temperatures. Inconsistent temperatures will result in thermal segregation which will adversely affect the unform compaction of the surface and result in irregularities in the smoothness of the surface. Inadequate compaction will shorten the life of the PFC surface due to the premature raveling, stripping of the asphalt binder from the aggregates or rutting.

The Contractor must strive to pave at a uniform and continuous speed to reduce surface imperfections. Ensure the paving operation provides a continuous, uniform, segregation-free flow of material during the PFC placement. To avoid stopping and restarting the paving operation, the Contractor must coordinate the following to the maximum extent possible:

- The number of haul units needed to maintain a consistent operation,

- The speed of the paver,
- Roller train capability to ensure adequate compaction,
- The plant production rate, and
- The speed of the MTV.

In the event of equipment malfunction the Contractor may continue operations, if possible, to place PFC mix quantities in transit or to safely maintain traffic. Discontinue further operations until equipment is repaired.

The thickness and application target rate for placing the PFC is typically established for the Project in the typical section and by plan note found in the Plans. Ensure the compacted thickness is no less than the thickness shown in the Plans and no greater than 1/4" inch more than the planned thickness.

In accordance with Section 405.05 of the Standard Specifications, the payment of the PFC placed each day will be limited to the calculated theoretical tons required for the area (SY) placed that day. The daily theoretical tons are obtained by multiplying the unit weight from the job mix formula for the PFC by the completed length and the area of the typical cross section as shown on the Plans that was placed during the day's operation.

The longitudinal joint for the PFC surface must be placed at the lane lines. Allowing the surface course longitudinal joint to meander across the driving lane will introduce additional stress to the pavement surface and result in a shorter longevity of the pavement surface due to raveling. The PFC longitudinal joint must also be offset from the underlying longitudinal joint by at least 3 inches. Ensure all joints are tight, smooth, butt-type joints.

(c) Material Transfer Vehicle (MTV)

An MTV must be used to transfer the PFC mix from the hauling trucks to the paving machine. The Resident Engineer may exempt use of the MTV from portions of a project due to small quantities, short isolated areas, poor condition of the pavement to be surfaced, proximity to bridge structures, etc.

The Resident Engineer will evaluate the MTV's performance by measuring the temperature profile of the mat immediately behind the paver screed using a non-contact thermometer at intervals of 50 ft. Each temperature profile consists of three surface temperature measurements taken transversely across the mat from 1 ft to 3 ft from the screed during the paving operations. Each profile will include three temperature measurements; one in the middle of the mat and two at the edges (1 ft inside

each edge). This initial evaluation may be done by the Contractor placing a 500-ton test strip.

Stop producing PFC mix if two of the temperature measurements in any profile differ by more than 10 ºF. Adjust operations before restarting the paving operation. The Resident Engineer may continue to take additional surface temperature profiles during the project.

MTVs that exceed 20,000 lb per axle will only be allowed to cross bridges if the unit's hopper is empty, the vehicle travels at crawl speed, and the wheels are placed over the underlying beam lines. For bridges in poor condition or posted for load limits, the Resident Engineer must consult the Bridge Division to determine additional limitations.

3. Compaction

Thin lifts of PFC cool very rapidly and need to be compacted more quickly than typical thicker lifts of hot mix asphalt. Immediately after placing the PFC, ensure the Contractor performs uniform compaction by completing two to three passes over the entire surface with approved steel, double-drum asphalt rollers (in non-vibratory mode) of at least 10 ton. The Contractor must use enough roller units to finish compacting the material before the temperature falls below 140 °F. Ensure that rollers do not stop on the freshly placed PFC. The rollers must be equipped with a water system and scrapers to prevent the fresh mix from adhering to the roller drums. If a water system is not sufficient to avoid pulling aggregate from the PFC surface, a release agent approved by the Resident Engineer should be added by the Contractor to the rollers.

The PFC is intended to be permeable to reduce splash and spray from vehicles during rain events. To prevent permeability reduction and aggregate degradation, avoid excessively rolling PFC in the driving lanes. The Resident Engineer will determine the acceptable extent of fracturing at the edge of the pavement due to rolling operations. Do not allow traffic on the new pavement until the rolling operation is complete and the PFC surface temperature is within 10 °F of the ambient temperature or 2 hours after the final rolling.

The typical compaction requirements associated with hot/warm mix asphalt pavements are not required in Section 405 of the Standard Specifications for PFC. Establishing a rolling pattern to optimize compaction or performing roadway density tests or are not required.

D. Safety and Environmental Considerations

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly

permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents), thickness and length & width of area of PFC placed.
- Daily application rate (yield rate) of PFC placed.
- Shot record of gallons and type of tack coat placed and resulting application rate.
- Temperatures of the PFC mixture taken throughout the day (recorded in the Daily Laydown Report).
- Receipt of haul tickets (electronic tickets) of PFC and quantity placed.
- Receipt of materials certifications and scale or weigher certification.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 405.05 of the Standard Specifications, the Residency will measure the weight of PFC placed for payment by the Ton. However, the amount paid for the project will not exceed the theoretical weight required for the area placed daily or the legal weight limits for each individual truckload.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for PFC, the residency project inspector will utilize the Department's Electronic Ticketing Portal system (HaulHub) similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each PFC load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

In accordance with Construction Control Directive No. 20020213, delivery tickets received on a project and used to support payment of those contract items paid by delivery weight must be checked for overload delivery trucks. State statute requires that no payment will be made for any material that exceeds the legal weight limit.

Ensure that the delivery tickets or electronic tickets include the information necessary to evaluate for overloaded trucks. Perform an analysis and omit payment for any amount of material that exceeds the allowable gross vehicle weight for a load. The HaulHub app should be used daily to generate a report that verifies the evaluation of overloaded vehicles. The report should be kept in the project records. Otherwise, written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

The payment of the PFC placed each day will be limited to the calculated theoretical tons required for the area (SY) placed that day. The daily theoretical tons are obtained by multiplying the unit weight from the job mix formula for the PFC by the completed length and the area of the typical cross section as shown on the Plans that was placed during the day's operation. For example:

- the unit weight from the job mix formula which is identified as ***Compacted Wt. (lb/sy/1"thick)*** is equal to 91.9, and
- the Contractor placed 2,500' length for the day, and
- the width for the day's run was 13' wide, and
- the typical section thickness is shown as 1-1/4", then
- the theoretical tons required for the day and limit for the day's payment would equal:
- 91.9 lb x (2,500' x 13') / 9 x 1.25" / 2,000 = 207.41 tons

As stated in Section 405.06 of the Standard Specifications, the Department will adjust payment for the asphalt binder used in the PFC mix in accordance with Section 411.06.B of the Standard Specifications. SiteManager will automatically calculate and place a Line Item Adjustment on the progressive estimate for the amount of asphalt binder price adjustment that is warranted. The adjustment is calculated from the Asphalt Binder Price Index difference from the month that bids

are received for the Project to the price index for the month the PFC is placed and paid for. It is critical to pay for the PFC placed in a timely manner on the progressive estimate to reflect an accurate binder adjustment is calculated.

Documentation of the PFC pay item paid by the Ton will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate field, enter the descriptive location or the station to station extents and location (i.e., direction, station extents, lane designation, etc.).

c. In the Placed Quantity field enter the tons of PFC complete in place as determined from haul tickets. This quantity may require adjustment after the overload analysis and daily theoretical analysis is performed as required in Construction Control Directive No. 20020213 and Section 405.05 of the Standard Specifications.

d. In the Remarks bubble enter the Book/Folder/Envelope # to provide the location of the documentation for the calculations (i.e., ticket audit spreadsheet, truck load tickets, etc.) and/or explain how the quantity was derived (i.e., reduction due to truck being returned, audit adjustment, certified truck load weight, etc.). Note in the project documentation any reductions to the quantity from the overload analysis and daily theoretical analysis along with the calculations.

e. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

405.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials and mix designs which were submitted by the Contractor were utilized on the project. Ensure the proposed asphalt mix designs for the PFC mixture submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. If the previously accepted proposed sources of materials and mix designs which were submitted by the Contractor were not utilized on the project are not on the Approved Sources list, contact Materials Division to confirm the status of source/product and mix design approvals. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the

material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

Ensure the payment of the PFC placed each day was limited to the calculated theoretical tons required for the area (SY) placed that day in accordance with Section 405.05 of the Standard Specifications. The daily theoretical tons are obtained by multiplying the unit weight from the job mix formula for the PFC by the completed length and the area of the typical cross section as shown on the Plans that was placed during the day's operation. Refer to Section 405.03.E.2 of this Manual for further details.

If your Contract includes the special provision for electronic ticketing for PFC, the residency project inspector will utilize the Department's Electronic Ticketing Portal system (HaulHub) similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each PFC load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

Ensure an analysis was performed and payment omitted for any amount of material that exceeds the allowable gross vehicle weight for a load. The HaulHub app should be used daily to generate a report that verifies the evaluation of overloaded vehicles. The report should be kept in the project records. Otherwise, written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

The Department will adjust payment for the asphalt binder used in the PFC mix in accordance with Section 411.06.B of the Standard Specifications. SiteManager will automatically calculate and place a Line Item Adjustment on the progressive estimate for the amount of asphalt binder price adjustment that is warranted. No further audit requirements should be necessary if the PFC is paid for in a timely manner on the progressive estimates.

C. Protection of the Work

Check that the PFC is satisfactorily maintained until the project is completed and any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

405 CHECKLIST – PERMEABLE FRICTION COURSE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed mix design for the PFC been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the proposed asphalt plant for production of the PFC been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix design and asphalt plant?					
Has the Contractor been notified of the information necessary on the haul tickets (or electronic tickets) to enable the evaluation of overload deliveries?					
Has the Contractor submitted the equipment list (including the MTV) for the proper placement and compaction of the PFC?					
Has the minimum surface temperature requirement of at least 60 °F for PFC been discussed with the Contractor?					
Have the acceptable temperature ranges for the application of the PFC mixture been discussed?					
Have the application rates for PFC specified in the Plans been discussed?					
Does the Contractor have a plan to coordinate the number of haul trucks, speed of the MTV/paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Has the payment for PFC being limited to the daily calculation of theoretical tons required been discussed with the Contractor?					
Does the Contractor have a plan for maintenance of traffic and protection of the PFC during its placement and opening to traffic?					

Are there special provisions included in the contract for PFC surfacing that need to be discussed with the Contractor? Such as smoothness, electronic tickets, etc.					
Are there bridges within the project which require attention for the MTV to cross the structure without causing damage to the bridge?					

Part 2: During Construction

Issue	Yes	No	N/A	Comments	Initials
Has the proposed mix design for the PFC been submitted by the Contractor and accepted by the Resident Engineer?					
Does the proposed asphalt plant for production of the PFC have a current certification and been accepted by the Resident Engineer?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix design and asphalt plant?					
Is the Contractor using the mix design that has been accepted by the Resident Engineer?					
Does the Contractor's haul tickets include the information necessary to enable the evaluation of overload deliveries?					
Does the Contractor's paver, MTV and rollers meet the specification requirements for the proper placement and compaction of the PFC?					
Does the surface temperature meet the minimum requirements of at least 60 °F prior to the placement of the PFC?					
Are the weather conditions clear of fog with no anticipated rain during the placement of the PFC?					
Are acceptable mix temperature ranges for the application of the PFC mixture (275-325 °F) being achieved and recorded in the laydown report?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Are the application rates for the PFC in compliance with the rates specified in the Plans?					
Is the MTV being used to place the PFC mix into the paving machine?					
Has the Contractor complied with not raising (dumping) the wings of the paver's receiving hopper during the paving operations.					
Are bridges within the project being adequately protected from the MTV crossing the structure?					
Is the Contractor placing the PFC to the width and thickness specified on the Plans?					
Are the longitudinal joints for the PFC surface being placed at the lane lines and offset from the underlying longitudinal joint by at least 3"?					
Is the Contractor sufficiently maintaining traffic and protecting the PFC during its placement?					
Is the Contractor coordinating the number of haul trucks, speed of the MTV/paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Is the Contractor complying with the compaction requirements using at least 2-3 uniform passes with double steel-wheel rollers immediately after the PFC is placed?					
Has the rolling operation been completed for at least 2 hours, or the PFC surface temperature fallen to within 10 °F of the ambient temperature prior to opening the completed PFC to traffic?					
Has a sample of the asphalt cement binder used in the PFC mix been taken from the asphalt plant and submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have samples of the PFC mixture been taken and tested at the frequencies in accordance with the FAST Guide?					
Have all of the test results and confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Has the Contractor properly disposed of waste materials, asphalt emulsion, etc.?					
Are truck delivery haul tickets (or electronic tickets) being evaluated for overloads in accordance with CCD No. 20020213?					
Is the payment for PFC being evaluated daily and limited to the calculation of theoretical tons required for the day's run?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the PFC been placed to the thickness and width as shown on the Plans?					
Has the Contractor taken adequate precautions to protect the completed PFC from damage?					
Were any conditions requiring corrective action or maintenance addressed sufficiently by the Contractor?					
Were samples of asphalt cement binder used in the PFC mix submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					
Was the PFC mixture sampled at the frequency required in the FAST Guide for acceptance testing?					
Were the truck delivery haul tickets (or electronic tickets) evaluated for overloads in accordance with CCD No. 20020213 and deductions of quantity made if needed?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Was the payment for PFC being evaluated daily and limited to the calculation of theoretical tons required for the day's run?					

SECTION 406 – OPEN-GRADED FRICTION SURFACE COURSE

406.01 GENERAL

This work consists of constructing an Open-Graded Friction Surface Course (OGFSC), which is a mixture of aggregate and bituminous material that is mixed at an asphalt plant and delivered to the Project and laid as the surface course of a pavement.

406.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Review special provisions and plan notes included in the Contract for surfacing pay items (i.e., material requirements, electronic ticketing, MTV, smoothness, etc.).
- Proposed mix designs and certified plants.
- Methods and equipment to be used.
- Information required on truck delivery tickets necessary to evaluate overloaded trucks.
- Weather limitations for construction.
- Surface preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Maintenance of traffic during construction.
- Compaction and rolling requirements.
- Traffic control during construction and opening OGFSC to traffic.

B. Acceptance of Materials

Review the material requirements in Section 708, "Plant Mix Bituminous Bases and Surfaces" of the Standard Specifications that pertain to the Open-Graded Friction Surface Course (OGFSC) required in the Plans.

The Contractor should submit its proposed sources of materials, mix designs and plant locations at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the OGFSC pay item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials, mix designs and plant locations. Resolve any questions or concerns with the submitted sources of materials, mix designs and plant locations with the Contractor in a timely manner. A written response accepting the proposed sources of materials, mix designs and plant locations must be sent to the Contractor and kept in the project file.

1. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt mix design submitted by the Contractor is on the Materials Division list of "Asphalt Mix Designs Approved for Use". Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

2. Contractor Proposed Asphalt Plants

Ideally, the Contractor will submit their proposed asphalt plant locations in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt plants submitted by the Contractor have a current ODOT certification. The plants must be reviewed for acceptance by the Resident Engineer based on the criteria of the type of plant as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases. When a plant is being installed to produce for a Project in your Residency notify:

Oklahoma Department of Environmental Quality
Air Quality Division
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: (405) 702-4100
Fax: (405) 702-4101

and

Oklahoma Department of Transportation
Materials Division
Independent Assurance Branch
5201 N.E. 122nd Street, Building 4011
Edmond, OK 73013
Phone: (405) 521-2677

In the notice, list the project number and the location and type of plant (concrete or asphalt).

3. Sources of Materials

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on those items.

The sources of materials for OGFSC mixes will be indicated on the approved Job Mix Formula (asphalt cement, aggregates, anti-stripping agents, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

C. Preparatory Work and Contractor Work Plans

Consider the following before surface construction work begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions and Plan Notes and determine any specific requirements that pertain to the Open-Graded Friction Surface Course (OGFSC) on your project.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing, ensure the Contractor or their designated subcontractor is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every delivery vehicle.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for OGFSC. The OGFSC is a unique surface course, and its handling, placement and compaction requirements are more stringent than the typical asphalt mixture and it is critical to use the proper techniques to successfully place this type of surface course.

2. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum surface temperature (at least 60 °F) and weather conditions required to proceed with the placement of the OGFSC.

Ensure that the cross slope, elevation, and alignment are correct and the base courses are processed and compacted in accordance with relevant sections of the Standard Specifications. Visually inspect the bases courses for any unacceptable areas of raveling, cracking or other deficiencies. Ensure the base courses are prepared within allowable tolerance to properly receive the required thickness of OGFSC material. The Resident Engineer must notify the Contractor of any concerns so that a resolution can be determined prior to proceeding with the surface construction.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the OGFSC. There are acceptable temperature ranges in Section 406.04 of the Standard Specifications for the OGFSC mix that should be discussed to ensure that the Contractor complies with these criteria that are essential to the successful completion of the work.

3. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

(a) Asphalt Mix Designs

The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation. Resolve any questions or concerns with the submitted mix designs with the Contractor in a timely manner. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

4. Contractor Proposed Asphalt Plants

Ideally, the Contractor will submit their proposed asphalt plants in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt plant submitted by the Contractor has a current ODOT certification.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

(a) Asphalt Plant Inspection and Scale Certification

The ODOT Materials Division – Independent Assurance (IA) Branch is responsible for inspecting asphalt plants each year and verifying that plant scales are certified every six months. The Hot Mix Asphalt (HMA) Plant List is maintained and posted on the Materials Division website that indicates the inspection status and scale certification status of all plants that may be used on ODOT construction projects.

The Residency will verify that the proposed asphalt plants submitted by the Contractor are on the Materials Division list of Hot Mix Asphalt (HMA) Plant List and that the inspection status and scale certification status are both listed as "current". If a proposed asphalt plant is not listed on this report or the plant status is not "current", contact Materials Division – Independent Assurance (IA) Branch for their input and recommendation. Resolve any questions or concerns with the submitted asphalt plants with the Contractor in a timely manner.

5. Contractor Proposed Equipment

The Contractor may include the equipment needed to place the OGFSC in their submittals prior to beginning construction. The various pieces of equipment required include the following:

- Trucks and transport units,
- Pavers,
- Material Transfer Vehicles, and
- Compactors.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 406.03.B of this Manual below.

D. Safety and Environmental Issues

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and

the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

406.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements in Section 708, "Plant Mix Bituminous Bases and Surfaces" of the Standard Specifications that pertain to the Open-Graded Friction Surface Course (OGFSC) required in the Plans.

The Contractor should submit its proposed mix designs, plants and sources of materials at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on the OGFSC pay item. The Resident Engineer must review for acceptance the Contractor's proposed mix designs, plants and sources of materials. Resolve any questions or concerns with the submitted mix designs, plants and sources of materials with the Contractor in a timely manner and prior to placing any OGFSC on the project. A written response accepting the proposed sources of materials and plants must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted and accepted mix designs, plants and sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

1. Contractor Proposed Mix Designs

Ensure the Contractor has submitted its proposed asphalt mix designs in advance of any work beginning on the OGFSC pay item. The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports

that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation.

Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

2. Contractor Proposed Asphalt Plants

Ensure the Contractor has submitted its proposed asphalt plant in advance of any work beginning on the OGFSC pay item.

The Residency will verify that the proposed asphalt plants submitted by the Contractor have a current ODOT certification as further described in Section 406.02.C.4 of this Manual. A written response accepting the plants must be sent to the Contractor and kept in the project file.

3. Acceptance of Materials

Ensure the Contractor has submitted its proposed sources of materials in advance of any work beginning on the OGFSC pay item.

The sources of materials for OGFSC mixes will be indicated on the approved Job Mix Formula (asphalt cement, aggregates, anti-stripping agents, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, visual appearance (excessive or insufficient asphalt binder, segregation, etc.), or other special provision requirements where Contractor tests are used for acceptance purposes.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Obtain a sample of the asphalt cement binder from the asphalt plant to submit to the ODOT Materials Division for acceptance [Document in Template C91018]

- Sample liquid asphalt materials in accordance with AASHTO R66. Use appropriate sample containers; plastic jugs for Emulsified Asphalt and tin cans for Asphaltic Cement Binders.

- Verify the OGFSC mixture complies with the requirements of the approved Job Mix Formula and applicable tolerances:
  - Gradation; Mechanical Analysis of Extracted Aggregate - AASHTO T 30 [Document in Template T30]
  - Asphalt Binder Content by Ignition – OHD L-26 [Document in Template C93013]

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product or mix design approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing. Additionally, review the equipment requirements for Open-Graded Friction Surface Course (OGFSC) in Sections 411.03 of the Standard Specifications. Review any special provisions or plan notes that pertain to the OGFSC.

Ensure the Contractor's proposed equipment complies with the requirements for OGFSC. An MTV is intended to be required when placing the OGFSC mixture. The 2019 Standard Specifications inadvertently omitted the requirement for the MTV in the surface course in Section 411.03, however, there should be a plan note that reinstates that requirement. The OGFSC is a unique surface course, and its handling, placement and compaction requirements are more stringent than the typical asphalt mixture and it is critical to use the proper techniques to successfully place this type of surface course.

Verify the Contractor's equipment meets the requirements of Sections 401.03, 406.03 and 411.03 of the Standard Specifications as follows.

1. Distributors and Supply Tanks

Ensure the Contractor provides distributors and supply tanks capable of uniformly applying bituminous material in accordance with the following:

- At the temperatures specified in the relevant specification sections;
- On variable widths of surface not to exceed 26 ft;
- At rates from 0.010 gal/yd² to 1.000 gal/yd²; and
- With constant pressure and uniform temperature.

Ensure the distributor can apply material to vertical faces of asphalt pavement at the joints between paving operations.

Ensure the Contractor provides a distributor equipped with the following:

- A tachometer,
- Pressure gauges,
- Volume metering devices or a calibrated tank,
- A thermometer for measuring temperatures of tank contents,
- A power unit for the pump,
- Full circulation spray bars adjustable vertically and laterally,
- A positive shut off valve, and
- Fittings that prevent bituminous material from dripping.

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to ensure uniform distribution of the bituminous material. If clogging or streaking of the applied bituminous material occurs, stop the operation and correct the problems creating these conditions before resuming distribution. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

2. Mixing Plants

The Contractor must provide asphalt preparation plants in accordance with AASHTO M 156 and the Department's plant certification requirements.

Reclaimed asphalt paving (RAP) material must not be exposed directly to the burner flame or high temperature combustion gases. Ensure plants modified for this purpose meet the manufacturer's requirements for the specific modifications. **Note**: RAP is not allowed to be included in Open-Graded Friction Surface Course (OGFSC).

Plants must include a closed system for storing and feeding mixtures with mineral fillers that maintains a constant material supply with minimal loss throughout the

mix production system. Ensure the mineral filler measuring device provides a consistent percentage of filler. The plant must provide a system that includes flow indicators or sensing devices to automatically stop mix production if mineral filler introduction ceases. The Resident Engineer must be allowed access to the mineral filler feeder systems for approval before use, if requested.

Plants must provide a separate system for mixtures with cellulose fibers to feed fibers into the mixture to obtain a uniform distribution into the OGFSC mix. Ensure the fiber supply system has the following characteristics:

- Low level and no-flow indicators,
- A printout or data file that records the feed rate, and
- A section of transparent pipe that allows observation of flow and feed consistency.

The Department will inspect plants every six months, or after every move.

3. Compactors

Ensure the Contractor provides self-propelled rollers of the following types:

- Vibratory double-drum steel wheel, or
- Non-vibratory double-drum steel wheel,

Ensure rollers are in good condition, capable of reversing without backlash, and operating at speeds that do not displace the bituminous mixture. Rollers must have properly working spray bars and nozzles along with scraper bars or brushes to ensure the mixture does not build up on the wheels during the compaction operation.

Ensure the steel wheeled compactors weigh at least 10 tons.

For compaction of the OGFSC, vibratory rollers will be operated in non-vibratory mode as specified in Section 406.04.I of the Standard Specifications. Pneumatic rollers must not be used on the OGFSC for achieving compaction.

The Contractor must use the number of rollers of proper type and weight to complete the compaction of the bituminous material before its temperature drops below the specified minimum.

Equipment that crushes the aggregate in the bituminous material should not be used.

4. Pavers

The Contractor must provide self-contained, self-propelled asphalt pavers equipped with an activated heated screed, and an automatic control device for placing the mixture to the slopes and grades shown on the Plans. Ensure the pavers can spread

and finish asphalt courses on lanes, shoulders, and similar construction to the widths and thicknesses shown on the Plans.

The paver must be equipped with a receiving hopper and a distribution system to uniformly place and spread the asphalt in front of the screed without causing asphalt segregation. The Department will not allow equipment designed to pick up asphalt from windrows and must be used in conjunction with a material transfer devise for the placement of the OGFSC.

Ensure the paver can operate at forward speeds to place the mixture in a uniform manner at a consistent speed.

The paver must include a heated strike off assembly to produce a finished surface that meets the specified evenness and uniform texture without tearing, shoving, or gouging the mixture or causing asphalt segregation.

(a) Safety Edge Attachment

A safety edge must be constructed when called for in the typical sections in the Plans. See Section 440 of the Standard Specifications and this Construction Manual for additional details.

Verify that the equipment used produces the safety edge to the specified slope and dimensions required in the Standard Specifications, Plans and ODOT Standard Drawings. In accordance with ODOT Standard Drawing PSE-2 (Note 5), all safety edges must meet the approval of the Resident Engineer. The Resident Engineer may require proof that the system proposed by the Contractor has been used on previous projects with acceptable results or may require that a test section be constructed prior to the beginning of work to demonstrate that the edge shape and compaction is to the satisfaction of the Resident Engineer.

The Contractor must equip the paver to ensure a 30 ± 5 degree wedge along the outside edge(s) of the roadway (measured from the horizontal plane) is in place after final compaction of the final surface course. The Contractor must use an approved mechanical edging device that will:

- apply compactive effort to the asphalt mixture to eliminate objectionable voids as the mixture passes through the wedge device, and
- produce a wedge with a uniform texture, shape, and density while automatically adjusting to varying heights encountered along the roadway shoulder.

5. Trucks and Transports

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for OGFSC, ensure the Contractor or their designated subcontractor/supplier is prepared to comply with the terms of the provision. That includes placing an identifying vehicle number on the driver side and the passenger or rear sides of every vehicle delivering OGFSC mix to the project.

Ensure trucks hauling asphalt mix comply with legal load limits and have tight, clean, smooth metal beds thinly coated with a minimum amount of soap solution, lime solution, or other material that prevents the mixture from adhering to the beds as approved by the Resident Engineer. The Contractor must prevent ponds of anti-adhesive solutions from forming in truck beds.

Solutions that contain diesel fuel or other contaminating solvents must not be used by the Contractor during material delivery.

Trucks hauling asphalt mix must have a canvas cover or other material large enough to protect the asphalt from the weather. If necessary, during cooler weather conditions or when longer hauls from the asphalt plant are necessary to a project, the Contractor should consider using insulated truck beds and fasten the covers so that the mixture remains at the specified temperature until delivery.

6. Material Transfer Vehicle (MTV)

A Material Transfer Vehicle (MTV) is the piece of equipment that transfers asphalt mix from the trucks to the paving machine. The MTV is required for the following reasons:

- Minimize aggregate segregation in the asphalt mix and improve the longevity of the asphalt pavement by having a more uniform asphalt layer being placed,
- Eliminate the truck bumping into the paver when positioning to unload the asphalt mix which will improve the smoothness of the asphalt pavement, and
- Minimize temperature variation of the asphalt mix and improve the longevity of the asphalt pavement by having a more uniform compaction of the asphalt layer being placed.

An MTV is intended to be required when placing the OGFSC mixture. The 2019 Standard Specifications inadvertently omitted the requirement for the MTV in the surface course in Section 411.03, however, there should be a plan note that reinstates that requirement. The Resident Engineer may exempt use of the MTV from portions of a project due to small quantities, short isolated areas, poor condition of the pavement to be surfaced, proximity to bridge structures, etc.

The MTV must be equipped with remixing augers or paddles to continuously remix asphalt in the transfer device. This improves the uniformity of the aggregate

distribution throughout the mix as well as providing a uniform temperature throughout the mix.

C. Construction Operations

The Pavement Preservation & Recycling Alliance (PPRA) has developed a website that provides a resource to owners, designers, and construction inspection personnel on the effective use of asphalt pavement preventive maintenance treatments (roadresource.org-treatment resource center) including OGFSC. You may visit their site to learn more about construction and quality assurance of these surface treatments by selecting from the index on the left side of their site (roadresource.org-ultra thin lift HMA). One example of their guidance found under the ultra-thin lift hot mix asphalt pavement's Preparation link is, "*Ensure crack sealing material applied prior to ultra-thin application is not excessive and is applied flush with the existing pavement.*"

The Contractor must construct a finished pavement surface as shown on the Plans and in accordance with Section 401.04.A(1), "Surface Elevation and Smoothness." The surface elevations for new pavement construction and overlays must be within 1/2 in of the elevations shown on the Plans. Ensure the surface smoothness is within 1/8 inch in 10 ft. Test for surface smoothness by placing a straightedge between two contacts on the finished surface and measuring the distance from the surface to the straightedge.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

Ensure the finished pavement structure is constructed in conformance to the widths and thicknesses of individual layers and the total thicknesses of asphalt shown on the Plans or directed by the Resident Engineer. If the planned width is not being achieved, stop the operation and correct the problems creating the incorrect dimension before resuming the paving operation.

The Contractor must correct material and dimension deficiencies that exceed specified tolerances using methods approved by the Resident Engineer, at no additional cost to the Department. The Resident Engineer may at their discretion accept out of specification work in accordance with Section 105.03 of the Standard Specifications as a reduced cost.

Verify the following complies with Section 406.04 of the Standard Specifications when constructing the Open-Graded Friction Surface Course (OGFSC).

1. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Section 406.04.F of the Standard Specifications

requires the placement of the OGFSC between April 1 to October 31, unless otherwise approved by the Resident Engineer.

To enable the successful placement of the OGFSC mix, ensure the Contractor does not schedule the placement of the OGFSC until the weather conditions meet the following:

- minimum roadway surface temperature of at least 60 °F,
- dry pavement surface, and
- weather conditions are clear of fog and no anticipated rain.

Ensure that the cross slope, elevation, and alignment are correct and the base courses are processed and compacted in accordance with relevant sections of the Standard Specifications. Visually inspect the bases courses for any unacceptable areas of raveling, cracking or other deficiencies. Ensure the base courses are prepared within allowable tolerance to properly receive the required thickness of OGFSC material. The Resident Engineer must notify the Contractor of any concerns so that a resolution can be determined prior to proceeding with the surface construction.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the OGFSC. The existing roadway surface must be cleared of vegetation, loose aggregate, soil and any debris before the Contractor commences with the placement of the OGFSC.

The Contractor must apply a tack coat or NT tack material in accordance with Section 407 of the Standard Specifications. The type and application rate for the tack coat will be specified in the Plans. Ensure the Contractor applies the proper type at the specified rate, unless otherwise agreed to by the Resident Engineer.

2. Spreading and Finishing

Ensure the Contractor complies with the required thickness, width and rates for the placement of the OGFSC mix as specified in the plans, special provisions and specifications, unless they are modified by the Resident Engineer.

(a) Loading and Hauling

Coordinate loading and hauling of the OGFSC with laydown operations to:

- Ensure the OGFSC mixture is placed at the temperature required by the approved Job Mix Formula (JMF) ± 25 °F,
- Verify there is no separation of the bituminous material from the aggregate in the OGFSC, and
- Trucks hauling OGFSC mix must have a canvas cover or other material large enough to protect the asphalt from the weather and

excessive cooling of the mix while it is being transported to the project site.

Record temperature readings taken of the mix throughout the day's paving operation on the Daily Report for Laying of Asphalt Mixture (Laydown Report). It is critical to monitor the temperature of the mixture to ensure it is consistently within the acceptable temperature range. An example of the Laydown Report may be found in the Appendix of this chapter of the Manual. Temperatures outside the acceptable ranges will likely result in:

- Too cold. The mixture will be difficult to achieve adequate compaction and will shorten the life of the OGFSC surface due to the premature raveling, stripping of the asphalt binder from the aggregates or rutting.
- Too hot. Overheating of the mixture will cause the asphalt cement binder to become over-oxidized and will shorten the life of the OGFSC surface due to premature raveling.
- Inconsistent temperatures. Inconsistent temperatures will result in thermal segregation which will adversely affect the unform compaction of the surface and result in irregularities in the smoothness of the surface. Inadequate compaction will shorten the life of the OGFSC surface due to the premature raveling, stripping of the asphalt binder from the aggregates or rutting.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for OGFSC, ensure the Contractor or their designated subcontractor/supplier is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every vehicle delivering OGFSC mix to the project.

Residency project inspector will utilize HaulHub similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each OGFSC load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

(b) Paver Operation and Joints

The OGFSC mix must be placed with a paver in conjunction with a material transfer vehicle (MTV). An MTV is intended to be required when placing the OGFSC mixture. The 2019 Standard Specifications inadvertently

omitted the requirement for the MTV in the surface course in Section 411.03, however, there should be a plan note that reinstates that requirement. Do not allow the Contractor to raise (dump) the wings of the paver's receiving hopper during the paving operations. Raising the paver wings will increase the potential for a segregated pavement surface (both mixture aggregate and thermal segregation). Do not allow the Contractor to windrow the OGFSC mix before spreading and finishing.

Prior to placing the OGFSC mix, ensure the Contractor has applied a tack coat or NT tack material in accordance with Section 407 of the Standard Specifications. The type and application rate for the tack coat will be specified in the Plans. Ensure the Contractor applies the proper type at the specified rate, unless otherwise agreed to by the Resident Engineer.

The OGFSC mixture must be placed at the temperature required by the approved Job Mix Formula (JMF) ± 25 °F. Ensure the paver includes a heated vibratory or combination vibratory tamping bar screed for the OGFSC placement. The Contractor must strive to pave at a uniform and continuous speed to reduce surface imperfections. Ensure the paving operation provides a continuous, uniform, segregation-free flow of material during the OGFSC placement. To avoid stopping and restarting the paving operation, the Contractor must coordinate the following to the maximum extent possible:

- The number of haul units needed to maintain a consistent operation,
- The speed of the paver,
- Roller train capability to ensure adequate compaction,
- The plant production rate, and
- The speed of the MTV.

In the event of equipment malfunction the Contractor may continue operations, if possible, to place OGFSC mix quantities in transit or to safely maintain traffic. Discontinue further operations until equipment is repaired. If the paver stops, all OGFSC material in the paver must be removed prior to restarting the paving operation in accordance with Section 406.04.G of the Standard Specifications.

The thickness and application target rate for placing the OGFSC is typically established for the Project in the typical section and by plan note found in the Plans. Ensure the compacted thickness is no less than the thickness shown in the Plans and no greater than 1/4" inch more than the planned thickness.

In accordance with Section 406.05 of the Standard Specifications, the payment of the OGFSC placed each day will be limited to the calculated theoretical tons required for the area (SY) placed that day. The daily

theoretical tons are obtained by multiplying the unit weight from the job mix formula for the OGFSC by the completed length and the area of the typical cross section as shown on the Plans that was placed during the day's operation.

The longitudinal joint for the OGFSC surface must be placed at the lane lines. Allowing the surface course longitudinal joint to meander across the driving lane will introduce additional stress to the pavement surface and result in a shorter longevity of the pavement surface due to raveling. The OGFSC longitudinal joint must also be offset from the underlying longitudinal joint by at least 3 inches. Ensure all joints are tight, smooth, butt-type joints.

(c) Material Transfer Vehicle (MTV)

An MTV must be used to transfer the OGFSC mix from the hauling trucks to the paving machine. The Resident Engineer may exempt use of the MTV from portions of a project due to small quantities, short isolated areas, poor condition of the pavement to be surfaced, proximity to bridge structures, etc.

The Resident Engineer will evaluate the MTV's performance by measuring the temperature profile of the mat immediately behind the paver screed using a non-contact thermometer at intervals of 50 ft. Each temperature profile consists of three surface temperature measurements taken transversely across the mat from 1 ft to 3 ft from the screed during the paving operations. Each profile will include three temperature measurements; one in the middle of the mat and two at the edges (1 ft inside each edge). This initial evaluation may be done by the Contractor placing a 500-ton test strip.

Stop producing OGFSC mix if two of the temperature measurements in any profile differ by more than 10 ºF. Adjust operations before restarting the paving operation. The Resident Engineer may continue to take additional surface temperature profiles during the project.

MTVs that exceed 20,000 lb per axle will only be allowed to cross bridges if the unit's hopper is empty, the vehicle travels at crawl speed, and the wheels are placed over the underlying beam lines. For bridges in poor condition or posted for load limits, the Resident Engineer must consult the Bridge Division to determine additional limitations.

3. Compaction

Thin lifts of OGFSC cool very rapidly and need to be compacted more quickly than typical thicker lifts of hot mix asphalt. Immediately after placing the OGFSC, ensure the Contractor performs uniform compaction by completing two to three passes over the entire surface with approved steel, double-drum asphalt rollers (in

non-vibratory mode) of at least 10 ton. The Contractor must use enough roller units to finish compacting the material before the temperature falls below 140 °F. Ensure that rollers do not stop on the freshly placed OGFSC. The rollers must be equipped with a water system and scrapers to prevent the fresh mix from adhering to the roller drums. If a water system is not sufficient to avoid pulling aggregate from the OGFSC surface, a release agent approved by the Resident Engineer should be added by the Contractor to the rollers.

The OGFSC is intended to be permeable to reduce splash and spray from vehicles during rain events. To prevent permeability reduction and aggregate degradation, avoid excessively rolling OGFSC in the driving lanes. The Resident Engineer will determine the acceptable extent of fracturing at the edge of the pavement due to rolling operations. Do not allow traffic on the new pavement until the rolling operation is complete and the OGFSC surface temperature is within 10 °F of the ambient temperature or 2 hours after the final rolling.

The typical compaction requirements associated with hot/warm mix asphalt pavements are not required in Section 406 of the Standard Specifications for OGFSC. Establishing a rolling pattern to optimize compaction or performing roadway density tests or are not required.

D. Safety and Environmental Considerations

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor should address the following:

- Providing traffic control during construction,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents), thickness and length & width of area of OGFSC placed.
- Daily application rate (yield rate) of OGFSC placed.
- Shot record of gallons and type of tack coat placed and resulting application rate.
- Temperatures of the OGFSC mixture taken throughout the day (recorded in the Daily Laydown Report).
- Receipt of haul tickets (electronic tickets) of OGFSC and quantity placed.
- Receipt of materials certifications and scale or weigher certification.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 406.05 of the Standard Specifications, the Residency will measure the weight of OGFSC placed for payment by the Ton. However, the amount paid will not exceed the theoretical weight required for the area placed daily or the legal weight limits for each individual truckload.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for OGFSC, the residency project inspector will utilize the Department's Electronic Ticketing Portal system (HaulHub) similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each OGFSC load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

In accordance with Construction Control Directive No. 20020213, delivery tickets received on a project and used to support payment of those contract items paid by delivery weight must be checked for overload delivery trucks. State statute requires that no payment will be made for any material that exceeds the legal weight limit.

Ensure that the delivery tickets or electronic tickets include the information necessary to evaluate for overloaded trucks. Perform an analysis and omit payment

for any amount of material that exceeds the allowable gross vehicle weight for a load. The HaulHub app should be used daily to generate a report that verifies the evaluation of overloaded vehicles. The report should be kept in the project records. Otherwise, written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

The payment of the OGFSC placed each day will be limited to the calculated theoretical tons required for the area (SY) placed that day. The daily theoretical tons are obtained by multiplying the unit weight from the job mix formula for the OGFSC by the completed length and the area of the typical cross section as shown on the Plans that was placed during the day's operation. For example:

- the unit weight from the job mix formula which is identified as ***Compacted Wt. (lb/sy/1"thick)*** is equal to 91.9, and
- the Contractor placed 2,500' length for the day, and
- the width for the day's run was 13' wide, and
- the typical section thickness is shown as 1-1/4", then
- the theoretical tons required for the day and limit for the day's payment would equal:
- 91.9 lb x (2,500' x 13') / 9 x 1.25" / 2,000 = 207.41 tons

As stated in Section 406.06 of the Standard Specifications, the Department will adjust payment for the asphalt binder used in the OGFSC mix in accordance with Section 411.06.B of the Standard Specifications. SiteManager will automatically calculate and place a Line Item Adjustment on the progressive estimate for the amount of asphalt binder price adjustment that is warranted. The adjustment is calculated from the Asphalt Binder Price Index difference from the month that bids are received for the Project to the price index for the month the OGFSC is placed and paid for. It is critical to pay for the OGFSC placed in a timely manner on the progressive estimate to reflect an accurate binder adjustment is calculated.

Documentation of the OGFSC pay item paid by the Ton will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate field, enter the descriptive location or the station to station extents and location (i.e., direction, station extents, lane designation, etc.).

c. In the Placed Quantity field enter the tons of OGFSC complete in place as determined from haul tickets. This quantity may require adjustment after the overload analysis and daily theoretical analysis is performed as required in Construction Control Directive No. 20020213 and Section 406.05 of the Standard Specifications.

d. In the Remarks bubble enter the Book/Folder/Envelope # to provide the location of the documentation for the calculations (i.e., ticket audit spreadsheet, truck load tickets, etc.) and/or explain how the quantity was derived (i.e., reduction due to truck being returned, audit adjustment, certified truck load weight, etc.). Note in the project documentation any reductions to the quantity from the overload analysis and daily theoretical analysis along with the calculations.

e. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

406.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials and mix designs which were submitted by the Contractor were utilized on the project. Ensure the proposed asphalt mix designs for the OGFSC mixture submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. If the previously accepted proposed sources of materials and mix designs which were submitted by the Contractor were not utilized on the project are not on the Approved Sources list, contact Materials Division to confirm the status of source/product and mix design approvals. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

Ensure the payment of the OGFSC placed each day was limited to the calculated theoretical tons required for the area (SY) placed that day in accordance with Section 406.05 of the Standard Specifications. The daily theoretical tons are obtained by multiplying the unit weight from the job mix formula for the OGFSC by the completed length and the area of the typical cross section as shown on the Plans that was placed during the day's operation. Refer to Section 406.03.E.2 of this Manual for further details.

If your Contract includes the special provision for electronic ticketing for OGFSC, the residency project inspector will utilize the Department's Electronic Ticketing Portal system (HaulHub) similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each OGFSC load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

Ensure an analysis was performed and payment omitted for any amount of material that exceeds the allowable gross vehicle weight for a load. The HaulHub app should be used daily to generate a report that verifies the evaluation of overloaded vehicles. The report should be kept in the project records. Otherwise, written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

The Department will adjust payment for the asphalt binder used in the OGFSC mix in accordance with Section 411.06.B of the Standard Specifications. SiteManager will automatically calculate and place a Line Item Adjustment on the progressive estimate for the amount of asphalt binder price adjustment that is warranted. No further audit requirements should be necessary if the OGFSC is paid for in a timely manner on the progressive estimates.

C. Protection of the Work

Check that the OGFSC is satisfactorily maintained until the project is completed and any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

406 CHECKLIST – OPEN-GRADED FRICTION SURFACE COURSE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed mix design for the OGFSC been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the proposed asphalt plant for production of the OGFSC been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix design and asphalt plant?					
Has the Contractor been notified of the information necessary on the haul tickets (or electronic tickets) to enable the evaluation of overload deliveries?					
Has the Contractor submitted the equipment list (including the MTV) for the proper placement and compaction of the OGFSC?					
Has the minimum surface temperature requirement of at least 60 °F for OGFSC been discussed with the Contractor?					
Have the acceptable temperature ranges for the application of the OGFSC mixture been discussed?					
Have the application rates for OGFSC specified in the Plans been discussed?					
Does the Contractor have a plan to coordinate the number of haul trucks, speed of the MTV/paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Has the payment for OGFSC being limited to the daily calculation of theoretical tons required been discussed with the Contractor?					
Does the Contractor have a plan for maintenance of traffic and protection of the OGFSC during its placement and opening to traffic?					

Are there special provisions included in the contract for OGFSC surfacing that need to be discussed with the Contractor? Such as smoothness, electronic ticketing, etc.					
Are there bridges within the project which require attention for the MTV to cross the structure without causing damage to the bridge?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed mix design for the OGFSC been submitted by the Contractor and accepted by the Resident Engineer?					
Does the proposed asphalt plant for production of the OGFSC have a current certification and been accepted by the Resident Engineer?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix design and asphalt plant?					
Is the Contractor using the mix design that has been accepted by the Resident Engineer?					
Does the Contractor's haul tickets (or electronic tickets) include the information necessary to enable the evaluation of overload deliveries?					
Does the Contractor's paver, MTV and rollers meet the specification requirements for the proper placement and compaction of the OGFSC?					
Does the surface temperature meet the minimum requirements of at least 60 °F prior to the placement of the OGFSC?					
Are the weather conditions clear of fog with no anticipated rain during the placement of the OGFSC?					
Are acceptable mix temperature ranges for the application of the OGFSC mixture (JMF ± 25 °F) being achieved and recorded in the laydown report?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Are the application rates for the OGFSC in compliance with the rates specified in the Plans?					
Is the MTV being used to place the OGFSC mix into the paving machine?					
Has the Contractor complied with not raising (dumping) the wings of the paver's receiving hopper during the paving operations.					
Are bridges within the project being adequately protected from the MTV crossing the structure?					
Is the Contractor placing the OGFSC to the width and thickness specified on the Plans?					
Are the longitudinal joints for the OGFSC being placed at the lane lines and offset from the underlying longitudinal joint by at least 3"?					
Is the Contractor sufficiently maintaining traffic and protecting the OGFSC during its placement?					
Is the Contractor coordinating the number of haul trucks, speed of the MTV/paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Is the Contractor complying with the compaction requirements using at least 2-3 uniform passes with double steel-wheel rollers immediately after the OGFSC is placed?					
Has the rolling operation been completed for at least 2 hours, or the OGFSC surface temperature fallen to within 10 °F of the ambient temperature prior to opening the completed OGFSC to traffic?					
Has a sample of the asphalt cement binder used in the OGFSC mix been taken from the asphalt plant and submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have samples of the OGFSC mixture been taken and tested at the frequencies in accordance with the FAST Guide?					
Have all of the test results and confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Has the Contractor properly disposed of waste materials, asphalt emulsion, etc.?					
Are truck delivery haul tickets (or electronic tickets) being evaluated for overloads in accordance with CCD No. 20020213?					
Is the payment for OGFSC being evaluated daily and limited to the calculation of theoretical tons required for the day's run?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the OGFSC been placed to the thickness and width as shown on the Plans?					
Has the Contractor taken adequate precautions to protect the completed OGFSC from damage?					
Were any conditions requiring corrective action or maintenance addressed sufficiently by Contractor?					
Were samples of asphalt cement binder used in the OGFSC mix submitted to ODOT Materials Division for testing in accordance with the FAST Guide?					
Was the OGFSC mixture sampled at the frequency required in the FAST Guide for acceptance testing?					
Were truck delivery haul tickets (electronic tickets) evaluated for overloads in accordance with CCD No. 20020213 and deductions of quantity made if needed?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Was the payment for OGFSC being evaluated daily and limited to the calculation of theoretical tons required for the day's run?					

SECTION 407 – FOG SEAL AND TACK COAT

407.01 GENERAL

This work consists of preparing and treating an existing bituminous or concrete surface with bituminous material. The following terms are included in Section 407 of the Standard Specification and in this Manual to describe the bituminous material used for fog seal and tack coat treatments:

Original Emulsion. A mixture of asphalt, water, and a small amount of emulsifying agent to maintain a uniform blend.

Diluted Emulsion. An original emulsion diluted with additional water to reduce the viscosity and to allow easier spraying, typically used for fog seals.

Residual Asphalt Content. The amount of asphalt remaining on the pavement surface after all the water (both in the original emulsion and any additional water from dilution) has evaporated.

407.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Review applicable special provisions included in the Contract and plan notes (i.e., material requirements, application rates, etc.).
- Methods and equipment to be used.
- Information required to quantify work performed (details for shot record, original emulsion prior to dilution measured for payment, etc.).
- Weather limitations for construction.
- Surface preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Traffic control and maintenance of traffic during construction.

B. Acceptance of Materials

Review the material requirements for emulsified asphalt and NT Tack Material found in Section 708.03, "Asphalt Materials" of the Standard Specifications and any special provisions included in the contract or plan notes that pertain to the fog seal and/or tack coat treatment required in the Plans.

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the fog seal and/or tack coat pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

The Residency will verify that the proposed source of materials for the fog seal and/or tack coat type submitted by the Contractor are on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name and manufacturer is shown in the Emulsified Asphalt list or the NT Tack Coat list (whichever is being used on the project) on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

C. Preparatory Work and Contractor Work Plans

Consider the following before fog seal/tack coat construction work begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions and Plan Notes and determine any specific requirements that pertain to the fog seal and/or tack coat pay items on your project.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for fog seal and/or tack coat treatments.

2. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure the Contractor has a method to adequately prepare the surface prior to placement of the fog seal and/or tack coat treatments.

Ensure that the Contractor is aware of the minimum surface temperature and weather conditions required to proceed with the placement of the next surfacing layer. The Contractor should not apply the tack coat when the anticipated surface temperature and weather conditions are not expected to reach acceptable conditions.

3. Contractor Proposed Equipment

The Contractor may include the equipment needed to place the fog seal and/or tack coat in their submittals prior to beginning construction. Distributor trucks and supply tanks are the primary pieces of equipment required to apply the fog seal and/or tack coat.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 407.03.B of this Manual below.

D. Safety and Environmental Issues

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to minimize inconvenience and damage to vehicles during the application of the emulsion,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

407.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements for emulsified asphalt and NT Tack Material found in Section 708.03, "Asphalt Materials" of the Standard Specifications and any special provisions included in the contract or plan notes that pertain to the fog seal and/or tack coat treatment required in the Plans. Additionally, review the Materials Division Qualified Products List (QPL-Bituminous Materials) to determine types of emulsified asphalt that are acceptable for use (for example, SS-1 is not currently listed in Section 708.03 of the Standard Specification however it is an acceptable type of emulsion for fog seal/tack coat treatments and is listed on the QPL).

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the fog seal and/or tack coat pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

The Residency will verify that the proposed source of materials for the fog seal and/or tack coat type submitted by the Contractor are on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name and manufacturer is shown in the

Emulsified Asphalt list or the NT Tack Coat list (whichever is being used on the project) on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Sampling of the fog seal/tack coat emulsified asphalt or NT Tack Coat is not required to be performed by the residency personnel. If there are issues that are causing concerns with the material being used (i.e., inconsistency of material, lack of adhesive properties, etc.), the Resident Engineer may contact Materials Division – Bituminous Branch for their input and recommendations.

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing.

Verify the Contractor's equipment meets the requirements of Sections 401.03 and 407.03 of the Standard Specifications as follows.

1. Distributors and Supply Tanks

Ensure the Contractor provides distributors and supply tanks capable of uniformly applying bituminous material in accordance with the following:

- At the temperatures specified in the relevant specification sections;
- On variable widths of surface not to exceed 26 ft;
- At rates from 0.010 gal/yd^2 to 1.000 gal/yd^2; and
- With constant pressure and uniform temperature.

Ensure the distributor can apply material to vertical faces of asphalt pavement at the joints between paving operations.

Ensure the Contractor provides a distributor equipped with the following:

- A tachometer,
- Pressure gauges,
- Volume metering devices or a calibrated tank,
- A thermometer for measuring temperatures of tank contents,
- A power unit for the pump,
- Full circulation spray bars adjustable vertically and laterally,
- A positive shut off valve, and
- Fittings that prevent bituminous material from dripping.

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to ensure uniform distribution of the bituminous material. If clogging or streaking of the applied bituminous material occurs, stop the operation and correct the problems creating these conditions before resuming distribution. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

C. Construction Operations

The Pavement Preservation & Recycling Alliance (PPRA) has developed a website that provides a resource to owners, designers, and construction inspection personnel on the effective use of asphalt pavement preventive maintenance treatments (roadresource.org-treatment resource center) including fog seal treatments. You may visit their site to learn more about construction and quality assurance of these surface treatments by selecting from the index on the left side of their site (roadresource.org-tack coat) (roadresource.org-fog seal). One example of their guidance found under the tack coat's Preparation link is, "*Between lifts of fresh asphalt, cleaning is commonly not needed. However, if the freshly laid pavement has become dirty, it behooves the contractor to clean any and all such locations prior to the next lift being tacked and paved.*"

The purpose of the tack coat is to develop the proper bond between all of the pavement layers. To perform as designed, it is critical that each layer of asphalt pavement is adequately bonded together in the pavement structure. Inadequate bonding between layers may result in premature delamination of layers, slippage cracks and fatigue cracks. An effective and uniform tack coat will also facilitate better compaction of the asphalt layer being placed which will add longevity to the pavement.

The purpose of the fog seal is to add life and extend the longevity of an asphalt pavement. It is intended to seal narrow cracks and restore flexibility to the pavement surface. The reduction of the oxidation to the pavement surface can reduce raveling and aggregate loss.

Verify the following complies with Section 407.04 of the Standard Specifications when constructing the fog seal and/or tack coat treatment required in the Plans:

1. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum surface temperature and weather conditions required to proceed with the placement of the next surfacing layer. The Contractor should not apply the tack coat when the anticipated surface temperature and weather conditions are not expected to reach acceptable conditions. Care should be taken in windy conditions to prevent unwanted drifting of the emulsion, especially into traffic in the work zone.

Ensure the Contractor adequately prepares the surface prior to placement of the fog seal and/or tack coat treatments. When the emulsion is applied to a dusty or dirty surface, the fog seal/tack coat will cling to the dust and dirt rather than the roadway surface which will adversely affect the bonding of the asphalt layers. The surface needs to be free of vegetation, soil, loose aggregate, and dust. A damp surface is acceptable, but do not allow the Contractor to apply the fog seal/tack coat to wet surfaces with free standing water. It is challenging to adequately clean a milled asphalt surface and extra effort might be necessary by the Contractor to eliminate the dust coating which would act as a bond breaker to the surface layer being placed. If dry sweeping is ineffective in removing the dust from the milled surface, the Contractor may need to use sweeping-vacuuming combination, wet sweeping or flushing the surface with water. The use of high-pressure air could also be used to blow debris from the surface.

2. Application of Emulsified Asphalt

The Original Emulsion as provided by a supplier is a mixture of asphalt, water, and a small amount of emulsifying agent to maintain a uniform blend. The Diluted Emulsion is an Original Emulsion diluted with additional water to reduce the viscosity and to allow easier spraying. The Contractor may elect to dilute the emulsion for the tack coat treatment, but the dilution ratio is typically higher for fog seals. The Residual Asphalt Content is the amount of asphalt remaining on the pavement surface after all of the water, both in the original emulsion and any additional water, has evaporated.

The gallons of Original Emulsion used will be measured for payment for the relevant pay item. The residency project inspector must measure the quantity of fog seal/tack coat placed utilizing the volume metering device on the distributor truck or readings from a calibrated tank. Document the beginning and ending meter reading for each day for progressive payments on the Shot Record report. A Shot Record spreadsheet that documents the information necessary can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Shot Record (Shot Record v1.4.xlsm).

Ensure the Contractor complies with the emulsion type, application rates and dilution ratio for the fog seal and/or tack coat treatments as specified in the plans, special provisions and specifications, unless they are modified by the Resident Engineer. Ensure the emulsion is sprayed within the acceptable temperature range in accordance with Table 708.4 in Section 708.03 of the Standard Specifications (between 70-185 °F for all emulsions) unless otherwise specified in the plans or special provisions.

The fog seal and/or tack coat treatment must be applied using a distributor truck meeting the requirements of Section 401.03 of the Standard Specifications.

Before allowing the Contractor to proceed with the application of the fog seal/tack coat, ensure the Contractor and residency project inspector are in agreement with the following:

- Quantity to be placed,
- Rate of application,
- Temperature of emulsion when applied, and
- Areas to be treated.

(a) Fog Seal

Ensure the Contractor applies the fog seal at a rate of 0.10 gal/yd² of diluted emulsion diluted at 5:1 water to original emulsion in accordance with Section 407.04.B of the Standard Specifications. Check the plan notes for your project to verify the application rate or dilution ratio have not been changed from the Standard Specification values. The Resident Engineer may alter the application rate or dilution ratio due to weather conditions, type of emulsion, or surface type being treated.

(b) Tack Coat

Ensure the Contractor applies the tack coat or NT tack material at the rates shown in Table 407:1 found below and in Section 407.04.C of the Standard Specifications. Check the plan notes for your project to verify the application rates have not been changed from the Standard Specification values. The Resident Engineer may alter the application rate or dilution ratio due to weather conditions, type of emulsion, or surface type being treated (milled surface, newly placed asphalt, etc.).

Table 407:1 Tack Application Rates		
Surface Type/Layer	**Original Emulsion gal/yd^2**	**Residual gal/yd^2**
New Asphalt (bottom)	0.060	0.035
Old Asphalt (bottom)	0.085	0.050
Milled (bottom)	0.085	0.050
New Fabric (bottom)	—	0.200
PFC, OGFSC (top)	0.100	0.060
UTBWC (top)	0.200	0.120
PCC (bottom)	0.075	0.045

Slow setting emulsions can likely be diluted with additional water to facilitate a more uniform coverage of the residual asphalt. This can be especially beneficial when residual rates of emulsified asphalt are specified below 0.05 gal/yd^2 . For higher application rates, the benefits of dilution are reduced. When the original emulsion is diluted, the rate of application must be increased proportionally to achieve the desired residual asphalt.

Paint a thin, uniform tack coat on all surfaces of curbs and gutters, manholes, and other structures that will come in contact with hot mix asphalt. Ensure the tack coat applications minimize damage and inconvenience to traffic and allow one way traffic without pickup or tracking the bituminous material.

(c) Uniform Application

It is extremely important that the fog seal and/or tack coat be uniformly applied to the pavement surface to obtain full coverage. One of the most critical components to achieve uniform application of the fog seal and/or tack coat treatment is the spray bar on the distributor truck. The spray bar is mounted to the back of the distributor truck and has a series of evenly spaced spray nozzles. The spray nozzles must be free-flowing and set at angles to ensure the spray fans do not interfere with each other. The height of the spray bar can affect the desired overlap of the spray fans. The illustration below shows the desired height/spray overlap to ensure a uniform application. The height of the spray bar could be affected by the amount of emulsion in the distributor truck; a full load will be lower and as the load becomes lighter the bar will rise. Monitor the height during the operation to ensure the coverage is acceptable.

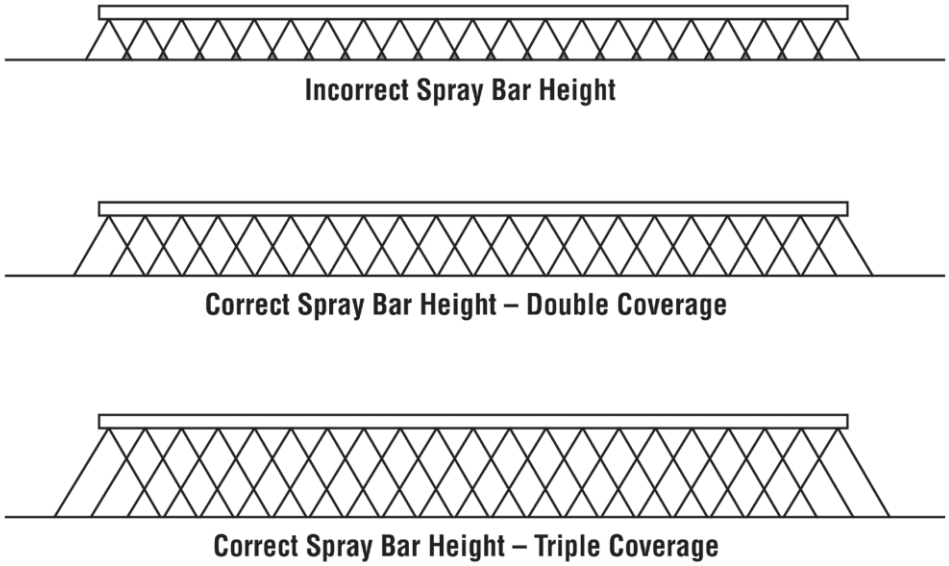

Figure 407:1. Illustration. Proper Spray Bar Height

If the fog seal/tack coat application appears to have streaks or stripes instead of a uniform appearance, stop the operation and ensure the Contractor check the following and corrects any deficiencies before resuming their operation:

- Clogged nozzles (could be caused by low temperature of emulsion)
- Incorrect nozzle size
- Incorrect nozzle orientation
- Lack of proper pressure in spray bar
- Incorrect spray bar height

When there are areas or locations that are inaccessible for the use of a distributor truck, ensure the Contractor has the equipment necessary to use a handheld spray wand to apply the tack coat. Ensure a uniform tack coat is applied on all surfaces of adjacent existing pavement, curb and gutter, manholes and any other structures that will come in contact with the hot mix asphalt when it is placed. The Contractor must not use a spray wand exclusively in locations accessible to the distributor truck.

(d) Calibration of Distributor Truck

It is important to verify the application rate of the fog seal/tack coat to ensure that the desired amount of residual asphalt is applied. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor

is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. There are multiple methods that the Contractor may use to calibrate the asphalt distributor including measuring the volume of emulsion sprayed into containers over a specified period of time or operating the distributor truck over pads that are weighed before and after the operation. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

3. Maintenance

Re-apply tack coat at a rate that ensures proper bonding if the tack loses its adhesive properties or is damaged by traffic before being covered by the next surfacing layer, as directed by the Resident Engineer, at no additional cost to the Department.

After the tack coat material is applied on the surface, the emulsified asphalt will "break" at the point when water separates enough from the residual asphalt to show a color change from brown to black. The emulsion is "cured" when all of the water has evaporated, and the asphalt properties have fully returned. The time needed for the emulsion to break or cure is dependent on the type of emulsion and the weather conditions. A hot, dry, windy climate will result in a faster evaporation rate than a cool, damp climate.

Tack coat tracking will adversely affect the bonding between the layers of asphalt pavement and reduce its longevity. It is important to minimize traffic on the newly applied emulsion until it has broken and cured if practical, to minimize tracking of the emulsion. Ensure that the tack coat breaks before the placement of the next surfacing layer of asphalt.

D. Safety and Environmental Considerations

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor should address the following:

- Providing traffic control during construction to minimize inconvenience and damage to vehicles during the application of the emulsion,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents), length & width of area of emulsion placed.
- Daily application rate of emulsion placed.
- Daily shot record of gallons and type of emulsion placed and resulting application rate.
- Receipt of materials certifications.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

The volume (gallons) of emulsion for Fog Seal, Tack Coat and NT Tack Material will be measured for payment as delivered from the supplier prior to any dilution.

Measure the quantity of fog seal/tack coat placed utilizing the volume metering device on the distributor truck or readings from a calibrated tank. Document the beginning and ending meter reading for each day for progressive payments on the Shot Record report.

Documentation of these Gallon pay items will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item (Fog Seal, Tack Coat or NT Tack Material) from the list of contract pay items.

b. In the appropriate field, enter the station-to-station extents and a descriptive location.

c. In the Placed Quantity field, enter the quantity (GAL) of the item completed.

d. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations, with different dimensions, select the ‘New’ button to create a new row for the selected pay item.

407.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials which were submitted by the Contractor were utilized on the project. If the previously accepted proposed sources of materials which were submitted by the Contractor were not utilized on the project are not on the Qualified Products List, contact Materials Division to confirm the status of source/product approvals. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

B. Audit Requirements

Ensure the volume (gallons) of emulsion for Fog Seal, Tack Coat and NT Tack Material was measured as delivered from the supplier prior to any dilution.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Check that the tack coat is satisfactorily maintained until the next asphalt surface is placed and the fog seal is maintained and protected from damage until the project is completed. Ensure that any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

Ensure the Contractor minimizes traffic on the newly applied emulsion until it has broken and cured if practical, to minimize tracking of the emulsion. Re-apply tack coat at a rate that ensures proper bonding if the tack loses its adhesive properties or is damaged by traffic before being covered by the next surfacing layer, as directed by the Resident Engineer, at no additional cost to the Department. Re-apply damaged or insufficient fog seal treatment at a rate that complies with the intent of the plans, as directed by the Resident Engineer, at no additional cost to the Department.

Ensure that the tack coat breaks before the placement of the next surfacing layer of asphalt.

407 CHECKLIST – FOG SEAL AND TACK COAT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed source of asphalt emulsion material been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent a response to the Contractor on the acceptance/nonacceptance of the source of asphalt emulsion?					
Have the minimum surface temperature requirements stated in the Standard Specifications been discussed with the Contractor for the placement of the next layer of asphalt?					
Has the equipment requirements including the use of a handheld spray wand for inaccessible areas been discussed?					
Have the acceptable emulsion temperature ranges for the spraying of the asphalt emulsion been discussed?					
Have the application rates for the asphalt emulsion specified in the Plans (or specifications) been discussed?					
Has the method of measurement being the gallons delivered from the supplier prior to dilution by the Contractor been discussed?					
Does the Contractor have a plan for maintenance and protection of traffic during the emulsion treatment?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed source of asphalt emulsion material been submitted by the Contractor and reviewed by the Resident Engineer and accepted?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the source of asphalt emulsion?					
Is the Contractor using the source of asphalt emulsion that has been accepted by the Resident Engineer?					
Has the confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Does the Contractor's distributor truck meet the specification requirements for the proper placement of the emulsion?					
Is the Contractor diluting the emulsion within an acceptable dilution ratio?					
Does the surface temperature meet the minimum requirements for the placement of the next layer of asphalt?					
Is the Contractor using a handheld spray wand for areas inaccessible to the distributor truck (adjacent pavement edge, face of curb & gutter, drainage structures, etc.)?					
Are the acceptable temperature ranges for the application of the asphalt emulsion (70-185 °F) being achieved?					
Are the application rates for the asphalt emulsion in compliance with the rates specified in the Plans (or specifications if not stated in the Plans)?					
Is the Contractor placing the asphalt emulsion to the width specified on the Plans?					
Is the emulsion being applied uniformly without streaking or thin/thick areas?					
Are daily shot records being kept by the residency project inspector to record quantity and application rates?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor sufficiently maintaining traffic and protecting traffic during the placement of the emulsion?					
Has the Contractor properly disposed of waste materials, asphalt emulsion, etc.?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor use the source of asphalt emulsion that has been accepted by the Resident Engineer?					
Has the emulsion been placed to the width and application rates specified in the Plans (or specifications if not stated in the Plans)?					
Was a handheld spray wand effectively used for inaccessible areas (adjacent pavement edge, face of curb & gutter, drainage structures, etc.)?					
Did the Contractor taken adequate precautions to protect the completed emulsion treatment from damage such as minimizing traffic on the newly applied emulsion until it has broken or cured?					
Were any conditions requiring corrective action or maintenance (tracking, streaking, non-uniform application, etc.) addressed sufficiently by the Contractor?					
Did the Contractor ensure that the tack coat broke sufficiently before the placement of the next surfacing layer of asphalt.					
Did the Contractor properly disposed of waste materials, asphalt emulsion, etc.?					

SECTION 408 – PRIME COAT

408.01 GENERAL

This work consists of preparing and treating the surface of a subgrade or subbase with bituminous material. The following terms are included in Section 408 of the Standard Specification and in this Manual to describe the bituminous material used for prime coat treatments:

Cutback. A mixture of asphalt and a petroleum solvent.

MC-30 and MC-70. Cutbacks with residual asphalt contents of at least 50 percent and 55 percent, respectively.

Original Emulsion. A mixture of asphalt, water, and a small amount of emulsifying agent to maintain a uniform blend.

Diluted Emulsion. An original emulsion diluted with additional water to reduce the viscosity and to allow easier spraying, typically used for fog seals.

Residual Asphalt Content. The amount of asphalt remaining on the surface of the subgrade or subbase after the petroleum solvent evaporates from the cutback. Alse, the amount of asphalt remaining on the pavement surface of the subgrade or subbase after all the water (both in the original emulsion and any additional water from dilution) has evaporated.

408.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Review applicable special provisions included in the Contract and plan notes (i.e., material requirements, application rates, etc.).
- Identify whether project is within an ODEQ designated non-attainment air quality county (Oklahoma and Tulsa Counties) and if cutback is allowed on the project.
- Methods and equipment to be used.
- Information required to quantify work performed (details for shot record, original emulsion prior to dilution measured for payment, etc.).
- Weather limitations for construction.
- Surface preparation requirements prior to and during construction.
- Contractor’s schedule/plan for the work.
- Traffic control and maintenance of traffic during construction.

B. Acceptance of Materials

Review the material requirements for MC-30 and MC-70 found in Section 708.03, "Asphalt Materials" of the Standard Specifications and any special provisions included in the contract or plan notes that pertain to the prime coat treatment required in the Plans. In ODEQ designated non-attainment air quality counties (Oklahoma and Tulsa Counties), an emulsion may be used in lieu of the cutbacks. The amount of emulsion used must achieve the same resulting residual asphalt residual content as the cutback prime coat would have achieved.

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the prime coat pay item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

The Residency will verify that the proposed source of materials for the prime coat type submitted by the Contractor are on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name and manufacturer is shown in the Cutback Asphalt or the Emulsified Asphalt list or the NT Tack Coat list (whichever is being used on the project) on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

C. Preparatory Work and Contractor Work Plans

Consider the following before prime coat construction work begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions and Plan Notes and determine any specific requirements that pertain to the prime coat pay item on your project.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for prime coat treatments.

(a) Cutback vs. Emulsion

Cutback bituminous material is the preferred prime coat material due to being able to penetrate more effectively into the subgrade or subbase. Due to the evaporation of the petroleum solvent in the cutback, its use is restricted on projects that are located within ODEQ designated non-attainment air quality counties (Oklahoma and Tulsa Counties). In ODEQ designated non-attainment air quality counties, an emulsion may be used in lieu of the cutbacks. The amount of emulsion used must achieve the same resulting residual asphalt residual content as the cutback prime coat would have achieved. (Note: The use of cutback in Oklahoma and Tulsa counties is permissible with prior written consent of ODEQ during Oklahoma's non-oxidant season beginning December 1 through the last day of February. Confirm the current regulations with the ODOT Environmental Programs Division before authorizing the use of cutback within Oklahoma or Tulsa Counties.)

Check the Plans for reference to the type of bituminous material required on the project (cutback or emulsion). If there is no requirement in the Plans, verify whether the project is located in an ODEQ designated non-attainment air quality county which would require the use of an emulsion. If the project is not within a ODEQ designated county, then a cutback product (MC-30 or MC-70) must be used.

2. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure the Contractor has a method to adequately prepare the surface prior to placement of the prime coat treatment.

Ensure that the Contractor is aware of the minimum ambient temperature (50 °F) and weather conditions required to proceed with the placement of the prime coat treatment.

3. Contractor Proposed Equipment

The Contractor may include the equipment needed to place the prime coat in their submittals prior to beginning construction. Distributor trucks and supply tanks are the primary pieces of equipment required to apply the prime coat.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 408.03.B of this Manual below.

D. Safety and Environmental Issues

Cutback bituminous material is usually the preferred prime coat material due to being able to penetrate more effectively into the subgrade or subbase. Due to the evaporation of the petroleum solvent in the cutback, its use is restricted on projects that are located within

ODEQ designated non-attainment air quality counties (Oklahoma and Tulsa counties). Ensure the Contractor complies with any restrictions from ODEQ and allow the use of an emulsified asphalt in lieu of the cutback, if necessary or if stated in the Plans. (Note: The use of cutback in Oklahoma and Tulsa counties is permissible with prior written consent of ODEQ during Oklahoma's non-oxidant season beginning December 1 through the last day of February. Confirm the current regulations with the ODOT Environmental Programs Division before authorizing the use of cutback within Oklahoma or Tulsa Counties.)

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to minimize inconvenience and damage to vehicles during the application of the cutback/emulsion,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

408.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements for MC-30 and MC-70 found in Section 708.03, "Asphalt Materials" of the Standard Specifications and any special provisions included in the contract or plan notes that pertain to the prime coat treatment required in the Plans. In ODEQ designated non-attainment air quality counties (Oklahoma and Tulsa counties), an emulsion may be used in lieu of the cutbacks. Review the Materials Division Qualified Products List (QPL-Bituminous Materials) to determine types of emulsified asphalt that are acceptable for use (for example, SS-1 is not currently listed in Section 708.03 of the Standard Specification however it is an acceptable type of emulsion for prime coat treatments and is listed on the QPL).

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the prime coat pay item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

The Residency will verify that the proposed source of materials for the prime coat type submitted by the Contractor are on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name and manufacturer is shown in the Cutback Asphalt or the Emulsified Asphalt list or the NT Tack Coat list (whichever is being

used on the project) on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Sampling of the prime coat cutback or emulsified asphalt is not required to be performed by the residency personnel. If there are issues that are causing concerns with the material being used (i.e., inconsistency of material, lack of adhesive properties, etc.), the Resident Engineer may contact Materials Division – Bituminous Branch for their input and recommendations.

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing.

Verify the Contractor's equipment meets the requirements of Sections 401.03 and 408.03 of the Standard Specifications as follows.

1. Distributors and Supply Tanks

Ensure the Contractor provides distributors and supply tanks capable of uniformly applying bituminous material in accordance with the following:

- At the temperatures specified in the relevant specification sections;
- On variable widths of surface not to exceed 26 ft;
- At rates from 0.010 gal/yd² to 1.000 gal/yd²; and
- With constant pressure and uniform temperature.

Ensure the distributor can apply material to vertical faces of asphalt pavement at the joints between paving operations.

Ensure the Contractor provides a distributor equipped with the following:

- A tachometer,

- Pressure gauges,
- Volume metering devices or a calibrated tank,
- A thermometer for measuring temperatures of tank contents,
- A power unit for the pump,
- Full circulation spray bars adjustable vertically and laterally,
- A positive shut off valve, and
- Fittings that prevent bituminous material from dripping.

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to ensure uniform distribution of the bituminous material. If clogging or streaking of the applied bituminous material occurs, stop the operation and correct the problems creating these conditions before resuming distribution. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting;

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

C. Construction Operations

The Pavement Preservation & Recycling Alliance (PPRA) has developed a website that provides a resource to owners, designers, and construction inspection personnel on the effective use of asphalt pavement preventive maintenance treatments (roadresource.org-treatment resource center) including the use of prime coat. You may visit their site to learn more about construction and quality assurance of these surface treatments by selecting from the index on the left side of their site (roadresource.org-prime coat). One example of their guidance found under the prime coat's Preparation link is, "*Emulsified products generally cure faster than cutback asphalts. Asphalt emulsions require a minimum of 24 hours to fully cure. Cutbacks require a minimum of 72 hours to fully cure.*"

The purpose of the prime coat is to protect the subgrade or subbase by maintaining the in-place density and moisture content until paving operations commence. If the placement of the initial asphalt base course layer is not anticipated to be placed in a timely manner resulting in a prolonged exposure of the subgrade or subbase, it becomes more critical to apply the prime coat treatment. The prime coat will also provide the following benefits for the base layer that is treated:

- Waterproof the base layer material,
- Fill surface voids and stabilize the fines to reduce raveling,
- Promote bonding to the first pavement layer.

The longevity of the prime coat's benefits are dependent on the type of base layer material treated, the amount of construction traffic exposure, the weather conditions, and the uniformity of the prime coat application.

Verify the following complies with Section 408.04 of the Standard Specifications when constructing the prime coat treatment required in the Plans:

1. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum ambient temperature (50 °F) and weather conditions required to proceed with the placement of the prime coat. Care should be taken in windy conditions to prevent unwanted drifting of the emulsion, especially into traffic in the work zone.

Ensure the Contractor adequately prepares the surface of the subgrade or subbase prior to placement of the prime coat treatment. The surface needs to be free of vegetation, soil, and loose aggregates to ensure maximum penetration of the prime coat. A damp surface is preferable, but do not allow the Contractor to apply the prime coat to wet surfaces with free standing water.

2. Application of Prime Coat

Ensure the Contractor complies with the cutback or emulsion type and application rates for the prime coat treatment as specified in the plans, special provisions and specifications, unless they are modified by the Resident Engineer. Ensure the cutback/emulsion is sprayed within the acceptable temperature range in accordance with Table 708.4 in Section 708.03 of the Standard Specifications unless otherwise specified in the plans or special provisions.

The prime coat treatment must be applied using a distributor truck meeting the requirements of Section 401.03 of the Standard Specifications.

The gallons of cutback/emulsion used for the prime coat will be measured for payment as delivered from the supplier prior to any dilution. The residency project inspector must measure the quantity of prime coat placed utilizing the volume metering device on the distributor truck or readings from a calibrated tank. Document the beginning and ending meter reading for each day for progressive payments on the Shot Record report. A Shot Record spreadsheet that documents the information necessary can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Shot Record (Shot Record v1.4.xlsm).

Construction traffic needs to be kept off the newly applied prime coat until the bituminous material has fully cured to keep it from being damaged. If traffic needs to be able to travel through the work area, the Contractor should apply the prime coat to no more than half the roadway width at a time while maintaining traffic on

the other untreated portion. Once the prime coat has cured, the other portion can be treated. To prolong the efficiency of the prime coat, construction traffic should be minimized to the extent possible.

Do not allow the Contractor to apply successive applications of prime coat or proceed with the construction of the base layer of the asphalt pavement until the prime coat cures and hardens.

Before allowing the Contractor to proceed with the application of the prime coat, ensure the Contractor and residency project inspector are in agreement with the following:

- Quantity to be placed,
- Rate of application,
- Temperature of cutback/emulsion when applied, and
- Areas to be treated.

(a) Cutback

Cutback bituminous material is usually the preferred prime coat material due to being able to penetrate more effectively into the subgrade or subbase. Due to the evaporation of the petroleum solvent in the cutback, its use is restricted on projects that are located within ODEQ designated non-attainment air quality counties (Oklahoma and Tulsa counties). Ensure the Contractor complies with any restrictions from ODEQ and allow the use of an emulsified asphalt in lieu of the cutback, if necessary or if stated in the Plans. Additionally, if the subgrade/subbase contains friable or non-cohesive materials, the Resident Engineer may approve the substitution of the emulsion in lieu of the cutback.

Ensure the Contractor applies the cutback prime coat as it is delivered at a rate between 0.10 gal/yd^2 to 0.40 gal/yd^2 in accordance with Section 408.04.D of the Standard Specifications. Check the plan notes for your project to verify the application rate has not been changed from the Standard Specification values. The Resident Engineer may alter the application rate due to weather conditions or surface type being treated (aggregate base, treated subgrade, non-cohesive soil, etc.). The gallons of original as delivered cutback used will be measured for payment for the prime coat pay item.

Ensure the cutback is sprayed within the acceptable temperature range in accordance with Table 708.4 in Section 708.03 of the Standard Specifications (between 50-120 °F for MC-30 and between 80-150 °F for MC-70) unless otherwise specified in the plans or special provisions.

(b) Emulsion

When required due to environmental reasons, or when specified in the Plans, or as approved by the Resident Engineer an emulsified asphalt may be used in lieu of a cutback. The Original Emulsion as provided by a supplier is a mixture of asphalt, water, and a small amount of emulsifying agent to maintain a uniform blend. The Diluted Emulsion is an Original Emulsion diluted with additional water to reduce the viscosity and to allow easier spraying and increased penetration into the subgrade/subbase material. The Contractor may elect to dilute the original emulsion for the prime coat treatment. The Residual Asphalt Content is the amount of asphalt remaining on the treated surface after all of the water, both in the original emulsion and any additional water, has evaporated.

Ensure the emulsion is sprayed within the acceptable temperature range in accordance with Table 708.4 in Section 708.03 of the Standard Specifications (between 70-185 °F for all emulsions) unless otherwise specified in the plans or special provisions.

If using an emulsion for the prime coat, ensure the Contractor applies the emulsion material at the rates necessary to achieve the same desired residual asphalt application rate as the cutback. The specifications require that cutback prime coat as it is delivered be applied at a rate between 0.10 gal/yd² to 0.40 gal/yd². Check the plan notes for your project to verify the application rates have not been changed from the Standard Specification values. The typical residual asphalt content for emulsions is approximately 60% (as shown in Table 407:1 of Section 407.04.C of the Standard Specifications) whereas the MC-30 is 50% and MC-70 is 55%. Therefore, it is likely that the application rates will require minimal adjustments. The Resident Engineer may alter the application rate due to weather conditions, type of emulsion, or surface type being treated (aggregate base, treated subgrade, non-cohesive soil, etc.). The gallons of Original Emulsion used as delivered from the supplier will be measured for payment for the prime coat pay item.

Slow setting emulsions can likely be diluted with additional water to facilitate a more uniform coverage of the residual asphalt. This can be especially beneficial when residual rates of emulsified asphalt are specified below 0.05 gal/yd^2 . For higher application rates, the benefits of dilution are reduced. When the original emulsion is diluted, the rate of application must be increased proportionally to achieve the desired residual asphalt.

(c) Uniform Application

It is important that the prime coat be uniformly applied to the pavement surface to obtain full coverage. One of the most critical components to achieve uniform application of the prime coat treatment is the spray bar on

the distributor truck. The spray bar is mounted to the back of the distributor truck and has a series of evenly spaced spray nozzles. The spray nozzles must be free-flowing and set at angles to ensure the spray fans do not interfere with each other. The height of the spray bar can affect the desired overlap of the spray fans. The illustration below shows the desired height/spray overlap to ensure a uniform application. The height of the spray bar could be affected by the amount of cutback/emulsion in the distributor truck; a full load will be lower and as the load becomes lighter the bar will rise. Monitor the height during the operation to ensure the coverage is acceptable.

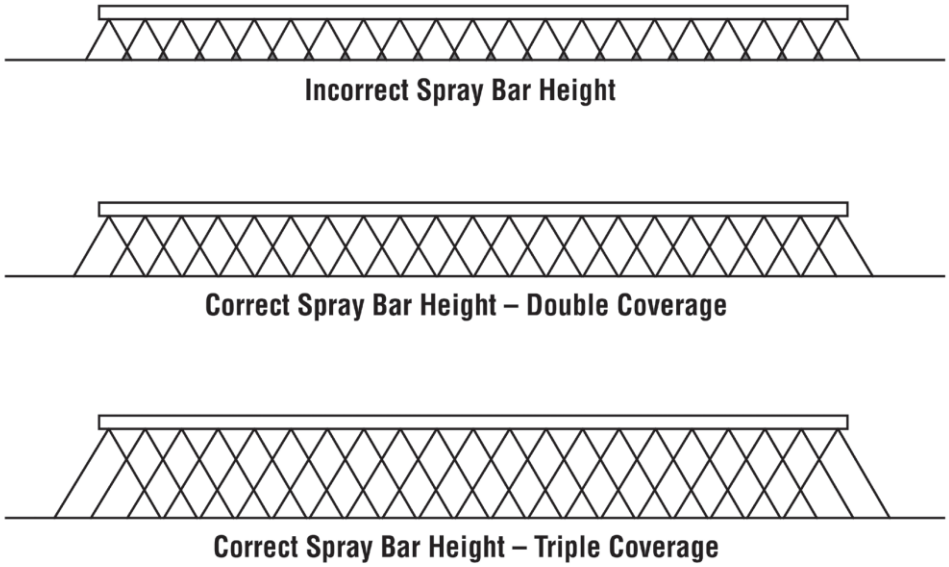

Figure 408:1. Illustration. Proper Spray Bar Height

If the prime coat application appears to have streaks or stripes instead of a uniform appearance, stop the operation and ensure the Contractor check the following and corrects any deficiencies before resuming their operation:

- Clogged nozzles (could be due to low temperature of cutback/emulsion)
- Incorrect nozzle size
- Incorrect nozzle orientation
- Lack of proper pressure in spray bar
- Incorrect spray bar height

When there are areas or locations that are inaccessible for the use of a distributor truck, ensure the Contractor has the equipment necessary to use a handheld spray wand to apply the prime coat. The Contractor must not use a spray wand exclusively in locations accessible to the distributor truck.

(d) Calibration of Distributor Truck

It is important to verify the application rate of the prime coat to ensure that the desired amount of residual asphalt is applied. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. There are multiple methods that the Contractor may use to calibrate the asphalt distributor including measuring the volume of cutback/emulsion sprayed into containers over a specified period of time or operating the distributor truck over pads that are weighed before and after the operation. A Calibration Shot Record spreadsheet that complies with NCHRP Report No. 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

3. Maintenance and Application of Blotter Material

The Contractor must correct deficiencies in prime coat application at no additional cost to the Department. The prime coat may be reapplied if it loses its adhesive properties or is damaged by traffic before being covered by the next subbase or base course asphalt layer, as directed by the Resident Engineer.

After the prime coat material is applied on the surface, the cutback/emulsified asphalt will "break" at the point when petroleum solvent/water separates enough from the residual asphalt to show a color change from brown to black. The prime coat is "cured" when all of the petroleum solvent/water has evaporated, and the asphalt properties have fully returned and have hardened. The time needed for the prime coat to break or cure is dependent on the type of cutback/emulsion used and the weather conditions. A hot, dry, windy climate will result in a faster evaporation rate than a cool, damp climate.

It is important to minimize traffic on the newly applied prime coat until it has cured and hardened if practical, to minimize tracking. Prime coat tracking will adversely affect its effectiveness and reduce its longevity.

The Contractor may elect to spread blotter material on the treated surface to absorb excess bituminous material to expedite the use of construction traffic though the work area. Ensure that the prime coat cures and hardens before the placement of the next subbase or base course layer of asphalt.

4. Waiving Prime Coat Application

The placement of the subbase or base course layer of asphalt must await the curing of the prime coat treatment that is applied. The time necessary for the full curing of the prime coat is dependent on the type of prime coat used, the type of material

treated, and the weather conditions. It is especially critical that when cutback is used that the full cure is obtained. If any petroleum solvent from the cutback has not evaporated fully, it will begin immediately deteriorating the base course layer of asphalt.

Many times, the Contractor will request that the prime coat be eliminated. And they will occasionally under-bid the cost of the prime coat pay item assuming that its use will be waived. Since the primary purpose of the prime coat is to protect the subgrade or subbase by maintaining the in-place density and moisture content until paving operations commence, it is occasionally decided to waive the application of the prime coat when the timely placement of the asphalt is scheduled. However, there are other benefits from the prime coat that might be considered more important than the timely placement of the asphalt, such as waterproofing the base and enhanced bonding to the first pavement layer. If the placement of the initial asphalt base course layer is not anticipated to be placed in a timely manner resulting in a prolonged exposure of the subgrade or subbase, it becomes more critical to apply the prime coat treatment. Therefore, the decision to waive the prime coat should be thoroughly discussed with the Resident Engineer and even the District Engineer.

If the use of the prime coat is waived, it is critical that the Contractor maintain the moisture content constantly until the base course layer of asphalt is placed. Maintaining the surface moisture while the asphalt is being placed will enhance the bonding as well.

D. Safety and Environmental Considerations

Cutback bituminous material is usually the preferred prime coat material due to being able to penetrate more effectively into the subgrade or subbase. Due to the evaporation of the petroleum solvent in the cutback, its use is restricted on projects that are located within ODEQ designated non-attainment air quality counties (Oklahoma and Tulsa counties). Ensure the Contractor complies with any restrictions from ODEQ and allow the use of an emulsified asphalt in lieu of the cutback, if necessary or if stated in the Plans. (Note: The use of cutback in Oklahoma and Tulsa counties is permissible with prior written consent of ODEQ during Oklahoma's non-oxidant season beginning December 1 through the last day of February. Confirm the current regulations with the ODOT Environmental Programs Division before authorizing the use of cutback within Oklahoma or Tulsa Counties.)

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor should address the following:

- Providing traffic control during construction to minimize inconvenience and damage to vehicles during the application of the cutback/emulsion,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents), length & width of area of prime coat placed.
- Daily application rate of prime coat placed.
- Daily shot record of gallons and type of prime coat placed and resulting application rate.
- Receipt of materials certifications.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

The volume (gallons) of cutback/emulsion for Prime Coat will be measured as delivered from the supplier prior to any dilution.

Measure the quantity of prime coat placed utilizing the volume metering device on the distributor truck or readings from a calibrated tank. Document the beginning and ending meter reading for each day for progressive payments on the Shot Record report.

Documentation of the Prime Coat pay item paid by the Gallon will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item (Prime Coat) from the list of contract pay items.

b. In the appropriate field, enter the station-to-station extents and a descriptive location.

c. In the Placed Quantity field, enter the quantity (GAL) of the item completed.

d. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations, with different dimensions, select the ‘New’ button to create a new row for the selected pay item.

408.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials which were submitted by the Contractor were utilized on the project. If the previously accepted proposed sources of materials which were submitted by the Contractor were not utilized on the project are not on the Qualified Products List, contact Materials Division to confirm the status of source/product approvals. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

B. Audit Requirements

Ensure the volume (gallons) of cutback/emulsion for Prime Coat was measured as delivered from the supplier prior to any dilution.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Check that the prime coat is satisfactorily maintained until the subbase or base course of asphalt is placed. Ensure that any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

Ensure the Contractor minimizes traffic on the newly applied prime coat until it has cured and hardened if practical, to minimize tracking of the prime coat. Prime coat tracking will adversely affect its effectiveness and reduce its longevity. The Contractor must correct deficiencies in prime coat application at no additional cost to the Department. The prime coat may be reapplied if it loses its adhesive properties or is damaged by traffic before being covered by the next subbase or base course asphalt layer, as directed by the Resident Engineer.

Ensure that the prime coat cures and hardens before the placement of the next subbase or base course layer of asphalt.

408 CHECKLIST – PRIME COAT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the use of emulsion in lieu of cutback been determined due to environmental reasons, plan requirements or other reasons approved by the Resident Engineer?					
Has the proposed source of cutback/emulsion material been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent a response to the Contractor on the acceptance/nonacceptance of the source of cutback/emulsion?					
Have the minimum ambient temperature requirements (50 °F) stated in the Standard Specifications been discussed with the Contractor for the placement of the prime coat?					
Have the equipment requirements including the use of a handheld spray wand for inaccessible areas been discussed?					
Have the acceptable cutback/emulsion temperature ranges for the spraying of the prime coat been discussed?					
Have the application rates for the cutback/emulsion specified in the Plans (or specifications) been discussed?					
Has the method of measurement being the gallons delivered from the supplier prior to dilution by the Contractor been discussed?					
Does the Contractor have a plan for maintenance and protection of traffic during the prime coat treatment?					
Does the Contractor have a plan for maintenance and protection of the prime coat treatment after it is applied?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed source of cutback/emulsion material been submitted by the Contractor and reviewed by the Resident Engineer and accepted?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the source of cutback/emulsion?					
Is the Contractor using the source of cutback/emulsion that has been accepted by the Resident Engineer?					
Has the test confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Does the Contractor's distributor truck meet the specification requirements for the proper placement of the prime coat?					
Does the ambient temperature meet the minimum requirements (50 °F) for placement of the prime coat?					
Is the Contractor using a handheld spray wand for areas inaccessible to the distributor truck?					
Are the acceptable temperature ranges for the application of the asphalt emulsion (70-185 °F) being achieved?					
Are acceptable temperature ranges for application of the cutback (between 50-120 °F for MC-30 and between 80-150 °F for MC-70) being achieved?					
Are the application rates for the cutback/emulsion in compliance with the rates specified in the Plans (or specifications if not stated in the Plans)?					
Is the Contractor placing the prime coat to the width specified on the Plans?					
Is the cutback/emulsion being applied uniformly without streaking or thin/thick areas?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Are daily shot records being kept by the residency project inspector to record quantity and application rates?					
Is the Contractor sufficiently maintaining traffic during the placement of the prime coat?					
Is the Contractor sufficiently protecting the prime coat after its placement?					
Has prime coat cured and hardened before placement of the next subbase or base course layer of asphalt?					
Has the Contractor properly disposed of waste materials, cutback/emulsion, etc.?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor use the source of cutback/emulsion that has been accepted by the Resident Engineer?					
Has the prime coat been placed to the width and application rates specified in the Plans (or specifications if not stated in the Plans)?					
Was a handheld spray wand effectively used for inaccessible areas?					
Did the Contractor taken adequate precautions to protect the completed prime coat from damage such as minimizing traffic until it has broken or cured?					
Were any conditions requiring corrective action or maintenance (tracking, non-uniform application, etc.) addressed sufficiently by the Contractor?					
Has the prime coat cured and hardened before the placement of the next subbase or base course layer of asphalt?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor properly disposed of waste materials, asphalt emulsion, etc.?					

SECTION 409 – FABRIC REINFORCEMENT FOR ASPHALT PAVEMENT

409.01 GENERAL

This work consists of applying reinforcement fabric with bituminous binder for asphalt pavement.

409.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Type of bituminous binder proposed for use (Section 409.02 of the Standard Specifications require the use of a PG graded asphalt cement).
- Review applicable special provisions included in the Contract and plan notes (i.e., material requirements, application rates, etc.).
- Methods and equipment to be used.
- Information required to quantify work performed (details for shot record, original emulsion prior to dilution measured for payment, etc.).
- Weather limitations for construction.
- Surface preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Traffic control and maintenance of traffic during construction.

B. Acceptance of Materials

Review the material requirements for fabric reinforcement found in Section 712.01, "Fabric Reinforcement for Asphalt Concrete Pavement" of the Standard Specifications and any special provisions included in the contract or plan notes that pertain to the fabric reinforcement required in the Plans. Review the material requirements for asphalt cement used for the bituminous binder found in Table 708:2 and Section 708.03, "Asphalt Materials" of the Standard Specifications and any special provisions included in the contract or plan notes that pertain to the bituminous binder required in the Plans.

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the fabric reinforcement and bituminous binder pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with

the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

The Residency will verify that the proposed source of materials for the fabric reinforcement product submitted by the Contractor is on the Materials Division Qualified Products List (QPL-Construction Fabrics). Ensure the product name and manufacturer is shown in the Section 712.01 – Fabric Reinforcement for Asphalt Concrete Pavement list on the QPL. If a proposed product/source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

The Residency will verify that the proposed source of materials for the bituminous binder product submitted by the Contractor are on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name and manufacturer is shown in the Asphalt Cement list on the QPL. If a proposed product/source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed product/source is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

C. Preparatory Work and Contractor Work Plans

Consider the following before fabric reinforcement construction work begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions and Plan Notes and determine any specific requirements that pertain to the fabric reinforcement and bituminous binder pay items on your project.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for the installation of the fabric reinforcement.

2. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure the Contractor has a method to adequately prepare the surface prior to the installation of the fabric reinforcement.

Ensure that the Contractor is aware of the minimum surface temperature and weather conditions required to proceed with the placement of the asphalt surfacing layer. The Contractor should not install the fabric reinforcement when the anticipated surface temperature and weather conditions are not expected to reach acceptable conditions to enable the placement of the asphalt surfacing layer.

3. Contractor Proposed Equipment

The Contractor may include the equipment needed to install the fabric reinforcement in their submittals prior to beginning construction. The primary pieces of equipment required to install the fabric reinforcement includes:

- Distributor truck and supply tanks
- Pneumatic-tired rollers
- Stiff bristled brooms

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 409.03.B of this Manual below.

D. Safety and Environmental Issues

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to minimize inconvenience and damage to vehicles during the application of the emulsion,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

409.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements for fabric reinforcement found in Section 712.01, "Fabric Reinforcement for Asphalt Concrete Pavement" of the Standard Specifications and any special provisions included in the contract or plan notes that pertain to the fabric reinforcement required in the Plans. Review the material requirements for asphalt cement used for the bituminous binder found in Table 708:2 and Section 708.03, "Asphalt Materials" of the Standard Specifications and any special provisions included in the contract or plan notes that pertain to the bituminous binder required in the Plans.

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the fabric reinforcement and bituminous binder pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

The Residency will verify that the proposed source of materials for the fabric reinforcement product submitted by the Contractor is on the Materials Division Qualified Products List (QPL-Construction Fabrics). Ensure the product name and manufacturer is shown in the Section 712.01 – Fabric Reinforcement for Asphalt Concrete Pavement list on the QPL. If a proposed product/source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

The Residency will verify that the proposed source of materials for the bituminous binder product submitted by the Contractor are on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name and manufacturer is shown in the Asphalt Cement list on the QPL. If a proposed product/source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed product/source is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, visual appearance (excessive or insufficient asphalt binder, segregation, etc.), or other special provision requirements where Contractor tests are used for acceptance purposes.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Verify the proposed product/manufacturer for the fabric reinforcement is listed on the QPL. [Document in Template AM5001]
    - fabric reinforcement for asphalt pavement - (QPL-Construction Fabrics)
- Verify the type of bituminous binder complies with the Plans and is on the Qualified Products List [Document in Template AM5001]:
    - Bituminous binder (asphalt cement) - (QPL-Bituminous Materials)
- Obtain a sample of the asphalt cement binder from the distributor truck or supply tank to submit to the ODOT Materials Division for acceptance [Document in Template C91018]
    - Sample liquid asphalt materials in accordance with AASHTO R66. Use appropriate sample containers; plastic jugs for Emulsified Asphalt and tin cans for Asphaltic Cement Binders.

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product or mix design approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing. Additionally, review the equipment requirements for Fabric Reinforcement for Asphalt Pavement in Section 409.03 of the Standard Specifications.

Ensure the Contractor's proposed equipment complies with the requirements for fabric reinforcement.

Verify the Contractor's equipment meets the requirements of Sections 401.03 and 409.03 of the Standard Specifications as follows.

1. Distributors and Supply Tanks

Ensure the Contractor provides distributors and supply tanks capable of uniformly applying bituminous material in accordance with the following:

- At the temperatures specified in the relevant specification sections;
- On variable widths of surface not to exceed 26 ft;
- At rates from 0.010 gal/yd² to 1.000 gal/yd²; and
- With constant pressure and uniform temperature.

Ensure the distributor can apply material to vertical faces of asphalt pavement at the joints between paving operations.

Ensure the Contractor provides a distributor equipped with the following:

- A tachometer,
- Pressure gauges,
- Volume metering devices or a calibrated tank,
- A thermometer for measuring temperatures of tank contents,
- A power unit for the pump,
- Full circulation spray bars adjustable vertically and laterally,

- A positive shut off valve, and
- Fittings that prevent bituminous material from dripping.

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to ensure uniform distribution of the bituminous material. If clogging or streaking of the applied bituminous material occurs, stop the operation and correct the problems creating these conditions before resuming distribution. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

2. Compactors

Ensure the Contractor provides self-propelled rollers of the following type:

- Pneumatic tire

Ensure rollers are in good condition, capable of reversing without backlash, and operating at speeds that do not displace the fabric reinforcement. Rollers must have properly working spray bars and nozzles along with scraper bars or brushes to ensure the mixture does not build up on the wheels during the compaction operation.

Pneumatic tired compactors must have at least seven pneumatic tires of equal size and diameter. Ensure the total weight of the tires produces an operating weight of at least 3,500 lbs per tire. The tires must be inflated to at least 90 percent of the maximum pressure recommended by the tire manufacturer. The tire pressure must be maintained for at least 1 hr after the start of operations and the variation in the range in pressure among the tires must not exceed 10 psi.

3. Miscellaneous Equipment

Provide the following miscellaneous equipment for the proper placement of the fabric reinforcement:

- Mechanical fabric laydown equipment capable of handling and placing full or partial rolls of fabric smoothly.
- Stiff bristle brooms to smooth the fabric.
- Scissors or blades to cut the fabric.
- Brushes to apply bituminous binder to fabric overlap at spliced joints.

C. Construction Operations

The purpose of the fabric reinforcement in the asphalt pavement is to reduce reflective cracking from the underlying pavement being overlaid. To perform as designed, it is critical that the asphalt pavement overlay is adequately bonded together to the underlying pavement structure. The use of the bituminous binder is critical to the proper bonding of the asphalt layers that are under/over the fabric reinforcement. Inadequate bonding between layers may result in premature delamination of layers, slippage cracks and fatigue cracks. An effective and uniform tack coat will also facilitate better compaction of the asphalt layer being placed which will add longevity to the pavement.

A clean and smooth surface is also critical to ensure the successful use of the bituminous binder/fabric reinforcement.

Verify the following complies with Section 409.04 of the Standard Specifications when constructing the fabric reinforcement required in the Plans:

1. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. For fabric reinforcement installation, apply bituminous binder when the ambient air temperature is at least 50 °F unless otherwise approved by the Resident Engineer. Do not allow the Contractor to place the bituminous binder/fabric reinforcement if it is raining or rain is imminent.

The pavement overlay must be placed immediately after installing the fabric reinforcement. Ensure that the Contractor is aware of the minimum surface temperature and weather conditions required to proceed with the placement of the next surfacing layer. The Contractor should not apply the fabric reinforcement when the anticipated surface temperature and weather conditions are not expected to reach acceptable conditions for laying the asphalt overlay. Care should be taken in windy conditions to prevent unwanted drifting of the bituminous binder, especially into traffic in the work zone.

Ensure the Contractor adequately prepares the surface prior to placement of the fabric reinforcement. When the bituminous binder is applied to a dusty or dirty surface, it will cling to the dust and dirt rather than the roadway surface which will adversely affect the bonding of the fabric reinforcement and asphalt layers. The surface needs to be free of foreign material such as vegetation, soil, loose aggregate, water and dust. It is challenging to adequately clean a milled asphalt surface and extra effort might be necessary by the Contractor to eliminate the dust coating which would act as a bond breaker to the surface layer being placed. If dry sweeping is ineffective in removing the dust from the milled surface, the Contractor may need to use sweeping-vacuuming combination, wet sweeping or flushing the surface with water. The use of high-pressure air could also be used to blow debris from the surface.

2. Application of Bituminous Binder

Ensure the Contractor complies with the bituminous binder type and application rates as specified in the plans, special provisions and specifications, unless they are modified by the Resident Engineer. Section 409.02 of the Standard Specifications requires the use of a PG graded asphalt cement for the bituminous binder.

Ensure the bituminous binder is sprayed within the acceptable temperature range (between 290-325 °F) in accordance with Section 409.04.B of the Standard Specifications unless otherwise specified in the plans or special provisions. Exceeding 325 °F could damage the fabric.

Ensure the Contractor uses an asphalt distributor truck meeting the requirements of Section 401.03 of the Standard Specifications to uniformly spray the area to be covered with fabric. When there are areas or locations that are inaccessible for the use of a distributor truck, ensure the Contractor has the equipment necessary to use a handheld spray wand to apply the bituminous binder.

The gallons of asphalt cement used for the bituminous binder will be measured for payment. The residency project inspector must measure the quantity of bituminous binder placed utilizing the volume metering device on the distributor truck or readings from a calibrated tank. Document the beginning and ending meter reading for each day for progressive payments on the Shot Record report. A Shot Record spreadsheet that documents the information necessary can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Shot Record (Shot Record v1.4.xlsm).

Paper or roofing felt should be used to provide neat cutoff lines at locations where the distributor application of bituminous binder starts or stops. The Contractor should apply the bituminous binder from 2-6 inches wider than the fabric. During binder application, avoid spills or excessive application causing flushing of the bituminous material.

The application rate for the bituminous binder should be between 0.20 gal/yd² to 0.25 gal/yd². The bituminous binder application rate may be adjusted in accordance with the minimum recommended rate as specified by the fabric manufacturer and as directed by the Resident Engineer.

Before allowing the Contractor to proceed with the application of the bituminous binder, ensure the Contractor and residency project inspector are in agreement with the following:

- Quantity to be placed,
- Rate of application,
- Temperature of bituminous binder when applied,
- Areas to be treated,

- Equipment to effectively place the fabric is on-site (mechanical fabric laydown equipment, pneumatic roller, stiff bristled broom, etc.)
- Verify no rain is forecasted, ambient temperature is at least 50 °F and surface temperature will allow for the immediate pavement overlay to proceed on the area where fabric reinforcement is placed.

3. Placement of Reinforcement Fabric

The Contractor must mechanically place the fabric before the bituminous binder cools and loses tackiness. Manual placement of the fabric will not be allowed. The Contactor must unroll and place the fabric on the binder with the unfused, fuzzy side down. The fabric needs to be placed as smoothly as possible which is why manual placement is not allowed. Ensure the Contractor uses a stiff bristled broom on the fabric to remove air bubbles, and to maximize contact with the bituminous binder and pavement. Excessive wrinkles should be cut and so that the fabric will lay flat. If the fabric becomes misaligned, cut, realign, and joint the fabric as directed by the Resident Engineer. If the Contractor is failing to place the fabric smoothly without excessive wrinkles, the operation should be stopped and adjustments made to correct the deficiencies.

The fabric needs to have overlaps at joints from 4-6 inches. To prevent the paver from disturbing and rolling up the fabric, overlap transverse joints in the direction of paving (ending edge of the old fabric roll over leading edge of new fabric roll). Apply additional binder to joints/overlaps as directed by the Resident Engineer. Transverse joints/overlaps may use a mop, brush, or hand-spray to apply the additional bituminous binder. The longitudinal joints/overlaps should use the distributor truck to apply the additional bituminous binder.

Self-propelled pneumatic-tired rollers must be used to embed reinforcement fabric into the bituminous binder before the bituminous binder cools and loses tackiness to effectively bond it to the pavement.

If excess binder bleeds through the fabric before placing pavement overlay, the Contractor must blot the excess binder by spreading clean, dry sand on the affected area as directed by the Resident Engineer. If a portion of the fabric doesn't get overlaid due to inefficiencies of the asphalt operation (equipment breakdown, unanticipated weather, etc.), blot the fabric with clean, dry sand before placing traffic directly on the fabric.

4. Tack Coat and Pavement Overlay

The pavement overlay must be placed immediately after placing the fabric, unless directed otherwise by the Resident Engineer.

The Contractor needs to apply a tack coat in accordance with Section 407, "Fog Seal and Tack Coat" as required by the Contract. The Resident Engineer will

approve the tack coat material type and rate of application. Do not allow the use of cutback asphalt that contains petroleum solvent for the tack coat.

Ensure the pavement overlay temperature does not exceed 325 °F to prevent damage to the fabric. To avoid damaging the fabric, ensure the Contractor minimizes turning movements. If necessary, turn pavers and vehicles gradually and broadcast clean, dry sand ahead of trucks and pavers to prevent fabric damage. Ensure that excess sand is removed with the broom ahead of paving operations.

The Contractor must repair damage to or debonding of the fabric reinforcement caused by traffic, wet weather conditions, improper installation, or equipment, at no additional cost to the Department in a manner approved by the Resident Engineer.

D. Safety and Environmental Considerations

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor should address the following:

- Providing traffic control during construction to minimize inconvenience and damage to vehicles during the application of the emulsion,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents), length & width of area of fabric reinforcement & bituminous binder placed.
- Quantity of fabric reinforcement placed.
- Daily application rate of bituminous binder placed.
- Daily shot record of gallons and type of bituminous binder placed and resulting application rate.
- Receipt of materials certifications.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

The final quantity for these pay items will be determined by the methods defined in Section 409.05 of the Standard Specifications.

(a) Square Yard Unit of Measure Pay Items

Measure the area covered by the Fabric Reinforcement installed in accordance with Section 409.04 of the Standard Specifications. Do not include overlaps between rows of fabric in any measurements in accordance with Section 409.05 of the Standard Specifications. The cost of providing the overlaps is to be included in the price paid for the area (SY) covered by the fabric reinforcement.

Documentation of the Fabric Reinforcement pay item paid by the Square Yard will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the Fabric Reinforcement pay item from the list of contract pay items.
2. In the appropriate field, enter the station-to-station extents and a descriptive location.
3. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations, with different dimensions, select the ‘New’ button to create a new row for the selected pay item.

(b) Gallon Unit of Measure Pay Items

The volume (gallons) of asphalt cement for Bituminous Binder will be measured for payment as delivered from the supplier.

Measure the quantity of Bituminous Binder placed utilizing the volume metering device on the distributor truck or readings from a calibrated tank. Document the beginning and ending meter reading for each day for progressive payments on the Shot Record report.

Documentation of the Bituminous Binder pay item paid by the Gallon will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the Bituminous Binder pay item from the list of contract pay items.
2. In the appropriate field, enter the station for each item and a descriptive location.
3. In the Placed Quantity field, enter the quantity (GAL) of the item completed.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations, select the 'New' button to create a new row for the selected pay item.

409.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials which were submitted by the Contractor were utilized on the project. If the previously accepted proposed sources of materials which were submitted by the Contractor were not utilized on the project are not on the Qualified Products List, contact Materials Division to confirm the status of source/product approvals. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

B. Audit Requirements

Ensure the area (SY) covered by the Fabric Reinforcement does not include overlaps between rows of fabric in any measurements in accordance with Section 409.05 of the Standard Specifications. The cost of providing the overlaps is to be included in the price paid for the area (SY) covered by the fabric reinforcement.

Ensure the volume (gallons) of asphalt cement used for Bituminous Binder was measured as delivered from the supplier prior to any dilution.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Check that the fabric reinforcement is satisfactorily maintained until the next asphalt surface is placed. The Contractor must repair damage to or debonding of the fabric

reinforcement caused by traffic, wet weather conditions, improper installation, or equipment, at no additional cost to the Department in a manner approved by the Resident Engineer.

Ensure the Contractor minimizes traffic on the newly applied fabric reinforcement until the next asphalt surface is placed. Apply tack coat at a rate that ensures proper bonding if the bituminous binder loses its adhesive properties or is damaged by traffic before being covered by the next surfacing layer, as directed by the Resident Engineer.

Ensure the pavement overlay temperature does not exceed 325 °F to prevent damage to the fabric. To avoid damaging the fabric, ensure the Contractor minimizes turning movements. If necessary, turn pavers and vehicles gradually and broadcast clean, dry sand ahead of trucks and pavers to prevent fabric damage. Ensure that excess sand is removed with the broom ahead of paving operations.

409 CHECKLIST – FABRIC REINFORCEMENT FOR ASHPALT PAVEMENT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proposed sources for fabric reinforcement and bituminous binder (asphalt cement) materials been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent a response to the Contractor on the acceptance/nonacceptance of the sources of materials?					
Has the minimum ambient temperature requirement (at least 50 °F) stated in the Standard Specifications been discussed with the Contractor for the placement of the fabric reinforcement?					
Have the minimum surface temperature requirements stated in the Standard Specifications been discussed with the Contractor for the immediate placement of asphalt overlay?					
Has the equipment requirements including the use of pneumatic rollers, stiff bristled brooms and a mechanical fabric laydown machine been discussed?					
Have the acceptable bituminous binder temperature ranges (290-325 °F) for the spraying of the asphalt cement been discussed?					
Have the application rates for the bituminous binder specified in the Plans (or specifications) been discussed?					
Have the overlap requirements for the fabric placement and their need for additional bituminous binder been discussed?					
Does the Contractor have a plan for maintenance and protection of traffic during the bituminous binder application?					
Is the Contractor prepared to immediately overlay the fabric with the next asphalt layer?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed sources for fabric reinforcement and bituminous binder (asphalt cement) materials been submitted by the Contractor and reviewed by the Resident Engineer and accepted?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the source of materials?					
Is the Contractor using the sources of fabric reinforcement and bituminous binder that have been accepted by the Resident Engineer?					
Has the confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Does the surface temperature meet the minimum requirements for the immediate placement of the asphalt overlay?					
Is the Contractor using adequate pneumatic rollers, stiff bristled brooms and a mechanical fabric laydown machine for the placement of the fabric?					
Does the Contractor's distributor truck meet the specification requirements for the proper placement of the bituminous binder?					
Is the Contractor using a handheld spray wand for areas inaccessible to the distributor?					
Are the acceptable temperature ranges for the application of the bituminous binder (290-325 °F) for the spraying of the asphalt cement being achieved?					
Are the application rates for the bituminous binder in compliance with the rates specified in the Plans (or specifications if not stated in the Plans)?					
Are the overlap requirements for the fabric placement and their need for additional bituminous binder being achieved?					
Is the fabric being placed smoothly with minimal wrinkles by a mechanical laydown machine?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor placing the bituminous binder and fabric to the width specified on the Plans?					
Are daily shot records being kept by the residency project inspector to record quantity and application rates of the bituminous binder?					
Is the Contractor sufficiently maintaining traffic and protecting traffic during the placement of the bituminous binder?					
Is the Contractor prepared to immediately overlay the fabric with the next asphalt layer?					
Has the Contractor properly disposed of waste materials, asphalt cement, fabric cutoff, etc.?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor use the sources of materials for the fabric and binder that were accepted by the Resident Engineer?					
Has the fabric and binder been placed to the width and application rates specified in the Plans (or specifications if not stated in the Plans)?					
Is the fabric relatively smooth and free of wrinkles?					
Did the Contractor taken adequate precautions to protect the completed fabric and binder from damage until the next asphalt layer was placed?					
Were any conditions requiring corrective action or maintenance (non-uniform application, wrinkles, etc.) addressed sufficiently by the Contractor?					
Is the Contractor aware that the pavement overlay temperature must not exceed 325 °F to prevent damage to the fabric?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor properly disposed of waste materials, asphalt cement binder, etc.?					

SECTION 410 –MICRO SURFACING

410.01 GENERAL

This section covers the materials, equipment, construction and application procedures for placing Micro Surfacing material, filling ruts, and surfacing existing paved surfaces. The Micro Surfacing shall be a mixture of a polymer-modified asphalt emulsion, 100 percent crushed mineral aggregate, mineral filler, water and other additives for control of set time in the field. All ingredients shall be properly proportioned, mixed and spread on the paved surface in accordance with Section 410 of the Standard Specifications and as directed by the Engineer.

410.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Review special provisions included in the Contract for surfacing pay items (i.e., material requirements, electronic ticketing, smoothness, etc.).
- Proposed mix designs and certified plants.
- Methods and equipment to be used.
- Information required on truck delivery tickets necessary to evaluate overloaded trucks.
- Weather limitations for construction.
- Surface preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Maintenance of traffic during construction.
- Traffic control during construction and opening micro surfacing to traffic.

B. Acceptance of Materials

Review the material requirements in Section 707, "Thin Surface Courses" of the Standard Specifications that pertain to the type of Micro Surfacing required in the Plans.

The polymer modified emulsified asphalt indicated in the micro surfacing mix design must be the slow-setting PMCSS-1h in accordance with Section 707.01.C of the Standard Specifications unless otherwise specified in the special provisions or plans.

The type of mineral aggregate (Type I, II or III Mineral Aggregate) required in the micro surfacing mix design is designated by the pay item shown in the Contract and must meet the gradation requirements shown on the approved Job Mix Formula and the sand equivalent requirements found in Table 707:1 from Section 707.01.B of the Standard Specifications.

The mineral filler for micro surfacing must be a recognized brand of portland cement free of lumps in accordance with Section 707.01.E of the Standard Specifications. Bagged portland cement may be acceptable for use as approved by the Resident Engineer.

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If the sources are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the Micro Surfacing item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials and mix designs. Resolve any questions or concerns with the submitted sources of materials and mix designs with the Contractor in a timely manner. A written response accepting the proposed sources of materials and mix designs must be sent to the Contractor and kept in the project file.

1. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt mix design submitted by the Contractor is on the Materials Division list of "Asphalt Mix Designs Approved for Use". Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

2. Sources of Materials

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on those items.

The sources of materials for micro surfacing mix will be indicated on the approved Job Mix Formula (emulsified asphalt, aggregates, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

The Residency will verify that the proposed source of materials for the polymer modified emulsified asphalt submitted by the Contractor is on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name (PMCSS-1h unless otherwise specified in the Plans) and manufacturer is shown in the Section 708.03 – Emulsified Asphalt list on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

C. Preparatory Work and Contractor Work Plans

Consider the following before surface construction work begins.

1. Contract Plans and Specifications

Review the Plans and distinguish the pay items included in the contract and which type of micro surfacing is listed. Review the Standard Specifications, Special Provisions and Plan Notes and determine the types of micro surfacing and polymer modified emulsified asphalt that is required. The polymer modified emulsified asphalt must be the rapid-setting PMCSS-1h in accordance with Section 707.01.C of the Standard Specifications unless otherwise specified in the special provisions or plans.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for micro surfacing. The paver (micro surfacing mixing machine with spreader box) requirements for micro surfacing are more stringent than the typical asphalt paver and it is critical to use the proper equipment to successfully place this type of surface.

2. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum surface and ambient temperatures (at least 50 °F and rising) and weather conditions required to proceed with the placement of the micro surfacing. The weather must not be foggy or rainy and no forecast temperature below 32 °F within 48 hours from the time of the placement of the micro surfacing.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the micro surfacing. The existing roadway surface must be cleared of vegetation, loose aggregate, soil and any debris before the Contractor commences with the placement of the micro surfacing. Additionally, the Contractor must dampen the pavement surface ahead of the paving operation without any free flowing water ahead of the spreader box.

3. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

(a) Asphalt Mix Designs

The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation. Resolve any questions or concerns with the submitted mix designs with the Contractor in a timely manner. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

4. Contractor Proposed Equipment

The Contractor may include the equipment needed to place the micro surfacing in their submittals prior to beginning construction. The various pieces of equipment required include the following:

- Trucks and transport units, and
- Micro surfacing mixing machine with spreader box.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 410.03.B of this Manual below. The specialized micro surfacing mixing machine with spreader box (combination mixer/paver) requirements for placing micro surfacing are more stringent than the typical asphalt paver and it is critical to use the proper equipment to successfully construct this type of surface. Historically, there have only been a couple of out-of-state contractors that have performed the micro surfacing on ODOT projects in the past due to the specialized nature of the work.

D. Safety and Environmental Issues

For storage of aggregates in a staging area near the project, stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. Additionally in Section 106.08, at the Contractor's request, the Department may allow the use of approved portions of the right-of-way for storing materials and staging their equipment. As part of the request for use of the site, the Contractor must provide the Resident Engineer with written documentation of the location of the proposed site, access and egress points, a proposed erosion control plan, a proposed traffic control plan, and any other information

required by the Resident Engineer relevant to use of the site for materials and equipment storage. For controlled access facilities, the approval from the Resident Engineer is subject to the approval of FHWA, prior to altering, severing or removing any right-of-way fences. Prior written permission of the owner or lessee is required for the use of private property and copies of such written permission must be provided upon request to the Resident Engineer.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to ensure no risk to health, safety and property damage,
- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and micro surfacing surface from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

410.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements in Section 707, "Thin Surface Courses" of the Standard Specifications that pertain to the type of Micro Surfacing required in the Plans.

The polymer modified emulsified asphalt must be the slow-setting PMCSS-1h in accordance with Section 707.01.C of the Standard Specifications unless otherwise specified in the special provisions or plans.

The type of mineral aggregate (Type I, II or III Mineral Aggregate) is designated by the pay item shown in the Contract and must meet the gradation requirements shown on the approved Job Mix Formula and the sand equivalent requirements found in Table 707:1 from Section 707.01.B of the Standard Specifications.

The mineral filler must be a recognized brand of portland cement free of lumps in accordance with Section 707.01.E of the Standard Specifications. Bagged portland cement may be acceptable for use as approved by the Resident Engineer.

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on the Micro Surfacing item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials and mix designs. Resolve any questions or concerns with the submitted sources of materials and mix designs with the Contractor in a timely manner and prior to placing

any micro surfacing on the project. A written response accepting the proposed sources of materials and mix designs must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted and accepted mix designs and sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

1. Contractor Proposed Mix Designs

Ensure the Contractor has submitted its proposed asphalt mix designs in advance of any work beginning on the micro surfacing pay item. The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation.

The polymer modified emulsified asphalt indicated in the micro surfacing mix design must be the slow-setting PMCSS-1h in accordance with Section 707.01.C of the Standard Specifications unless otherwise specified in the special provisions or plans.

The type of mineral aggregate (Type I, II or III Mineral Aggregate) required in the micro surfacing mix design is designated by the pay item shown in the Contract and must meet the gradation requirements shown on the approved Job Mix Formula and the sand equivalent requirements found in Table 707:1 from Section 707.01.B of the Standard Specifications.

Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

2. Acceptance of Materials

Ensure the Contractor has submitted its proposed sources of materials in advance of any work beginning on the micro surfacing pay item.

The sources of materials for micro surfacing mix will be indicated on the approved Job Mix Formula (emulsified asphalt, aggregates, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

The mineral filler for micro surfacing must be a recognized brand of portland cement free of lumps in accordance with Section 707.01.E of the Standard

Specifications. Bagged portland cement may be acceptable for use as approved by the Resident Engineer.

The Residency will verify that the proposed source of materials for the polymer modified emulsified asphalt submitted by the Contractor is on the Materials Division Qualified Products List (QPL-Bituminous Materials). Ensure the product name (PMCSS-1h unless otherwise specified in the Plans) and manufacturer is shown in the Section 708.03 – Emulsified Asphalt list on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, visual appearance (excessive or insufficient asphalt binder, segregation, etc.), or other special provision requirements where Contractor tests are used for acceptance purposes.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Obtain a sample of the polymer modified emulsified asphalt, PMCSS-1h (unless otherwise required in the special provisions, plans and approved mix design) used in the micro surfacing mixture to submit to the ODOT Materials Division for acceptance. [Document in Template C91006]
    - Sample liquid asphalt materials in accordance with AASHTO R66. Use appropriate sample containers; plastic jugs for Emulsified Asphalt and tin cans for Asphaltic Cement Binders.
- Verify the micro surfacing mixture complies with the requirements of the approved Job Mix Formula and applicable tolerances:
    - Gradation; Mechanical Analysis of Extracted Aggregate - AASHTO T 30 [Document in Template T30]

- Asphalt Binder Content by Ignition – OHD L-26 [Document in Template C93013]

- Verify the aggregate used in the micro surfacing mixture complies with the requirements of Table 707.1 of the Standard Specifications:
  - Sand Equivalent – AASHTO T 176 [Document in Template C93004]

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product or mix design approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing. Additionally, review the equipment requirements for the micro surfacing mixing machine in Section 410.03 of the Standard Specifications. Review any special provisions that pertain to the micro surfacing.

Ensure the Contractor's proposed equipment complies with the specific requirements for micro surfacing. The specialized micro surfacing mixing machine with spreader box (combination mixer/paver) requirements for placing micro surfacing are more stringent than the typical asphalt paver and it is critical to use the proper equipment to successfully construct this type of surface. Historically, there have only been a couple of out-of-state contractors that have performed the micro surfacing on ODOT projects in the past due to the specialized nature of the work.

Verify the Contractor's equipment meets the requirements of Sections 401.03 and 410.03 of the Standard Specifications as follows.

1. Micro Surfacing Mixing Machine with Spreader Box

The micro surfacing mixing machine must be able to effectively blend the paving mixture with a self-propelled, compartmented, continuous flow machine with a non-slipping aggregate delivery system (belt over chain). Ensure the machine has a continuous flow mixing unit able to accurately deliver and proportion the aggregate, polymer modified emulsion, mineral filler, field control additives and water to a revolving multi-blade, twin shafted mixer and discharge the mixed product on a continuous flow basis. Ensure the mixture is thoroughly blended and

no uncoated aggregate is visible upon discharge from the mixing unit. Ensure the machine has self-loading material devices to allow for a continuous micro surfacing operation, thereby minimizing construction joints. The machine must be equipped with opposite side driving stations to optimize longitudinal alignment and equipped to allow the operator to have full hydrostatic control of the forward and reverse speed during the application of the micro surfacing material. Continuous-run equipment will be required to ensure continuity of mix and reduction of start-up joints.

In some cases, and with the Engineer's approval, truck mounted units may be used for short narrow roadways, crossovers, and irregular areas. Ensure truck mounted units are equipped with a positive, non-slipping aggregate delivery system (belt over chain) and have the capability of applying a minimum of 10 tons of aggregate without recharging the aggregate bin.

Ensure the following additional features for the effective use of the Contractor's micro surfacing mixing machine operation:

(a) Water Pressure System

The mixing machine must be equipped with a water pressure system and nozzle type spray bar to provide a water spray ahead of and outside the spreader box when required. The existing pavement surface being overlaid must be dampened to ensure a sufficient bond of the micro surface treatment.

(b) Calibration & Proportioning Devices

The mixing machine must be equipped with individual volume or mass controls or other gauging devices for measuring and proportioning each material added to the mix. The Contractor must calibrate, properly mark, and positively interlock each material control device. The aggregate feed to the mixer must be equipped with a revolution counter or similar device so that the amount of asphalt emulsion, aggregate and mineral filler used may be determined at any time. Ensure each mixing unit is calibrated prior to commencement of the work. Calibrations must be performed and verified in the presence of the residency project inspector. Once calibrated, any aggregate and emulsion flow changes require the approval of the Engineer. The water and additive may be adjusted in the field to control the mix properties to produce an acceptable mix. With the Engineer's approval, previous calibration documentation covering the exact materials to be used may be acceptable provided they were made within the last three (3) months.

(c) Emulsion Pump

The Contractor must use a heated positive displacement type emulsion pump.

(d) Spreader Box

Ensure the machine has a hydraulically adjustable (adjustable while applying mixture) type spreader box and positive screed adjustment for yield control. Verify the spreader box is attached to the mixer is equipped with ribbon flights mounted on an adjustable shaft to continually agitate and distribute the material throughout the box.

The spreader box must be equipped with curb bumpers and replaceable runners with a minimum of 5-foot long end runners. Ensure the box is equipped with a sufficient walkway to provide access to either side of the spreader box without walking through the freshly applied material. The box must be capable of laying mix to a width of 14 feet. The equipment must provide sufficient turbulence to prevent the mix from setting in the box or causing excessive build-up or lumps.

To prevent the loss of mixture from the box, ensure flexible seals are attached in the front and rear, in contact with the road. A full width application box equipped with a secondary strike-off located approximately 2-3 feet behind the primary strike-off to minimize transverse corrugations is required. Ensure the secondary strike-off has elevation and width adjustments similar to the primary strike-off, and has a pivot point where it can be tilted for texturing or raised completely off the surface.

The use of burlap drags or other drags necessary to obtain the desired surface texture, must be approved by the Engineer. Replace drags that have excessive build-up. The Contractor must keep drags in a completely flexible condition at all times.

C. Construction Operations

The Pavement Preservation & Recycling Alliance (PPRA) has developed a website that provides a resource to owners, designers, and construction inspection personnel on the effective use of asphalt pavement preventive maintenance treatments (roadresource.org-treatment resource center) including micro surfacing. You may visit their site to learn more about construction and quality assurance of these surface treatments by selecting from the index on the left side of their site (roadresource.org-micro surfacing). One example of their guidance found under the micro surfacing's Preparation link is, "*Thermoplastic pavement markings should be abraded and removed from the roadway, as should heavily built up layers of epoxy or waterborne paint and reflective glass beads. The existing surface should be thoroughly cleaned before micro surfacing.*"

Micro surfacing is designed to extend the life of the asphalt pavement and is useful for filling ruts and leveling the driving lanes, increasing skid resistance and protecting the pavement surface from further oxidation and raveling.

To successfully apply micro surfacing, it is critical that the Contractor have experience performing this type of work that requires specialized equipment. A poorly applied micro

surfacing can result in premature failure of the overlay. Care must be taken to adhere to seasonal and weather limitations along with using the necessary application rates for the materials. Adjustments may need to be considered to accommodate the conditions incurred on the project; surface being overlaid, weather conditions, traffic volumes, material characteristics, etc.

The timely delivery of the aggregates to the micro surfacing mixing machine is critical to the continuous placement of the micro surfacing. Typically, the Contractor will stockpile the aggregates near the project site to ensure timely delivery. Stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. The area where aggregate is stockpiled must be prepared to preserve the quality and gradation of the material.

Review all aspects of Section 410.04 of the Standard Specifications prior to beginning the micro surfacing operation, including the following:

1. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. To enable the successful placement of the micro surfacing, ensure the Contractor does not schedule the placement of the micro surfacing until the weather conditions meet the following:

- minimum surface and ambient temperatures are at least 50 °F and rising,
- weather conditions are clear of fog and no anticipated rain., and
- no forecast temperature below 32 °F within 48 hours from the time of the placement of the micro surfacing.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the micro surfacing. The existing roadway surface must be cleared of vegetation, loose aggregate, soil and any debris before the Contractor commences with the placement of the micro surfacing. Additionally, the Contractor must dampen the pavement surface ahead of the paving operation without any free flowing water ahead of the spreader box.

2. Application of Micro Surfacing

The existing pavement surface being overlaid must be dampened to ensure a sufficient bond of the micro surface treatment. The mixing machine must be equipped with a water pressure system and nozzle type spray bar to provide a water spray ahead of and outside the spreader box when required. The rate of application of the fog spray may be adjusted as the temperature, surface texture, humidity, and dryness of the pavement change. The fogging operation shall be used to dampen the existing pavement surface and no ponding of water is permitted.

The Contractor must screen aggregates at the stockpile to eliminate oversize materials in the mix. The emulsified asphalt used in the micro surfacing mixture

must be a temperature ranging from 70 °F to 185 °F in accordance with Table 708:4 of Section 708.03 of the Standard Specifications.

Ensure the micro surfacing mix is the appropriate consistency upon leaving the mixer. There should be a sufficient amount of material throughout the spreader box at all times to obtain complete and uniform coverage. Avoid overloading the spreader box. Lumpy or unmixed aggregate will not be permitted. Aggregate spilled from the micro surfacing mixing machine or encountered on the existing road must not be used and should be cleared in advance of the micro surfacing placement. Ensure the Contractor's operation does not leave streaks in the finished surfaces, excess buildup, uncovered areas, or unsightly appearance on longitudinal or transverse joints.

The Contractor must provide suitable width spreading equipment to produce the minimum number of longitudinal joints throughout project. In accordance with Section 410.03.A(3), the spreader box must be capable of laying mix to a width of 14 ft. Additionally, the equipment must provide sufficient turbulence to prevent the mix from setting in the box or causing excessive build-up or lumps. Do not allow additional water to be sprayed into the spreader box.

(a) Test Strip

Section 410.04.D of the Standard Specifications requires the Contractor to construct a test strip that is minimum 500 ft. long for the Resident Engineer's evaluation. The location of the test strip is at the discretion of the Resident Engineer and typically is placed on the shoulder, if available. The test strip should be evaluated to ensure that:

- The modified emulsion and the mineral aggregate are compatible under field conditions.
- The micro surfacing mixing machine produces a uniform mix.
- The fogging of the existing pavement surface ahead of the micro surfacing is sufficiently dampened.
- The mix test results meet the requirements for proportioning the asphalt, mineral filler, and mineral aggregate.
- The mix meets the performance requirements for set, cure, and stability.
- The thickness of the micro surfacing conforms to the typical section.
- The texture is free from excessive scratch marks, tears, or other surface irregularities.
- The cured mixture adheres fully to the underlying surface in a timely manner.

(b) Mixture

The micro surfacing mixture must have sufficient stability so that premature breaking of the material in the spreader box does not occur. The Contractor must provide a homogeneous mixture during and following mixing and spreading, that is free of excess liquids.

(c) Rut Filling

Fill ruts, utility cuts, and depressions in the existing surface with preliminary micro surfacing material where indicated in the Plans and before final surface course is placed. Ruts deeper than 1/2 in must be filled independently with a rut filling spreader box, either 5 ft or 6 ft in width. For irregular or shallow rutting 1/2 in or less in depth, a leveling course may be used as directed by the Engineer. Use the same spreader box for the leveling course as used for the surface course. However, use a steel or high density strike-off in lieu of a flexible rubber. Using a rut fill spreader box, crown each individual rut fill to compensate for traffic compaction at a rate of 1/8 in per 1 in of rut depth. Place rut filling and open to traffic a minimum of 24 hours prior to surfacing. All materials, mixture composition, equipment, and construction procedures and requirements must be as specified for micro surfacing.

(d) Handwork

For surface areas which cannot be accessed by the mixing machine, hand squeegees may be used to provide complete and uniform coverage. Lightly dampen the area to be hand worked, if necessary, prior to mix placement. Handwork areas must resemble the same finish as that applied by the spreader box as much as possible. All handwork areas should be completed prior to placement of the final surfacing.

(e) Longitudinal Joint and Lines

Longitudinal joints must be placed on lane lines. Allow the use of partial width passes only when necessary or when filling ruts with a rut filling spreader box. Do not allow the use of partial width passes as the last pass of any paved areas. Provide a maximum overlap of 3 in for longitudinal joints. Provide maximum difference in joint elevation of 0.25 in when measured by placing a 10 ft straight edge over the joint and measuring the elevation difference.

Straight lines at intersections, curbs, and shoulders to yield a good appearance are required. The Contractor must mask off the end of streets, if necessary, to provide a straight line. Longitudinal edge lines shall not vary by more than ± 2 in horizontal variance in any 96 ft of length.

(f) Application Rate Tolerance

The Contractor must control the spread rate for all full-width micro surfacing, not intended as a leveling course, to within plus or minus two pounds per square yard of spread rate based on the weight of dry aggregate. Use the full-width spread rates specified in Section 410.04.E of the Standard Specifications of 18 pounds (for Type I) and 25 pounds (for Type II) per square yard, unless otherwise shown in the Plans or approved by the Resident Engineer.

In accordance with Section 410.04.E of the Standard Specifications, a five-percent (5%) reduction in unit price must be applied for each pound of aggregate per square yard outside the spread rate tolerances established above for each day's placement of material. In lieu of pay reduction, the Contractor may elect to overlay the deficient area at no additional cost to the Department. Do not allow the Contractor to continue operations and placement of materials outside the spread rate tolerances. The Contractor must make adjustments as necessary in the placement operation to maintain production within the tolerances given.

(g) Cleanup

The Contractor must remove micro surfacing in all utility access areas (manholes and valve boxes), gutters and intersections as specified by the Resident Engineer. All excess debris associated with the performance of the work must be removed on a daily basis.

(h) Curing and Maintaining Traffic

The Contractor must protect the micro surfacing from traffic damage until the mixture curs and does not adhere to vehicle tires. The micro surfacing operation must stop each day early enough to allow the mixture to cure and allow traffic to safely travel over the completed work before sunset. Any damage to the micro surfacing must be repaired by the Contractor to the satisfaction of the Resident Engineer at no additional cost to the Department.

D. Safety and Environmental Considerations

For storage of aggregates in a staging area near the project, stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. Additionally in Section 106.08, at the Contractor's request, the Department may allow the use of approved portions of the right-of-way for storing materials and staging their equipment. As part of the request for use of the site, the Contractor must provide the Resident Engineer with written documentation of the location of the proposed site, access and egress points, a proposed erosion control plan, a proposed traffic control plan, and any other information required by the Resident Engineer relevant to use of the site for materials and equipment storage. For controlled access facilities, the approval from the Resident Engineer is subject

to the approval of FHWA, prior to altering, severing or removing any right-of-way fences. Prior written permission of the owner or lessee is required for the use of private property and copies of such written permission must be provided upon request to the Resident Engineer.

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should effectively address the following:

- Providing traffic control during construction to ensure no risk to health, safety and property damage,
- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and micro surfacing surface from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents), thickness and length & width of area of micro surfacing placed.
- Daily aggregate application rate (yield rate) of micro surfacing placed.
- Receipt of haul tickets (electronic tickets) of Type of micro surfacing and quantity placed.
- Receipt of materials certifications and scale or weigher certification.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

The final quantity for these pay items will be determined by the methods defined in Section 410.05 of the Standard Specifications. The Resident Engineer will measure completed micro surfacing as the relevant mineral aggregate pay item (Type I, II or III), by the dry weight (including mineral filler). The Polymer-Modified Emulsified Asphalt will be measured by the volume (gallon) or weight (ton) of the original emulsion, whichever unit specified in the Contract.

In accordance with Section 410.04.E of the Standard Specifications, a five-percent (5%) reduction in unit price must be applied for each pound of aggregate per square

yard outside the spread rate tolerances established above for each day's placement of material.

The Contractor must provide certified scales capable of providing an automated ticket printout for each truck load of aggregate material (including mineral filler) delivered to the micro surfacing mixing machine. Each ticket must include the project number, ticket number, truck number, date and batch weight and type of material loaded on each ticket.

If using the bill of lading for the determination of the quantity of polymer modified emulsified asphalt, subtract the unused portion of emulsion from the total of the bill of ladings to determine the quantity to by paid.

(a) Gallon Unit of Measure Pay Items

The volume (gallons) of polymer modified emulsified asphalt will be measured for payment as delivered from the supplier when the pay item in the Contract is designated to be paid by the Gallon.

Measure the quantity of polymer modified emulsified asphalt placed utilizing the volume metering device on the distributor truck or readings from a calibrated tank. Document the beginning and ending meter reading for each day for progressive payments.

Documentation of the Polymer Modified Emulsified Asphalt when paid by the Gallon will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the Polymer-Modified Emulsified Asphalt pay item from the list of contract pay items.
2. In the appropriate field, enter the station for each item and a descriptive location.
3. In the Placed Quantity field, enter the quantity (GAL) of the item completed.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations, select the 'New' button to create a new row for the selected pay item.

(b) Ton Unit of Measure Pay Items

A five-percent (5%) reduction in unit price will be applied for each pound of aggregate per square yard outside the spread rate tolerances established above for each day's placement of material. In lieu of pay reduction, the

Contractor may elect to overlay the deficient area at no additional cost to the Department.

Documentation of the relevant micro-surfacing pay items paid by the Ton will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate pay item from the list of contract pay items.
2. In the appropriate field, enter the descriptive location or the station to station extents and location (i.e., direction, station extents, lane designation, etc.).
3. In the Placed Quantity field enter the tons of mineral aggregate complete in place as determined from haul tickets. This quantity may require adjustment after the spread rate tolerance analysis is performed as required in Section 410.04.E of the Standard Specifications. For polymer modified emulsified asphalt paid by the Ton, enter the tons completed in place as determined in a manner approved by the Resident Engineer.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown. Note in the project documentation any reductions to the quantity from the overload analysis and daily theoretical analysis along with the calculations.
5. For additional areas or additional locations, select the 'New' button to create a new row for the selected pay item.

410.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials and mix designs which were submitted by the Contractor were utilized on the project. Ensure the proposed asphalt mix designs for the micro surfacing mixture submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. If the previously accepted proposed sources of materials and mix designs which were submitted by the Contractor were not utilized on the project are not on the QPL or Approved Sources list, contact Materials Division to confirm the status of source/product and mix design approvals. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for

the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

Ensure the payment of the mineral aggregate placed each day was limited to the calculated theoretical tons required for the area (SY) placed that day in accordance with the full-width spread rates specified in Section 410.04.E of the Standard Specifications of 18 pounds (for Type I) and 25 pounds (for Type II) per square yard, unless otherwise shown in the Plans or approved by the Resident Engineer.

In accordance with Section 410.04.E of the Standard Specifications, a five-percent (5%) reduction in unit price must be applied for each pound of aggregate per square yard outside the spread rate tolerances established above for each day's placement of material. In lieu of pay reduction, the Contractor may elect to overlay the deficient area at no additional cost to the Department.

C. Protection of the Work

Check that the micro surfacing is satisfactorily maintained until the project is completed and any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

410 CHECKLIST – MICRO SURFACING

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed mix design for the micro surfacing been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the proposed source of polymer modified emulsified asphalt been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix design and source of asphalt emulsion?					
Has the Contractor submitted the equipment list for the proper placement of the micro surfacing?					
Have the minimum surface temperature and ambient temperature requirements stated in the Standard Specifications been discussed with the Contractor?					
Have the application spread rates for the micro surfacing specified in the Plans been discussed?					
Does the Contractor have a plan for maintenance of traffic and protection of the micro surfacing during its placement and opening to traffic?					
Do the plans require crack sealing or rut filling prior to the placement of the final micro surfacing layer?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed mix design for the micro surfacing been submitted by the Contractor and reviewed by the Resident Engineer and accepted?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the proposed source of polymer modified emulsified asphalt been submitted by the Contractor and reviewed by the Resident Engineer and accepted?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix design and source of asphalt emulsion?					
Is the Contractor using the mix design and source of asphalt emulsion that has been accepted by the Resident Engineer?					
Is the Contractor using the type of mineral aggregate required in the Plans?					
Is the emulsified asphalt used in the micro surfacing mixture at a temperature between 70 °F to 185 °F?					
Does the Contractor's aggregate haul tickets include the information necessary to quantify the tons used each day?					
Does the Contractor's micro surfacing mixing machine and spreader box meet the specification requirements for the proper placement of the micro surfacing?					
Is the existing pavement surface ahead of the micro surfacing being sufficiently dampened?					
Does the surface temperature and ambient temperature meet the minimum requirements of at least 50 °F and rising prior to the placement of the micro surfacing?					
Are the weather conditions clear of fog with no anticipated rain during the placement of the micro surfacing?					
If rut filling was required in the Plans, is the Contractor using a rut filling spreader box on ruts deeper than 1/2"?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Are the application spread rates for the micro surfacing in compliance with the rates specified in the specifications or Plans?					
Is the Contractor placing the micro surfacing to the width specified on the Plans?					
Is the micro surfacing mixing machine producing a uniform mix free of uncoated aggregates and lumps?					
Are the longitudinal joints being placed at the lane lines and properly overlapped?					
Is the texture of the micro surfacing free from excessive scratch marks, tears, or other surface irregularities?					
Is the Contractor sufficiently maintaining traffic and protecting the micro surfacing during its placement?					
Has a sample of the asphalt emulsion been taken and submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					
Have samples of the mineral aggregate been taken and tested for sand equivalent results at the frequencies in accordance with the FAST Guide?					
Have samples of the micro surfacing mixture been taken and tested at the frequencies in accordance with the FAST Guide?					
Have all of the test results and confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Has the Residency evaluated the spread rate tolerances for each day's placement of material and applied a 5% reduction in unit price for each pound of aggregate per square yard outside the tolerance?					
Has the Contractor properly cleaned up the project and disposed of waste materials, asphalt emulsion, etc.?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor use the products and sources of materials reviewed/accepted by the Resident Engineer?					
Has the micro surfacing been placed to the thickness and width as shown on the Plans?					
Is the texture of the micro surfacing free from excessive scratch marks, tears, or other surface irregularities?					
Is the cured micro surfacing mixture adhering fully to the underlying surface in a timely manner?					
Has the Contractor taken adequate precautions to protect the completed micro surfacing from damage?					
Were any conditions requiring corrective action or maintenance addressed sufficiently by the Contractor?					
Was a sample of the asphalt emulsion used in the micro surfacing mix submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					
Was the micro surfacing mixture sampled and tested at the frequency required in the FAST Guide for acceptance testing?					
Was a sample of the mineral aggregate taken and tested for sand equivalent results at the frequencies in accordance with the FAST Guide?					
Was the evaluation of the spread rate tolerances for each day's placement of material and application of a 5% reduction in unit price for each pound of aggregate per square yard outside the tolerance completed by the Residency?					

SECTION 411 – HOT MIX ASPHALT / WARM MIX ASPHALT

411.01 GENERAL

This work consists of constructing one or more courses of bituminous mixture on the prepared foundation (roadbed or base). Bituminous (asphalt) mixture includes Hot Mix Asphalt and Warm Mix Asphalt.

Hot Mix Asphalt (HMA) is defined as an asphalt binder and aggregate mixture which includes the various mixture types of Superpave, Stone Matrix Asphalt (SMA), Rich Bottom Layer (RBL) and Rich Intermediate Layer (RIL).

Warm Mix Asphalt (WMA) is defined as an asphalt binder and aggregate mixture which, by additive or process, can be produced and placed at a reduced temperature from normal HMA temperatures. WMA requirements are the same as for HMA except where noted.

411.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Review special provisions and plan notes included in the Contract for surfacing pay items (i.e., material requirements, electronic ticketing, MTV, smoothness, etc.).
- Proposed mix designs and certified plants.
- Methods and equipment to be used.
- Information required on truck delivery tickets (or electronic tickets) necessary to evaluate overloaded trucks.
- Weather limitations for construction.
- Surface preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Maintenance of traffic during construction.
- Compaction and rolling requirements.
- Traffic control during construction and opening HMA to traffic.

B. Acceptance of Materials

Review the material requirements in Section 708, "Plan Mix Bituminous Bases and Surfaces" of the Standard Specifications that pertain to the type of asphalt mixture (Superpave, SMA, RBL or RIL) required in the Plans.

The type of asphalt mixture (Superpave, SMA, RBL or RIL) is designated by the pay item shown in the Contract and must meet the gradation requirements shown on the approved

Job Mix Formula and the sand equivalent requirements for the aggregates found in Table 708:1 from Section 708.02.A of the Standard Specifications.

The Contractor should submit its proposed sources of materials, mix designs and plant locations at the Preconstruction Meeting. If the sources of materials, mix designs and plant locations are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the relevant HMA pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials, mix designs and plant locations. Resolve any questions or concerns with the submitted sources of materials, mix designs and plant locations with the Contractor in a timely manner. A written response accepting the proposed sources of materials, mix designs and plant locations must be sent to the Contractor and kept in the project file.

1. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt mix design submitted by the Contractor is on the Materials Division list of "Asphalt Mix Designs Approved for Use". Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

2. Contractor Proposed Asphalt Plants

Ideally, the Contractor will submit their proposed asphalt plant locations in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt plants submitted by the Contractor have a current ODOT certification. The plants must be reviewed for acceptance by the Resident Engineer based on the criteria of the type of plant as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases. When a plant is being installed to produce for a Project in your Residency notify:

Oklahoma Department of Environmental Quality
Air Quality Division
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: (405) 702-4100
Fax: (405) 702-4101

and

Oklahoma Department of Transportation
Materials Division
Independent Assurance Branch
5201 N.E. 122nd Street
Building 4011
Edmond, OK 73013
Phone: (405) 521-2677

In the notice, list the project number and the location and type of plant (concrete or asphalt).

3. Sources of Materials

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on those items.

The sources of materials for HMA mixes (Superpave, SMA, RBL or RIL) will be indicated on the approved Job Mix Formula (asphalt cement, aggregates, anti-stripping agents, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

Section 411.04.B(4) of the Standard Specifications discusses the use of hydrated lime or commercial lime slurry as the anti-stripping agent if needed to meet the requirements of Section 708.04 of the Standard Specifications or when the project is located in Beaver, Cimarron or Texas County. Additional information regarding the use of lime as an anti-stripping agent may be obtained from the Materials Division Bituminous Branch.

The Residency will verify that the proposed source of materials for any asphalt release agents submitted by the Contractor is on the Materials Division Qualified Products List (QPL-Asphalt Release Agents). The release agents may be used on truck beds and rollers. Ensure the product name and manufacturer is shown on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate

source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

C. Preparatory Work and Contractor Work Plans

Consider the following before HMA construction work begins.

1. Contract Plans and Specifications

Review the Plans and distinguish the pay items included in the contract and which types of HMA (Superpave, SMA, RBL or RIL) are listed. Review the Standard Specifications, Special Provisions and Plan Notes and determine any special requirements for the types of HMA that are required.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing, ensure the Contractor or their designated subcontractor is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every delivery vehicle.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for types of HMA that are required.

2. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum surface temperature and weather conditions required to proceed with the placement of the HMA. The minimum surface temperature requirements are dependent on the lift thickness being placed and whether HMA or WMA is being used. Refer to Table 411:1 in Section 411.04.H of the Standard Specifications for the surface temperature requirements. Additional weather limitations include:

- Do not begin placing HMA if frost exists in or on the foundation.

- Stop operations if the material becomes too cold to be leveled and consolidated.
- Stop plant production immediately if it starts raining. The Contractor may place material already in transit; however, the Contractor shall assume the risk of weather related impacts and remedy any unacceptable work if they decide to proceed with its use under those conditions.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the HMA. The existing roadway surface must be cleared of vegetation, loose aggregate, soil and any debris before the Contractor commences with the placement of the HMA. Usually, tack coat will be applied prior to the placement of the HMA to ensure an effective bond between the asphalt pavement layers. Ensure the Contractor complies with the requirements of Section 407, "Fog Seal and Tack Coat" of the Standard Specifications when performing the tack coat treatment.

The purpose of the tack coat is to develop the proper bond between all of the pavement layers. To perform as designed, it is critical that each layer of asphalt pavement is adequately bonded together in the pavement structure. Inadequate bonding between layers may result in premature delamination of layers, slippage cracks and fatigue cracks. An effective and uniform tack coat will also facilitate better compaction of the asphalt layer being placed which will add longevity to the pavement.

Ensure the Contractor adequately prepares the surface prior to placement of the tack coat treatments. When the emulsion is applied to a dusty or dirty surface, the tack coat will cling to the dust and dirt rather than the roadway surface which will adversely affect the bonding of the asphalt layers. The surface needs to be free of vegetation, soil, loose aggregate, and dust. A damp surface is acceptable, but do not allow the Contractor to apply the tack coat to wet surfaces with free standing water. It is challenging to adequately clean a milled asphalt surface and extra effort might be necessary by the Contractor to eliminate the dust coating which would act as a bond breaker to the surface layer being placed. If dry sweeping is ineffective in removing the dust from the milled surface, the Contractor may need to use sweeping-vacuuming combination, wet sweeping or flushing the surface with water. The use of high-pressure air can also be used to blow debris from the surface.

3. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

(a) Asphalt Mix Designs

The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation. Resolve any questions or concerns with the submitted mix designs with the Contractor in a timely manner. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

4. Contractor Proposed Asphalt Plants

Ideally, the Contractor will submit their proposed asphalt plants in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed asphalt plant submitted by the Contractor has a current ODOT certification.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

(a) Asphalt Plant Inspection and Scale Certification

The ODOT Materials Division – Independent Assurance (IA) Branch is responsible for inspecting asphalt plants each year and verifying that plant scales are certified every six months. The Hot Mix Asphalt (HMA) Plant List is maintained and posted on the Materials Division website that indicates the inspection status and scale certification status of all plants that may be used on ODOT construction projects.

The Residency will verify that the proposed asphalt plants submitted by the Contractor are on the Materials Division list of Hot Mix Asphalt (HMA) Plant List and that the inspection status and scale certification status are both listed as "current". If a proposed asphalt plant is not listed on this report or the plant status is not "current", contact Materials Division – Independent Assurance (IA) Branch for their input and recommendation. Resolve any questions or concerns with the submitted asphalt plants with the Contractor in a timely manner.

5. Contractor Proposed Equipment

The Contractor may include the equipment needed to place the HMA in their submittals prior to beginning construction. The various pieces of equipment required include the following:

- Trucks and transport units,
- Pavers,
- Material Transfer Vehicles (required in some instances), and
- Compactors.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 411.03.B of this Manual below.

D. Safety and Environmental Issues

For storage of aggregates in a staging area near the project, stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. Additionally in Section 106.08, at the Contractor's request, the Department may allow the use of approved portions of the right-of-way for storing materials and staging their equipment. As part of the request for use of the site, the Contractor must provide the Resident Engineer with written documentation of the location of the proposed site, access and egress points, a proposed erosion control plan, a proposed traffic control plan, and any other information required by the Resident Engineer relevant to use of the site for materials and equipment storage. For controlled access facilities, the approval from the Resident Engineer is subject to the approval of FHWA, prior to altering, severing, or removing any right-of-way fences. Prior written permission of the owner or lessee is required for the use of private property and copies of such written permission must be provided upon request to the Resident Engineer.

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and HMA surface from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

411.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the material requirements in Section 708, "Plan Mix Bituminous Bases and Surfaces" of the Standard Specifications that pertain to the type of asphalt mixture (Superpave, SMA, RBL or RIL) required in the Plans.

The type of asphalt mixture (Superpave, SMA, RBL or RIL) is designated by the pay item shown in the Contract and must meet the gradation requirements shown on the approved Job Mix Formula and the sand equivalent requirements for the aggregates found in Table 708:1 from Section 708.02.A of the Standard Specifications.

The Contractor should submit its proposed sources of materials, mix designs and plant locations at the Preconstruction Meeting. If the sources of materials, mix designs and plant locations are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the relevant HMA pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials, mix designs and plant locations. Resolve any questions or concerns with the submitted sources of materials, mix designs and plant locations with the Contractor in a timely manner. A written response accepting the proposed sources of materials, mix designs and plant locations must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted and accepted mix designs, plants and sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

1. Contractor Proposed Mix Designs

Ensure the Contractor has submitted its proposed asphalt mix designs in advance of any work beginning on the relevant HMA pay items (Superpave, SMA, RBL or RIL). The Residency will verify that the proposed asphalt mix designs submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. There are various reports that can be accessed on the Materials Division website that are grouped by Producer, Contract, County or Mix ID. If a proposed asphalt mix design is not listed on these reports, contact Materials Division – Bituminous Branch for their input and recommendation.

Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use. A written response accepting the mix designs must be sent to the Contractor and kept in the project file.

2. Contractor Proposed Asphalt Plants

Ensure the Contractor has submitted its proposed asphalt plant in advance of any work beginning on the relevant HMA pay items.

The Residency will verify that the proposed asphalt plants submitted by the Contractor have a current ODOT certification as further described in Section 411.02.C.4 of this Manual. A written response accepting the plants must be sent to the Contractor and kept in the project file.

3. Acceptance of Materials

Ensure the Contractor has submitted its proposed sources of materials and mix designs in advance of any work beginning on the relevant HMA pay items (Superpave, SMA, RBL or RIL).

The sources of materials for HMA mixes will be indicated on the approved Job Mix Formula (asphalt cement, aggregates, anti-stripping agents, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

Section 411.04.B(4) of the Standard Specifications discusses the use of hydrated lime or commercial lime slurry as the anti-stripping agent if needed to meet the requirements of Section 708.04 of the Standard Specifications or when the project is located in Beaver, Cimarron or Texas County. Additional information regarding the use of lime as an anti-stripping agent may be directed to the Materials Division Bituminous Branch.

The Residency will verify that the proposed source of materials for any asphalt release agents submitted by the Contractor is on the Materials Division Qualified Products List (QPL-Asphalt Release Agents). The release agents may be used on truck beds and rollers. Ensure the product name and manufacturer is shown on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, visual appearance (excessive or insufficient asphalt binder, segregation, etc.), or other special provision requirements where Contractor tests are used for acceptance purposes.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Obtain a sample of the HMA mix from the asphalt plant to submit to the ODOT Materials Division for TSR testing. [Document in Template C93005]
- Obtain a sample of the asphalt cement binder used in the HMA mix from the asphalt plant to submit to the ODOT Materials Division for acceptance. [Document in Template C91018]
    - Sample liquid asphalt materials in accordance with AASHTO R66. Use appropriate sample containers; plastic jugs for Emulsified Asphalt and tin cans for Asphaltic Cement Binders.
- Verify the aggregate used in each HMA mixture type complies with the requirements of Table 708:1 of the Standard Specifications:
    - Sand Equivalent – AASHTO T 176 [Document in Template C93004]
- Verify each HMA mixture type complies with the requirements of the approved Job Mix Formula and applicable tolerances [Document in Template C93015]:
    - Gradation; Mechanical Analysis of Extracted Aggregate - AASHTO T 30 [Document in Template C93015]
    - Asphalt Binder Content by Ignition – OHD L-26 [Document in Template C93015]
    - Percent density of compacted asphalt specimen (lab molded density) – OHD L-14 [Document in Template C93015]
- Verify each HMA mixture complies with the requirements for the roadway density:
    - HMA Density Test for Pavement Cores – AASHTO T 30 [Document in Template C93016]
- Verify each HMA mixture complies with the requirements for the longitudinal joint density:

- Asphalt Longitudinal Joint Density – OHD L-14 [Document in Template C93019]

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product or mix design approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 401.03 of the Standard Specifications contains requirements for general equipment that will be used on various types of surfacing. Additionally, review the equipment requirements for HMA in Section 411.03 of the Standard Specifications. Review any special provisions and plan notes that pertain to any of the HMA pay items.

Ensure the Contractor's proposed equipment complies with the requirements for the relevant HMA pay items. Verify if an MTV is required for your specific project. The 2019 Standard Specifications inadvertently omitted the requirement for the MTV in the surface course in Section 411.03, however, there may be a plan note that reinstates that requirement. The MTV is intended to be required for the following situations:

- When the pavement on the project is designed for a minimum of 10 million ESALs, and
- For the top two lifts of the pavement structure, or
- When specifically required in the special provisions or plan notes.

Verify the Contractor's equipment meets the requirements of Sections 401.03 and 411.03 of the Standard Specifications as follows.

1. Distributors and Supply Tanks

Ensure the Contractor provides distributors and supply tanks capable of uniformly applying bituminous material in accordance with the following:

- At the temperatures specified in the relevant specification sections;
- On variable widths of surface not to exceed 26 ft;
- At rates from 0.010 gal/yd^2 to 1.000 gal/yd^2; and
- With constant pressure and uniform temperature.

Ensure the distributor can apply material to vertical faces of asphalt pavement at the joints between paving operations.

Ensure the Contractor provides a distributor equipped with the following:

- A tachometer,
- Pressure gauges,
- Volume metering devices or a calibrated tank,
- A thermometer for measuring temperatures of tank contents,
- A power unit for the pump,
- Full circulation spray bars adjustable vertically and laterally,
- A positive shut off valve, and
- Fittings that prevent bituminous material from dripping.

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to ensure uniform distribution of the bituminous material. If clogging or streaking of the applied bituminous material occurs, stop the operation and correct the problems creating these conditions before resuming distribution. The Resident Engineer may require the Contractor to confirm the rate and uniformity of the distribution application by calibration of the equipment. The Contractor is required to calibrate the distribution operation to stay within the 0.01 gal/SY tolerance stated in Section 401.03.A of the Standard Specifications. A Calibration Shot Record spreadsheet that complies with NCHRP Report 9-40A can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting:

- Calibration Shot Record (Tack Calibration v0.1.xlsm).

2. Mixing Plants

The Contractor must provide asphalt preparation plants in accordance with AASHTO M 156 and the Department's plant certification requirements.

Reclaimed asphalt paving (RAP) material must not be exposed directly to the burner flame or high temperature combustion gases. Ensure plants modified for this purpose meet the manufacturer's requirements for the specific modifications. **Note**: RAP is not allowed to be included in stone matrix asphalt (SMA), rich bottom layer (RBL) or rich intermediate layer (RIL).

Plants must include a closed system for storing and feeding mixtures with mineral fillers that maintains a constant material supply with minimal loss throughout the mix production system. Ensure the mineral filler measuring device provides a consistent percentage of filler. The plant must provide a system that includes flow indicators or sensing devices to automatically stop mix production if mineral filler introduction ceases. The Resident Engineer must be allowed access to the mineral filler feeder systems for approval before use, if requested.

Plants must provide a separate system for mixtures with cellulose fibers to feed fibers into the mixture to obtain a uniform distribution into the PFC mix. Ensure the fiber supply system has the following characteristics:

- Low level and no-flow indicators,
- A printout or data file that records the feed rate, and
- A section of transparent pipe that allows observation of flow and feed consistency.

The Department will inspect plants every six months, or after every move.

3. Compactors

Ensure the Contractor provides self-propelled rollers of the following types:

- Vibratory steel wheel,
- Non-vibratory steel wheel,
- Pneumatic tire, or
- A combination of the three types.

Ensure rollers are in good condition, capable of reversing without backlash, and operating at speeds that do not displace the bituminous mixture. Rollers must have properly working spray bars and nozzles along with scraper bars or brushes to ensure the mixture does not build up on the wheels during the compaction operation.

Vibratory rollers must be equipped with working amplitude controls or frequency controls designed specifically for the compaction of the specified bituminous material.

Ensure the steel wheeled compactors weigh at least 10 tons.

Pneumatic tired compactors must have at least seven pneumatic tires of equal size and diameter. Ensure the total weight of the tires produces an operating weight of at least 3,500 lbs per tire. The tires must be inflated to at least 90 percent of the maximum pressure recommended by the tire manufacturer. The tire pressure must be maintained for at least 1 hr after the start of operations and the variation in the range in pressure among the tires must not exceed 10 psi.

The Contractor must use the number of rollers of proper type and weight to complete the compaction of the bituminous material before its temperature drops below the specified minimum.

Equipment that crushes the aggregate in the bituminous material should not be used.

4. Pavers

The Contractor must provide self-contained, self-propelled asphalt pavers equipped with an activated heated screed, and an automatic control device for placing the HMA mixture to the slopes and grades shown on the Plans. Ensure the pavers can spread and finish asphalt courses on lanes, shoulders, and similar construction to the widths and thicknesses shown on the Plans.

The paver must be equipped with a receiving hopper and a distribution system to uniformly place and spread the asphalt in front of the screed without causing asphalt segregation. The Department will not allow equipment designed to pick up asphalt from windrows. The asphalt paver must be used in conjunction with a material transfer devise for the placement of the upper layers of the HMA on higher volume roadways. Verify if an MTV is required for your specific project.

Ensure the paver can operate at forward speeds to place the mixture in a uniform manner at a consistent speed.

The paver must include a heated strike off assembly to produce a finished surface that meets the specified evenness and uniform texture without tearing, shoving, or gouging the mixture or causing asphalt segregation.

(a) Safety Edge Attachment

A safety edge must be constructed when called for in the typical sections in the Plans. See Section 440 of the Standard Specifications and this Construction Manual for additional details.

Verify that the equipment used produces the safety edge to the specified slope and dimensions required in the Standard Specifications, Plans and ODOT Standard Drawings. In accordance with ODOT Standard Drawing PSE-2 (Note 5), all safety edges must meet the approval of the Resident Engineer. The Resident Engineer may require proof that the system proposed by the Contractor has been used on previous projects with acceptable results or may require that a test section be constructed prior to the beginning of work to demonstrate that the edge shape and compaction is to the satisfaction of the Resident Engineer.

The Contractor must equip the paver to ensure a 30 ± 5 degree wedge along the outside edge(s) of the roadway (measured from the horizontal plane) is in place after final compaction of the final surface course. The Contractor must use an approved mechanical edging device that will:

- apply compactive effort to the asphalt mixture to eliminate objectionable voids as the mixture passes through the wedge device, and

- produce a wedge with a uniform texture, shape, and density while automatically adjusting to varying heights encountered along the roadway shoulder.

5. Trucks and Transports

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for HMA, ensure the Contractor or their designated subcontractor/supplier is prepared to comply with the terms of the provision. That includes placing an identifying vehicle number on the driver side and the passenger or rear sides of every vehicle delivering HMA mix to the project.

Ensure trucks hauling asphalt mix comply with legal load limits and have tight, clean, smooth metal beds thinly coated with a minimum amount of asphalt release agents (soap solution, lime solution, or other material that prevents the mixture from adhering to the beds) as approved by the Resident Engineer. The Contractor must prevent ponds of asphalt release agents (anti-adhesive solutions) from forming in truck beds.

Solutions that contain diesel fuel or other contaminating solvents must not be used by the Contractor as asphalt release agents during material delivery.

Trucks hauling asphalt mix must have a canvas cover or other material large enough to protect the asphalt from the weather. If necessary, during cooler weather conditions or when longer hauls from the asphalt plant are necessary to a project, the Contractor should consider using insulated truck beds and fasten the covers so that the mixture remains at the specified temperature until delivery.

The Contractor is required to maintain records of the liquid asphalt materials hauled in transports and must make those records available to the Resident Engineer upon request. This information could be valuable in instances where problems occur on the project that need to be evaluated for their cause for correction. The information that is specified in Section 411.03.D to be maintained by the Contractor includes:

- Delivery date,
- Asphalt grade,
- Source,
- Quantity,
- Invoice number, and
- Material hauled in the previous load in the transport unit.

6. Material Transfer Vehicle (MTV)

A Material Transfer Vehicle (MTV) is the piece of equipment that transfers asphalt mix from the trucks to the paving machine. The MTV is required for the following reasons:

- Minimize aggregate segregation in the asphalt mix and improve the longevity of the asphalt pavement by having a more uniform asphalt layer being placed,
- Eliminate the truck bumping into the paver when positioning to unload the asphalt mix which will improve the smoothness of the asphalt pavement, and
- Minimize temperature variation of the asphalt mix and improve the longevity of the asphalt pavement by having a more uniform compaction of the asphalt layer being placed.

Verify if an MTV is required for your specific project and which layers are subject to its use. The 2019 Standard Specifications inadvertently omitted the requirement for the MTV in the surface course in Section 411.03, however, there may be a plan note that reinstates that requirement. The MTV is intended to be required for the following situations:

- When the pavement on the project is designed for a minimum of 10 million ESALs, and
- For the top two lifts of the pavement structure, or
- When specifically required in the special provisions or plan notes.

The Resident Engineer may exempt use of the MTV from portions of a project due to small quantities, short isolated areas, poor condition of the pavement to be surfaced, proximity to bridge structures, etc.

The MTV must be equipped with remixing augers or paddles to continuously remix asphalt in the transfer device. This improves the uniformity of the aggregate distribution throughout the mix as well as providing a uniform temperature throughout the mix.

C. Construction Operations

The Contractor must construct a finished pavement surface as shown on the Plans and in accordance with Section 401.04.A(1), "Surface Elevation and Smoothness." The surface elevations for new pavement construction and overlays must be within 1/2 in of the elevations shown on the Plans. Ensure the surface smoothness is within 1/8 inch in 10 ft. Test for surface smoothness by placing a straightedge between two contacts on the finished surface and measuring the distance from the surface to the straightedge.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. Note

that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

Ensure the finished pavement structure is constructed in conformance to the widths and thicknesses of individual layers and the total thicknesses of asphalt shown on the Plans or directed by the Resident Engineer. If the planned width is not being achieved, stop the operation and correct the problems creating the incorrect dimension before resuming the paving operation.

The Contractor must correct material and dimension deficiencies that exceed specified tolerances using methods approved by the Resident Engineer, at no additional cost to the Department. The Resident Engineer may at their discretion accept out of specification work in accordance with Section 105.03 of the Standard Specifications as a reduced cost.

Verify the following complies with Section 411.04 of the Standard Specifications when constructing the Hot/Warm Mix Asphalt (Superpave, SMA, RBL or RIL):

1. Weather Limitations

Review the weather limitation and surface preparation requirements in Sections 411.04.H and 411.04.I of the Standard Specifications or as modified in the Contract or plan notes.

Ensure that the Contractor is aware of the minimum surface temperature and weather conditions required to proceed with the placement of the HMA. The minimum surface temperature requirements are dependent on the lift thickness being placed and whether HMA or WMA is being used. Table 411:1 in Section 411.04.H of the Standard Specifications requires the following:

Table 411:1
Compacted Thickness and Surface Temperature

Lift Thickness, *inches*	**Surface Temperature, °F**		
	Hot Mix Asphalt	**Warm Mix Asphalt (Foamed)**	**Warm Mix Asphalt (Non-Foamed)**
> 3	40	35	35
2 - 3	45	40	35
< 2	50	45	40

NOTE: Due to the use of cellulose fibers in the mix, do not place SMA if the surface temperature is below 60 °F.

Additional weather limitations include:

- Do not begin placing HMA if frost exists in or on the foundation.

- Stop operations if the material becomes too cold to be leveled and consolidated.
- Stop plant production immediately if it starts raining. The Contractor may place material already in transit; however, the Contractor shall assume the risk of weather related impacts and remedy any unacceptable work if they decide to proceed with its use under those conditions.

2. Plant Operations

The sources of materials for HMA mixes (Superpave, SMA, RBL or RIL) will be indicated on the approved Job Mix Formula (asphalt cement, aggregates, anti-stripping agents, etc.). Any revisions to the sources indicated on the approved Job Mix Formula should be reviewed and accepted by the Materials Division Bituminous Branch prior to use by the asphalt producer.

The asphalt plant must heat the bituminous material and aggregates to temperatures in accordance with the approved Job Mix Formula and Section 708.03, "Asphalt Materials." The plant must provide a continuous supply of bituminous material to the mixer. The heater unit flames must be adjusted to avoid damaging or depositing soot on the aggregate and avoid localized overheating.

Ensure the aggregate for plants are properly screened and stored to control the gradation of hot dry aggregates as follows:

- At least two bins for Type S5 and Type S6 mixtures, and
- At least three bins for all other mixtures.

Section 411.04.B(4) of the Standard Specifications discusses the use of hydrated lime or commercial lime slurry as the anti-stripping agent if needed to meet the requirements of Section 708.04 of the Standard Specifications or when the project is located in Beaver, Cimarron or Texas County. When required, ensure the amount of lime added is between 0.5% and 2.0% hydrated lime or commercial lime slurry solids by weight of the aggregates treated as shown on the mix design. The lime must be incorporated in a manner that thoroughly and uniformly distributes lime onto the aggregate surface or into the mixture. Metering equipment must be used to ensure the required quantity of lime is adequate. Fines collected by the baghouse or other dust-collection equipment may be reintroduced into the mixing drum.

Hydrated lime will be added to the aggregate by on of the following methods, unless otherwise shown on the plans or mix design:

- Add in an approved pug mill mixer with damp aggregate containing water at least 2% above saturated surface dry condition.
- Add into the drum-mix plant immediately before asphalt binder addition or in the pug mill of the batch plant before asphalt binder addition. If a batch plant is used, dry mix aggregates and lime before adding asphalt binder.

Commercial lime slurry will be added to the aggregate by on of the following methods, unless otherwise shown on the plans or mix design:

- Mix in a suitable pugmill mixer with the aggregate.
- During mixture production, mix with aggregates between the plant cold feeds and the dryer or mixing drum.

3. Mixing

The plant operation must be capable of accurately combining aggregates in the mixer in accordance with the mix design proportions. The bituminous material must be accurately measured to result in the asphalt content in accordance with the mix design, and loaded into the mixer. Ensure the moisture content of the asphalt is no more than 0.75 percent at the point of mixture discharge. The Department will not accept uncoated or non-uniform mixtures.

Ensure deliveries to the storage silo or roadway are in accordance with the mix design during daily startup or shutdown of plant operations. The producer must empty the plant, silo and cold feed bins and refill the bins with the proper aggregates before changing mixtures.

4. Plant Startup Requirements for New Construction and Overlays

Section 411.04.C of the Standard Specification requires the Contractor to use the approved mix design (Superpave, SMA, RBL or RIL) for the project to produce enough asphalt to calibrate the plant, testing equipment, and testing procedures before placing the asphalt on the project. The Resident Engineer may waive plant startup requirements if the same plant and location have recently produced the same asphalt mix design successfully.

The Resident Engineer will sample and test the asphalt for asphalt cement content, aggregate gradation, air voids, and voids in mineral aggregate (VMA). The Contractor's test results need to be compared with the Resident Engineer's test results. Based on the results, the Contractor will make adjustments to the materials or plant operations if necessary. These plant startup requirements should be performed for each mix design used on the project, especially if there are significant differences such as for an SMA mix.

The asphalt from the plant startup operation can be used to meet the control strip requirements on temporary construction only. Asphalt from the startup operations cannot be used on the mainline. Adjustments to the plant production and materials should continue to be made until all requirements are met. If no temporary locations are available on the project, the plant startup mixture becomes the Contractor's property at no additional cost to the Department.

5. Surface Preparation and Tack Coat

Ensure that the cross slope, elevation, and alignment are correct and the subgrade, subbase or base courses are processed and compacted in accordance with relevant sections of the Standard Specifications. Visually inspect the subgrade or subbase for soft spots, ruts, and grade deficiencies. Visually inspect the bases courses for any unacceptable areas of raveling, cracking or other deficiencies. Ensure that the subgrade, subbase or base courses are prepared within allowable tolerance to properly receive the required thickness of base course material. The Resident Engineer must notify the Contractor of any concerns so that a resolution can be determined prior to proceeding with the surface construction.

Ensure the Contractor has a method to adequately prepare the surface prior to placement of the HMA. The existing roadway surface must be cleared of vegetation, loose aggregate, soil and any debris before the Contractor commences with the placement of the HMA. Usually, tack coat will be applied prior to the placement of the HMA to ensure an effective bond between the asphalt pavement layers. Ensure the Contractor complies with the requirements of Section 407, "Fog Seal and Tack Coat" of the Standard Specifications when performing the tack coat treatment.

The purpose of the tack coat is to develop the proper bond between all of the pavement layers. To perform as designed, it is critical that each layer of asphalt pavement is adequately bonded together in the pavement structure. Inadequate bonding between layers may result in premature delamination of layers, slippage cracks and fatigue cracks. An effective and uniform tack coat will also facilitate better compaction of the asphalt layer being placed which will add longevity to the pavement.

Ensure the Contractor adequately prepares the surface prior to placement of the tack coat treatments. When the emulsion is applied to a dusty or dirty surface, the tack coat will cling to the dust and dirt rather than the roadway surface which will adversely affect the bonding of the asphalt layers. The surface needs to be free of vegetation, soil, loose aggregate, and dust. A damp surface is acceptable, but do not allow the Contractor to apply the tack coat to wet surfaces with free standing water. It is challenging to adequately clean a milled asphalt surface and extra effort might be necessary by the Contractor to eliminate the dust coating which would act as a bond breaker to the surface layer being placed. If dry sweeping is ineffective in removing the dust from the milled surface, the Contractor may need to use sweeping-vacuuming combination, wet sweeping or flushing the surface with water. The use of high-pressure air could also be used to blow debris from the surface.

6. Control Strip Requirements

Section 411.04.D of the Standard Specifications requires a control strip for any type of HMA (Superpave Type S3, Superpave Type S4, SMA, RBL or RIL) that the

plan quantity exceeds 5,000 tons, unless otherwise indicated in the Contract or plans.

After meeting the plant startup requirements, the Contractor must construct at least one control strip on a detour to verify the required production mix characteristics and establish rolling patterns. If a detour is unavailable, construct on the shoulder; if a shoulder is unavailable, construct on the mainline. The initial asphalt control strip should not exceed 500 tons. The Contractor and Resident Engineer will sample and test this mixture for asphalt cement content, aggregate gradation, air voids, VMA, and roadway density. Make adjustments to production and placement procedures if the placement of the initial asphalt control strip produces failing results, and repeat the test process for a second control strip. The Department will make pay adjustments for deviations on the second asphalt control strip at the pay factor rate in accordance with Section 411.04.N(2)(a), "Basis of Acceptance and Payment." If required, create additional asphalt control strips on the shoulder until an acceptable mixture is produced (within the 100 percent pay factor range). The Department will make pay adjustments for asphalt control strips after the second asphalt control strip placement in accordance with Section 411.04.N(2)(a), "Basis of Acceptance and Payment."

If the Resident Engineer determines the initial placement of the asphalt control strip to be acceptable in accordance with Section 411.04.N(2)(a), "Basis of Acceptance and Payment," the Department will pay for the control strip quantities in accordance with Section 411.04.N(2)(a), "Basis of Acceptance and Payment," and allow the Contractor to proceed with production paving operations.

Unacceptable asphalt will not be allowed to remain on the mainline or the shoulder. The Contractor must remove and replace unacceptable asphalt at no additional cost to the Department.

7. Spreading and Finishing

The existing roadway surface must be cleared of vegetation, loose aggregate, soil and any debris before the Contractor commences with the placement of the HMA. Usually, tack coat will be applied prior to the placement of the HMA to ensure an effective bond between the asphalt pavement layers. Ensure the Contractor complies with the requirements of Section 407, "Fog Seal and Tack Coat" of the Standard Specifications when performing the tack coat treatment. The Contractor must place the asphalt on a dry surface with a paver in accordance with Section 411.03.C, "Pavers." For adequate control of the width of the HMA layer being placed and uniform longitudinal joints, the Contractor should establish the alignment along one pavement edge with a string or wire line. The Contractor is not allowed to windrow the HMA mix upon delivery to the project. The Contractor may use hand tools to dump, spread, rake, and compact the asphalt to the compacted thickness in areas inaccessible to mechanical spreading and finishing equipment.

The HMA mixture must be spread uniformly adjacent to curbs, gutters, manholes, and other structures so that the compacted surface is 1/4 in above the edges of the structures. Before placing the mixture against these structures, ensure the Contractor cleans and coats them with a thin, uniform tack coat in accordance with Section 407, "Fog Seal and Tack Coat."

The Contractor must strive to pave at a uniform and continuous speed to reduce surface imperfections. Ensure the paving operation provides a continuous, uniform, segregation-free flow of material during the HMA placement. To avoid stopping and restarting the paving operation between trucks delivering the HMA, the Contractor must coordinate the following to the maximum extent possible:

- The number of haul units needed to maintain a consistent operation,
- The speed of the paver (and MTV when required),
- Roller train capability to ensure adequate compaction, and
- The plant production rate.

If the Resident Engineer determines that sporadic material delivery is adversely affecting the mat quality, the Resident Engineer may direct paving operations to suspend until the Contractor makes appropriate adjustments.

Correct unsatisfactory asphalt mat immediately. The Resident Engineer may suspend paving operation until the Contractor produces a satisfactory result. Remove and replace unsatisfactory asphalt as directed by the Resident Engineer, at no additional cost to the Department.

(a) Loading and Hauling

Ensure proper coordination of loading and hauling of the HMA (Superpave, SMA, RBL or RIL) with laydown operations to:

- Ensure the HMA mixture is placed at the temperature required by the approved Job Mix Formula (JMF) ± 25 °F, but not to exceed plant mix temperature of 345 °F
- Verify there is no separation of the bituminous material from the aggregate in the HMA resulting in uncoated aggregate, and
- Trucks hauling HMA mix must have a canvas cover or other material large enough to protect the asphalt from the weather and excessive cooling of the mix while it is being transported to the project site.

Record temperature readings taken of the mix throughout the day's paving operation on the Daily Report for Laying of Asphalt Mixture (Laydown Report). It is critical to monitor the temperature of the mixture to ensure it is consistently within the acceptable temperature range. An example of the Laydown Report may be found in the Appendix of this chapter of the Manual. Temperatures outside the acceptable ranges will likely result in:

- Too cold. The mixture will be difficult to achieve adequate compaction and will shorten the life of the HMA surface due to the premature raveling, stripping of the asphalt binder from the aggregates or rutting.
- Too hot. Overheating of the mixture will cause the asphalt cement binder to become over-oxidized and will shorten the life of the HMA surface due to premature raveling.
- Inconsistent temperatures. Inconsistent temperatures will result in thermal segregation which will adversely affect the unform compaction of the surface and result in irregularities in the smoothness of the surface. Inadequate compaction will shorten the life of the HMA surface due to the premature raveling, stripping of the asphalt binder from the aggregates or rutting.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for HMA, ensure the Contractor or their designated subcontractor/supplier is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every vehicle delivering HMA mix to the project.

Residency project inspector will utilize HaulHub similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each HMA load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

(b) Paver Operation

In some instances, the HMA mix must be placed with a paver in conjunction with a material transfer vehicle (MTV). The 2019 Standard Specifications inadvertently omitted the requirement for the MTV in the surface course in Section 411.03, however, there may be a plan note that reinstates that requirement. Verify if an MTV is required for your specific project and which layers are subject to its use.

Do not allow the Contractor to raise (dump) the wings of the paver's receiving hopper during the paving operations. Raising the paver wings will increase the potential for a segregated pavement surface (both mixture aggregate and thermal segregation). Do not allow the Contractor to windrow the HMA mix before spreading and finishing.

Prior to placing the HMA mix, ensure the Contractor has applied a tack coat or NT tack material in accordance with Section 407 of the Standard Specifications. The type and application rate for the tack coat will be specified in the Plans. Ensure the Contractor applies the proper type at the specified rate, unless otherwise agreed to by the Resident Engineer.

The HMA mixture must be placed at the temperature required by the approved Job Mix Formula (JMF) ± 25 °F. Ensure the paver includes a heated vibratory or combination vibratory tamping bar screed for the HMA placement.

In the event of equipment malfunction the Contractor may continue operations, if possible, to place HMA mix quantities in transit or to safely maintain traffic. Discontinue further operations until equipment is repaired.

The thickness and application target rate for placing the HMA is typically established for the Project in the typical section and by plan note found in the Plans. Record the tons of HMA placed along with the area (square yards) covered during the day's paving operation on the Daily Report for Laying of Asphalt Mixture (Laydown Report). It is critical to monitor the thickness and application rate versus the planned application rate (yield) to ensure there is not an overrun of the planned quantity. An example of the Laydown Report may be found in the Appendix of this chapter of the Manual.

(c) Material Transfer Vehicle (MTV)

Verify if an MTV is required for your specific project and which layers are subject to its use. The 2019 Standard Specifications inadvertently omitted the requirement for the MTV in the surface course in Section 411.03, however, there may be a plan note that reinstates that requirement. The MTV is intended to be required for the following situations:

- When the pavement on the project is designed for a minimum of 10 million ESALs, and
- For the top two lifts of the pavement structure, or
- When specifically required in the special provisions or plan notes.

The Resident Engineer may exempt use of the MTV from portions of a project due to small quantities, short isolated areas, poor condition of the pavement to be surfaced, proximity to bridge structures, etc.

The MTV must be equipped with remixing augers or paddles to continuously remix asphalt in the transfer device. This improves the uniformity of the aggregate distribution throughout the mix as well as providing a uniform temperature throughout the mix.

The Resident Engineer will evaluate the MTV's performance by measuring the temperature profile of the mat immediately behind the paver screed using a non-contact thermometer at intervals of 50 ft. Each temperature profile consists of three surface temperature measurements taken transversely across the mat from 1 ft to 3 ft from the screed during the paving operations. Each profile will include three temperature measurements; one in the middle of the mat and two at the edges (1 ft inside each edge). This initial evaluation may be done by the Contractor placing a 500-ton test strip.

Stop producing HMA mix if two of the temperature measurements in any profile differ by more than 10 ºF. Adjust operations before restarting the paving operation. The Resident Engineer may continue to take additional surface temperature profiles during the project.

MTVs that exceed 20,000 lb per axle will only be allowed to cross bridges if the unit's hopper is empty, the vehicle travels at crawl speed, and the wheels are placed over the underlying beam lines. For bridges in poor condition or posted for load limits, the Resident Engineer must consult the Bridge Division to determine additional limitations.

8. Joints

It is important to stagger joints in succeeding layers of the HMA when it is being placed. Ensure the Contractor has a strategic plan on where they plan to place the joints when placing each layer. The longitudinal joints need to be staggered on succeeding layers by approximately 6 in. And the transverse joints need to be staggered by at least 6 in but would typically be much more than that on longer projects. Ensure all joints are tight, smooth, butt-type joints.

Ensure the longitudinal joints in the top asphalt layer, or in the layer upon which an open-graded friction course (UTBWC, PFC, OGSFC, etc.) will be placed, are at the lane lines. The Contractor must place all longitudinal joints in the pavement structure within 1 ft of the lane lines and each HMA longitudinal joint must also be offset from the underlying longitudinal joint by at least 6 inches, unless otherwise shown in the plans. Allowing the longitudinal joint (especially the surface course joint) to meander across the driving lane will introduce additional stress to the pavement structure and result in a shorter longevity of the pavement surface due to raveling. For adequate control of the width of the HMA layer being placed and uniform aligning of longitudinal joints, the Contractor should establish the alignment along one pavement edge of the layer being placed with a string or wire line.

The longitudinal and transverse joints must be properly bonded and sealed with tack coat. When making joints between old and new pavements, or between successive days' work, ensure a continuous bond between the surfaces. The Contractor may need to cut back the transverse edge of the previous course to its

full depth to expose a fresh surface. Ensure that all edges are properly coated with a tack coat and the asphalt mixture is placed directly against it to the depth and grade shown on the Plans.

(a) Longitudinal Joint Density

It is a challenge to achieve proper and uniform density at joints, especially the longitudinal joint. Poor density at the joints causes a more permeable area in the pavement which will lead to premature failures of the asphalt pavement due to raveling or stripping of the asphalt binder from the aggregates. Proper application of tack coat, laying the asphalt to the proper thickness, uniform temperature of the mix and timely uniform coverage by the rollers all impact the compaction of the HMA. In an effort to prioritize the joint density challenge, many state DOT's (including ODOT which implemented theirs in 2014) have adopted a longitudinal joint density specification.

In accordance with Section 411.04.J(2) of the Standard Specifications, joint density evaluations must be performed at each pavement edge of the layer being placed that is or will become a longitudinal joint for each lot or sublot at locations where roadway density tests are to be taken. The joint density is determined in accordance with OHD L-14. The use of a thin-lift nuclear density gauge is the preferred method to obtain the in-place unit weight of the HMA. If a suitable correlation has been established, the thin-lift nuclear density gauge may also be used to obtain the percent density, otherwise coring of the HMA layer will be required. The residency must document the results of the longitudinal joint density testing in SiteManager in Template C93019 as required by the FAST Guide.

The longitudinal joint density is considered failing if the in-place unit weight (density) at the joint is more than 3.0 pcf below the in-place unit weight (density) at the random sample location at the same station and the measured (by core or correlation) joint density is less than 90%.

Investigate longitudinal joint density failures and ensure the Contractor takes corrective actions during production and placement to improve the joint density. The Resident Engineer may suspend HMA production on the project if two (2) consecutive evaluations fail. Production may resume only after the Engineer approves changes to production or placement methods. Since the frequency of the longitudinal joint density testing is each 1,000 tons of HMA place, projects with low quantity may not need to consider suspending production from two (2) consecutive evaluation failures. However, performing and evaluating the density tests is still required and beneficial.

9. Compaction

The Contractor must operate compactors (rollers) in accordance with the equipment manufacturer's recommendations.

Section 411.04.K(1) of the Standard Specifications require the sequencing of the rolling pattern on the layers of HMA be performed as follows:

- steel drum rollers for the initial (breakdown) compaction for each placed layer of asphalt mixture,
- followed with at least two uniform coverages with self-propelled pneumatic tired rollers to kneed the aggregates together more effectively, and
- finish rolling with a steel-drum roller to remove any deformations caused by the pneumatic tire rollers.

The Contractor may use rakes and additional fresh material to correct the surface if mat displacement occurs during rolling. For areas inaccessible to compaction equipment, ensure the Contractor compacts the mixture using hot hand tampers, smoothing irons, or mechanical tampers. If approved by the Resident Engineer, use a trench compactor to transmit compression to depressed areas. Care must be taken to avoid displacing the line and grade of the edges of asphalt.

Ensure the HMA mixture does not adhere to the wheels of the compactors. Pulling of the aggregate from the mix can be especially difficult to avoid with pneumatic tired rollers. Contractors may preheat the tires or use a skirt around the tires during cold weather paving. The Residency should verify that the proposed source of materials for any asphalt release agents used on rollers by the Contractor is on the Materials Division Qualified Products List (QPL-Asphalt Release Agents). Ensure the product name and manufacturer is shown on the QPL. Ensure the Contractor repairs any surface damage incurred from aggregate adhering to the compactors and takes immediate action to address the issue.

The Contractor must remove mixture that is defective, cracked, loose, broken, or mixed with dirt or other foreign matter, and replace with new asphalt, at no additional cost to the Department. When replaced, the patching material must be shaped and compacted to conform to the surrounding area in a manner approved by the Resident Engineer.

Ensure the asphalt immediately behind the paver is at least 250 °F for HMA and 215 °F for WMA. Compaction of thicker layers to the target density and thinner layers to the optimum density must be achieved prior to the temperature of the asphalt dropping below 140 °F. Obtain the approval of the Resident Engineer prior to attempting to further compact any HMA layers that are below 140 °F.

Ensure the Contractor continues to compact the asphalt in accordance with the approved rolling pattern each day. Ensure the rolling sequence, the type of

compactor, and the maximum roller speed are in accordance with Table 411:3 from Section 411.04.K(2)(b) of the Standard Specifications.

Table 411:3
Rolling for Compaction

Rolling Sequence	Type of Compactor	Maximum Roller Speed, *ft/s*
Initial	Steel-Drum or Pneumatic-Tired	3.7
Intermediate	Pneumatic-Tired	4.4
Finish	Static Steel-Drum	4.4

If the Contractor does not have enough rollers on-site, they may need to lower the HMA plant production rate or add rollers to the paving operation to avoid exceeding the maximum roller speeds.

Ensure the establishment of the optimal roller pattern and the daily compaction effort is properly documented. Ensure the records include a detailed description of the equipment, including weight, tire pressure, speed, and the number of coverages. Ensure the roller operators and superintendent (or other Contractor representative), sign the records at the end of each day's operation. Immediately after signing, submit the records to the Resident Engineer at the conclusion of work on each day for inspection.

10. Acceptance Criteria for Compaction

The Resident Engineer will accept layers (lifts) of HMA placed in a thickness of at least 1-1/2” in nominal thickness on the basis of density determined by cutting cores from the roadway in accordance with Section 411.04.K(2)(a), "Layers At Least 1-1/2 inches Thick."

The Resident Engineer will accept layers (lifts) of HMA placed in a thickness less than 1-1/2” in nominal thickness on the basis of compactive effort determined by an established roller pattern in accordance with Section 411.04.K(2)(b), "Layers Less Than 1-1/2 inches Thick."

The Resident Engineer will accept layers of all thicknesses on a lot-by-lot basis. The Department considers a lot to be 1,000 tons of asphalt. The Resident Engineer may terminate a lot and designate a new one if the Contractor makes adjustments to the material or production and placement procedures. Lots may also be terminated when the paving operation is paused between phases. In instances when a lot is terminated prior to reaching 1,000 tons placed, the remaining balance of tons will be added to the previous 1,000 ton lot or may be considered as its own lot.

Typically, if the remaining balance of tons is less than 500 tons, it would be added to the previous 1,000 ton lot.

(a) Layers At Least 1-1/2 inches Thick

For layers of HMA placed that are at least 1-1/2 inches thick, the Contractor will be required to provide roadway cores extracted from the HMA layer to determine the roadway density that was achieved. Ensure the target density of each lot is 94 percent of the Maximum Theoretical Density, determined by the specific gravity of the asphalt in accordance with AASHTO T 209.

The asphalt density for each lot is the average of three random samples from the lot. At times and locations directed by the Resident Engineer, the Contractor must saw or core samples from the pavement of at least 6 in on the cut side or diameter. The Department will perform tests on the samples or on the mat using a nuclear density gauge that has been correlated with roadway cores in accordance with OHD L 14.

The Department will base acceptance and pay adjustments on Department-approved tests in accordance with the following Table 411:2 from Section 411.04.K(2)(a) of the Standard Specifications:

Table 411:2
Pay Adjustments for Lot Density

Pay Adjustment Factor (PAF) [a] % of Maximum Theoretical Density	**Average Lot Density (ALD)**
> 97.0 [c]	Unacceptable [b]
92.0 – 97.0 [c]	1
91.0 – 91.9	1.00 − (0.07)(92.0 − ALD)
88.1 – 90.9	0.93 − (0.15)(91.0 − ALD)
< 88.1	Unacceptable [b]

[a] Use PAF for Roadway Density in the Combined Pay Factor equation in accordance with Section 411.04.N(2)(a), "Basis of Acceptance and Payment."

[b] Unless otherwise directed by the Engineer, remove and replace unacceptable lots at no additional cost to the Department.

[c] For Rich Intermediate Layer (RIL) only, change 97.0 to 98.0.

(b) Layers Less Than 1-1/2 inches Thick

For layers of HMA placed that are less than 1-1/2 inches thick, the Contractor will not be required to provide roadway cores to determine the roadway density. Instead of coring, they will establish a rolling pattern that optimizes the density of the HMA layer. The Contractor must use test strips and monitor asphalt placement daily to obtain approval from the Resident Engineer for rolling patterns generating optimum compaction. While the Department considers the target to be 94 percent of Maximum Theoretical Density, the Resident Engineer will base acceptance on the Contractor's performance, as approved by the Resident Engineer, to obtain optimum compaction.

The Contractor will use compaction test strips that are 500 yd^2 of asphalt pavement to establish the optimum roller pattern. The Contractor must continue to construct test strips until the Resident Engineer approves of the number, size, and weight of compactors, and the number of coverages made by the compactors to obtain the acceptable density. An approved nuclear or non-nuclear density gauge must be used to determine the density of the test strip and the breakover point where optimum density is reached.

The Resident Engineer may require a new compaction test strip when one of the following conditions exists:

- There is a change in the material or mix design;
- There is reason to believe a compaction test strip density is not representative of the material being placed; or
- The foundation material has changed significantly.

11. Tolerances and Opening to Traffic

The Contractor must construct a finished pavement surface as shown on the Plans and in accordance with Section 401.04.A(1), "Surface Elevation and Smoothness."

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

Ensure the finished pavement structure is constructed in conformance to the widths and thicknesses of individual layers and the total thicknesses of asphalt shown on the Plans or directed by the Resident Engineer.

The Contractor must correct material and dimension deficiencies that exceed specified tolerances using methods approved by the Resident Engineer, at no additional cost to the Department. The Resident Engineer may at their discretion accept out of specification work in accordance with Section 105.03 of the Standard Specifications as a reduced cost.

Do not allow traffic on the pavement until after final rolling and the pavement has cooled sufficiently to ensure traffic will not damage the pavement surface. Water or other artificial means may be used to assist in cooling, as approved by the Resident Engineer.

12. Acceptance Criteria for Mix Properties

The Contractor is required to provide quality control personnel to ensure the production of acceptable products. Ensure the quality control personnel oversee the process control of asphalt materials during handling, mixing, and placing operations.

At no time will the Resident Engineer provide instructions to the Contractor or producer as to the setting of dials, gauges, scales, or meters; however, the Resident Engineer may advise the Contractor or producer against continuing any operations or sequences of operations that will result in non-compliance with the Contract requirements.

The residency must document the test results for acceptance in accordance with the requirements in the FAST Guide for the HMA (Superpave, SMA, RBL or RIL). If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

In accordance with Section 411.04.N of the Standard Specifications, the Resident Engineer will accept and pay for, or reject, each lot of asphalt pavement as defined in accordance with the following:

(a) Basis of Acceptance and Payment

In accordance with Section 411.04.N(2) of the Standard Specifications, the Resident Engineer will consider the test results of the following mix properties to determine acceptance and payment for the HMA placed:

- asphalt cement content,
- air voids, and
- roadway density.

The Resident Engineer may use several test methods to determine acceptability of asphalt cement content, air voids, and roadway density (in accordance with Section 411.04.K of the Standard Specifications). The Resident Engineer will only use one test method, but may perform multiple tests using that method to measure each characteristic. The Resident Engineer will calculate the average deviation for each characteristic in accordance with Table 411:4 from Section 411.04.N(2)(b) of the Standard Specifications and use the average of the deviations (without regard to sign) to determine acceptance and calculate pay factors.

Table 411:4
Acceptance Schedule

Characteristics	1 Test	Pay Factor
Deviation from JMF (Without Regard to Sign)		
Asphalt Cement Content (Extraction, Nuclear or Ignition Oven) Target JMF Percent	0.00 – 0.40	1
	0.41 – 0.80	1.40 - (Deviation from JMF)
	> 0.80	Unacceptable [b]
Asphalt Cement Content (Digital Printout from Hot-Mix Plant) Target JMF Percent	0.00 – 0.20	1
	0.21 – 0.30	1.80 - 4 x (Deviation from JMF)
	> 0.30	Unacceptable [b]
Average of Deviations from Target (Without Regard to Sign)		
Air Void (Lab Molded Samples) [a] Target (Superpave, SMA) = 4% Target (RBL) = 2% Target (RIL) = 3%	0.00 – 1.50	1
	1.51 – 2.50	$-0.16X + 0.24X + 1.00$
	> 2.50	Unacceptable [b]

[a] X is the average of deviations.

[b] Unless otherwise directed by the Resident Engineer, remove and replace unacceptable lots at no additional cost to the Department.

For the characteristics of asphalt cement content and air voids, the Resident Engineer will disregard algebraic signs of the deviations to calculate averages. The Resident Engineer will address deviations above or below the target for these characteristics.

Gradation and VMA (voids in mineral aggregate) test results are not included in the pay adjustment calculation defined in the Standard Specifications. The residency will perform sieve analyses in accordance with Section 708.04, "Composition of Mixtures," or as modified by the

special provisions. If a sieve analysis result does not fall within the tolerances specified in the JMF, the Contractor must obtain test results that demonstrate that the asphalt mixture meets the following requirements in accordance with Section 708.04, "Composition of Mixtures":

- The gradation falls within the broad band; and
- The air voids at Ndes and VMA fall within the ranges.

The Department will require a new mix design if the broad band gradation, air voids at N_{des}, or VMA requirements are not met.

The Resident Engineer will apply calculated pay factors for asphalt cement content, air voids, and roadway density to all acceptable asphalt pavement. The Resident Engineer may consider additional pay factors for other characteristics including but not limited to smoothness. The Resident Engineer will base the total pay adjustments for deficiencies on the following:

- All pay adjustments will be based on the individual pay factors shown in Table 411:2, "Pay Adjustments for Lot Density" and Table 411:4, "Acceptance Schedule" of the Standard Specifications.
- Except for smoothness, pay factors will be applied on a lot by lot basis.
- For smoothness, pay factors will be applied on an extent by extent basis.

The Resident Engineer will evaluate and accept HMA placed on a lot-by-lot basis. The Department considers a lot to be 1,000 tons of asphalt. The Resident Engineer may terminate a lot and designate a new one if the Contractor makes adjustments to the material or production and placement procedures. Lots may also be terminated when the paving operation is paused between phases. In instances when a lot is terminated prior to reaching 1,000 tons placed, the remaining balance of tons will be added to the previous 1,000 ton lot or may be considered as its own lot. Typically, if the remaining balance of tons is less than 500 tons, it would be added to the previous 1,000 ton lot.

Pay adjustments on lots will be calculated and assessed as each 1,000 ton lot is completed for deficiencies in asphalt cement content, roadway density, and air voids using the following formula. If test results are unavailable for a characteristic (such as roadway density) once the 1,000 tons is completed, an interim adjustment will be made assuming pay factors of 1.00 for the then unknown characteristics and corrected later when test results are completed. When your contract includes the smoothness special provision, pay adjustments for smoothness (by the extent) will be evaluated and assessed separately from the adjustments for mix properties (by the lot).

The Resident Engineer will determine the total pay adjustment (combined pay factor) for asphalt pavement with deviations, using the following equation:

$$CPF = \frac{4RD + 3AC + 3AV}{10}$$

Where:

CPF	=	Combined pay factor,
RD	=	Pay factor for roadway density (from Table 411:2),
AC	=	Pay factor for asphalt cement content (from Table 411:4), and
AV	=	Pay factor for air voids (from Table 411:4).

For layers less than 1-1/2 in thick, the Resident Engineer will use a pay factor of “one" for roadway density.

When using this formula for the acceptance of surface courses or bases (ultra-thin bonded wearing course, permeable friction course, open-graded friction surface course, and open-graded bituminous base mixes), that do not have a target roadway density or target for air voids, the Resident Engineer will use pay factors of "one" for both roadway density and air voids.

Spreadsheets are available to calculate the Combined Pay Factor for HMA that complies with Section 411.04.N of the Standard Specifications. The spreadsheets can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting one of the following options, as applicable:

- Combined pay factor of Superpave HMA using roadway cores – CPF 411 v1.22.xlsm
- Combined pay factor of Superpave HMA using nuclear density gauge – CPF 411 NG v2.03.xlsm

(b) Resident Engineer’s Acceptance Procedures

Once a lot has been defined, maintain its identity throughout the mixing and placement process. It is important to properly document the limits and locations of each lot in a manner that enables it to be clearly identified at a later date. If there are failing tests results on the HMA, there may be a need for additional sampling & testing of the HMA mix placed in that lot or the HMA mix may be deemed unacceptable to the degree that requires removal and replacement.

The Resident Engineer may perform varying amounts of the following sampling and testing per lot.

- Asphalt cement content test: one mixture sample randomly selected, split and tested in accordance with Table 411:4.
- Roadway density: three specimens randomly selected and each tested, averaged, and considered as one test in accordance with Table 411:2. Run one maximum theoretical specific gravity test or if applicable run two and average as one test split from the mixture sample.
- Air voids (lab-molded): two specimens split from mixture sample, tested, averaged, and considered as one test in accordance with Table 411:4.

The Resident Engineer will use Tables 411:2 and 411:4 for determining acceptance and calculating the combined pay factors (CPF) for each lot in accordance with the formula above.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

The Contractor must correct material and dimension deficiencies that exceed specified tolerances using methods approved by the Resident Engineer, at no additional cost to the Department. The Resident Engineer may at their discretion accept out of specification work in accordance with Section 105.03 of the Standard Specifications as a reduced cost.

(c) Application of Pay Adjustments on Progressive Estimates

Pay adjustment deductions that are calculated in accordance with the Contract should be documented on progressive estimates in SiteManager using a Line Item Adjustment tied to the appropriate HMA pay item in the Contract. This would include HMA pay adjustment deductions for mix properties as determined using the CPF formula. The appropriate Line Item Adjustment in SiteManager would be:

- HMA Deduction as per Sec. 411.

Smoothness pay adjustment deductions that are calculated in accordance with the Contract should be documented on progressive estimates in SiteManager using a Contract Adjustment. The appropriate Contract Adjustment in SiteManager would be:

- Smoothness Adjustment.

Any other deductions applied for gradation, VMA, segregated mix or any other characteristic that does not meet the specification requirements that are not specifically prescribed in the Contract, must be documented by change order. To apply a deduction on the progressive estimate in a timely manner for a situation that requires a change order, use a Line Item Adjustment tied to the appropriate HMA pay item in the Contract. Once the change order for the deduction is approved, the progressive estimate must reflect the pay adjustment charged to the new line item from the change order and the line item adjustments must be removed. The appropriate Line Item Adjustment in SiteManager would be:

- SUBSTANDARD ITEM.

All deductions should be communicated to the Contractor and applied on a progressive estimate in a timely manner. Any incentive earned by the Contractor for exceptionally smooth pavement, must be documented by change order.

D. Safety and Environmental Considerations

For storage of aggregates in a staging area near the project, stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. Additionally in Section 106.08, at the Contractor's request, the Department may allow the use of approved portions of the right-of-way for storing materials and staging their equipment. As part of the request for use of the site, the Contractor must provide the Resident Engineer with written documentation of the location of the proposed site, access and egress points, a proposed erosion control plan, a proposed traffic control plan, and any other information required by the Resident Engineer relevant to use of the site for materials and equipment storage. For controlled access facilities, the approval from the Resident Engineer is subject to the approval of FHWA, prior to altering, severing, or removing any right-of-way fences. Prior written permission of the owner or lessee is required for the use of private property and copies of such written permission must be provided upon request to the Resident Engineer.

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

The Standard Specifications require measurement of in-place field density using a nuclear density gauge according to AASHTO T 310 for some items of work, such as longitudinal joint density of asphalt pavements. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory

Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and HMA surface from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Type of HMA (Superpave Type S3, Superpave Type S4, SMA, RBL, RIL, etc.) placed.
- Locations (station extents, direction, lane, lift, etc.), thickness and length & width of area of HMA placed.
- Daily application rate (yield rate) of HMA placed.
- Shot record of gallons and type of tack coat placed and resulting application rate.
- Temperatures of the HMA mixture taken throughout the day (recorded in the Daily Laydown Report).
- Receipt of haul tickets (electronic tickets) of Type of HMA and quantity placed.
- Receipt of materials certifications and scale or weigher certification.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 411.05 of the Standard Specifications, the residency will measure the HMA as a combined mixture including all aggregate, liquid asphalt and other materials required in the approved mix design for the type of HMA being placed.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing for

HMA, the residency project inspector will utilize the Department's Electronic Ticketing Portal system (HaulHub) similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each HMA load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

In accordance with Construction Control Directive No. 20020213, delivery tickets received on a project and used to support payment of those contract items paid by delivery weight must be checked for overload delivery trucks. State statute requires that no payment will be made for any material that exceeds the legal weight limit.

Ensure that the delivery tickets or electronic tickets include the information necessary to evaluate for overloaded trucks. Perform an analysis and omit payment for any amount of material that exceeds the allowable gross vehicle weight for a load. The HaulHub app should be used daily to generate a report that verifies the evaluation of overloaded vehicles. The report should be kept in the project records. Otherwise, written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

In accordance with Section 411.04.N(2) of the Standard Specifications, the Resident Engineer will consider the test results of the mix properties to determine acceptance and payment for the HMA placed. All pay adjustments for mix properties will be based on the individual pay factors shown in Table 411:2, "Pay Adjustments for Lot Density" and Table 411:4, "Acceptance Schedule." Pay adjustments for mix properties will be calculated and applied on a lot by lot basis. Pay adjustment deductions can be applied by Line Item Adjustment in SiteManager or by change order. The calculations for these deductions will be placed in a Book, Folder or Envelope, or as an attachment to the change order.

Spreadsheets are available to calculate the Combined Pay Factor for HMA that complies with Section 411.04.N of the Standard Specifications. The spreadsheets can be found on the ODOT Materials Division website (Common Asphalt Spreadsheets) by selecting one of the following options, as applicable:

- Combined pay factor of Superpave HMA using roadway cores – CPF 411 v1.22.xlsm
- Combined pay factor of Superpave HMA using nuclear density gauge – CPF 411 NG v2.03.xlsm

When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. For smoothness, pay factors will be applied on an extent by extent basis and applied separately from the adjustments for mix properties. Pay adjustment deductions can

be applied by Contract Adjustment in SiteManager. Pay adjustment incentives will require a change order for payment. The calculations for these adjustments will be placed in a Book, Folder or Envelope, or as an attachment to the change order.

The Department will adjust payment for the asphalt binder used in the HMA mix in accordance with Section 411.06.B of the Standard Specifications. SiteManager will automatically calculate and place a Line Item Adjustment on the progressive estimate for the amount of asphalt binder price adjustment that is warranted. The adjustment is calculated from the Asphalt Binder Price Index difference from the month that bids are received for the Project to the price index for the month the HMA is placed and paid for. It is critical to pay for the HMA placed in a timely manner on the progressive estimate to reflect an accurate binder adjustment is calculated.

Documentation of the relevant HMA pay item paid by the Ton will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item (Superpave Type S3, Superpave Type S4, SMA, RBL, RIL, etc.) from the list of contract pay items.

b. In the appropriate field, enter the descriptive location or the station to station extents and location (i.e., direction, station extents, lane designation, etc.).

c. In the Placed Quantity field enter the tons of HMA complete in place as determined from haul tickets. This quantity may require adjustment after the overload analysis is performed as required in Construction Control Directive No. 20020213.

d. In the Remarks bubble enter the Book/Folder/Envelope # to provide the location of the documentation for the calculations (i.e., ticket audit spreadsheet, truck load tickets, etc.) and/or explain how the quantity was derived (i.e., reduction due to truck being returned, audit adjustment, certified truck load weight, etc.). Note in the project documentation any reductions to the quantity from the overload analysis.

e. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

411.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials and mix designs which were submitted by the Contractor were utilized on the project. Ensure the proposed asphalt mix designs for the HMA mixture item (Superpave Type S3, Superpave Type S4, SMA, RBL, RIL, etc.) submitted by the Contractor are on the Materials Division list of Asphalt Mix Designs Approved for Use. If the previously accepted mix designs which were submitted by the Contractor were not utilized on the project, contact Materials Division to confirm the status of the mix design approvals. The use of unapproved materials will

require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

If your Contract includes the special provision for electronic ticketing for HMA, the residency project inspector will utilize the Department's Electronic Ticketing Portal system (HaulHub) similarly to the duties performed with paper tickets but will be done utilizing the HaulHub application (app). The inspector will verify on the app the delivery of each HMA load (electronic ticket) to the project using the identifying vehicle number associated with each load shown on the app. An electronic ticket may be noted as rejected or partial payment if needed. Additional information on the efficient use of the HaulHub app by the residency personnel can be found on their website for HaulHub University.

Ensure an analysis was performed and payment omitted for any amount of material that exceeds the allowable gross vehicle weight for a load. The HaulHub app should be used daily to generate a report that verifies the evaluation of overloaded vehicles. The report should be kept in the project records. Otherwise, written documentation of the analysis such as a spreadsheet should be kept in the project files. Refer to Construction Control Directive No. 20020213 for further information.

When your contract includes the smoothness special provision (SP430-2QA "Pavement and Bridge Deck Smoothness"), follow those requirements for testing, evaluation, correction and pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

Ensure that pay adjustments for mix properties and smoothness (if applicable) were calculated and applied on the progressive estimate by Line Item Adjustment, Contract Adjustment or Change Order as necessary.

The Department will adjust payment for the asphalt binder used in the HMA mix in accordance with Section 411.06.B of the Standard Specifications. SiteManager will automatically calculate and place a Line Item Adjustment on the progressive estimate for the amount of asphalt binder price adjustment that is warranted. No further audit requirements should be necessary if the HMA is paid for in a timely manner on the progressive estimates.

C. Protection of the Work

Check that the HMA is satisfactorily maintained until the project is completed and any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

411 CHECKLIST – HOT MIX ASPHALT / WARM MIX ASPHALT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the necessary types of HMA (Superpave, SMA, RBL or RIL) required in the Plans been identified?					
Have the proposed mix designs for the HMA been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the proposed asphalt plant for the production of the HMA been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the proposed source of asphalt release agent been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix designs and asphalt plant?					
Has the Contractor been notified of the information necessary on the haul tickets (or electronic tickets) to enable the evaluation of overload deliveries?					
Has the Contractor submitted the equipment list (including the MTV if required) for the proper placement and compaction of the HMA?					
Have the minimum surface temperature requirements stated in the Standard Specifications been discussed with the Contractor?					
Have the acceptable mix temperature ranges for the application of the HMA mixture been discussed?					
Have the application (yield) rates for the HMA specified in the Plans been discussed?					
Have all of the FAST Guide requirements for sampling & testing the HMA mixture and documenting results in SiteManager been performed by the residency?					

Does the Contractor have a plan to coordinate the number of haul trucks, speed of the MTV/paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Does the Contractor have a plan for maintenance of traffic and protection of the HMA during its placement and opening to traffic?					
Are there special provisions included in the contract for HMA that need to be discussed with the Contractor? Such as smoothness, electronic tickets, etc.					
Are there bridges within the project which require attention for the MTV to cross the structure without causing damage to the bridge?					

Part 2: During Construction

Issue	Yes	No	N/A	Comments	Initials
Has the proposed mix design for the HMA been submitted by the Contractor and reviewed by the Resident Engineer and accepted?					
Does the proposed asphalt plant for the production of the HMA have a current certification and has been accepted by the Resident Engineer?					
Has the proposed source of asphalt release agent been submitted by the Contractor and reviewed by the Resident Engineer and accepted?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix designs and asphalt plant?					
Is the Contractor using the mix design and asphalt plant that has been accepted by the Resident Engineer?					
Have the requirements for plant startup (Section 411.04.C) and control strip (Section 411.04.D) in the specifications been met by the contractor?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the Contractor's haul tickets (or electronic tickets) include the information necessary to enable the evaluation of overload deliveries?					
Does the Contractor's paver, MTV and rollers meet the specification requirements for the proper placement and compaction of the HMA?					
Does the surface temperature meet the minimum requirements from Table 411:1 for the lift thickness being used prior to the placement of the HMA?					
Are the acceptable temperature ranges for the placement of the HMA mixture (± 25 °F of approved JMF) being achieved and recorded in the laydown report?					
Are the application (yield) rates for the HMA in compliance with the rates specified in the Plans?					
Is the MTV being used to place the HMA mix into the paving machine?					
Has the Contractor complied with not raising (dumping) the wings of the paver's receiving hopper during the paving operations?					
Are bridges within the project being adequately protected from the MTV crossing the structure?					
Is the Contractor placing the HMA to the width and thickness specified on the Plans?					
Are all the longitudinal joints for the HMA being placed within 1' the lane lines and offset from the underlying longitudinal joint by at least 6"?					
Are the longitudinal joint density evaluations being performed in accordance with Section 411.04.J(2) at the frequencies specified in the FAST Guide?					
Is the Contractor sufficiently maintaining traffic and protecting the HMA during its placement?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor coordinating the number of haul trucks, speed of the MTV/paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Is the Contractor complying with the compaction requirements prior to the HMA surface temperature falling below 140 °F using steel-wheel rollers for breakdown and finish rolling with at least two uniform coverages of pneumatic rollers in-between?					
For layers less than 1-1/2" thick, has a roller pattern been established to optimize the compaction? And, is the Contractor documenting the performance of daily compaction effort?					
Has the rolling operation been completed and the HMA surface temperature cooled sufficiently to prevent damage prior to opening the completed HMA to traffic?					
Has a sample of the asphalt cement binder used in the HMA mix been taken from the asphalt plant and submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					
Have samples of the HMA aggregate been taken and tested for sand equivalent results at the frequencies in accordance with the FAST Guide?					
Have samples of the HMA mixture been taken and tested at the frequencies in accordance with the FAST Guide?					
Have all of the test results and confirmation of sources/products on the QPL been documented in SiteManager by the residency?					
Has the Residency evaluated the basis of acceptance and pay adjustments of the HMA in accordance with Section 411.04.N(2) for mix properties and compaction?					
Has the Contractor properly disposed of waste materials, asphalt emulsion, etc.?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Are the truck delivery haul tickets (or electronic tickets) being evaluated for overloads in accordance with CCD No. 20020213?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the HMA been placed to the thickness and width as shown on the Plans?					
Has the Contractor taken adequate precautions to protect the completed HMA from damage?					
Were any conditions requiring corrective action or maintenance addressed sufficiently by the Contractor?					
Was a sample of the asphalt cement binder used in the HMA mix submitted to the ODOT Materials Division for testing in accordance with the FAST Guide?					
Was the HMA mixture sampled at the frequency required in the FAST Guide for acceptance testing?					
Were pay adjustments of the HMA calculated and applied in accordance with Section 411.04.N(2)?					
Were the truck delivery haul tickets (or electronic tickets) evaluated for overloads in accordance with CCD No. 20020213 and deductions of quantity made if needed?					
Have the requirements for testing, evaluation, correction and pay adjustments been done in accordance with the smoothness special provision?					

SECTION 412 – COLD-MILLING PAVEMENT

412.01 GENERAL

This work consists of cold-milling and removing pavement surfaces to the specified depth, and removing ridges, ruts, and imperfections.

412.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Distinguish the limits of the cold-milling (location, area and thickness) required in the Plans.
- Discuss the intent of the Plans when profile milling is required to correct smoothness of ride or to provide tie-ins to existing pavement or bridges.
- Ownership of the millings and their proper disposal.
- Methods and equipment to be used.
- Acceptable tolerances for elevation, smoothness, width and thickness.
- Review special provisions included in the Contract related to the cold-milling item (i.e., SP108-81 for disincentive for exposed cold-milling pavement).
- Contractor's schedule/plan for the work.
- Maintenance and protection of traffic during construction.
- Traffic control during construction and impacts from haul trucks entering/exiting the work zone.
- Timely application of next pavement layer or fog seal on milled surface.
- Clean up and opening to traffic considerations.

B. Acceptance of Materials

None required.

C. Preparatory Work and Contractor Work Plans

Consider the following before the cold-milling operation begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions and Plan Notes for requirements governing the cold-milling pavement operation. Some projects include a plan note that requires the millings to become property of the Department and may define where the millings are to be stockpiled. Ensure the Contractor is aware of any specified requirements of the ownership and handling of the millings.

Check the Contract for the special provision, SP108-81 "Disincentive for Exposed Cold-Milled Pavement". When your contract includes this special provision, discuss the requirements with the Contractor to emphasize the assessment of disincentive charges when warranted. Section 412.04 of the Standard Specifications requires the Contractor to immediately apply fog seal to milled areas unless the asphalt overlay is placed on the milled surface the same day. The special provision provides monetary leverage to ensure the Contractor minimizes a prolonged exposure of the milled surface to adverse weather and traffic impacts.

2. Contractor Proposed Equipment

The Contractor may include the equipment needed to perform the cold-milling operation in their submittals prior to beginning construction. The various pieces of equipment required include the following:

- Trucks,
- Broom and other equipment necessary for clean up, and
- Milling machine.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 412.03.B of this Manual below.

3. Contractor's Proposed Sequence

The Contractor's proposed sequence of operations should address the following:

- Performing the cold-milling and the scheduled placement of the overlying asphalt pavement in a timely manner.
- Weather conditions should be considered for the timely placement of the overlying asphalt pavement or fog seal.
- Coordination of haul trucks and their entry/exit from the work zone in a safe manner.
- Clean up of milled area and opening to traffic.

D. Safety and Environmental Issues

The millings and debris must be collected and disposed of in accordance with the Plans and applicable laws, rules, and regulations. Discuss the Contractor's proposed method to distribute any excess millings on the side-slopes for review and approval by the Resident Engineer, when applicable.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to ensure no risk to health, safety and property damage,

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, millings, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

412.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

None required.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 412.03 of the Standard Specifications contains requirements for the milling machine that will be used for the cold-milling operation. Additionally, the Contractor will need to use self-propelled stiff bristled broom and other equipment to adequately remove millings and dust prior to opening the area to traffic or proceeding with the application of the fog seal or tack coat.

Verify the Contractor's equipment meets the requirements of Sections 412.03 of the Standard Specifications as follows.

1. Milling Machine

The Contractor must provide a self-propelled milling machine that has the following characteristics:

- Can plane at least 1-1/2 in deep in a single pass;
- Has the power, traction, and stability to maintain accurate depth of cut and slope;
- Automatically establishes profile grades along each side of the milling machine by referring to the existing pavement with a ski or matching shoe, or by an independent grade control;
- Automatically controls cross slope; and
- Has an integral loading mechanism to remove the material cut from the pavement surface and discharge it into a truck in one operation.

C. Construction Operations

The Pavement Preservation & Recycling Alliance (PPRA) has developed a website that provides a resource to owners, designers, and construction inspection personnel on the effective use of asphalt pavement preventive maintenance treatments (roadresource.org-treatment resource center) including cold-milling pavements. You may visit their site to learn more about construction and quality assurance of cold-milling by selecting from the

index on the left side of their site (roadresource.org-cold milling). One example of their guidance found under the Preparation link is, "*Remove any raised roadway markings such as reflectors and delineators to avoid damage to equipment and produce a better RAP product.*"

Cold-milling is used for various reasons and to address the following issues:

- Poor surface conditions (raveling, stripping, bleeding, rutting, shoving, cracking, etc.),
- Poor ride quality,
- Grade and cross-slope issues, and
- Maintaining the current elevation of the roadway surface after placement of overlay.

It is important to understand the reason for the cold-milling operation and what is intended to be addressed so that the completed cold-milled surface accomplishes the intent.

Verify the following complies with Section 412.04 of the Standard Specifications when performing the cold-milling operation:

1. Milling Operation and Tolerances

Ensure the Contractor mills the existing pavement to the line, grade, and cross section shown on the plans, and provides a milled surface that has a uniform texture and a smooth riding surface for traffic. Make passes to remove irregularities and to profile the surface to the depth and cross slope shown on the Plans. Prevent traffic hazards.

Ensure no deviations are greater than 3/16" in a 10' section in any direction. It is critical to verify that adjacent passes of the milling machine meet this tolerance along the longitudinal and transverse joints. Additionally, if the milling machine needs maintenance of the cutting teeth (missing or worn teeth), the surface may fail to meet the required tolerance. The Contractor must make corrections to any deviations in excess of the acceptable tolerance, as approved by the Resident Engineer.

2. Hauling Millings and Cleanup

Removed materials are to be disposed by the Contractor in accordance with Section 104.09, "Removal and Disposal of Salvaged Materials, Structures, and Obstructions" of the Standard Specifications. Typically, the millings become property of the Contractor and will likely be used for recycled asphalt pavement (RAP) by an asphalt producer. Some projects include a plan note that requires the millings to become property of the Department and may define where the millings are to be stockpiled. Ensure the Contractor is aware of any specified requirements of the ownership and handling of the millings.

Do not allow the Contractor to distribute any excess millings on the side-slopes unless the Resident Engineer approves of the disposal method. Excess millings

may be disposed of along the side slopes of the roadway shoulders in a manner approved by the Engineer. Typically, they may be distributed and spread evenly across the side slopes of the roadway while ensuring that none are disposed of within 100 ft of a lake or other body of water or any bridge over a river/creek.

The milled surface will require sweeping and cleaning following the use of the milling machine. Section 412.04 requires the application of fog seal or tack coat immediately following the milling operation. Therefore, the surface must be prepared in accordance with Section 407.04 of the Standard Specifications to ensure an adequate bond of the fog seal/tack coat.

3. Exposed Cold-Milled Pavement Surface

In accordance with Section 412.04 of the Standard Specifications, at the end of the daily milling operation, the Contractor must:

- Ensure that milled surface is smooth.
- Unless overlaying the milled area with bituminous material on the same day, immediately apply fog seal to the milled areas, in accordance with Section 407, "Fog Seal and Tack Coat" of the Standard Specifications.

(a) Disincentive for Exposed Cold-Milled Pavement

Check the Contract for the special provision, SP108-81 "Disincentive for Exposed Cold-Milled Pavement". When your contract includes this special provision, discuss the requirements with the Contractor to emphasize the assessment of disincentive charges when warranted. The specifications requires the Contractor to immediately apply fog seal to milled areas unless the asphalt overlay is placed on the milled surface the same day. The special provision provides monetary leverage to ensure the Contractor minimizes a prolonged exposure of the milled surface to adverse weather and traffic impacts.

The intent of this provision is to minimize the time of exposure of milled paving surfaces. Fog sealing the cold-milled surface does not exempt the Contractor from the disincentive. A disincentive of $0.02 per square yard per hour will be assessed for all cold-milled surfaces not overlayed within 48 hours of being exposed by cold-milling operations. The disincentive will be assessed each hour after the 48 hours, and continue until the cold-milled surfaces are no longer exposed to the elements as determined by the Engineer. The following additional considerations and exemptions are included in the special provision:

- The Engineer may allow cold-milled surfaces to remain exposed for up to 96 hours (in lieu of the 48 hours previously defined) if the Contractor, at no additional cost to the Department, covers the exposed cold-milled surfaces with an approved trackless tack coat meeting the

requirements of Special Provision 708-25 within 48 hours of being exposed by cold-milling operations. The trackless tack coat layer must be maintained, ensuring that the trackless tack is of sufficient adhesion or tack coat must be reapplied prior to overlaying the cold-milled surface(s). In the event that trackless tack is used, the above disincentive will be assessed each hour after the 96 hours, and continue until the cold-milled surfaces are overlayed.

- Extents of cold-milling required to provide a smooth transition to bridge approaches or to existing pavements will be exempt from this provision. However, if these extents are to be left exposed for more than 48 hours, they must be fog sealed or the disincentive set forth in this provision will apply for each hour in excess of the 48 hours until the fog seal or surfacing is placed.

D. Safety and Environmental Considerations

The millings and debris must be disposed of in accordance with applicable laws, rules, and regulations. Do not allow the Contractor to distribute any excess millings on the side-slopes unless the Resident Engineer approves of the disposal method.

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should effectively address the following:

- Providing traffic control during construction to ensure no risk to health, safety and property damage,
- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, millings, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents, direction, lane, etc.), thickness and length & width of area of cold-milling performed.
- Quantity of cold-milling performed.
- Note whether the fog seal or the overlying asphalt pavement layer was applied on the milled surface on the same day as the milling was performed.

- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 412.06 of the Standard Specifications, the residency will measure the completed cold-milling by the Square Yard.

Documentation of the Cold-Milling pay item paid by the Square Yard will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the Cold Milling pay item from the list of contract pay items.

b. In the appropriate field, enter the station-to-station extents and a descriptive location.

c. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.

d. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

412.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

None required.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Ensure no deviations are greater than 3/16" in a 10' section in any direction. The Contractor must make corrections to any deviations in excess of the acceptable tolerance, as approved by the Resident Engineer. Unless overlaying the milled area with bituminous material on the same day, ensure the Contractor immediately applied fog seal to the milled areas.

Check the Contract for the special provision, SP108-81 "Disincentive for Exposed Cold-Milled Pavement". When your contract includes this special provision, ensure the proper calculation and assessment of disincentive charges were applied when warranted.

Typically, the millings become property of the Contractor and will likely be used for recycled asphalt pavement (RAP) by an asphalt producer. Some projects include a plan note that requires the millings to become property of the Department and may define where the millings are to be stockpiled. Ensure the Contractor complied with any specified requirements of the ownership and handling of the millings.

The Contractor must remove the millings and debris generated from the cold-milling operation. When approved by the Resident Engineer, ensure the Contractor distributed and spread any excess millings evenly across the side slopes of the roadway. Ensure that none of the millings are disposed of within 100 ft of a lake or other body of water or any bridge over a river/creek. Ensure the Contractor adequately sweeps the roadway/shoulder to remove all millings from the pavement surface.

412 CHECKLIST – COLD-MILLING PAVEMENT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the equipment requirements for the milling machine and the use of stiff bristled brooms and other cleanup equipment been discussed?					
Does the Contractor have a plan for maintenance and protection of traffic during the cold-milling operation?					
Is the Contractor prepared to immediately fog seal or overlay the cold milled surface with the next asphalt layer?					
Does the contract for the project contain special provision SP108-81? If so, has it been discussed with the Contractor?					
Do the project plans include a plan note that requires the millings to become property of the Department?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the Contractor's milling machine meet the requirements of Section 412.03?					
Does the cold milled surface have a uniform texture that is smooth and complies with the 10' straightedge requirements?					
Is the Contractor sufficiently maintaining traffic and protecting traffic during the cold-milling operation?					
Is the Contractor immediately fog sealing or overlaying the cold milled surface with the overlying asphalt layer?					
Is the Contractor complying with the terms of special provision SP108-81 (if applicable)?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor stockpiling all millings in the designated location for ODOT's future use? (for projects with the plan note that the millings become property of the Department)					
Is the Contractor sweeping and cleaning the milled surface following the milling operation in preparation of the fog seal/tack coat application?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the cold milled surface have a uniform texture that is smooth and complies with the 10' straightedge requirements?					
Is the Contractor sufficiently maintaining traffic and protecting traffic on the cold-milled surface?					
Did the Contractor immediately fog seal or overlay the cold milled surface with the overlying asphalt layer?					
Did the Contractor comply with the terms of special provision SP108-81 (if applicable)?					
If the Contractor did not comply with the terms of special provision SP108-81 (if applicable) and left the exposed cold-milled surface exposed longer than the allowable time, were disincentives applied?					
Were any conditions requiring corrective action or maintenance (non-uniform surface, timely application of fog seal, etc.) addressed sufficiently by the Contractor?					
Did the Contractor properly cleanup the milled surface and dispose of waste materials?					

SECTION 413 – RUMBLE STRIP

413.01 GENERAL

This work consists of constructing noise-generating rumble strips in the asphalt or portland cement concrete (PCC) pavement on driving lanes or the roadway shoulders.

Rumble strips categories are defined as follows:

Method HMA-CON. Continuous rumble strips cut in ASPHALT shoulders.

Method HMA-CYC. A cyclic pattern of rumble strips cut in ASPHALT shoulders.

Method CENTERLINE HMA-CON. Continuous rumble strips cut on centerline of ASPHALT.

Method PCC-CON. Continuous rumble strips cut in PCC shoulders.

Method PCC-CYC. A cyclic pattern of rumble strips cut in PCC shoulders.

Method CENTERLINE PCC-CON. Continuous rumble strips cut on centerline of PCC.

413.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Types and locations of rumble strip required in the Plans.
- Review special provisions, plan notes and ODOT Standard Drawings regarding requirements for installation and layout of rumble strips.
- Methods and equipment to be used.
- Contractor's schedule/plan for the work.
- Traffic control and maintenance of traffic during construction.
- Cleanup and disposal of debris generated from installation of rumble strip.

B. Acceptance of Materials

None required.

C. Preparatory Work and Contractor Work Plans

Consider the following before rumble strip installation work begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions, ODOT Standard Drawings and Plan Notes and determine any specific requirements that pertain to the rumble strip pay items on your project.

Review the plan details for the types and locations of rumble strip required for the project. Review the requirements of the ODOT Standard Drawings for various types, proper dimensions and layout pattern details.

2. Fog Seal on Asphalt Pavement

In accordance with Section 413.04 of the Standard Specifications, the Contractor is required to apply a fog seal to all rumble strips that are cut into asphalt pavements. However, by memo from the Chief Engineer and Traffic Division Engineer to the Field Division Engineers dated July 20, 2016, the requirement for fog sealing rumble strip in asphalt pavement has been revoked. No fog seal is required.

Copy of the memo may be found in the Appendix of this this chapter of the Manual.

3. Contractor Proposed Equipment

The Contractor must provide a machine that produces incised grooves to the specified pattern and dimensional tolerances shown on the Plans. The Contractor may use a single pass of a multi-cutter machine or multiple passes of a single-cutter machine to construct the grooves.

D. Safety and Environmental Issues

The millings and debris generated from cutting the rumble strips must be disposed of in accordance with applicable laws, rules, and regulations. Discuss the Contractor's proposed method for collecting and disposing of the debris. The Contractor cannot distribute the cuttings or debris on the side-slopes unless the Resident Engineer approves of the disposal method.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to minimize inconvenience and damage to vehicles during the installation of the rumble strips,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, debris from cutting rumble strips, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

413.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

None required.

B. Equipment and Methods

Verify that the equipment used produces incised grooves to the specified pattern and dimensional tolerances shown on the Plans and ODOT Standard Drawings.

C. Construction Operations

Verify the following complies with Section 413.04 of the Standard Specifications and the relevant ODOT Standard Drawings when constructing the types of rumble strip required in the Plans:

1. Types and Classifications of Rumble Strip

Verify the pay items and types of rumble strip required in the Plans and Contract. Typically, the following types of rumble strip with their associated method of measurement (units) are required for installation on either PC Concrete Pavement (PCC) or Hot Mix Asphalt Pavement (HMA):

- Cyclic (CYC) – Linear Foot (LF)
- Cyclic Group (CYC Group) – Each Group (EAGP)
- Continuous (CON) – Linear Foot (LF)
- Centerline Continuous – Linear Foot (LF)

A raised rumble strip option using stacked layers of thermoplastic stripe may be used in lieu of the milled rumble strip for cyclic group transverse rumble strips if specified in the plans or when approved by the Resident Engineer. Refer to ODOT Standard Drawing RS1-2 for additional details regarding raised rumble strip.

2. Dimensions and Patterns of Rumble Strip

Review the requirements of the ODOT Standard Drawings for various types, proper dimensions and pattern details before construction of the rumble strips. Check the Plans for any additional details that might supersede the ODOT Standard Drawings. Refer to the following ODOT Standard Drawings or the latest version of the Standards:

- Cyclic Rumble Strip (Non-Interstate System Only) – RS1-2
- Centerline Rumble Strip (Non-Interstate System Only) – RS2-2
- Continuous Rumble Strip (Interstate System Only) – RS3-1

The dimension of each incision for the rumble strip requires the following dimensions:

- Cut on a 12” radius
- Cut to a depth of 1/2" – 5/8”
- Resulting length of cut is 7” ± 1”

The width of the incision cut varies (12”, 16” or 24”) depending on the type and location of the rumble strip. Refer to the applicable ODOT Standard Drawing for those additional details.

The spacing of the incision cut varies (12” or 24”) depending on the type and location of the rumble strip. Refer to the applicable ODOT Standard Drawing for those additional details.

3. General Layout Details of Rumble Strip

Review the requirements of the previously listed ODOT Standard Drawings for various layout details. Check the Plans for any additional details that might supersede the ODOT Standard Drawings.

General layout details to evaluate and confirm in the ODOT Standard Drawings and Plans before construction of the rumble strips include the following:

- Distance from edge of rumble strip to longitudinal joints or traffic stripe.
- Minimum distance from incision cut to transverse joints in PC Concrete Pavement is 18” for all types of rumble strip.
- Incision cuts are not permitted on bridge decks or bridge approach slabs.
- Gaps in continuous and cyclic rumble strips are required for ramps, median openings and intersections. High use commercial, industrial or subdivision driveways may be eligible for a gap if approved by the Resident Engineer or shown in the Plans.

4. Cleanup, Disposal of Debris and Fog Seal

The Contractor must remove millings and debris generated from cutting the rumble strips before reopening the roadway to traffic. Ensure the Contractor adequately sweeps the roadway/shoulder to remove all cuttings from the pavement surface before opening to traffic.

The millings and debris generated from cutting the rumble strips must be disposed of in accordance with applicable laws, rules, and regulations. Do not allow the Contractor to distribute the debris on the side-slopes unless the Resident Engineer approves of the disposal method. Cuttings may be disposed of along the side slopes of the roadway shoulders in a manner approved by the Engineer. Typically, they may be distributed and spread evenly across the side slopes of the roadway while

ensuring that none are disposed of within 100 ft of a lake or other body of water or any bridge over a river/creek.

In accordance with Section 413.04 of the Standard Specifications, the Contractor is required to apply a fog seal to all rumble strips that are cut into asphalt pavements. However, by memo from the Chief Engineer and Traffic Division Engineer to the Field Division Engineers dated July 20, 2016, the requirement for fog sealing rumble strip in asphalt pavement has been revoked. No fog seal is required. Copy of the memo may be found in the Appendix of this this chapter of the Manual.

D. Safety and Environmental Considerations

The millings and debris generated from cutting the rumble strips must be disposed of in accordance with applicable laws, rules, and regulations. Do not allow the Contractor to distribute the cuttings or debris on the side-slopes unless the Resident Engineer approves of the disposal method.

Ensure the Contractor protects workers and traffic during construction. At a minimum, the Contractor should address the following:

- Providing traffic control during construction to minimize inconvenience and damage to vehicles during the installation of the rumble strips,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, debris from cutting rumble strips, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents, direction, etc.), types and quantities of rumble strip installed.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

There are several pay items for the various types of rumble strip that might be used. Typically, the rumble strip pay items are measured and paid by the Linear Foot (LF) but some contracts may include a cyclic rumble strip pay item measured and paid by Each Group (EAGP).

Review the applicable ODOT Standard Drawings or plan notes for details on the method of measurement for the rumble strip items. Typically, for cyclic rumble strip, the 10’ gaps between the 50’ length of continuous rumble strip are included in the measured length for payment. However, other gaps at ramps, intersections, bridges or transverse joints in PC concrete pavement are not included in the linear foot measurements for cyclic or continuous rumble strip pay items.

(a) Linear Foot Unit of Measure Pay Items

Documentation of the relevant Rumble Strip pay item paid by the Linear Foot will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate pay item from the list of contract pay items.
2. In the appropriate fields, enter both a descriptive location and the station-to-station extents.
3. In the Placed Quantity field, enter the measured quantity (LF) of the item completed.
4. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations with different dimensions, select the ‘New’ button to create a new row for the selected pay item.

(b) Each Group Unit of Measure Pay Items

Documentation of the relevant Rumble Strip pay item paid by the Each Group will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate pay item from the list of contract pay items.
2. In the appropriate field, enter the station for each item and a descriptive location.
3. In the Placed Quantity field, enter the quantity (EAGP) of the item completed.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations, select the ‘New’ button to create a new row for the selected pay item.

413.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

None required.

B. Audit Requirements

Ensure the method of measurement for the rumble strip is performed in accordance with the applicable ODOT Standard Drawings or plan notes. Typically, for cyclic rumble strip, the 10' gaps between the 50' length of continuous rumble strip are included in the measured length for payment. However, other gaps at ramps, intersections, bridges or transverse joints in PC concrete pavement are not included in the linear foot measurements for cyclic or continuous rumble strip pay items.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated, unless gaps are intentionally omitted in accordance with the method of measurement. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Ensure the incision cut dimensions, patterns and layout of the rumble strip meet the requirements and tolerances required in the applicable ODOT Standard Drawings or plan details. The Contractor must make corrections to any rumble strip installed in excess of the acceptable tolerance, as approved by the Resident Engineer.

The Contractor must remove millings and debris generated from cutting the rumble strips before reopening the roadway to traffic. When approved by the Resident Engineer, ensure the Contractor distributed and spread the cuttings evenly across the side slopes of the roadway. Ensure that none of the cuttings are disposed of within 100 ft of a lake or other body of water or any bridge over a river/creek. Ensure the Contractor adequately sweeps the roadway/shoulder to remove all cuttings from the pavement surface.

413 CHECKLIST – RUMBLE STRIP

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the equipment requirements for the rumble strip cutting machine and the use of stiff bristled brooms and other cleanup equipment been discussed?					
Have the types and locations of rumble strip required in the Plans been discussed?					
Have the requirements of the ODOT Standard Drawings been reviewed and discussed for the various types, proper dimensions and layout pattern details?					
Does the Contractor have a plan for maintenance and protection of traffic during the rumble strip installation?					
Has the proper cleanup and disposal of debris from rumble strip installation been discussed?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor's rumble strip cutting machine meeting the requirements for dimensions and tolerances for the incisions specified in the applicable ODOT Standard Drawings?					
Are the types and locations of rumble strip required in the Plans being laid out and installed?					
Are the various types of rumble strip being installed to the proper dimensions and layout pattern details in accordance with the plans and ODOT Standard Drawings?					
Is the Contractor sufficiently maintaining traffic and protecting traffic during the rumble strip installation operation?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor maintaining the required distance from the rumble strips to the lane striping?					
Is the Contractor maintaining the required distance (18") from rumble strips to the transverse joints in PC Concrete pavement?					
Are gaps in the rumble strip being used as specified in the applicable ODOT Standard Drawings for ramps, median openings, intersections and bridge decks & approach slabs?					
Is the Contractor adequately cleaning up and properly disposing the debris from rumble strip installation?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Were the various types of rumble strip installed to the proper dimensions and layout pattern details in accordance with the plans and ODOT Standard Drawings?					
Did the Contractor maintain the required distance from the rumble strips to the lane striping?					
Did the Contractor maintain the required distance (18") from rumble strips to the transverse joints in PC Concrete pavement?					
Are gaps in the rumble strip used as specified in the applicable ODOT Standard Drawings for ramps, median openings, intersections and bridge decks & approach slabs?					
Were any conditions requiring corrective action or maintenance addressed sufficiently by the Contractor?					
Did the Contractor adequately clean up and properly dispose of the debris from rumble strip installation?					

SECTION 414 – PORTLAND CEMENT CONCRETE PAVEMENT

414.01 GENERAL

This work consists of constructing the following types of portland cement concrete (PCC) pavement on a prepared base:

- Plain jointed (doweled or undoweled),
- Continuously reinforced,
- Bonded overlay (over existing PCC or asphalt pavements),
- Unbonded overlay (over existing PCC or asphalt pavements),
- Railroad approach slabs, and
- Terminal joint sleeper slabs.

Additional PC concrete information is contained in this section regarding equipment and material requirements that are referenced in other sections throughout the ODOT Standard Specifications.

414.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Contractor's requirement to provide a Buy America certification and meet all associated documentation submittal requirements.
- Review special provisions, plan notes and ODOT Standard Drawings included in the Contract for PCC pavement pay items (i.e., material requirements, optimized gradation, electronic ticketing, smoothness, etc.).
- Proposed mix designs and certified plants.
- Methods and equipment to be used.
- Weather limitations for construction.
- Surface preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work.
- Maintenance of traffic during construction.
- Placement and finishing requirements.
- Texturing requirements. In accordance with Note 8 on ODOT Standard Drawing LECS-5, the Contractor must longitudinally tine the PCC pavement unless otherwise specified in the Plans or as directed by the Resident Engineer.
- Traffic control during construction and opening PCC pavement to traffic.

B. Acceptance of Materials

Review the material requirements in Section 701, "Portland Cement Concrete" of the Standard Specifications that pertain to the ingredients to produce PC concrete (cement, aggregates, cement substitutes, admixtures, etc.) and other components used in the construction of the PCC pavement (curing compound, joint sealers, etc.) required in the Plans. Additionally, review the material requirements in Section 723, "Reinforcing Steel" of the Standard Specifications that pertain to the steel bars for concrete reinforcement and dowels used in the PCC pavement.

The Contractor should submit its proposed sources of materials, mix designs and plant locations at the Preconstruction Meeting. If the sources of materials, mix designs and plant locations are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the relevant PCC pavement pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials, mix designs and plant locations. Resolve any questions or concerns with the submitted sources of materials, mix designs and plant locations with the Contractor in a timely manner. A written response accepting the proposed sources of materials, mix designs and plant locations must be sent to the Contractor and kept in the project file.

1. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed PC concrete mix design submitted by the Contractor meets the requirements of Section 701 of the Standard Specifications. The information required on each PC concrete mix design may be found in Section 701.01.C of the Standard Specifications. Mix designs must be reviewed for acceptance by the Resident Engineer based on the criteria of the material and its intended use as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

2. Contractor Proposed PC Concrete Batch Plants

Ideally, the Contractor will submit their proposed concrete batch plant locations in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed concrete batch plants submitted by the Contractor have a current ODOT certification. The plants must be reviewed for acceptance by the Resident Engineer based on the criteria of the type of plant as further detailed below in the **Preparatory Work and Contractor Work Plans** portion of this section below.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases. When a plant is being installed to produce for a Project in your Residency notify:

Oklahoma Department of Environmental Quality
Air Quality Division
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: (405) 702-4100
Fax: (405) 702-4101

and

Oklahoma Department of Transportation
Materials Division
Independent Assurance Branch
5201 N.E. 122nd Street
Building 4011
Edmond, OK 73013
Phone: (405) 521-2677

In the notice, list the project number and the location and type of plant (concrete or asphalt).

3. Sources of Materials

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If that information is not provided at that meeting, ensure it is submitted in advance of any work beginning on those items.

The sources of materials for the ingredients to produce PC concrete will be listed on the PC concrete mix designs (cement, aggregates, cement substitutes, admixtures, etc.) submitted by the Contractor. Any revisions to the sources indicated on the PC concrete mix design should be reviewed for acceptance by the Resident Engineer prior to use by the concrete batch plant.

The sources of materials for other components used in the construction of the PCC pavement (reinforcement steel, dowels, curing compound, joint sealers, etc.) must also be submitted to the Resident Engineer for acceptance. Any revisions to these sources should be reviewed for acceptance by the Resident Engineer prior to use in the PCC pavement construction.

The Contractor must provide a Buy America certification in accordance with Section 106.01.B of the Standard Specifications including all required forms and mill test reports as specified. Project specific certification letters from the

Contractor and subcontractors demonstrating their understanding and intent to comply with the Buy America requirements should be submitted at the Preconstruction Conference and no later than work beginning on steel containing items. Installation of steel products should not begin until all required certification documentation, including the letters, have been submitted.

The Residency will verify that the proposed source of materials for the ingredients to produce PC concrete and other components used in the construction of the PCC pavement submitted by the Contractor is on the Materials Division Qualified Products List (QPL). Ensure the product name and manufacturer is shown on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

C. Preparatory Work and Contractor Work Plans

Consider the following before PCC pavement construction operations begin.

1. Contract Plans and Specifications

Review the Plans and distinguish the pay items included in the contract that pertain to the PCC pavement. Review the Standard Specifications, Special Provisions and Plan Notes and determine any special requirements for the types of PCC pavement that are required.

In accordance with Note 8 on ODOT Standard Drawing LECS-5, the Contractor must longitudinally tine the PCC pavement unless otherwise specified in the Plans or as directed by the Resident Engineer. In accordance with Section 414.04.I(6)(a) of the Standard Specifications, on roads or streets with a posted speed limit of 45 mph or less, the Contractor may request an alternate finish. The Contractor must obtain written approval from the appropriate local entity to provide an alternate texture and submit the proposal to the Resident Engineer at least 14 days before beginning paving. Written approval from the Resident Engineer to substitute the alternate texture replaces the need for a change order or price adjustment.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness

special provision, follow those requirements for testing, evaluation, correction and pay adjustments.

ODOT is implementing the use of electronic ticketing for material delivered to the project. If your Contract includes the special provision for electronic ticketing, ensure the Contractor or their designated subcontractor is prepared to comply with the terms of the provision. That includes registering to use the Department's Electronic Ticketing Portal system (HaulHub) and placing an identifying vehicle number on the driver side and the passenger or rear sides of every delivery vehicle.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for the PCC pavement.

2. Weather Limitations and Surface Preparation

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the maximum surface temperature and weather conditions required to proceed with the placement of the PCC pavement. The surface temperature must be below 110 °F to proceed with the placement of the PCC pavement. Do not allow the Contractor to begin placing PC concrete if frost exists in or on the base.

For unbonded PCC pavement, the Contractor may reduce the surface temperature by spraying a fine water fog on the base. Additionally, on waterproof bases (such as asphalt) the Contractor may apply a white pigmented curing compound or lime slurry for temperature reduction. For bonded PCC pavement, the specifications state that the Contractor is not allowed to attempt to reduce the base temperature by applying water and other agents which can prevent proper concrete bonding. However, the use of water may be acceptable as long as no free standing water remains on the surface prior to placement of the PC concrete.

Review Section 414.04.A of the Standard Specifications for the requirements for the preparation of the existing surface or base. There are specific requirements associated with bonded and unbonded PCC pavements that need to be followed. When placing the PCC pavement on a asphalt surface, bonding is not a concern. The longevity of the PCC pavement will be reduced if the bonding/unbonding occurs where it is not intended. Ensure the Contractor has a method to adequately prepare the base in the manner required for the type of PCC pavement on the project.

3. Contractor Proposed Mix Designs

Ideally, the Contractor will submit their proposed mix designs in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

(a) Concrete Mix Designs

The Residency is responsible for reviewing and approving the proposed concrete mix designs submitted by the Contractor. Section 701.01.C prescribes the information that must be included in each concrete mix design. If the proposed concrete mix design fails to include any of the information listed, it should be returned in writing to the Contractor with a list of deficiencies needing to be included for resubmission. Each PC concrete mix design must include the following information:

- Project identification,
- Contractor's and Producer's name and address,
- Mix design designation,
- Mix design intended use,
- Expected travel time from batch to placement,
- If the concrete will be pumped,
- Aggregate sources, gradation, moisture content, and saturated surface dry batch mass,
- Water source and test reports required by Section 701.04, "Water,"
- Fine aggregate fineness modulus,
- Cement type and source,
- Type of cement substitutions, if used, and source,
- Type of admixtures and sources,
- High Range Water Reducer, if used in accordance with Section 701.03,
- Material proportions,
- Unit weight,
- Air content,
- Slump,
- Water to cement ratio,
- Compressive strengths at 7 days and 28 days,
- Compressive strengths at 72 hours for high early strength concrete, and
- Flexural strength at 28 days or 56 days for Class A used for concrete paving in accordance with Section 701.01.A.

Most of the criteria for the basis of acceptance of concrete mix designs can be found in Section 701 of the Standard Specifications, including the following:

- Table 701:1 – minimum cement content, air content, water/cement ratio, slump and minimum 28-day compressive strength,
- Tables 701:2 and 701:3 – maximum allowable cement substitutions,
- Table 701:12 – Types of coarse aggregate required for various Classes of PC concrete, and
- Section 701.03, "Admixtures".

Unless the Contractor uses an Optimized Gradation based mix design, the proportions of the coarse and fine aggregate must be in accordance with ACI 211.1. Typically, the proportion by weight of coarse-to-fine aggregates is around 60/40 (roughly 55-65% coarse and 35-45% fine). Additionally, the total volume of the coarse and fine aggregates combined is typically 60-75% of the total concrete volume.

Additional criteria for work specific to a mix design may be found in Special Provisions in the Contract (such as SP 701-14 "Optimized Gradation for PC Concrete Pavement) or relevant sections of the Standard Specifications (such as Section 516.02.B for Class AA Concrete for Drilled Shafts).

The Residency will verify that the proposed sources of materials submitted by the Contractor for the ingredients on their concrete mix designs are on the ODOT Materials Division Qualified Products List (QPL) or Approved Rock, Stone, & Sand Sources lists. Ensure the product name and manufacturer/supplier is listed. If a proposed product/source is not on the QPL or approved aggregate source list, contact Materials Division to confirm the status of the product/source approval.

A written response approving the mix designs must be sent to the Contractor and kept in the project file.

4. Contractor Proposed PC Concrete Batch Plants

Ideally, the Contractor will submit their proposed concrete batch plants in time for the Preconstruction Conference. If they are not submitted at that time, emphasize the need for timely submission to allow for review and corrections (if necessary) prior to construction beginning on the applicable items of work.

The Residency will verify that the proposed concrete batch plant submitted by the Contractor has a current ODOT certification. The status of concrete batch plant certifications can be found on the ODOT Materials Division website (Hydraulic Cement Concrete Plant List). If the plant does not have a "current" certification, it is the responsibility of the residency to conduct a plant inspection as further detailed below.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly

permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

(a) Concrete Plant Inspection

Concrete plant inspections are the responsibility of the residency or consultant engineering firm acting as a residency as stated in the ODOT Concrete Plant Inspection Policy found on the Materials Division website. Inspection requirements can be found in Section 414.03 of the Standard Specifications. Plants must be inspected every 6 months or after every relocation of a portable plant.

Concrete plants must be inspected to ensure compliance with the referenced specifications prior to accepting plant produced concrete material on an ODOT construction project. The ODOT Inspection Form 414-IF must be used to document the plant inspection. The completed inspection form along with a copy of the current scale certification needs to be submitted to the Materials Division – Independent Assurance (IA) Branch for their use to update the database. The residency may decide not to perform the plant inspection if they verify on the Hydraulic Cement Concrete Plant List that a recent inspection has been performed and the inspection status is "current".

D. Safety and Environmental Issues

For storage of aggregates in a staging area near the project, stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. Additionally in Section 106.08, at the Contractor's request, the Department may allow the use of approved portions of the right-of-way for storing materials and staging their equipment. As part of the request for use of the site, the Contractor must provide the Resident Engineer with written documentation of the location of the proposed site, access and egress points, a proposed erosion control plan, a proposed traffic control plan, and any other information required by the Resident Engineer relevant to use of the site for materials and equipment storage. For controlled access facilities, the approval from the Resident Engineer is subject to the approval of FHWA, prior to altering, severing, or removing any right-of-way fences. Prior written permission of the owner or lessee is required for the use of private property and copies of such written permission must be provided upon request to the Resident Engineer.

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and PCC pavement from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, concrete truck washout, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

414.03 INSPECTION GUIDELINES DURING CONSTRUCTION

There are many resources available for the inspection of PCC pavements through the American Concrete Pavement Association (ACPA) and other affiliates and organizations, including:

- ACPA's Wikipave – an encyclopedic resource featuring technical and general information about concrete pavements. A catalog of technical sheets on various PCC pavement subjects.
- National Concrete Pavement Technology Center (CP Tech Center) – a national hub for concrete pavement research and technology transfer. There is information about anything PCC pavement related that can be asked. A couple of manuals/technical papers found in this library include:
    - Integrated Materials and Construction Practices for Concrete Pavement (IMPC)
    - Concrete Pavement Field Reference ~ Pre-Paving (EB237P Pre-Paving Field Ref)
    - Overview of Stringless Paving (Stringless Paving Brief)
    - Stages of Hydration Chart from the 2019 IMPC Manual (Hydration Poster)

A. Acceptance of Materials

Review the material requirements in Section 701, "Portland Cement Concrete" of the Standard Specifications that pertain to the ingredients to produce PC concrete (cement, aggregates, cement substitutes, admixtures, etc.) and other components used in the construction of the PCC pavement (curing compound, joint sealers, etc.) required in the Plans.

Additionally, review the material requirements in Section 723, "Reinforcing Steel" of the Standard Specifications that pertain to the steel bars for concrete reinforcement and dowels used in the PCC pavement.

The Contractor should submit its proposed sources of materials, mix designs and plant locations at the Preconstruction Meeting. If the sources of materials, mix designs and plant locations are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the relevant PCC pavement pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials, mix designs and plant locations. Resolve any questions or concerns with the submitted sources of materials, mix designs and plant locations with the Contractor in a

timely manner. A written response accepting the proposed sources of materials, mix designs and plant locations must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted and accepted mix designs, plants and sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

1. Contractor Proposed Mix Designs

Ensure the Contractor has submitted its proposed concrete mix designs in advance of any work beginning on the PCC pavement. The Residency will verify that the proposed sources of materials and products submitted by the Contractor for the ingredients on their concrete mix designs are on the ODOT Materials Division Qualified Products List (QPL) or Approved Rock, Stone, & Sand Sources lists. If a proposed source is not on the QPL or approved aggregate source list, contact Materials Division to confirm the status of the source/product approval.

The Resident Engineer will approve the concrete mix design in accordance with Section 701.01.C of the Standard Specifications. Refer to Section 414.02.C.3 of this Manual for additional details regarding the review and approval of concrete mix designs. A written response approving the mix designs must be sent to the Contractor and kept in the project file. As soon as practical, the Residency will obtain sufficient samples of aggregates to be utilized and perform applicable tests on these materials.

2. Contractor Proposed PC Concrete Batch Plants

Ensure the Contractor has submitted its proposed concrete batch plants in advance of any work beginning on the PCC pavement pay items.

The Residency will verify that the proposed concrete batch plant submitted by the Contractor has a current ODOT certification. If the proposed concrete batch plant does not have a current certification, it is the Residency's responsibility to conduct the plant inspection and submit the inspection report to the ODOT Materials Division. Refer to Section 414.02.C.4 of this Manual for additional details regarding the plant inspection. A written response accepting the plants must be sent to the Contractor and kept in the project file.

If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

3. Acceptance of Materials

Ensure the Contractor has submitted its proposed sources of materials and mix designs in advance of any work beginning on the PCC pavement pay items.

The sources of materials for the ingredients to produce PC concrete will be listed on the PC concrete mix designs (cement, aggregates, cement substitutes, admixtures, etc.). Any revisions to the sources indicated on the PC concrete mix design should be reviewed for acceptance by the Resident Engineer prior to use by the concrete batch plant.

The sources of materials for other components used in the construction of the PCC pavement (reinforcement steel, dowels, curing compound, joint sealers, etc.) must also be submitted to the Resident Engineer for acceptance. Any revisions to these sources should be reviewed for acceptance by the Resident Engineer prior to use in the PCC pavement construction.

The Contractor must provide a Buy America certification in accordance with Section 106.01.B of the Standard Specifications including all required forms and mill test reports as specified. Project specific certification letters from the Contractor and subcontractors demonstrating their understanding and intent to comply with the Buy America requirements should be submitted at the Preconstruction Conference and no later than work beginning on steel containing items. Installation of steel products should not begin until all required certification documentation, including the letters, have been submitted.

The Residency will verify that the proposed source of materials for the ingredients to produce PC concrete and other components used in the construction of the PCC pavement submitted by the Contractor is on the Materials Division Qualified Products List (QPL). Ensure the product name and manufacturer is shown on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate

items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, visual appearance (excessive or insufficient asphalt binder, segregation, etc.), or other special provision requirements where Contractor tests are used for acceptance purposes.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Obtain a sample of the Fine Aggregate from the concrete batch plant and verify the gradations comply with Table 701:11 of the Standard Specifications. [Document in Template T27]
    - Verify the product and source is listed on the Approved Rock, Stone & Sand Sources list (HC Concrete Aggregate, Fine)
- Obtain a sample of the Coarse Aggregate from the concrete batch plant and verify the gradations comply with Table 701:12 of the Standard Specifications for the appropriate size number (57, 67, etc.). [Document in Template T27]
    - Verify the product and source is listed on the Approved Rock, Stone & Sand Sources list (HC Concrete Aggregate, Coarse)
- Verify the Hydraulic Cements (Type I, Type II, etc.) product and source used in the PC concrete as indicated on the concrete mix design are listed on the QPL-Hydraulic Cements. [Document in Template AM5001]
- Verify the Fly Ash (Class C or Class F) product and source used in the PC concrete as indicated on the concrete mix design is listed on the QPL-Fly Ash. [Document in Template AM5001]
- Verify the Slag Cement (Grade 100 or Grade 120) product and source used in the PC concrete as indicated on the concrete mix design is listed on the QPL-Slag Cement. [Document in Template AM5001]
- Verify the Silica Fume product and source used in the PC concrete as indicated on the concrete mix design is listed on the QPL-Silica Fume. [Document in Template AM5001]
- Verify the Admixture products and sources (Air Entraining, Corrosion-Inhibiting, other chemical admixtures) used in the PC concrete as indicated on the concrete mix design are listed on the QPL-HC Concrete Admixtures, Liquid. [Document in Template AM5001]
- Verify the Curing Agents used on the PCC pavement is listed on the QPL-HC Concrete Curing Agents. [Document in Template AM5001]
    - Verify the product and source is listed on the Liquid Membrane Curing Compound list – only the Type 2 White-Pigmented curing compound is acceptable for use on PCC pavement
- Verify the Reinforcing Steel product and source used in the PCC pavement is listed on the QPL-Reinforcing Steel under the Bar Steel Reinforcement, Billet-Mill portion of the list. [Document in Template AM5001]

- Verify the Dowel Bars and Dowel Bar Baskets used in the PCC pavement is listed on the QPL-Reinforcing Steel under the Dowel Bars and Baskets portion of the list. [Document in Template AM5001]
- Obtain fresh concrete samples from the project site and verify the PC concrete complies with the requirements for Class A Concrete:
    - Fresh Concrete Test (slump, air, temperature, etc.) - AASHTO T 119 and AASHTO T 152 [Document in Template C94025]
    - Compressive Strength of Concrete Cylinders – AASHTO T 22 [Document in Template C94014]

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product or mix design approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of Section 414.03 of the Standard Specifications. Review any special provisions and plan notes that pertain to the PCC pavement pay items.

Verify the Contractor's equipment meets the requirements of Section 414.03 of the Standard Specifications as follows.

1. Concrete Batch Plants and Mixers

Ensure the proposed concrete batch plant has a current ODOT certification. If the concrete batch plant does not have a current certification, it is the Residency's responsibility to conduct the plant inspection and submit the inspection report to the ODOT Materials Division. Refer to Section 414.02.C.4(a) of this Manual for further details regarding the residency's responsibilities for conducting the concrete batch plant inspection.

Ensure the batching plant includes bins, weighing hoppers, and scales for each size of fine and coarse aggregate. If using cement in bulk, the plant must include a bin, hopper, and separate scale for cement. The weighing hoppers must be sealed and vented to prevent dusting. Ensure gauges and dials function properly. Storage silos for cementitious materials must be vented during filling or use. If using a

pressurized air system for discharge, ensure that it has moisture traps to reduce caking of materials during storage.

The storage and handling of the aggregates at the batch plant must be done in accordance with Section 106.08 of the Standard Specifications. Aggregates from different sources and with different gradations must be stockpiled separately and handled in a manner to preserve their quality and gradation. The maintenance of the stockpile must assure there is no segregation of the gradation of the aggregates. Figure 414:1 illustrates a well-organized batch plant site that clearly organizes the various types of aggregates being utilized.

Figure 414:1. Photo. Concrete Batch Plant Site

The concrete may be mixed at the work site in a central-mix plant or in truck mixers. Obtain the Resident Engineer's approval for the type of truck mixer. Do not allow the mixers to exceed the manufacturer recommended capacity or the batch of concrete may not become uniformly mixed.

The mixers require regularly scheduled cleaning and maintenance. Ensure the concrete supplier repairs or replaces the pickup and throw-over blades that are worn one-sixth or more of the original blade width. Upon request, the concrete supplier must provide the manufacturer's design or permanent marks on the blades to show the blade's dimensions and configurations in reference to original height and depth. The Department recommends drilling holes with a diameter of ¼ in [6 mm] near the ends and midpoint of each blade as reference points.

2. Placing and Finishing Equipment

The Contractor must utilize a slip form paver or fixed form method to spread, strike-off, and finish concrete, as approved by the Resident Engineer.

(a) Slip Form Paver

The use of a slip form paver is the preferred method to place constant width PCC pavement in areas with sufficient length to facilitate its use. The paving machine must be able to spread, consolidate, screed, and float-finish the concrete in one pass of the machine (to minimize hand-finishing) to the lines and grades required in the Plans. The paving machine must use vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface. Ensure the machine vibrates for the full width and depth of the pavement. The sliding side forms must have rigid, lateral connections to prevent them from spreading and maintain a straight and vertical edge of the pavement.

Provide vibrating paving machines with vibrators set at the minimum frequency ratings shown in Table 414:1 of Section 414.03.B(1) of the Standard Specifications. Ensure the spud vibrators do not come into contact with the joint, load transfer devices, subgrade, or side forms.

(b) Fixed Form Method

The use of the fixed form method will be used to place PCC pavement in short, isolated areas with insufficient length to use a slip form paver or for pavement sections with a variable width. The Contractor must use a finishing machine as described below. The use of a vibrating or rotary strike-off screed is only permitted in areas inaccessible to mainline paving equipment when approved by the Resident Engineer.

The finishing machine must be equipped with at least two oscillating-type transverse screeds for finishing the surface to the tolerances required by the Contract. The finishing machine must include surface pan-type vibrators for pavement thicknesses no greater than 8 in or internal-type vibrators with immersed tubes or multiple spuds to consolidate the full width and depth of the pavement. The vibrators may be attached to the spreader or the finishing machine or mounted on a separate carriage. Ensure the frequency ratings are in accordance with Table 414:1, "Vibrator Frequencies." Ensure the vibrators do not come into contact with the joint, load transfer devices, subgrade, or side forms.

Vibrating or rotary strike-off screeds with fixed forms may be used in areas inaccessible to mainline paving equipment to construct radii, inlet basins, gore areas, lane tapers and intersection quadrants as approved by the Resident Engineer. Ensure the screeds do not cause segregation or grout buildup due to overuse. Ensure the Contractor uses spud-type hand

operated vibrators at a frequency rating of at least 3,500 impulses per minute to achieve thorough consolidation and uniformity of the pavement.

(c) Forms and Header Boards

The Contractor must provide metal straight side forms with thicknesses of at least 7/32 in and lengths of at least 10 ft. Forms are to be set to a depth equal to the concrete thickness shown on the Plans, and capable of supporting equipment operating on the forms.

Flexible or curved forms may be used with devices for secure settings capable of withstanding equipment impact and vibration for curves with a radius of 100 ft or less.

Header boards cut to the cross section of the paving slab, must be placed parallel to the transverse joint if stopping paving operations and header boards are used. The boards must be designed and installed to ensure accurate installation of dowels or tie bars as shown on the Plans.

Ensure the flange braces extend out on the base at least two-thirds of the form height. Remove damaged forms and use repaired forms that the Resident Engineer has inspected and approved. Ensure the top face of the form varies no more than 1/8 inch in 10 ft from a true plane, and alignment varies no more than 1/4 inch in 10 ft. Ensure the forms are cleaned of concrete, grout, and other materials. Before use, ensure the Contractor covers the forms with a form release agent.

(d) Miscellaneous

The Contractor must provide work bridges, 10 ft straightedges, and other hand tools to complete the PCC pavement as required by the Contract. Depending on the Contractors paving operation, multiple work bridges may be necessary to facilitate the work (tining, curing, etc.). Work bridges must span the pavement being placed and provide a safe working platform to perform the duties required. Ensure the Contractor replaces warped floats or straightedges and defective finishing tools.

3. Texturing Equipment

Most PCC pavements will require a burlap drag texture along with either a transverse or longitudinal time. The type of texture being used on the project should be determined at the Preconstruction Meeting and prior to any work beginning on the PCC pavement. If the project is on a local road or municipal street, the local agency may have preference on the texture used on the project.

(a) Burlap Drag

The Contractor must provide fabric texturing equipment mounted on a separate work bridge spanning the PCC pavement that consists of a drag of seamless strips of burlap or cotton that produces a uniform, gritty texture. Ensure a strip of fabric with a width of at least 3 ft is in contact with the full width of the pavement during texturing. Ensure the drag consists of at least two layers of fabric. Ensure the bottom layer of fabric is 6 in wider than the top. Figure 414:2 illustrates the burlap being effectively located behind the slip form paver.

Figure 414:2. Photo. Burlap Drag Finish

(b) Transverse Finish

The Contractor must provide a texturing machine that is a vibrating roller or a comb, equipped with steel tines. Ensure the machine is self-propelled and automatically lifts the roller or tine comb bar near the edge of the pavement. The texturing machine must create transverse grooves from 1/8 in to 3/16 in wide, and from 1/8 in to 3/16 in deep and spaced on a rake from 1/2 in to 1 in apart (in accordance with ODOT Standard Drawing LECS-5). Hand-texturing in areas inaccessible to mechanical equipment will be allowed.

(c) Longitudinal Tining

When longitudinally tining concrete pavement, the Contractor must provide a mechanically operated tining machine with a single row of metal tines that covers the full width in a single pass at a uniform speed and depth. The Contractor must provide a tining machine with automatic horizontal and vertical controls to ensure straight and uniform grooves. The tining machine must create longitudinal grooves from 1/8 in to 3/16 in wide, from 1/8 in to 3/16 in deep, and spaced from 1/2 in to 1 in apart.

4. Floats

The Contractor must provide mechanical or hand operated floats to smooth the concrete after strike off and consolidation. Ensure the trowel blade of hand operated floats are rigid, straightedge, from 12 ft to 18 ft long, and 8 in to 12 in wide. Ensure the float is capable of working longitudinally or transversely.

A finishing machine with the float pan type finisher may be used instead of a mechanical or hand operated float if this method obtains the surface tolerances required by the Contract.

5. Spraying Equipment

The Contractor must provide fully atomizing equipment to apply the white-pigmented curing membrane. Ensure it is equipped with a tank agitator that will keep the compound mixed. Verify the application rate based on the tank capacity of the spraying equipment. Pressure tank hand sprayers must be used to apply the curing membrane to vertical surfaces, irregular areas, or edges after form removal.

6. Shot Blasting Equipment

When required in the Plans, the Contractor must provide shot blasting equipment capable of collecting used shot and waste material. The use of recycled shot will be allowed if requested by the Contractor. The Contractor must collect and properly dispose of materials removed in the cleaning.

7. Joint Installation and Sealing Equipment

Proper sawing and sealing of the PCC pavement is critical to its longevity. The Contractor must provide joint sawing and sealing equipment in accordance with Section 415.03 of the Standard Specifications as follows:

(a) Concrete Saw

The Contractor must provide concrete saws capable of sawing concrete joints to the dimensions shown on the Plans or in accordance with ODOT Standard Drawing LECS-5. The concrete saw may be a conventional wet

cut type or early-entry dry cut type. At least one standby saw must be available in a timely manner in case of breakdown due to the time critical nature of installing the sawed contraction joints to reduce the potential for random cracking of the PCC pavement. Ensure the Contractor maintains an ample supply of saw blades at the work site during sawing operations. Artificial lighting will be required for nighttime sawing.

Early-entry saws are much lighter than the conventional sawing equipment which allows the sawing to begin on the PCC pavement earlier. Performing the sawing earlier allows shallower sawcut depths than the conventional sawing. Other differing features on early-entry saws may include:

- Skid plate (keeper plate) straddling the blade that exerts pressure on the concrete surface to minimize chipping or raveling of the sawcut.
- Most use a dry cutting operation with specialized blades that do not require water for cooling.
- Uses an upward cutting rotation of the blade to push the cutting debris out of the joint.

Ensure the Contractor follows the early-entry saw manufacturer's recommendations and complies with the following requirements listed in Section 414.04.H(3) of the Standard Specifications. Figure 414:3 shows an early-entry dry cut type sawing machine being used to install transverse contraction joints.

Figure 414:3. Photo. Early-entry saw

(b) High-Pressure Water Pumping System

The Contractor must provide high-pressure water pumping systems capable of flushing concrete slurry from sawed joints.

(c) Sand Blasting Unit

The Contractor must provide compressed air sand blasting units capable of cleaning joint surfaces as specified. Ensure the units include traps to remove free water and oil from the compressed air.

(d) Air Compressor

The Contractor must provide air compressors capable of delivering compressed air with a pressure of at least 90 psi. Ensure the compressors include traps to remove free water and oil from the compressed air.

(e) Extrusion Pump

The Contractor must provide air-powered extrusion pumps to apply joint sealer. Ensure the pump output is capable of delivering the volume of the joint sealer to the joint as specified.

(f) Injection Tool

The Contractor must provide a mechanical injection device to insert the sealer into the joint.

(g) Joint Sealer Kettle

The Contractor must provide a double-bottom oil-bath indirect-flame type kettle if the joint sealant requires heating. Ensure the kettle is capable of mixing, heating, delivering, and maintaining the specified temperature.

C. Construction Operations

The Contractor must construct a finished pavement surface as shown on the Plans and in accordance with Section 401.04.A(1), "Surface Elevation and Smoothness." The surface elevations for new pavement construction and overlays must be within 1/2 in of the elevations shown on the Plans. Ensure the surface smoothness is within 1/8 inch in 10 ft. Test for surface smoothness by placing a straightedge between two contacts on the finished surface and measuring the distance from the surface to the straightedge.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision;

however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

Ensure the finished pavement structure is constructed in conformance to the widths and thicknesses shown on the Plans or directed by the Resident Engineer. If the planned width is not being achieved, stop the operation and correct the problems creating the incorrect dimension before resuming the paving operation.

The Contractor must correct material and dimension deficiencies that exceed specified tolerances using methods approved by the Resident Engineer, at no additional cost to the Department. The Resident Engineer may at their discretion accept out of specification work in accordance with Section 105.03 of the Standard Specifications as a reduced cost.

Verify the following complies with Section 414.04 of the Standard Specifications when constructing the PCC pavement:

1. Weather Limitations

Review the weather limitation and surface preparation requirements in the Plans and Standard Specifications. The Contractor must mix, place, and finish concrete and saw cut the contraction joints when there is enough natural light to facilitate the work, unless artificial lighting is approved by the Resident Engineer.

Ensure that the Contractor is aware of the maximum surface temperature and weather conditions required to proceed with the placement of the PCC pavement. The surface temperature must be below 110 °F to proceed with the placement of the PCC pavement. Do not allow the Contractor to begin placing PC concrete if frost exists in or on the base.

For unbonded PCC pavement, the Contractor may reduce the surface temperature by spraying a fine water fog on the base. Additionally, on waterproof bases (such as asphalt) the Contractor may apply a white pigmented curing compound or lime slurry for temperature reduction. For bonded PCC pavement, the specifications state that the Contractor is not allowed to attempt to reduce the base temperature by applying water and other agents which can prevent proper concrete bonding. However, the use of water may be acceptable as long as no free standing water remains on the surface prior to placement of the PC concrete.

Ensure the temperature of the mixed concrete is between 50 °F to 90 °F during mixing, delivery and placement of the PC concrete. During extreme cold or hot weather conditions, the Contractor may have to use one or more of the following methods to meet surface and concrete mix temperature requirements:

- Postpone the placement of the PCC pavement until weather conditions improve.
- Replace a portion of the water for ice in the truck mixer at the concrete batch plant.

- Schedule the PCC pavement placement for nighttime operations.

2. Preparation of Existing Surface or Base

Ensure the Contractor complies with the requirements for the preparation of the existing surface or base in accordance with Section 414.04.A of the Standard Specifications. There are specific construction requirements associated with bonded and unbonded PCC pavements that need to be followed to ensure that they perform as designed. The longevity of the PCC pavement will be reduced if the bonding/unbonding occurs where it is not intended.

Ensure the Contractor adequately prepares the existing pavement surface or base in the manner required for the type of PCC pavement on the project as follows:

(a) General

Ensure the Contractor trims the grade to the elevation shown on the Plans after grading and compacting the roadbed and base where the PCC pavement is going to be constructed. Ensure the Contractor also complies with the following additional requirements listed in Section 414.04.A(1) of the Standard Specifications:

- Extend the work at least 3 ft beyond the edges of the concrete pavement. This area will provide room for the tracks for the paver and work bridges and the concrete finishing personnel. This should be indicated on the Typical Sections in the Plans.
- All of the subgrades and bases constructed meet the tolerances for elevation, straightedge, width and thickness in accordance with Section 301.04.A of the Standard Specification.
- All of the asphalt base, bond breaker, and leveling course constructed meet the tolerances for elevation, straightedge, width and thickness in accordance with Section 401.04.A of the Standard Specifications.
- All milled surfaces meet the tolerances for straightedge specified in accordance Section 412 of the Standard Specifications. The milled surface must be constructed to the line, grade, width and cross section shown on the plans.
- Any low areas in the base must be filled with concrete during paving operations, not with material trimmed from bases or subgrades.
- Correct the alignment and grade elevations of the forms and string lines immediately before placing the concrete. Reset and check disturbed forms or string lines.
- Ensure the subgrade or base is uniformly moist when placing the concrete unless waterproof subgrade or base course cover material is required by the Contract.

If any of the specified tolerances are not in compliance, stop the operation and correct the problems creating these conditions before allowing the Contractor to begin placement of the PCC pavement.

(b) Unbonded Concrete Overlays

Ensure the Contractor constructs the bond breaker as specified in the Plans where the unbonded PCC pavement is going to be constructed. Some designs will not require a bond breaker for unbonded concrete overlays, such as placement on top of an existing asphalt surface. Ensure the Contractor complies with the following additional requirements listed in Section 414.04.A(2) of the Standard Specifications:

- When asphalt is specified as the bond breaker, construct the base or leveling course in accordance with Section 411 of the Standard Specifications. Clean the pavement surface before placing the asphalt.
- If required by the Contract, mill the surface before concrete placement in accordance with Section 412 of the Standard Specifications. After milling, tight blade the surface to remove ridges and loose material. Evenly distribute any remaining fine particles across the milled surface to promote adequate bond breaking.
- If milling operations expose underlying concrete pavement, spray exposed concrete with tack coat and cover with separator fabric or use other methods of ensuring breaking the bond to the new PCC pavement as specified in the Plans or as approved by the Resident Engineer.

If any of the specified bond breaking methods are not in compliance with the Plans and specifications, stop the operation and correct the problems creating these conditions before allowing the Contractor to begin placement of the unbonded PCC pavement.

(c) Bonded Concrete Overlays on Concrete Pavement

Ensure the Contractor removes medium and high severity pavement cracking before surface preparation and placement of the PCC overlay and replace as indicated. Failure to address these areas will surely result in almost immediate failures in the new bonded PCC pavement. Medium and high severity pavement cracks include:

- shattered slabs,
- D-cracks into the wheel paths,
- broken slab corners into wheel paths, and
- cracks wider than 1/2 in that are faulting, spalled or scaled.

Before allowing the Contractor to proceed with the concrete patching, ensure the Contractor and residency project inspector are in agreement with the pavement-patching limits. There should be pay items in the Plans and Contract to facilitate the concrete pavement patching needed but if not, a change order must be considered to add this work.

After completion of the concrete pavement patching, ensure the Contractor also complies with the following additional requirements listed in Section 414.04.A(3)(a) of the Standard Specifications:

1. Surface Preparation.

   Shotblasting is required for the surface preparation for bonded concrete overlays placed onto existing PCC pavement. Prepare the entire surface to be overlayed by thoroughly cleaning the surface by milling and then shotblasting, or just shotblasting. Do not allow the use of water to clean the cold-milled debris from the surface as slurry may develop and weaken the bond between the overlay and the surface.

   Remove all dirt, oil, laitance, or loose material from the surface and edges. Remove excess joint sealant on the surface. Joint sealant in the joint slot may be left in place. Remove all pavement markings, raised pavement markers, and adhesives during the shotblasting operation.

   Ensure the Contractor collects and properly disposes of materials and debris removed in the cleaning operation in a manner approved by the Resident Engineer.

2. Surface Cleaning

   Clean the entire surface with an oil-free, compressed air blast before applying the overlay to the surface. The Department will allow the use of water for final cleaning only after the shotblasting operation, as approved by the Resident Engineer. Remove all freestanding water before placing concrete.

   After cleaning, only allow the paving machine and the concrete delivery trucks to use the cleaned surface. Ensure the concrete trucks drive on the prepared surface directly in front of the paving machine. The Contractor may choose to use a side-delivery material transfer device to eliminate the need to run the concrete delivery trucks on the cleaned surface. Prevent contamination of the cleaned pavement surface before placing the overlay. If the concrete becomes contaminated during concrete placement, stop production until the contamination is removed.

   Do not allow the cleaned surface to become contaminated with oil, grease, water, mud, or other foreign objects from a concrete truck. Remove the truck from the cleaned surface, remove the

contaminants, and ensure the truck is clean and repaired before returning to the project.

3. Joint Identification

   It is critical that the joints in the bonded concrete overlay are placed directly over all joints in the existing PCC pavement being overlaid.

   Identify the exact location of both sides of contraction, expansion, and longitudinal joints in the existing pavement for matching the sawing locations in the bonded concrete overlay once it is placed.

(d) Bonded Overlays on Asphalt Pavement

Prepare the surface to be overlaid by cleaning and milling as required in the Plans. Remove dirt, oil, laitance, and loose material from the surface and edges in a manner approved by the Resident Engineer. Remove all pavement markings, raised pavement markers, and adhesives.

Ensure the Contractor collects and properly disposes of materials removed in the cleaning operation in a manner approved by the Resident Engineer.

3. Handling and Batching Materials

Ensure the concrete batch plant has a current ODOT certification prior to beginning production of PC concrete on the project. If the concrete batch plant does not have a current certification, it is the Residency's responsibility to conduct the plant inspection and submit the inspection report to the ODOT Materials Division. Refer to Section 414.02.C.4 of this Manual for additional details regarding the plant inspection.

Ensure the concrete batch plant and hauling equipment continuously supply material to the work site. Fine and coarse aggregate must be delivered to the concrete batch plant in advance of the paving operation to allow time for sampling and testing by the residency personnel. Ensure the concrete plant contains enough material for a full day of paving operations. Materials must be delivered and stockpiled in accordance with Section 106.08 of the Standard Specifications.

Materials for PC concrete must be measured and batched in accordance with AASHTO M 157, unless otherwise required by the Contract. Different aggregate sizes used in the PC concrete mix must be weighed in separate hoppers. The cementitious material must also be measured by weight to ensure the proper amount required in the PC concrete mix design is being used in each batch. Separate scales and hoppers with devices that indicate the complete discharge of the batch must be used.

In accordance with Section 414.04.B of the Standard Specifications, the Contractor must use an electronically-controlled automatic batch weight and printer system that indicates the net batch weight of material delivered to the transporting truck.

Ensure the weights are printed on a ticket that includes the quantities of admixtures and the volume of water incorporated into the load. Ensure the combined weights of the materials, when converted to a volume, are within 2 percent of the volume on the ticket, minus the target air content.

The information on the batch ticket can be compared to the approved PC concrete mix design to confirm the appropriate amounts of each material, admixture and water are being used.

When required by the Plans or requested by the Contractor to expedite the work, high early strength concrete used for PCC pavement must meet the requirements of 701.01 of the Standard Specifications. ensure high early strength concrete meets the minimum strength requirements within 72 hr of placement.

4. Mixing Concrete

PC concrete must be mixed and delivered in accordance with AASHTO M 157, unless otherwise required by the Contract. The PC concrete will be mixed at the work site, in a central mix plant, or in truck mixers as approved by the Resident Engineer. The manufacturer recommended capacity for the mixer must not be exceeded.

Mixed concrete must be placed no more than 1 hr after the water, cement, and aggregate are combined. The residency project inspector should be monitoring the time from the mixing to the time of discharge to ensure that the 1 hr limit is adhered to by the Contractor. Additionally, ensure the temperature of the mixed concrete is between 50 °F to 90 °F during mixing, delivery and placement of the PC concrete. If the Contractor is not complying with these requirements, stop paving operations to resolve the problems before resuming the paving operation.

Ensure the Contractor also complies with the following additional requirements listed in Section 414.04.C of the Standard Specifications:

- Mix the concrete from 45 seconds to 90 seconds if at the work site or a central mixing plant. Mixing time ends when the discharge chute opens. For multiple drum mixers, include the transfer time as part of the mixing time.
- Remove the contents of the mixer drum before starting the next batch.
- Control the mixer's drum speed in accordance with the manufacturer’s recommendations.
- The Resident Engineer may allow 10 percent overload of the mixer if the concrete does not spill and the concrete test data are satisfactory.
- Ensure that a portion of the mixing water enters the drum before the cement and aggregates. Keep a uniform flow of water, and ensure that all water is in the drum within the first 15 seconds of the mixing. Keep the throat of the drum free from accumulations that restrict the flow of materials.

- Adjust water to improve workability if transit mixers or agitators deliver the PCC. Increase mixing by 30 revolutions when adding water, and maintain the water to cementitious material ratio.

5. Setting Forms

When the Contractor is using formed paving equipment, the forms must be set to line and grade by shimming, or other methods approved by the Resident Engineer.

Ensure the Contractor also complies with the following additional requirements listed in Section 414.04.E of the Standard Specifications:

- Correct variations in the foundation course that prevent placing forms to the line or grade shown on the Plans.
- Stake forms in place with at least three pins per 10 ft section.
- Place a pin at each side of the joints.
- Tightly lock form sections, and ensure that there is no movement.
- Ensure the forms do not deviate from true line by more than 1/4 in.
- Forms must be rigid enough to withstand the use of the finishing machine.
- Clean and oil forms before placing the concrete.

6. Placing Concrete

When the Contractor is placing the concrete for the PC pavement, care should be taken to minimize rehandling when placing concrete on the grade or base. Discharging concrete into a spreading device and mechanically spreading it onto the grade will minimize segregation of the PC concrete mix. The Contractor must use truck mixers, truck agitators, or non-agitating hauling equipment capable of discharging concrete without segregation. Between transverse joints, the concrete should be continuously placed without using intermediate bulkheads.

The residency must verify that the previously submitted and accepted sources of materials and concrete mix designs are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

The residency project inspector is responsible for sampling and testing the PC concrete. Obtain fresh concrete samples from the project site and verify the PC concrete complies with the requirements for Class A Concrete (slump, air, temperature, cylinders for compressive strength testing, etc.). Document the test results in the appropriate SiteManager sample record (Template C94025 and C94014 for compressive strength).

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced

price, make adjustments to material being delivered, improve stockpiling methods, etc.).

Ensure the Contractor complies with the following additional requirements listed in Section 414.04.F(1) of the Standard Specifications:

- Hand spread concrete with appropriate tools to minimize segregation. Do not allow the use of handheld vibrators to spread or move the PC concrete.
- Ensure soil or foreign materials are not tracked onto the recently placed concrete.
- Ensure concrete cures for at least 3 days before allowing finishing equipment on it for placement of adjacent lanes. Before allowing other equipment onto the pavement, ensure that the concrete attains a strength in accordance with Subsection 414.04.N, "Opening to Traffic."
- Ensure continuous forward movement if using a slip-form paver. Coordinate mixing, delivering, and spreading operations to provide uniform progress, minimizing stopping and starting.
- Stop vibratory and tamping elements if the forward movement of the paver stops.
- Consolidate concrete against the grade, face of the forms, and joint assemblies. Minimize the operation of vibrators in a single location to that required for consolidation. Do not allow the use of handheld vibrators to facilitate the finishing operation of the PC concrete by promoting grout forming on the surface.
- Deposit concrete near expansion and contraction joints without displacing the joint assemblies.
- Remove foreign materials that fall onto the completed slab as approved by the Resident Engineer.
- Do not place concrete without the presence of the residency project inspector, unless otherwise approved by the Resident Engineer.
- The final strike off, consolidation and finishing of the PC concrete must be completed in accordance with Section 414.03.C.8 of this Manual and Section 414.04.I of the Standard Specifications.

(a) Continuously Reinforced Concrete Pavement (CRCP)

There are many challenges when constructing Continuously Reinforced Concrete Pavement (CRCP) to ensure the pavement performs as intended and provides the expected longevity. To ensure the superior performance commonly associated with CRCP, uniformity and consistency of concrete placement and reinforcement steel location along the project are critical. There are resources available for guidance to construction inspection personnel. One document published by FHWA is their *"Continuously*

Reinforced Concrete Pavement Manual – Guidelines for Design, Construction, Maintenance, and Rehabilitation".

The Contractor must spray a standard, white, wax-based curing compound on the asphalt at the rate of 1 gal per 150 ft² to disrupt the bond between the asphalt and the CRCP unless otherwise shown in the Plans. Ensure the curing compound is applied uniformly without streaking and thin/thick areas. Allow the bond breaker to dry before beginning the placement of the reinforcing steel bars.

Ensure the Contractor also complies with the following additional requirements listed in Section 414.04.F(2) of the Standard Specifications:

1. Preparation of Steel Reinforcement

   Remove dirt, oil, paint, grease, mill scale, and loose or thick rust from the reinforcing steel. The Department does not consider minor, thin, powdery rust that does not reduce the effective cross section to be detrimental.

2. Placement of Reinforcement for CRCP

   Place reinforcement steel on chairs or high-chair bars. Place the quantity of longitudinal and transverse members as shown on the Plans. Handle the reinforcement so that the bars remain flat and undistorted during concrete placement.

   Install the chairs or high-chair bars to support reinforcement as shown on the Plans. Arrange the chairs to ensure the reinforcement is not permanently displaced during placement and consolidation.

   Space high-chair bars adjacent to other transverse members to allow for proper concrete placement; especially important at reinforcement laps.

   If using forms, ensure the Contractor applies the form oil before placing reinforcement. It is critical that the reinforcement steel is clean and free of any form oil or other bond breaker.

   Ensure the reinforcing steel and supports meet the following conditions and tolerances:

   - The horizontal position is within 1/2 in of the longitudinal dimensions and within 2 in of the transverse dimensions shown on the Plans.
   - The vertical position is within 1/2 in of the longitudinal and transverse dimensions shown on the Plans.
   - The bars are free from kinks or bends that prevent assembly or installation.
   - Do not weld chairs to transverse bars.

- The base supports the chairs, and prevents overturning and penetration into the base.

Samples of the chair or high-chair bar must be made available upon request as well as Working Drawings that indicate the layout of the chairs. If the chairs do not adequately support the reinforcing steel during concrete placement and finishing, stop the operations and take corrective action to ensure the final position of the reinforcing steel complies with the Plans and required tolerances for placement.

The Contractor may request the use of a tube feeding system to install the reinforcing steel into the CRCP. There have been problems with the tube feeding system and it is not allowed in many state DOT's. As stated in Note 11 on the ODOT Standard Drawing CRCP1-4, mechanical placement of the steel using tube feeder will not be allowed on ODOT projects.

(b) Lap Splices in Reinforcing Steel

The Contractor must lap the longitudinal reinforcing bars in a staggered pattern as shown on the Plans. The stagger pattern and other details regarding the construction of the CRCP may be found in ODOT Standard Drawing CRCP1-4. Laps in the longitudinal reinforcement must be secured by tying, fastening with clips, or otherwise securely fastening to ensure continuous reinforcement.

7. Joints

PCC pavements are constructed with joints to accommodate concrete shrinkage and to control crack locations. For example, the Contractor must construct transverse contraction joints perpendicular to the surface of the slab in a timely manner. Contraction joints sawed to the minimum specified depth in a timely manner are critical to avoiding random cracking of the PCC pavement that would occur from the early stages of shrinkage of the PC concrete. Additional information from the American Concrete Pavement Association (ACPA) regarding jointed concrete pavements may be found on their website (Joints). Information available at this site includes:

- Why PCC pavements need to be jointed.
- Joint spacing.
- Sawcut timing and depth.
- Types on joints.
- Joint Mechanics.
- Joint construction.

Maintaining proper sawing and sealing of the PCC pavement is critical to its longevity. Water intrusion into the joint from a pavement's surface can cause distress in the PCC pavement especially during freeze/thaw cycles. Additionally, an unsealed joint is susceptible to intrusion of incompressibles (small aggregate or other debris) into the joint. The joint taking on water and incompressibles can lead to spalling, base or subgrade softening, dowel bar corrosion, and pavement joint blow-ups.

Joints must be installed of the type, dimensions, and locations shown on the Plans. Project plans typically include Joint Layout sheets for PCC pavement projects that will provide information regarding the general layout of the joints on the project. Additional details regarding dimensions and various types of joints may be found in ODOT Standard Drawing LECS-5. The joints should be laid out and aligned using guidelines or devices approved by the Resident Engineer. Additional information from the American Concrete Pavement Association (ACPA) regarding various types of joints and their proper layout for different configurations of concrete pavements may be found on their website (Joint Layout). Information available at this site includes:

- Rules for joint layout.
- Joint layout terminology.
- Joint layout at intersections, cul-de-sacs, roundabouts, etc.

For bonded concrete overlays placed on existing PCC pavements, ensure the Contractor constructs the sawed joints directly over existing transverse and longitudinal joints.

Ensure the sawed joints are straight and true to line. The Contractor must repair joints that are not straight or meet the required dimensions. The sawed joints must be sealed in accordance with Section 415.04 of the Standard Specifications.

(a) Longitudinal Joints

The Contractor is required to saw and seal longitudinal contraction joints. When there is a longitudinal construction joint resulting from the construction sequence, the joint does not require sawing or sealing in accordance with ODOT Standard Drawing LECS-5.

The Contractor must place deformed steel tie bars of a length, size, spacing, and material as indicated in the Plans, perpendicular to the longitudinal joint. In accordance with ODOT Standard Drawing LECS-5, the requirements for the tie bars include the following:

- Use No. 5 deformed reinforcing steel bars that are 2'6" long and spaced at 3'0" center-to-center for tied butt joints and longitudinal construction joints.

- Use No. 4 deformed reinforcing steel bars that are 2'6" long and spaced at 2'6" center-to-center for sawed longitudinal joints that are not construction joints.
- Tie bars shall not be placed closer than 24" to an eventual transverse joint.
- Tie bars shall be placed at the mid-point of the PCC pavement slab (T/2 = halfway between the top and bottom of the pavement).
- For sawed longitudinal joints that are not construction joints, the tie bars are to be supported at each end by an approved bar support system or placed by an approved mechanical device (typically a bar inserter incorporated into the slip form paver) into the fresh concrete.
- For tied butt joints and longitudinal construction joints, the tie bars are to be installed in a manner approved by the Resident Engineer. Typically, the Contractor will insert them into the face of the joint into the fresh concrete or will drill a hole into the hardened concrete and use an epoxy resin Type H to bond them in place. Each of these methods can produce adverse effects to the PCC pavement if not done properly. Inserting the bars into the fresh concrete at the face of the joint can cause the surface of the pavement to heave or push up and cause a bump. Drilling a hole and using epoxy must be done in accordance with the epoxy manufacturer's recommendations to ensure an adequate bond that does not allow the tie bar to pull out. When drilling the hole and using epoxy, ensure the Contractor's method meets the manufacturer's recommendations and specification requirements as follows:
  - hole dimension,
  - hole/bar is perpendicular to joint,
  - hole/bar is parallel to pavement surface,
  - removal of dust to ensure proper bond, and
  - sufficient amount of epoxy.
- For tied butt joints and longitudinal construction joints, omit the tie bars for non-tied joints specified on the Plans (typically for isolation joints located at ramps and intersections).

Ensure tie bars placed by mechanical equipment during concrete placement or by securing tie bars using supports, prevent displacement of the bars during concrete placement. The Contractor must repair or replace loose bars at no additional cost to the Department. Do not allow bars to be painted, coated, or enclosed in tubes or sleeves as that will cause debonding from the concrete.

For sawed longitudinal joints that are not construction joints, the Contractor must saw the longitudinal contraction joint to the depth shown on the Plans, without damaging the pavement or joint. Ensure the sawed depth maintains

at least 1/2" of clearance to the top of the tie bar. Ensure the sawed areas are cleaned of all dust, chalk, and contaminants and the joint is filled with an approved joint-sealing material.

Ensure the Contractor allows the joint sealant to cure before allowing construction equipment and other vehicles on the pavement. Adjacent surfaces should not vary by more than 1/8 in using a 10 ft straightedge.

(b) Transverse Expansion or Isolation Joints

Ensure the Contractor complies with the following requirements regarding the installation of the expansion joint filler material as listed in Section 414.04.H(2)(a) of the Standard Specifications:

- Make the expansion joint filler continuous from form to form.
- Shape it along the form from the base to the keyway.
- Provide lengths of joint filler equal to the width of the pavement, or the width of one lane.
- Use joint filler that is not damaged or repaired.
- Punch pre-molded joint filler to the diameter of the dowels.
- Unless otherwise approved by the Resident Engineer, use lengths of joint filler equal to the width of the pavement. When placing two or more traffic lanes of pavement, use pre-molded filler in sections equal to the width of one lane.
- Clip or lace joint filler sections together if there is more than one section per joint.
- Extend the bottom edge of the filler to below the bottom of the slab.

Unless otherwise required by the Contract, ensure the top edge is 1 in below the surface of the pavement. In accordance with ODOT Standard Drawing LECS-5, the joint filler material is only placed in the bottom two-thirds of the PCC pavement thickness (2/3 T). While the concrete is being placed, ensure the Contractor protects the top of the filler using a metal channel cap of at least 10-gauge material, with flanges at least 1-1/2 in deep.

The Contractor will withdraw the installing bar after striking off and placing the concrete on both sides of the joint, leaving the pre-molded filler in place. Before removing the installing bar and channel cap, ensure the Contractor vibrates the concrete and incorporates additional freshly mixed concrete into depressions left by the installing bar.

NOTE: For clarification of the reference to the installing bar, Section 414.04(j)2.1 of the 1976 Edition of the ODOT Standard Specifications states in part,

"An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. The installing bar shall be a substantial metal plate or shape and shall have a length of 1/2" less than the specified width of the slab and shall be cut to the specified crown of the slab in cross section. It shall be staked in position so that the top edge will be not more than 1" below the proposed pavement surface; the lower edge shall be cut to conform to the prescribed cross section of the subgrade; the installing bar shall be slotted from the bottom as necessary to permit the installation of the required dowels and may be further cut away at intervals along its length so as to allow the concrete to make contact with the premolded filler at close intervals. Suitable means shall be provided on the bar for facilitating its removal. Header boards, sheet metal holders, or other devised in lieu of the installing bar, must meet the approval of the Engineer."

Once the installing bar and channel cap have been removed, ensure the Contractor:

- Exposes the joint filler material for the full width of the slab.
- Cleans and re-oils the installing bar before installing the next joint.
- After removing the side forms, opens the ends of the transverse joints at the edges of the pavement for the depth of the slab.
- Before opening the pavement to traffic, seals or tops out pre-molded joints with joint-sealing filler required by the Contract.
- Leaves a uniform strip of joint-sealing filler slightly below the surface of the pavement.

The Contractor may use steel templates or other joint-forming dividers to construct concrete curbing joints that cannot be sawed and install them at locations as necessary during concrete placement.

(c) Transverse Contraction Joints

The Contractor must construct transverse contraction joints by sawing to the depth as required in the Plans in a timely manner without damaging the pavement or joint. Typically, conventional sawing should begin between 6-12 hours of the PC concrete being placed, depending on the weather conditions. In accordance with ODOT Standard Drawing LECS-5, the depth of the saw cut will be one-third of the PCC pavement thickness (T/3) and the width shall be at least 1/8". Succeeding joints should be sawed consecutively from the beginning to the end of the day's run, and all transverse joints must be sawed soon enough to prevent uncontrolled transverse cracking. Any uncontrolled random cracking that develops must be repaired at no additional cost to the Department. Additional information

from the American Concrete Pavement Association (ACPA) regarding sawing contraction joints may be found on their website (Joints).

Ensure the Contractor complies with the following requirements regarding the sealing of the transverse contraction joints as listed in Section 414.04.H(2)(b) of the Standard Specifications:

- Clean and dry the sawed joint area.
- Keep the area around the joint free from dust, chalk, contaminants, and spalling.
- Fill the sawed joint area with joint sealing material.
- Ensure the curing period for the joint sealant is complete before allowing construction equipment and vehicles on the pavement.

(d) Transverse Construction Joints for Jointed Pavement

The Contractor must construct transverse construction joints when concrete operations are interrupted for more than 30 min, or as field conditions require during concrete operations. Ensure transverse construction joints are not constructed within 10 ft of expansion or contraction joints. If, at the time of interruption, not enough concrete has been placed to form a slab at least 10 ft long, remove the concrete to the preceding joint and dispose of the material in a manner approved by the Resident Engineer.

When dowels are required in the PCC pavement, the Contractor must provide a rigid header with holes or slots for dowel bars with the same spacing and dimensions of an expansion joint. An alternative header construction method may be submitted to the Resident Engineer for approval. Typically, the Contractor will drill a hole into the hardened concrete and use an epoxy resin Type H to bond them in place. If not done properly, using this method can produce adverse effects to the PCC pavement. Drilling a hole and using epoxy must be done in accordance with the epoxy manufacturer's recommendations to ensure an adequate bond that does not allow the dowel bars to pull out. When using this method, ensure the Contractor's method meets the manufacturer's recommendations and specification requirements as follows:

- hole dimension,
- hole/bar is perpendicular to joint,
- hole/bar is parallel to pavement surface,
- removal of dust to ensure proper bond, and
- sufficient amount of epoxy.

(e) Transverse Construction Joints for Continuously Reinforced Concrete Pavement

The Contractor must install transverse construction joints at the end of each workday or when paving operations are interrupted for more than 30 min, or as field conditions require during concrete operations.

Ensure the Contractor complies with the following requirements regarding the transverse construction joints for CRCP as listed in Section 414.04.H(2)(d) of the Standard Specifications:

- Form the joint by placing the concrete against a header board.
- Extend the longitudinal reinforcing steel through the header board and support from the base to prevent deflections.
- Cover the reinforcement that extends beyond the header board with sheets of plywood or other material so that workers can walk on the steel without displacing it and concrete does not spill on the base during screeding operations.
- Make construction joints and lap splices as shown on the Plans.

The Contractor must use hand vibrators to consolidate pavement areas adjacent to the sides of transverse construction joints and refinish the surface. These areas must extend at least 10 ft from the joint. Ensure the adjacent surfaces do not vary by more than 1/8 in using a 10 ft straightedge

(f) Lightweight Early-Entry Saw Joints

The Department will allow the construction of transverse contraction joints using a lightweight, early-entry saw. Early-entry saws are much lighter than the conventional sawing equipment which allows the sawing to begin on the PCC pavement earlier. Typically, conventional sawing should begin between 6-12 hours of the PC concrete being placed where early-entry sawing would begin between 1–4 hours, depending on the weather conditions. Performing the sawing earlier allows shallower sawcut depths than the conventional sawing. Other differing features on early-entry saws may include:

- Skid plate (keeper plate) straddling the blade that exerts pressure on the concrete surface to minimize chipping or raveling of the sawcut.
- Most use a dry cutting operation with specialized blades that do not require water for cooling.
- Uses an upward cutting rotation of the blade to push the cutting debris out of the joint.

Ensure the Contractor follows the early-entry saw manufacturer's recommendations and complies with the following requirements listed in Section 414.04.H(3) of the Standard Specifications:

- Ensure the blade is 1/8 in thick and the sawed joint is at least 1-1/2 in deep.
- Begin sawing the joint when the concrete is hard enough to cut without raveling, chipping, spalling, or tearing.
- Check the sawed faces to ensure that early cutting does not cause joint undercutting.
- Delay sawing if raveling, chipping, spalling, or tearing is occurring or if the undercutting is deep enough to cause structural weakness or excessive joint roughness. The skid plate should be a deterrent for this occurring, if properly used.
- Saw the joints consecutively at the spacing required by the Contract. Immediately after sawing, clean the cut and adjacent concrete surface.
- Re-apply the liquid membrane curing compound on the PCC pavement surface on all areas damaged by the equipment and sawing operation.
- Inspect the lightweight early entry saw joints the next day. If a crack is not evident within 24 hours re-saw the joint to a depth of T/3.
- Clean and seal joints in accordance with the manufacturer's recommendations, unless otherwise required by the Contract.

Additionally, for bonded concrete overlays placed on existing PCC pavements, ensure the Contractor constructs the sawed joints directly over existing transverse and longitudinal joints, and uses the following methods unless otherwise required in the Plans:

- Overlay sections equal to or less than 4 in thick; saw the joints 1/2 in deeper than the overlay concrete; and
- Overlay sections thicker than 4 in; saw joints to a depth of T/3.

(g) Load Transfer Devices

Load transfer between panels of plain jointed PCC pavement is critical to its longevity. Most performance problems with plain jointed PCC pavement are a result of poorly performing joints. Poor performance such as faulting, pumping and corner breaks may occur from joints with poor load transfer efficiency. All of these problems worsen when transverse construction joints deflect under traffic loads. The effectiveness of the load transfer devices can keep slabs in vertical alignment and minimize deflections in the concrete slab.

The placement method of load transfer devices is optional. The Contractor may secure the load transfer devices (dowels) in place or mechanically place

them with a dowel bar inserter used in conjunction with the slip form paver. The dowels must be placed perpendicular to the transverse joints and parallel to the surface and centerline of the slab and vary no more than 3/8 in from the position shown on the Plans. Ensure the Contractor complies with the following requirements shown in ODOT Standard Drawing LTU-5:

- Use smooth Grade 60 steel dowel bars that are 18" long and spaced at 12" center-to-center for all transverse joints in dowel jointed PCC pavement in locations required in the Plans.
- The diameter of the dowel bars is determined by the PCC pavement slab thickness as shown in the Dowel Bar Table on the Standard Drawing.
- Dowel bars shall be placed at the mid-point of the PCC pavement slab as measured from the pavement surface to the center of the dowel bar. The accepted tolerance required is the dowel bar must be within 1/2 the diameter of the dowel bar.
- Dowel bars shall have a shop applied epoxy coating over their entire length. The ends of the dowel bars do not require epoxy coating.
- Dowel bars shall be completely coated in the field immediately before paving with a form release agent to break the bond between the dowel bar and the PC concrete. The epoxy coating alone does not provide sufficient bond breaker and the form release agent is critical.
- When baskets are used to secure the dowel bars in place, the basket shall have sufficient rigidity to be securely held in place during the placement of the PC concrete. The same type of basket selected by the Contractor shall be used throughout the project.
- The Contractor must demonstrate to the Resident Engineer a staking pattern that shall sector the Dowel baskets such that the final dowel bar position is within the required tolerance.
- Cap expansion joint dowels as shown on the Standard Drawing (alternating ends on adjacent bars). The caps must have between 1-2" of air space in the end of the expansion caps.
- For expansion joints, the Contractor shall provide suitable installing devices and additional stakes to hold the joint filler material vertical and securely in line and position.

When the Contractor chooses to mechanically place the dowel bars with an inserter used in conjunction with the slip form paver, they must prove to the Resident Engineer that the final dowel bar position is within the required tolerance. The Contractor must check and verify the placement of mechanically injected dowel bars using an approved steel locator and cover meter. (ODOT Standard Specification requires the use of the SOILTEST Model CT-4950A Micro-Covermeter, or an approved equivalent.)

8. Final Strike Off, Consolidation and Finishing

The Contractor must perform the strike off, consolidation, and finishing of the PCC pavement in the following sequence:

- Strike off and consolidation,
- Float and removal of laitance,
- Straightedge, and
- Finish the final surface.

Do not allow the Contractor to apply water to the concrete surface to assist in finishing operations unless the Resident Engineer approves otherwise. If the application of water is approved, the water must be applied as a fog spray using approved spray equipment. Applying excessive water to aid in the hand finishing may result in grout build-up on the surface that is susceptible to premature cracking, spalling and raveling.

Ensure the Contractor sufficiently consolidates the concrete adjacent to the joints using mechanical vibrators or handheld vibrators to prevent voids between the concrete and the joint material, around all load transfer devices, and at any joint assembly units.

(a) Slip Form Paving

The use of a slip form paver is the preferred method to place constant width PCC pavement in areas with sufficient length to facilitate its use. The Contractor will use the slip form paver to strike off, consolidate, and initially finish the concrete. At the beginning of the day's paving operation, ensure the Contractor uses a straightedge at the construction joint and the adjacent PCC pavement slab longitudinally and transversely until the machine produces slab smoothness within the acceptable tolerances required in Section 401.04.A of the Standard Specifications (the surface smoothness is within 1/8 inch in 10 ft).

Ensure the Contractor tests for compliance with straightedge requirements constantly throughout the paving operation. Ensure the edge of the pavement slab meets the elevations as indicated, and test using a 10 ft straightedge perpendicular to the centerline of the roadway. Ensure the outer 6 in of the pavement does not deviate more than 1/4 in from the bottom of the straightedge.

The Contractor must correct valleys or depressions that do not drain, at no additional cost to the Department.

It is the intent that the slip form paver complete the placement of the PCC pavement and the Contractor should limit hand finishing to correction of surface defects. Proper use of the slip form paver will result in a smoother

and higher quality PCC pavement that will be longer lasting. Excessive hand finishing may result in deviations in the smoothness and grout build-up on the surface that is susceptible to premature cracking, spalling and raveling.

(b) Fixed Form Paving

The use of the fixed form method will be used to place PCC pavement in short, isolated areas with insufficient length to use a slip form paver or for pavement sections with a variable width. The Contractor must use a finishing machine equipped with at least two oscillating-type transverse screeds for finishing the surface to the tolerances required by the Contract. The finishing machine must include surface pan-type vibrators for pavement thicknesses no greater than 8 in or internal-type vibrators with immersed tubes or multiple spuds to consolidate the full width and depth of the pavement. The use of hand finishing with a portable vibrating or rotary strike-off screed is only permitted in areas inaccessible to mainline paving equipment when approved by the Resident Engineer.

When using the finishing machine, strike-off and screed freshly placed concrete. Ensure the machine consolidates the pavement and creates a uniform texture. Ensure the Contractor keeps the tops of the forms clean from PC concrete build-up or other material. To prevent an irregular finish, ensure the machine travels on the forms without lifting, wobbling, or moving unnecessarily.

Maintain a uniform ridge (head) of concrete in front of the screed during the first pass of the finishing machine. Ensure the use of a vibrator in accordance with Section 414.03.B of the Standard Specifications to vibrate the full width of concrete paving slabs. Handheld vibrators must be used in locations inaccessible to the finishing machine. Do not allow the Contractor to use the handheld vibrators to move the PC concrete as over-vibrating will cause segregation in the PC concrete mix.

1. Hand Finishing

   Hand finishing will be allowed in narrow or irregular areas or when paving equipment breaks down and concrete is deposited on the ground or is in transit.

   The PCC pavement in hand finished areas must be constructed within the acceptable tolerances required in Section 401.04.A of the Standard Specifications (the surface smoothness is within 1/8 inch in 10 ft).

   In hand finishing areas, the Contractor must use a portable vibrating or rotary strike-off screed to strike off the freshly placed concrete. The screed must be at least 2 ft longer than the maximum width of the slab. Ensure the Contractor uses spud-type hand operated

vibrators at a frequency rating of at least 3,500 impulses per minute to achieve thorough consolidation and uniformity of the pavement.

The screed must be moved on the forms, in the same direction as the paving operation, with combination of longitudinal and transverse shearing motions. Ensure the ends of the screed do not rise from the side forms during strike off. This process is repeated to produce a uniform surface and texture, free of porous areas. Ensure the screeds do not cause segregation or grout buildup due to overuse.

2. Hand Floating

The Contractor must provide mechanical or hand operated floats to smooth the concrete after strike off and consolidation. Ensure the trowel blade of hand operated floats are rigid, straightedge, from 12 ft to 18 ft long, and 8 in to 12 in wide. Ensure the float is capable of working longitudinally or transversely.

Long handled floats must be used to smooth and fill in porous areas. Ensure the required cross-slope and crown in the pavement is maintained. After floating, excess water and laitance must be removed with a straightedge. While operating the float, ensure the Contractor overlaps successive passes one-half the length of the float blade.

(c) Straightedge Testing and Surface Correction

The Contractor must use a 10 ft straightedge to test the smoothness of the concrete surface while the concrete is still plastic and after floating and removing excess water. Ensure the PCC pavement slab smoothness is within the acceptable tolerances required in Section 401.04.A of the Standard Specifications (the surface smoothness is within 1/8 inch in 10 ft).

Ensure the Contractor follows the Straightedge Testing and Surface Correction in accordance with the following requirements listed in Section 414.04.I(5) of the Standard Specifications:

- Hold the straightedge against the surface parallel to the road centerline.
- Advance the straightedge in successive stages of no more than one-half the length of the straightedge.
- Fill depressions with freshly mixed concrete, then strike-off, consolidate, and refinish.
- Cut and refinish high areas.
- Ensure that the adjacent surfaces across joints are smooth.
- Continue straightedge testing and surface corrections until the entire surface conforms to the grade and typical section shown on the Plans.

- Ensure the Contractor replaces warped floats or straightedges and defective finishing tools.

(d) Texturing

The Contractor must provide fabric texturing equipment to apply a texture drag before the pavement final finish to produce a uniform surface of gritty texture on the entire pavement surface. For pavement at least 16 ft wide, the fabric texturing equipment must be mounted on a separate work bridge spanning the PCC pavement. Ensure a strip of fabric with a width of at least 3 ft is in contact with the full width of the pavement during texturing. Ensure the drag consists of at least two layers of fabric with the bottom layer of fabric being 6 in wider than the top. The Contractor must consistently clean the drag of encrusted mortar and replace permanently encrusted drags with new ones.

After dragging is complete, the Contractor must mechanically groove (tine) and texture the driving lanes and ramps in a transverse or longitudinal direction, using a texturing machine that is a vibrating roller or a comb, equipped with steel tines. Unless otherwise required by the Contract, the Department will not require tining on shoulders.

In accordance with Note 8 on ODOT Standard Drawing LECS-5, the Contractor must longitudinally tine the PCC pavement unless otherwise specified in the Plans or as directed by the Resident Engineer.

On any roads or streets with a posted speed limit of 45 mph or less, the Contractor may request that the tining be exempt from the PCC pavement. The Contractor must obtain written approval from the appropriate local entity to provide an alternate texture and submit the proposal to the Resident Engineer at least 14 days before beginning paving. Written approval from the Resident Engineer to substitute the alternate texture replaces the need for a change order or price adjustment.

The edges of the pavement must be rounded along the sides of the slab to the radius as shown on the Plans after the final finish, but before the concrete sets. In accordance with ODOT Standard Drawing LECS-5, the radius will be 1/8". The radius must be well-defined and continuous with a smooth, dense mortar finish. At the joints, the surface must be broomed to eliminate tool marks adjacent to the joints without damaging joint edges.

1. Transverse Finish

   The Contractor must provide a texturing machine that is a vibrating roller or a comb, equipped with steel tines to construct transverse grooves perpendicular to the centerline of the pavement. Transverse grooving consists of creating transverse grooves from 1/8 in to 3/16 in wide, from 1/8 in to 3/16 in deep, and spaced on a rake from

1/2 in to 1 in apart (in accordance with ODOT Standard Drawing LECS-5).

The grooving pattern must be repeated across the pavement in the driving lanes and ramps for the full length of the poured PCC pavement. The grooves must be formed in the plastic concrete without tearing or bringing the coarse aggregate to the surface. Ensure the machine automatically lifts the roller or tines near the edge of pavement. Ensure the overlap between grooving passes is less than 3 in. Hand-groove methods in areas inaccessible to mechanical grooving equipment will be allowed.

Ensure the Contractor identifies the location of transverse joints prior to beginning the placement of the PCC pavement each day. The transverse tine marks can cause raveling at the joints when they are in close proximity to each other. The tined grooves must be at least 1 in away from either side of all transverse joints and no greater than 3 in. Figure 414:4 illustrates excellent crack development from the sawed contraction joint. The tining grooves appear to be at least 1 in away from the sawed joint, but the Contractor in this instance should provide more spacing between the tined grooves to ensure adequate distance is provided.

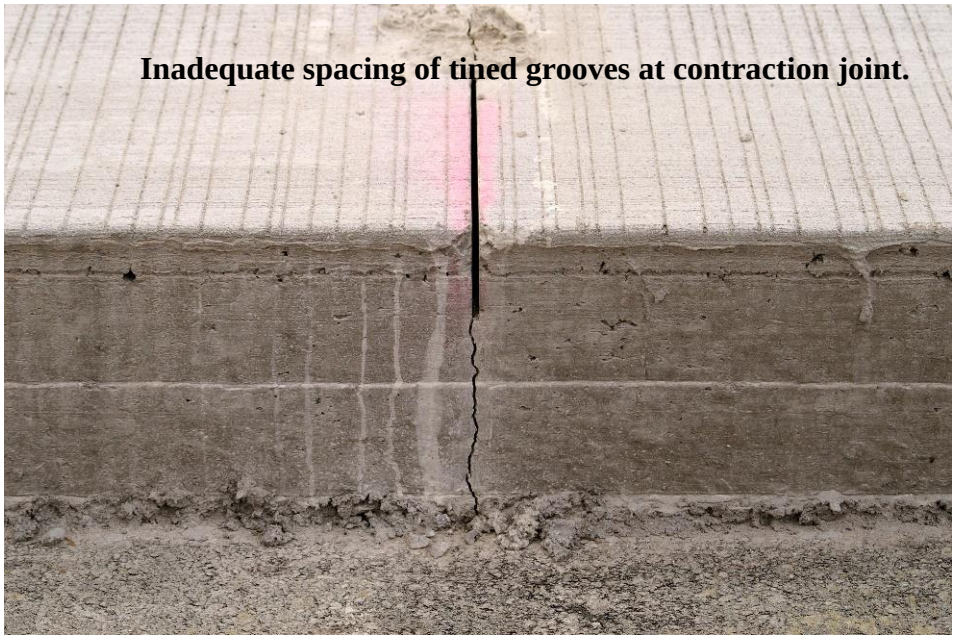

Figure 414:4. Photo. Sawed Contraction Joint

2. Longitudinal Finish

In accordance with Note 8 on ODOT Standard Drawing LECS-5, the Contractor must longitudinally tine the PCC pavement unless otherwise specified in the Plans or as directed by the Resident Engineer.

The Contractor must provide a mechanically operated tining machine with a single row of metal tines that covers the full width of the PCC pavement being placed in a single pass at a uniform speed and depth to construct longitudinal grooves parallel to the centerline of the pavement. Longitudinal tining consists of creating longitudinal grooves from 1/8 in to 3/16 in wide, from 1/8 in to 3/16 in deep, and spaced from 1/2 in to 1 in apart.

Ensure the tining operation is done at such a time and manner that the desired surface texture is achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets. Start the grooves at least 6 in from the edge of the pavement. If the concrete pavement has concrete curbs, start the grooves at least 12 in from the face of curb.

Ensure a 2 in to 3 in wide strip of pavement, centered about any intermediate longitudinal joints in the concrete pavement surface, is protected from longitudinal surface tining for the length of the concrete pavement surface. The longitudinal tine marks can cause raveling at the longitudinal joints when they are in close proximity to each other.

Hand-tining methods in small, isolated areas inaccessible to mechanical grooving equipment will be allowed.

9. Curing

Curing of the PC concrete maintains moisture and temperature conditions in the freshly placed mixture to allow the effective hydration of the cementitious components. The Contractor must cover and cure the entire surface of the newly placed PC concrete immediately after completing the texturing operations so marring of the PCC pavement surface will not occur, in accordance with Section 414.04.J of the Standard Specifications. The Contractor must properly use one or more of the following methods:

- Wetted cotton or burlap mats,
- Impervious membrane method,
- White polyethylene sheeting, or
- Curing for cold weather.

Failure to provide sufficient cover material, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of

concrete operations. If the Contractor fails to properly cure the freshly placed PC concrete in a timely manner, stop the operation and ensure they take the actions necessary to remedy any deficiencies in their methods.

Do not allow the PC concrete to be left exposed for more than 30 min between stages of curing or during the curing period.

(a) Cotton or Burlap Mats

When the Contractor chooses to use the cotton/burlap mat method for curing, ensure their work complies with the following requirements listed in Section 414.04.J(1) of the Standard Specifications:

- Cover the pavement surface with mats within 30 min. Ensure marring of the PCC pavement surface does not occur.
- Use mats long enough or wide enough to extend beyond the edges of the slab by at least twice the thickness of the pavement.
- Saturate the mats with water in a timely manner. The prolonged placement of dry mats will absorb moisture from the PC concrete and will likely cause shrinkage cracking in the PCC pavement surface.
- Secure the mats sufficiently to keep them in direct contact with the PC concrete surface.
- Ensure the mats are moist and in direct contact with the PC concrete surface for at least 72 hr after concrete placement, unless otherwise required by the Contract or directed by the Resident Engineer. If the mats are removed prior to the 72 hr requirement, ensure the Contractor applies a subsequent impervious membrane cure within 30 min of the mat removal.

In accordance with Section 701.07.A of the Standard Specifications, the Contractor must provide new burlap free of starch, filler, or other substances added during the manufacturing process. If the burlap contains these substances, it must be washed repeatedly rinsing in clear water. Alternatively, the Department will allow old burlap if its only previous use was for curing concrete. The Department will not allow the use of worn burlap or burlap with holes that has lost its moisture retaining ability.

In accordance with Section 701.07.B of the Standard Specifications, the Contractor must provide new cotton mats, or used cotton mats, used only for curing concrete. The Department will not allow the use of worn cotton mats or cotton mats with holes that have lost its moisture retaining ability.

(b) Impervious Membrane

Due to PCC pavements having a high exposed surface area for the volume of PC concrete requiring curing, the use of the impervious membrane is typically the most efficiently used method to accomplish the proper cure.

When the Contractor chooses to use the impervious membrane method for curing, ensure their work complies with the following requirements listed in Section 414.04.J(2) of the Standard Specifications:

- Only the Type 2 white-pigmented curing compound is acceptable for curing PCC pavement using the impervious membrane method. Verify the product and source is listed on the Liquid Membrane Curing Compound list of the QPL-HC Concrete Curing Agents.
- Uniformly spray the pavement with white-pigmented curing compound immediately after texturing operations and before the concrete sets. If the pavement is initially cured with cotton/burlap mats, apply the curing compound within 30 min after removing the moistened mats.
- Avoid applying the curing compound during rain.
- Ensure the compound is thoroughly mixed and the pigment is uniformly dispersed.
- Use a mechanical sprayer, as specified in Section 414.03.H of the Standard Specifications to apply the curing compound. The equipment must be fully atomizing (applies a fine mist) and equipped with a tank agitator that will keep the curing compound mixed. The application rate must be verified based on the tank capacity of the spraying equipment. Pressure tank hand sprayers must be used to apply the curing membrane to vertical surfaces, irregular areas, or edges after form removal.
- Apply the curing compound immediately after texturing operations at a minimum rate of 1 gal per 200 ft^2. If the temperature on the roadway is more than 100 °F, apply the curing compound at a minimum rate of 1 gal per 150 ft^2.
- For bonded concrete overlays, apply the curing compound immediately after texturing operations at a minimum rate of 1 gal per 100 ft^2.
- Hand spraying irregular widths, shapes, and surfaces exposed by removed forms will be allowed. Apply curing compound to the sides of the slabs upon removing the side forms.
- Ensure the curing compound is not applied to the inside faces of construction joints as it will act as a bond breaker.
- Ensure the curing compound creates a film that will harden within 4 hr of application.

- Use additional curing compound to repair damage to the membrane that occurs during the curing period.

Figure 414:5 illustrates a uniformly applied spray on the pavement with white-pigmented curing compound immediately after texturing operations. Ensure the curing compound is free of streaks and thinly applied areas.

Figure 414:5. Photo. Uniformly applied curing compound

(c) White Polyethylene Sheeting

When the Contractor chooses to use the white polyethylene sheeting method for curing, ensure their work complies with the following requirements listed in Section 414.04.J(3) of the Standard Specifications:

- Cover the surface and sides of the pavement with polyethylene sheeting.
- Use sheeting long enough or wide enough to extend beyond the edges of the slab by at least twice the thickness of the pavement.
- Overlap adjacent sheeting units at least 18 in.
- Secure the sheeting to keep it in contact with the surface.
- Ensure the sheeting remains in place for 72 hr after concrete placement, unless otherwise required by the Contract or directed by the Resident Engineer. If the mats are removed prior to the 72 hr requirement, ensure the Contractor applies a subsequent impervious membrane cure within 30 min of the mat removal.

In accordance with Section 701.07.D of the Standard Specifications, the Contractor must provide sheet materials that comply with ASTM C171 requirements. The Department will not allow the use of sheet sections that have lost its moisture retaining ability.

(d) Curing for Cold Weather

The Contractor is required to maintain the quality and strength of the concrete during cold weather placement. If the Contractor proceeds with placement of the PCC pavement during cold weather periods, they must take the necessary precautions to protect the freshly placed PC concrete; such as covering it with a combination of white polyethylene sheeting and burlap/cotton blankets. Any frost-damaged concrete must be replaced at no additional cost to the Department.

10. Miscellaneous Requirements after Placement of Concrete

There are multiple actions that are required by the Contractor once the PCC pavement has been placed, consolidated, finished, textured and cured. Ensure the Contractor complies with the following requirements listed in Sections 414.04.K through 414.04.O of the Standard Specifications:

(a) Removing Forms

The Contractor must avoid damaging the pavement while removing forms. Identify any voids or honeycombed areas and ensure the Contractor repairs them with grout in a manner approved by the Resident Engineer. The sides of the slab that are exposed after the form removal must be cured with impervious membrane.

(b) Sawing and Sealing Joints

Maintaining proper sawing and sealing of the PCC pavement is critical to its longevity. Water intrusion into the joint from a pavement's surface can cause distress in the PCC pavement especially during freeze/thaw cycles. Additionally, an unsealed joint is susceptible to intrusion of incompressibles (small aggregate or other debris) into the joint. The joint taking on water and incompressibles can lead to spalling, base or subgrade softening, dowel bar corrosion, and pavement joint blow-ups.

Joints must be installed of the type, dimensions, and locations shown on the Plans. Project plans typically include Joint Layout sheets for PCC pavement projects that will provide information regarding the general layout of the joints on the project. Additional details regarding dimensions and various types of joints may be found in ODOT Standard Drawing LECS-5.

Ensure the sawed joints are straight and true to line. The Contractor must repair joints that are not straight or meet the required dimensions. The sawed joints must be sealed in accordance with Section 415.04 of the Standard Specifications.

(c) Protection of Pavement

It is the Contractor's responsibility to protect the PCC pavement surface from rain. The Contractor must be prepared to take the necessary precautions to protect the freshly placed PC concrete in case of an unanticipated rain; such as covering it with a combination of white polyethylene sheeting and burlap/cotton blankets. The Contractor is required to repair or replace damage to the PCC pavement due to rain, at no additional cost to the Department.

It is the Contractor's responsibility to protect the PCC pavement from damage due to any traffic. If damage occurs to the pavement before the area is open to traffic, the Contractor must repair or replace the damaged sections at no additional cost to the Department. It is their responsibility to seek reimbursement from any known vehicle owner or insurance carrier.

(d) Opening PCC Pavement to Traffic

Do not allow traffic on the pavement for at least 14 days after concrete placement, unless otherwise approved by the Resident Engineer. The Resident Engineer may approve opening the pavement to traffic when it reaches the minimum compressive strength requirement of 3,000 psi.

With the approval of the Resident Engineer, the Contractor may use maturity meters for the basis of form removal or opening roadways to traffic, at no additional cost to the Department. The Contractor must submit a plan for the use of maturity meters for approval. The Resident Engineer may contact the ODOT Materials Division for assistance when reviewing the maturity meter proposal.

11. Tolerances

The Contractor must construct a finished pavement surface as shown on the Plans and in accordance with Section 401.04.A(1), "Surface Elevation and Smoothness." The surface elevations for new pavement construction and overlays must be within 1/2 in of the elevations shown on the Plans. Ensure the surface smoothness is within 1/8 inch in 10 ft. Test for surface smoothness by placing a straightedge between two contacts on the finished surface and measuring the distance from the surface to the straightedge.

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and

pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

Ensure the finished pavement structure is constructed in conformance to the widths and thicknesses shown on the Plans or directed by the Resident Engineer. If the planned width is not being achieved, stop the operation and correct the problems creating the incorrect dimension before resuming the paving operation.

(a) Thickness of PCC Pavement

It is the Contractor's responsibility to perform coring of the completed PCC pavement to determine the thickness. The coring must be after any grinding operations are completed to correct bumps identified from using a 10' straightedge or from measuring the pavement in accordance with the smoothness special provision. Cores will be taken at random sampling locations as directed by the Resident Engineer. The residency project inspector must be present during the coring operation to verify the locations and thickness measurements obtained at each location. The core diameter size shall be at the discretion of the Resident Engineer unless used for testing for compressive strength.

Using a tape measure, take the average of a minimum of two measurements 90 degrees apart from the ends of each core to account for any inconsistencies with symmetry in the core. The average of the measurements of three cores will be used to determine the thickness of the pavement used to represent each 2,500 sy^2 lot in accordance with Section 414.04.R of the Standard Specifications. Deficient thickness will be accepted in accordance with the pay adjustments calculated for the Combined Pay Factor for each 2,500 sy^2 lot in accordance with Section 414.04.R of the Standard Specifications. If the core is to be used for compressive strength testing for acceptance, it shall be sampled and tested in accordance with AASHTO T 24/T24M and shall be a minimum diameter of 3".

12. Acceptance of Pavement

While the Contractor shall be fully and exclusively responsible for producing an acceptable product, acceptance responsibility rests with the Resident Engineer.

Determination of acceptability and pay factors for gradation, air content, strength, and thickness will be made in accordance with Table 414:2, "Acceptance Schedule" from Section 414.04.R of the Standard Specifications. The pay adjustments for the characteristics will be based on the following equations:

$$CPF = \frac{4(S+T)+G+AC}{10}$$

$$PA = (CPF - 1)(Q_C \times CUP_C + Q_P \times CUP_P)$$

Where:

CPF = Combined pay factor,

S = Pay factor for strength,

T = Pay factor for thickness,

G = Pay factor for gradation,

AC = Pay factor for air content,

PA = Pay adjustment,

Q_C = Cubic yards of concrete in a 2,500 yd² lot (partial lots prorated),

CUP_C = Contract unit price of concrete only ($/yd³),

Q_P = Square yards of concrete in a 2,500 yd² lot (partial lots prorated), and

CUP_P = Contract unit price of concrete placement ($/yd²).

Note: CUP_C and Q_C include only the concrete material. CUP_P and Q_P include all other labor and materials required in the concrete pavement (reinforcing steel, dowels, curing compound, etc.).

The Engineer will use Table 414:2 from Section 414.04.R of the Standard Specifications for determining the pay factor for each characteristic in each 2,500 yd² lot and calculating the combined pay factors for each lot for the acceptance of the PCC pavement.

Table 414:2 Acceptance Schedule		
Characteristics	**1 Test**	**Pay Factor [a]**
Gradation [c] – Deviation from the target (without regard to signs):		
Coarse or fine aggregates % passing No. 200 sieve Target Spec. Range, *%*	0	1
	0.01 0.60	$1 - 0.10x$
	0.61 – 1.80	$1.03 - 0.15x$
	> 1.80	Unacceptable [b]
Air content [c] – Deviation from the target (without regard to signs):		
Target = 6.0%	0 – 1.50	1
	1.51 – 3.00	$-0.10x^2 + 0.29x + 0.79$
	> 3.00	Unacceptable [b]
Strength [d] – Deviation from minimum strength of target (considering signs):		
Target = 3,000 psi	0 – 1,000 psi	Pay Factor = (Actual Strength/Specified Strength)
	> 1,000 psi	Unacceptable [b]
Thickness [e] – Deviation from minimum (considering signs) (English):		
% Deficient	0 – 2.0	1
	2.1 – 4.0	$1.10 - 0.05(PD)$
	4.1 – 6.0	$1.30 - 0.10(PD)$
	6.1 – 8.0	$1.60 - 0.15(PD)$
	> 8.0	Unacceptable [b]

[a] Where *x* is the Average of Deviations and *PD* is Percent Deficient.

[b] Unless otherwise directed by the Engineer, products testing in this range are unacceptable and shall be removed and replaced at no additional cost to the Department.

[c] Gradation and air content – 1 specimen and 1 test for each characteristic per sublot.

[d] Strength – 3 cylinders per lot averaged and considered as 1 test in Table 414:2.

[e] Thickness – After grinding operations, determine the thickness of the pavement using the average of 3 cores at times and locations directed by the Engineer.

(a) Pay Factor Determination and Acceptance Procedures

Once a lot has been defined, maintain its identity throughout the mixing and placement process. The Department will use pay factors, determined from random sampling and testing of a lot at the appropriate locations, in computing its pay adjustment.

Pay adjustments will be based on the individual pay factors shown in Table 414:2 on a lot to lot basis for each characteristic. A lot will normally be defined as 2,500 yd^2. The Resident Engineer may terminate a lot and designate a new one if the Contractor makes adjustments to the material or production and placement procedures. Lots may also be terminated when the paving operation is paused between phases. In instances when a lot is terminated prior to reaching 2,500 yd^2 placed, the remaining balance of yd^2 will be added to the previous 2,500 yd^2 lot or may be considered as its own lot. Typically, if the remaining balance of yd^2 is less than 1,250 yd^2, it would be added to the previous 2,500 yd^2 lot.

The Resident Engineer may make an interim adjustment assuming pay factors of 1.00 for the then unknown characteristics (such as thickness which is typically taken upon completion of the paving operation) and will correct later when testing is complete. The total adjustment in pay for the four characteristics (gradation, air content, strength, and thickness) in the Table 414:2 will be the sum of the pay adjustments on individual lots.

The Department will use random samples to test concrete and will test for all test characteristics except smoothness on a lot to lot basis. Determination of acceptability and pay adjustments for smoothness (when the smoothness special provision is included in the contract), will be covered by separate specifications and calculation procedures for smoothness pay adjustments.

The Resident Engineer may reject any load of mixture that is visually unacceptable for reasons of being too wet, excessively segregated, or otherwise obviously deficient. Furthermore, the Department will extensively test sections of completed pavement that appear to be seriously inadequate based on visual observation or knowledge of other deficiencies. The Department will not use the results of such tests for pay adjustment purposes, but will use them to determine whether the section is totally unacceptable and must be removed. The Resident Engineer may reject pavement slabs with unsound concrete, uncontrolled cracking, malfunctioning sawed joints, spalling, honeycombing, surface irregularities, insufficient thickness, or other deficiencies associated with poor quality pavements. Any rejected pavement slabs must be removed and replaced in a manner approved by the Resident Engineer at no additional cost to the Department.

(b) Thickness Measurement Determination

It is the Contractor's responsibility to perform coring of the completed PCC pavement to determine the thickness. Cores will be taken at random sampling locations as directed by the Resident Engineer. The residency project inspector must be present during the coring operation to verify the locations and thickness measurements obtained at each location.

To determine the average thickness for a lot, the Department will only consider the minimum thickness plus 2 percent for core thicknesses greater than 2 percent thicker than the minimum thickness (e.g. if the minimum thickness shown on the Plans equals 10 in, the Department will only consider 10.2 in for the average thickness determination for a core thickness of 10.3 in).

The Department will not include in its average thickness determination measurements that are more than 8 percent thinner than the minimum thickness shown on the Plans, or the measurements from exploratory cores. If the measurement of any core is thinner than the minimum thickness shown on the Plans by 8 percent or more, take exploratory cores at intervals of at least 10 ft, parallel to the centerline until the Department finds a core that is less than 8 percent thinner than the minimum thickness.

The Contractor must fill core holes with concrete or alternate non-shrink grout material as approved by the Resident Engineer.

(c) Application of Pay Adjustments on Progressive Estimates

Pay adjustment deductions that are calculated in accordance with the Contract should be documented on progressive estimates in SiteManager using a Line Item Adjustment tied to the appropriate PCC pavement pay item in the Contract. This would include PCC pavement pay adjustment deductions for gradation, air content, compressive strength and thickness characteristics as determined using the CPF formula. The appropriate Line Item Adjustment in SiteManager would be:

- PCCP Deduction as per Sec. 414.

Smoothness pay adjustment deductions that are calculated in accordance with the Contract should be documented on progressive estimates in SiteManager using a Contract Adjustment. The appropriate Contract Adjustment in SiteManager would be:

- Smoothness Adjustment.

Any other deductions applied for gradation, random cracking, poor tined texture or any other characteristic that does not meet the specification requirements that are not specifically prescribed in the Contract, must be documented by change order. To apply a deduction on the progressive estimate in a timely manner for a situation that requires a change order, use a Line Item Adjustment tied to the appropriate PCC pavement pay item in the Contract. Once the change order for the deduction is approved, the progressive estimate must reflect the pay adjustment charged to the new line item from the change order and the line item adjustments must be removed. The appropriate Line Item Adjustment in SiteManager would be:

- SUBSTANDARD ITEM.

All deductions should be communicated to the Contractor and applied on a progressive estimate in a timely manner. Any incentive earned by the Contractor for exceptionally smooth pavement, must be documented by change order.

(d) Unacceptable or Rejected Work

Any rejected pavement slabs must be removed and replaced in a manner approved by the Resident Engineer at no additional cost to the Department. The Resident Engineer may reject pavement slabs with pour quality materials or workmanship or for having a Characteristic with an unacceptable pay factor as designated in Table 414:2 from Section 414.04.R of the Standard Specifications (i.e., average thickness determination measurements that are more than 8 percent thinner than the minimum thickness shown on the Plans).

When replacing rejected slabs, the Contractor must remove a width of at least one lane and a length of at least one 15 ft concrete panel. If the removal is within 15 ft of any transverse joint, remove the slab to the joint. If a deficient unit does not warrant removal, as directed by the Resident Engineer, the Department will not pay for the deficient unit.

D. Safety and Environmental Considerations

For storage of aggregates in a staging area near the project, stockpiling and handling of materials must comply with Section 106.08 of the Standard Specifications. Additionally in Section 106.08, at the Contractor's request, the Department may allow the use of approved portions of the right-of-way for storing materials and staging their equipment. As part of the request for use of the site, the Contractor must provide the Resident Engineer with written documentation of the location of the proposed site, access and egress points, a proposed erosion control plan, a proposed traffic control plan, and any other information required by the Resident Engineer relevant to use of the site for materials and equipment storage. For controlled access facilities, the approval from the Resident Engineer is subject to the approval of FHWA, prior to altering, severing, or removing any right-of-way fences. Prior written permission of the owner or lessee is required for the use of private property and copies of such written permission must be provided upon request to the Resident Engineer.

If the Contractor stockpiles aggregate, operates a crusher, mixer or portable plant, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases.

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and PCC pavement from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, concrete truck washout, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Type and quantities of PCC Pavement placed (dowel jointed, CRCP, patching, terminal joint, etc.).
- Locations (station extents, direction, lane, etc.), thickness and length & width of area of PCC Pavement placed.
- Fresh concrete test results (slump, air content, mix temperature, etc.). [Document in Template C94025]
- Gallons and type of curing compound placed and resulting application rate.
- Receipt of load tickets (electronic tickets) of PC concrete and quantity placed.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

PCC pavement is paid for as a combination of two pay items in the Contract. There is a "Placement" pay item that is measured and paid by the square yard (SY) and a pay item to pay for the cubic yards (CY) of PC Concrete required for the pavement. The Department considers the cost of coring and filling core holes taken for thickness verification to be included in the contract unit price for the relevant PCC pavement pay items.

The Contractor must include the cost of placing concrete pavements, including relevant labor and material (except the PCC), and the cost of reinforcing steel, load transfer devices, joint fillers, and joint sealants in the contract unit price for the relevant "Placement" pay items. The various "Placement" pay items paid by the SY that are used to designate the type of PCC pavement being used on a project include:

- P.C. Concrete Pavement (Placement) – This pay item is used for undoweled plain jointed PCC pavement.
- Dowel Jointed P.C. Concrete Pavement (Placement)
- Continuously Reinforced P.C.C. Pavement (Placement)
- Bonded P.C.C. Overlay (Placement)
- Full Depth P.C.C. Patch (Placement)
- Partial Depth P.C.C. Patch (Placement)

The Contractor must include the cost of the PC concrete used in PCC pavements in the CY pay item in the Contract. The Department will not pay additional cost for substitutions of high early-strength concrete for standard PC concrete. The pay item used to pay for the CY of PC Concrete required for the pavement is:

- P.C. Concrete for Pavement

Other pay items included in Section 414 of the Standard Specification include an item for use at railroad crossings and terminal joints used in continuously reinforced PCC Pavements. The Contractor must include the cost of all labor, concrete, reinforcing steel, load transfer devices, joint fillers, and joint sealants in the contract unit price for the relevant pay items. The pay items for use at railroad crossings and terminal joints are as follows:

- P.C. Railroad Approach Slabs – SY
- Terminal Joint – Each
- Terminal Joint Sleeper Slab – SY

In accordance with Sections 414.05 of the Standard Specifications, the residency will measure the relevant PCC pavement pay items as follows:

- PCC placement, of the type shown on the Plans, will be measured by the area (SY) of accepted and complete-in-place pavement.
- The volume of PC concrete used for new pavement construction (except for detours and crossovers), will be measured by the CY based on the actual length paved multiplied by the actual width and the theoretical thickness shown on the Plans. The width for measurement will be the width from outside to outside of the completed pavement (when integral curb is used, the measurement will be to the back of the curb).
- The volume of PCC used for overlaying existing pavement, bonded or unbonded, will be measured by the CY using the concrete batch ticket count, or other documentation approved by the Resident Engineer.
- Detours and crossovers will be measured and paid for as shown on the Plans.

In accordance with Section 414.04.R of the Standard Specifications, the Resident Engineer will consider the test results of the gradation, air content, compressive

strength and thickness characteristics to determine acceptance and payment for the PCC pavement placed. All pay adjustments for the PCC pavement characteristics will be based on the individual pay factors shown in Table 414:2, "Acceptance Schedule" and the calculated Combined Pay Factor (CPF) as required in Section 414.04.R of the Standard Specifications. Pay adjustments for the PCC pavement characteristics will be calculated and applied on a lot by lot basis. Pay adjustment deductions can be applied by Line Item Adjustment in SiteManager or by change order. The calculations for these deductions will be placed in a Book, Folder or Envelope, or as an attachment to the change order.

(a) Square Yard Unit of Measure Pay Items

Documentation of these Square Yard items will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate item from the list of contract pay items.
2. In the appropriate fields, enter both a descriptive location and the station-to-station extents.
3. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

(b) Cubic Yard Unit of Measure Pay Items

Documentation of these Square Yard items will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate item from the list of contract pay items.
2. In the appropriate fields, enter both a descriptive location and the station-to-station extents.
3. In the Placed Quantity field, enter the calculated quantity (CY) of the item completed.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

5. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

(c) Each Unit of Measure Pay Items

A partial payment of an "Each" pay item is not acceptable. Any partial payment for an "Each" pay item must be made by change order.

Documentation of these items will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate item from the list of contract pay items.
2. In the appropriate fields, enter both a descriptive location and the station location for each item.
3. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
4. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

414.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials and concrete mix designs which were submitted by the Contractor were utilized on the project. If the previously accepted sources of materials and components of the PC concrete indicated on the mix designs which were submitted by the Contractor were not utilized on the project are not on the QPL or Approved Sources list, contact Materials Division to confirm the status of source/product approvals. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as additional sampling/testing of materials, removing & replacing work, accepting work at a reduced price, etc.

The Contractor must provide a Buy America certification in accordance with Section 106.01.B of the Standard Specifications including all required forms and mill test reports as specified. The Resident Engineer will be responsible for withholding payment for the work until compliance has been determined.

Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the

material being produced, size and frequency of placements, or concern with visual appearance or characteristics of the material.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

When your contract includes the smoothness special provision (SP430-2QA "Pavement and Bridge Deck Smoothness"), follow those requirements for testing, evaluation, correction and pay adjustments. For smoothness, pay factors will be applied on an extent by extent basis and applied separately from the adjustments for mix properties. Pay adjustment deductions can be applied by Contract Adjustment in SiteManager. Pay adjustment incentives will require a change order for payment. The calculations for these adjustments will be placed in a Book, Folder or Envelope, or as an attachment to the change order.

Ensure that pay adjustments for gradation, air content, compressive strength and thickness characteristics and smoothness (if applicable) were calculated and applied on the progressive estimate by Line Item Adjustment, Contract Adjustment or Change Order as necessary.

Ensure the volume (CY) of PC concrete measured for new pavement construction (except for detours and crossovers), was calculated based on the actual length paved multiplied by the actual width and the theoretical thickness shown on the Plans. Ensure the volume (CY) of PC concrete measured for overlaying existing pavement, bonded or unbonded, was calculated based on the concrete batch ticket count, or other documentation approved by the Resident Engineer.

C. Protection of the Work

Check that the PCC pavement is satisfactorily maintained until the project is completed and any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

Ensure that all rejected pavement slabs are removed and replaced in a manner approved by the Resident Engineer. The Resident Engineer may reject pavement slabs with pour quality materials or workmanship, damage due to any traffic or weather conditions, or for having a Characteristic with an unacceptable pay factor as designated in Table 414:2 from Section 414.04.R of the Standard Specifications (i.e., average thickness determination measurements that are more than 8 percent thinner than the minimum thickness shown on the Plans).

Do not allow traffic on the pavement for at least 14 days after concrete placement, unless otherwise approved by the Resident Engineer. The Resident Engineer may approve opening the pavement to traffic when it reaches the minimum compressive strength requirement of 3,000 psi.

414 CHECKLIST – PORTLAND CEMENT CONCRETE PAVEMENT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the necessary types of PCC pavement (dowel jointed, CRCP, bonded/unbonded, etc.) required in the Plans been identified?					
Have the proposed mix designs for the PC concrete been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Does the proposed concrete mix design include all the information required in Section 701.01.C?					
Has the proposed concrete batch plant for the production of the PC concrete been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Does the residency need to perform a concrete plant inspection due to the use of a portable batch plant or the plant not having a current certification?					
Have the proposed sources of materials (dowels, steel, curing compound, etc.) been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Contractor provided proper material certifications, forms and mill test reports including the Buy America letters from the Contractor and subcontractors for the steel products?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix designs and concrete batch plant?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the various sources of materials including the ingredients in the PC concrete mix design?					
Has the Contractor submitted the equipment list for the proper construction of the PCC pavement?					

Have the maximum surface temperature (110 °F) requirements stated in the Standard Specifications been discussed with the Contractor?					
Have the acceptable concrete mix temperature ranges (50-90 °F) for the mixed concrete been discussed?					
Have the surface preparation requirements specific to the type of PCC pavement being used been discussed?					
Does the Contractor have a plan to coordinate the number of concrete trucks, speed of the paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Has the type of texture (longitudinal or transverse tining) to be used on the PCC pavement been discussed?					
Have the requirements for proper curing of PCC pavement been discussed with the Contractor?					
Does the Contractor have a plan for maintenance of traffic and protection of the PCC pavement during its construction?					
Are there special provisions included in the contract for PCC pavement that need to be discussed with the Contractor? Such as smoothness, optimized gradation, etc.					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proposed mix designs for the PC concrete been submitted by the Contractor and accepted by the Resident Engineer?					
Does the proposed concrete batch plant for the production of the PC concrete have a current certification?					
Did the residency perform a concrete plant inspection due to the use of a portable batch plant or the plant not having a current certification?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proposed sources of materials (dowels, steel, curing compound, etc.) been submitted by the Contractor and accepted by the Resident Engineer?					
Has the Contractor submitted Buy America certifications including all required forms, mill test reports and letters as specified prior to installing steel products?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix designs and concrete batch plant?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the various sources of materials including the ingredients in the PC concrete mix design?					
Is the Contractor using the mix design, concrete plant and sources of materials that has been accepted by the Resident Engineer?					
Have all of the FAST Guide requirements for sampling coarse/fine aggregates at the concrete plant and documenting products on the QPL in SiteManager been performed by the residency?					
Does the Contractor's equipment (paver, finishing machine, mechanical tining machine, etc.) meet the specification requirements for the proper construction of the PCC pavement?					
Is the surface temperature where concrete is being placed below 110 °F as required in the Standard Specifications?					
Is the PC concrete mix being delivered within acceptable temperature ranges (50-90 °F)?					
Are the surface preparation requirements specific to the type of PCC pavement (bonded/unbonded) being achieved by the Contractor?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor lay out transverse joint locations to ensure transverse tining is not placed within 1" of the joint?					
Do dowel bars have a shop-applied epoxy coating and a field applied form release agent immediately before paving in accordance with Std. LTU-5?					
Are dowel baskets rigid and being sufficiently secured to ensure they do not move during concrete placement?					
Has the Contractor laid out isolation/expansion joints as required in the Plans?					
Is the Contractor effectively coordinating the number of concrete trucks, speed of the paver and plant production rate to ensure a continuous paving operation free of stopping and restarting?					
Have all of the FAST Guide requirements for sampling & testing the fresh concrete mix and documenting results in SiteManager been performed by the residency?					
Is the concrete being properly consolidated with special attention to vibrating at joints and around dowel baskets?					
Is the Contractor placing the PCC pavement to the width and thickness specified on the Plans?					
Is the Contractor finishing the PCC pavement without adding water to the surface and with minimal hand finishing?					
Is the Contractor effectively using a 10' straightedge to test the smoothness of the concrete surface while the concrete is still plastic and after floating?					
Is the Contractor using fabric texturing equipment to apply a texture drag before the final tining to produce a uniform surface of gritty texture?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the texture (longitudinal or transverse tining) being installed on the PCC pavement with texturing machine that is a vibrating roller or a comb, equipped with steel tines?					
Do the grooves (longitudinal or transverse tining) being installed on the PCC pavement meet the dimensions and pattern required on Std. LECS-5?					
Is the Contractor providing proper curing of PCC pavement in a timely manner (within 30 minutes)?					
Is the Type 2 white-pigmented curing compound being applied uniformly at the required application rate?					
Is the Contractor maintaining traffic and protecting the PCC pavement from traffic during its construction?					
Is the Contractor performing the sawing to the required depth in a timely manner to keep random cracking from occurring?					
Does the contract include the smoothness special provision that requires smoothness testing by the Contractor?					
Is the Contractor waiting at least 14 days to open the PCC pavement to traffic? Or has the Resident Engineer approved the opening to traffic once the compressive strength reaches 3,000 psi?					
Have 2,500 sy lots been defined and are all of the tests for the characteristics (slump, air, gradation and thickness) required to calculate the pay factors being obtained?					
Has the Resident Engineer provided the locations for thickness cores to the Contractor?					
Has the Resident Engineer rejected any section of completed PCC pavement that will require removal and replacement?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor use the products and sources of materials reviewed/accepted by the Resident Engineer?					
Was payment for the work withheld until all required Buy America certifications for the steel products were approved by Materials Division?					
Has the Contractor taken adequate precautions to protect the completed PCC pavement from damage?					
Has the Contractor maintained the curing compound as required?					
Has the Contractor obtained cores in the presence of the residency project inspector at the locations provided by the Resident Engineer to obtain thickness measurements?					
Did the Contractor perform the sawing to the required depth in a timely manner to eliminate any random cracking?					
Is the Contractor sawing and sealing joints as required?					
Were any conditions or rejected pavement slabs requiring corrective action or maintenance addressed sufficiently by the Contractor?					
Was the fresh PC concrete mix sampled at the frequency required in the FAST Guide for acceptance testing and documented in SiteManager?					
Was the CY of PC concrete measured for new pavement construction calculated based on the actual length paved multiplied by the actual width and the theoretical thickness shown on the Plans?					
Was the CY of PC concrete measured for overlaying existing pavement, bonded or unbonded, calculated based on the concrete batch ticket count?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Were pay adjustments of the PCC pavement calculated and applied in accordance with Section 414.04.R?					
Have the requirements for testing, evaluation, correction and pay adjustments been done in accordance with the smoothness special provision?					

SECTION 415 – CONCRETE JOINT SEALING

415.01 GENERAL

This work consists of sawing, cleaning, and sealing joints in existing portland cement concrete pavement. Information contained in the section regarding joint sealing is referenced in other sections throughout the ODOT Standard Specifications, especially Section 414.

415.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Locations to perform the concrete joint sealing required in the Plans.
- Proposed sources of material and material requirements.
- Review special provisions, plan notes and ODOT Standard Drawings included in the Contract for PCC pavement joint sealing pay items (i.e., joint sealer and filler material requirements, etc.).
- Methods and equipment to be used.
- Will a representative of the joint sealer/filler manufacturer be required on the job site at the beginning of the joint-sealing operation.
- Weather limitations for construction.
- Joint preparation requirements prior to and during construction.
- Contractor's schedule/plan for the work. Sealing must be completed on the same day as the preparation/cleaning of the joints.
- Traffic control during construction and opening PCC pavement to traffic.

B. Acceptance of Materials

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources of materials are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the concrete joint sealing pay item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

1. Sources of Materials

The Residency will verify that the proposed source of materials for the joint fillers and sealers submitted by the Contractor is on the Materials Division Qualified Products List (QPL). Ensure the product name and manufacturer is shown on the

QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

C. Preparatory Work and Contractor Work Plans

Consider the following before PCC pavement construction operations begin.

1. Contract Plans and Specifications

Review the Plans, Standard Specifications, Special Provisions and Plan Notes and determine any special requirements for the concrete joint sealing pay item that are required.

2. Weather Limitations and Surface Preparation

Review the weather limitation and joint preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum temperature and weather conditions required to proceed with the installation of the concrete joint sealing material. The joint must be dry and the temperature of the joint must be above 40 °F to proceed with the placement concrete joint sealing material. There are stringent joint preparation requirements including sandblasting to ensure no contamination of the joint prior to application of the joint filler or sealer.

D. Safety and Environmental Issues

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and PCC pavement joint sealing from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, debris from joint sawing & sealing, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

415.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources of materials are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the concrete joint sealing pay item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted and accepted mix designs, plants and sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

1. Sources of Materials

The Residency will verify that the proposed source of materials for the joint fillers and sealers submitted by the Contractor is on the Materials Division Qualified Products List (QPL). Ensure the product name and manufacturer is shown on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Verify the Joint Sealer used on the PCC pavement is listed on the QPL-Joint Fillers & Sealers. [Document in Template AM5001]

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of Section 415.03 of the Standard Specifications. Review any special provisions and plan notes that pertain to the concrete joint sealing pay item.

1. Joint Sawing and Sealing Equipment

(a) Concrete Saw

The Contractor must provide conventional wet cut type concrete saws capable of sawing concrete joints to the dimensions shown on the Plans or in accordance with ODOT Standard Drawing LECS-5. Portable handheld saws are not allowed to be used.

(b) High-Pressure Water Pumping System

The Contractor must provide high-pressure water pumping systems capable of flushing concrete slurry from sawed joints.

(c) Sand Blasting Unit

The Contractor must provide compressed air sand blasting units capable of cleaning joint surfaces as specified. Ensure the units include traps to remove free water and oil from the compressed air.

(d) Air Compressor

The Contractor must provide air compressors capable of delivering compressed air with a pressure of at least 90 psi. Ensure the compressors include traps to remove free water and oil from the compressed air.

(e) Extrusion Pump

The Contractor must provide air-powered extrusion pumps to apply joint sealer. Ensure the pump output is capable of delivering the volume of the joint sealer to the joint as specified.

(f) Injection Tool

The Contractor must provide a mechanical injection device to insert the sealer into the joint.

(g) Joint Sealer Kettle

The Contractor must provide a double-bottom oil-bath indirect-flame type kettle if the joint sealant requires heating. Ensure the kettle is capable of mixing, heating, delivering, and maintaining the specified temperature.

C. Construction Operations

Maintaining proper sawing and sealing of the PCC pavement is critical to its longevity. Water intrusion into the joint from a pavement's surface can cause distress in the PCC pavement especially during freeze/thaw cycles. Additionally, an unsealed joint is susceptible to intrusion of incompressibles (small aggregate or other debris) into the joint. The joint taking on water and incompressibles can lead to spalling, base or subgrade softening, dowel bar corrosion, and pavement joint blow-ups.

Verify the following complies with Section 415.04 of the Standard Specifications when performing the concrete joint sealing operation:

1. Weather Limitations

Ensure that the Contractor is aware of the minimum temperature and weather conditions required to proceed with the installation of the concrete joint sealing material. Ensure the joint is dry and the temperature of the joint is above 40 °F before the Contractor proceeds with the placement of the concrete joint sealing material.

2. Sawing and Cleaning Joint Faces

Concrete joints must be sealed on the same day that they are cleaned. Ensure the Contractor does not proceed with cleaning of the concrete joints when the weather conditions or forecast would prevent the installation of the concrete joint sealing material.

(a) Sawing Joints

The Contractor must provide conventional wet cut type concrete saws capable of sawing concrete joints to the dimensions shown on the Plans or in accordance with ODOT Standard Drawing LECS-5. Portable handheld saws are not allowed to be used. The Contractor must produce joints of uniform width with cut faces on both sides along its full length.

(b) Flushing Joints

The Contractor must remove the slurry from the joint area after sawing by flushing it with a high-pressure water pumping system and other equipment as necessary.

(c) Cleaning Joint Faces

The sawed faces of the joints must be cleaned of foreign material before the Contractor installs the joint sealer or filler. Do not allow the Contractor to blow-dry the joints with compressed air or use portable hand saws to clean joint faces.

1. Sandblasting

   Ensure the Contractor complies with the following requirements for sandblasting the concrete joint listed in Section 415.04.C(2) of the Standard Specifications:

   - Sandblast joint faces after they dry.
   - Attach the sandblaster nozzle to a mechanical aiming device to direct the sandblast at a 45° angle and maintain sandblasting at less than 2 in from the joint faces.
   - Blow out the joints after sandblasting using filtered (oil and moisture free) compressed air at least 90 psi and 120 ft^3/min.
   - Use a blow tube that fits into the joint.
   - Repeat the sandblasting and blowing until no residual dust or coating remains in the joint.

2. Joint Contamination

   Ensure the Contractor cleans the concrete joints of any contaminates (due to traffic or weather) before sealing joints.

3. Backer Rod

When indicated in the Plans or recommended by the sealant manufacturer, ensure the Contractor installs a backer rod before applying sealant. Backer rod of the type recommended by the joint sealant material manufacturer must be used. Install backer rod to the dimensions shown on the Plans or in accordance with ODOT Standard Drawing LECS-5.

Do not allow the Contractor to install backer rod until the joint has been properly sandblasted and cleaned and the Contractor is prepared to begin installation of the joint sealer material.

4. Sealing Joints

Concrete joints must be sealed on the same day that they are cleaned. If the Contractor cleans the concrete joints and weather conditions prevent the installation of the concrete joint sealing material, the cleaning operation must be repeated prior to installation of the joint sealer material.

(a) Approval of Joints for Sealing

The residency project inspector will examine concrete joints sawed, cleaned and prepared for sealing. Ensure the concrete joints are sawed at a uniform width with cut faces on both sides to the dimensions shown on the Plans or in accordance with ODOT Standard Drawing LECS-5. Ensure the slurry is removed from the joint area after sawing by flushing it with a high-pressure water pumping system and the joints and joint faces must be cleaned of

foreign material by sandblasting. Do not approve joints for sealing if the joints are contaminated or wet.

(b) Installation of Joint Sealers/Fillers – Manufacturer's Representative

To ensure the Contractor sufficiently prepares the concrete joints and uses proper equipment and methods to install the joint sealer/filler, the Resident Engineer may require that a representative of the joint sealer/filler manufacturer be on the job site at the beginning of the joint-sealing operation. The representative shall demonstrate the manufacturer's installation standards to help ensure a satisfactory performance of the Contractor and product. This is a requirement of Section 415.04.E(2) of the Standard Specifications, and the Contractor is obliged to comply when requested by the Resident Engineer.

(c) Application of Joint Sealers

Concrete joints must be sealed on the same day that they are cleaned. Ensure the Contractor does not proceed with cleaning of the concrete joints when the weather conditions or forecast would prevent the installation of the concrete joint sealing material. Ensure the joint is dry and the temperature of the joint is above 40 °F before the Contractor proceeds with the placement of the concrete joint sealing material.

The shape factor of the joint sealer along with the cleanliness of the joint faces are critical to obtain the desired bonding and function of sealed concrete joints. The joint shape factor is the final pressed shape of the silicone joint sealing material. The tooling operation will firmly press the freshly applied material intimately against the cut sides of the recess and the backer rod surfaces. The rounded shape of the top and bottom of the silicone as illustrated on ODOT Standard Drawing LECS-5, allows the sealant to properly flex and maintain adherence to the concrete joint faces. Self-leveling sealants will be installed flush with the pavement surface.

The Contractor must use an acceptable mechanical injection tool to Inject sealers into the concrete joint. Ensure that the sealers bond to the joint face surfaces. For surfaces of joint sealers that require tooling, use a mechanical device to make a concave surface from 1/4 in to 1/2 in below the pavement surface. The tooling must be completed before a skin develops on the surface of the sealer. Soap or oil cannot be used as a tooling aid, as it could contaminate the joint surface and cause debonding. Tooling is not required for self-leveling joint sealers.

5. Opening to Traffic and Correcting Bonding Failures

Ensure the freshly applied joint sealant is no longer sticky before allowing the Contractor to open the sealed pavement surface to traffic.

Verify all joint sealers/fillers are properly adhered to the concrete joint faces and are withstanding weather and traffic conditions. The Contractor must repair joint sealers/fillers that fail to bond to sawed concrete joint surfaces, at no additional cost to the Department.

D. Safety and Environmental Considerations

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and PCC pavement joint sealing from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, debris from joint sawing & sealing, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents, direction, lane, joint location, etc.) and quantities of concrete joint sealing performed.
- Note whether the joint sealing was performed on the same day as the sawing and cleaning and joint preparation was performed.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 415.05 of the Standard Specifications, the residency will measure the completed concrete joint sealing by the Linear Foot.

NOTE: In accordance with Section 414.06 of the Standard Specifications, the cost for the joint fillers/sealers used in PCC Pavement pay items will be included in the unit cost for the relevant "Placement" pay items in the Contract and will not be measured for payment under Section 415.

Documentation of the Concrete Joint Sealing pay item paid by the Linear Foot will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the Concrete Joint Sealing pay item from the list of contract pay items.

b. In the appropriate field, enter the station-to-station extents and a descriptive location.

c. In the Placed Quantity field, enter the measured quantity (LF) of the item completed.

d. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

415.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials which were submitted by the Contractor were utilized on the project. If the previously accepted sources of materials were not utilized on the project, ensure the substituted source is on the QPL. If the substituted source is not on the QPL, contact Materials Division to confirm the status of the source/product approval. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as removing & replacing work, accepting work at a reduced price, etc.

Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. Document the use of approved materials in SiteManager.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantity paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Do not allow traffic on the completed sealed concrete joints until the freshly applied joint sealant is no longer sticky.

Verify all joint sealers/fillers are properly adhered to the concrete joint faces and are withstanding weather and traffic conditions. The Contractor must repair joint sealers/fillers that fail to bond to sawed concrete joint surfaces, at no additional cost to the Department.

Verify any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

415 CHECKLIST – CONCRETE JOINT SEALING

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proposed products and sources of materials (joint sealer/filler, etc.) been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the proposed products and sources of materials?					
Is the Resident Engineer going to require a representative of the joint sealer/filler manufacturer be on the job site at the beginning of the joint sealing operation?					
Has the Contractor submitted the equipment list for the proper construction of the concrete joint sealer?					
Has the minimum temperature of the pavement joint (40 °F) requirement stated in the Standard Specifications been discussed with the Contractor?					
Has the requirement for joint sealing being completed on the same day as the preparation/cleaning of the joints been discussed?					
Does the Contractor have a plan for maintenance of traffic and protection of the joint sealing operation during its construction?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proposed products and sources of materials (joint sealer/filler, etc.) been submitted by the Contractor and reviewed/accepted by the Resident Engineer prior to the joint sealing operation?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the sources of materials?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have all of the FAST Guide requirements for documenting products on the QPL in SiteManager been performed by the residency?					
Has the Resident Engineer required a representative of the joint sealer/filler manufacturer be on the job site prior to beginning the joint sealing operation?					
Does the Contractor's equipment (saw, sandblasting unit, extrusion pump, etc.) meet the specification requirements for the proper concrete joint sealing operation? NOTE: Handheld saws are not allowed.					
Is the Contractor sawing concrete joints to the dimensions shown on Std. LECS-5 with cut faces on both sides of the joint?					
Is the Contractor completing joint sealing on the same day as the preparation/cleaning of the joints?					
Is the joint dry and has a surface temperature at least 40 °F prior to installing the joint sealer?					
Are the joint flushing/cleaning requirements, including sandblasting, being achieved by the Contractor?					
Has the backer rod been installed, and the joint sealer tooled to the shape required on Std. LECS-5?					
Is the Contractor maintaining traffic and protecting the joint sealing operation from traffic during its construction?					
Is the completed sealed concrete joints given enough time to cure and are no longer sticky prior to opening to traffic?					
Are all joint sealers properly adhered to the concrete joint faces and withstanding weather and traffic conditions?					
Has the Resident Engineer identified any section of completed concrete joint sealer that will require replacement?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the Contractor taken adequate precautions to protect the completed concrete joint sealant from damage?					
Has the residency personnel verified all joint sealers are properly adhered to the concrete joint faces and withstanding weather and traffic conditions?					
Have all conditions and locations requiring corrective action been successfully remedied to the satisfaction of the Resident Engineer?					
Did the Contractor use the products and sources of materials (joint sealer/filler, etc.) reviewed/accepted by the Resident Engineer for the joint sealing operation?					
Did the residency personnel perform all of the FAST Guide requirements for documenting products on the QPL in SiteManager?					

SECTION 416 – DOWEL BAR RETROFIT

416.01 GENERAL

This work consists of restoring load transfer in existing portland cement concrete (PCC) pavement by installing epoxy coated dowel bars across transverse joints or cracks.

416.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed sources of material and material requirements.
- Contractor's requirement to provide a Buy America certification and meet all associated documentation submittal requirements.
- Review special provisions, plan notes and ODOT Standard Drawings included in the Contract for PCC pavement dowel bar retrofit pay items (i.e., dowel bar size, mortar material requirements, etc.).
- Methods and equipment to be used.
- Weather limitations for construction.
- Joint slots preparation and patching requirements.
- Contractor's schedule/plan for the work.
- Traffic control during construction and opening PCC pavement to traffic.

B. Acceptance of Materials

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources of materials are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the dowel bar retrofit pay item.

The Residency will verify that the proposed source of materials submitted by the Contractor is on the Materials Division Qualified Products List (QPL). Ensure the product name and manufacturer is shown on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

Ensure the following materials meet the requirements of Section 416.02 of the Standard Specifications and are on the QPL:

1. Dowel Bars

The Contractor must provide epoxy-coated dowel bars in accordance with Section 723.08, "Epoxy Coated Reinforcement Bars" of the Standard Specifications with dimensions shown on the Plans or in accordance with ODOT Standard Drawing PCPR-4. Tight-fitting, nonmetallic end caps that allow the bar to move 1/4 in at each end must be provided.

The Contractor must provide a Buy America certification in accordance with Section 106.01.B of the Standard Specifications including all required forms and mill test reports as specified. Project specific certification letters from the Contractor and subcontractors demonstrating their understanding and intent to comply with the Buy America requirements should be submitted at the Preconstruction Conference and no later than work beginning on steel containing items. Installation of steel products should not begin until all required certification documentation, including the letters, have been submitted.

2. PC Concrete Patching Material & Curing Compound

The Contractor must provide PC concrete patching material to backfill retrofit slots in accordance with Section 701.16. PC concrete patching material must be mixed, placed, and cured in accordance with the manufacturer's recommendations. The PC concrete patching material may be extended by using aggregate in accordance with Section 701.05, "Fine Aggregate," and Section 701.06, "Coarse Aggregate," excluding the gradation requirements. The Contractor must use a PC concrete mix design for the patching material (including additives) that develops a compressive strength of at least 4,000 psi in 6 hr.

The Contractor must provide curing compound in accordance with Section 701.07, "Curing Agents."

C. Preparatory Work and Contractor Work Plans

Review the Plans, Standard Specifications, Special Provisions and Plan Notes and determine any special requirements for the concrete joint sealing pay item that are required.

Review the weather limitation and joint slots preparation and patching requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum temperature and weather conditions required to proceed with the installation of the concrete joint sealing material. The joint must be dry and the ambient temperature must be above 50 °F to proceed with the placement concrete patching material in the dowel bar slots.

D. Safety and Environmental Issues

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and PCC pavement dowel bar retrofit operation from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, debris from cutting and patching slots, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

416.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

The Contractor should submit its proposed sources of materials at the Preconstruction Meeting. If the sources of materials are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the dowel bar retrofit pay item.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials. Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

1. Contractor Proposed Mix Designs for Mortar Patching Material

Ensure the Contractor has submitted its proposed concrete mix designs in advance of any work beginning on the dowel bar retrofit pay item. The Residency will verify that the proposed sources of materials and products submitted by the Contractor for the ingredients on their concrete mix designs are on the ODOT Materials Division Qualified Products List (QPL) or Approved Rock, Stone, & Sand Sources lists. If a proposed source is not on the QPL or approved aggregate source list, contact Materials Division to confirm the status of the source/product approval.

The Resident Engineer will approve the concrete patching material mix design that includes a mortar mix that meets the property requirements in accordance with Section 701.16 of the Standard Specifications. A written response approving the mix designs must be sent to the Contractor and kept in the project file. As soon as practical, the Residency will obtain sufficient samples of aggregates to be utilized and perform applicable tests on these materials.

The Contractor must provide a mortar for retrofitting PCC pavements with dowel bars in accordance with Table 701:26 from Section 701.16 of the Standard Specifications. The mortar properties shown in Table 701:26 include compressive strength and various other properties that the mortar must obtain. Verify the dowel bar retrofit mortar product and source as indicated on the concrete mix design are listed on the QPL- Dowel Bar Retrofit Mortar.

In accordance with Section 701.16, the mortar mix will include an aggregate extender size number 8 from Table 701:12 from Section 701.06 of the Standard Specifications, to form the concrete patching material. The concrete patching material mix design (including additives) must develop a compressive strength of at least 4,000 psi in 6 hr.

2. Sources of Materials

The Residency will verify that the proposed source of materials for the dowel bar retrofit construction submitted by the Contractor is on the Materials Division Qualified Products List (QPL). Ensure the product name and manufacturer is shown on the QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

The Contractor must provide a Buy America certification in accordance with Section 106.01.B of the Standard Specifications including all required forms and mill test reports as specified. Project specific certification letters from the Contractor and subcontractors demonstrating their understanding and intent to comply with the Buy America requirements should be submitted at the Preconstruction Conference and no later than work beginning on steel containing items. Installation of steel products should not begin until all required certification documentation, including the letters, have been submitted.

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items.

The Residency must perform and document the following acceptance tests/procedures as applicable:

- Obtain a sample of the Fine Aggregate from the concrete batch plant and verify the gradations comply with Table 701:11 of the Standard Specifications. [Document in Template T27]
    - Verify the product and source is listed on the Approved Rock, Stone & Sand Sources list (HC Concrete Aggregate, Fine)
- Obtain a sample of the Coarse Aggregate from the concrete batch plant and verify the gradations comply with Table 701:12 of the Standard Specifications for size number 8 aggregate. [Document in Template T27]
    - Verify the product and source is listed on the Approved Rock, Stone & Sand Sources list (HC Concrete Aggregate, Coarse)
- Verify the Hydraulic Cements (Type I, Type II, etc.) product and source used in the PC concrete as indicated on the concrete mix design are listed on the QPL-Hydraulic Cements. [Document in Template AM5001]
- Verify the Dowel Bar Retrofit Mortar product and source as indicated on the concrete mix design are listed on the QPL- Dowel Bar Retrofit Mortar. [Document in Template AM5001]
- Verify the Dowel Bars and Dowel Bar Baskets used in the PCC pavement is listed on the QPL-Reinforcing Steel under the Dowel Bars and Baskets portion of the list. [Document in Template AM5001]
- Verify the Curing Agents used on the PCC pavement is listed on the QPL-HC Concrete Curing Agents. [Document in Template AM5001]

If any test results do not meet the specification requirements, notify the Contractor in a timely manner and discuss the manner in which the failing test result will be handled (i.e, resample/retest, remove & replace work, accept work at a reduced price, make adjustments to material being delivered, improve stockpiling methods, etc.).

During construction, verify that the previously submitted and accepted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work. The Residency may contact Materials Division to confirm the status of the source/product or mix design approval.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of Section 416.04 of the Standard Specifications. Review any special provisions and plan notes that pertain to the concrete joint sealing pay item.

1. Slot Sawing Equipment

The Contractor must use a gang saw capable of sawing at least three slots in the pavement at one time. It is critical that the dowel bars are perpendicular to the contraction joint in the PCC pavement or additional stresses may occur which will result in premature failure of the PC concrete slab. Ensure the vertical and horizontal alignment of the sawed slots do not exceed 1/4 in.

2. PC Concrete Removal Equipment

The Contractor must remove concrete from the slot area with a jackhammer no larger than the 30 lb class. If this jackhammer damages the pavement, discontinue its use and replace with a lighter jackhammer. It is the Contractor's responsibility to effectively remove the PC concrete from the slots without causing damage to the PCC pavement.

3. Sand Blasting Equipment

Before installing the dowel, exposed surfaces and cracks in the slots must be sandblasted. The Contractor must provide compressed air sand blasting units capable of surfaces of the slots. Ensure the units include traps to remove free water and oil from the compressed air.

C. Construction Operations

Load transfer between panels of plain jointed PCC pavement is critical to its longevity. Most performance problems with plain jointed PCC pavement are a result of poorly performing joints. Poor performance such as faulting, pumping and corner breaks may occur from joints with poor load transfer efficiency. All of these problems worsen when transverse construction joints deflect under traffic loads. The effectiveness of the load transfer devices can keep slabs in vertical alignment and minimize deflections in the concrete slab.

To successfully perform the dowel bar retrofit operation, it is critical that the Contractor have experience performing this type of work. A poorly installed dowel bar retrofit can result in poor performance of the PCC pavement such as faulting, pumping and corner breaks. Additionally, the slot patching material may deteriorate and crack prematurely and become dislodged by the traffic.

Verify the following complies with Section 416.04 of the Standard Specifications when constructing the PCC pavement:

1. Slot Sawing

The Contractor must use a gang saw capable of sawing at least three slots in the pavement at one time. It is critical that the dowel bars are perpendicular to the contraction joint in the PCC pavement or additional stresses may occur which will result in premature failure of the PC concrete slab. The slots must be centered over

the cracks and transverse joints, and the slots aligned so that the longitudinal axis of each dowel bar is parallel to the pavement centerline and the surface of the lower of the two panels. Ensure the vertical and horizontal alignment of the sawed slots do not exceed 1/4 in.

In accordance with ODOT Standard Drawing PCPR-4, unless otherwise shown in the Plans, the slots will be placed as follows:

- Three slots/bars per wheel path,
- Slots/bars will be placed 12” to 15” apart,
- Slots/bars must be at least 18” from the edge of the driving lane,
- Slots shall not be cut on top of any longitudinal crack/joint in the existing PCC pavement,
- Slot width will be between 2-1/2” to 4”, and
- Slot depth will be determined by the thickness of the PCC pavement and diameter of the dowel bar to enable the center of the dowel bar to be installed at the midpoint of the PCC pavement.

2. Concrete Removal and Sandblasting Slots

The Contractor must remove concrete from the slot area with a jackhammer no larger than the 30 lb class. If this jackhammer damages the pavement, discontinue its use and replace with a lighter jackhammer. It is the Contractor's responsibility to effectively remove the PC concrete from the slots without causing damage to the PCC pavement.

Before installing the dowel, the Contractor must sandblast all exposed slot surfaces and cracks in the slots, and clean slots of saw slurry and loose material. Poor slot surface preparation will likely result in the slot patching material deteriorating and cracking prematurely.

The Contractor must remove debris generated from cutting the slots before reopening the roadway to traffic. Ensure the Contractor adequately sweeps the roadway to remove all cuttings from the pavement surface and disposes of the waste material in a manner approved by the Resident Engineer.

3. Foam Core Board

The Contractor must place a 1/4" thick foam core board (in accordance with ODOT Standard Drawing PCPR-4) to maintain the continuity of the existing transverse joint or crack. The foam core board must be sized and shaped to fit tightly around the dowel bar and to the bottom and sides of the slots. All existing transverse joints and cracks must be caulked with an approved sealant at the bottom and sides of the slots, to prevent the concrete patching material from entering the joint or crack. Ensure the Contractor removes excess caulking to create a smooth, level joint or crack surface.

The foam core board must be installed in a manner that it remains in position and tight to all edges during patch material placement. The Contractor may use tabs to hold the foam core board in place and may cut or remove existing joint sealant to accommodate the tabs. If the foam core board shifts during the placement of concrete patching material, the Contractor must remove and replace the slot patching material and dowel bar in a manner approved by the Resident Engineer at no additional cost to the Department.

4. Dowel Bars, Caps and Chairs

Dowel bars with the diameter as shown in the Plans or as required on ODOT Standard Drawing PCPR-4, shall have a shop applied epoxy coating over their entire length. The ends of the dowel bars do not require epoxy coating. Tight-fitting, nonmetallic end caps that allow the bar to move 1/4 in at each end must be provided.

Nonmetallic dowel bar chairs are required to keep the dowel bars from moving during concrete placement. The dowel bar chairs must be placed at the locations shown on the Plans or in accordance with ODOT Standard Drawing PCPR-4, within the vertical and horizontal tolerances.

Dowel bars shall be completely coated in the field immediately before installation with a thin coat of form release oil. Do not allow oil to contaminate concrete surfaces to be overlaid or the surfaces of the slots.

The Contractor must place the dowel bar assembly (with chairs and foam core board attached) across the transverse joint or crack as specified. Ensure that chairs hold the dowel bars in place and provide at least 1/2 in clearance between the bottom of the dowel and the bottom of the slot. If the foam core board or dowel bars shift during the placement of concrete patching material, the Contractor must remove and replace the slot patching material and dowel bar in a manner approved by the Resident Engineer at no additional cost to the Department.

5. Protection of Existing PCC Pavement Surface

Ensure existing concrete surfaces in the slots are clean and dry, or prepared in accordance with the manufacturer recommendations. Remove excess water from the slots before placing the concrete patching material.

It is the Contractor's responsibility to effectively remove the PC concrete from the slots without causing damage to the PCC pavement. Any damage to the existing pavement caused by Contractor operations must be repaired in a manner approved by the Resident Engineer at no additional cost to the Department.

6. Concrete Patching Material Placement

The Resident Engineer will approve the concrete patching material mix design that includes a mortar mix that meets the property requirements in accordance with

Section 701.16 of the Standard Specifications. The Contractor must provide a mortar for retrofitting PCC pavements with dowel bars in accordance with Table 701:26 from Section 701.16 of the Standard Specifications.

In accordance with Section 701.16, the mortar mix will include an aggregate extender size number 8 from Table 701:12 from Section 701.06 of the Standard Specifications, to form the concrete patching material. The concrete patching material mix design (including additives) must develop a compressive strength of at least 4,000 psi in 6 hr.

When placing concrete patching material into the slot, the Contractor must vibrate the material to consolidate it and completely encase the dowel bar. The vibrator head's diameter shall not exceed 1-1/4 in. Obtain the Resident Engineer's approval before placing concrete in ambient temperatures below 50 °F.

7. Slot Surface Finish, Curing and Sawing

Once the concrete patching material has been placed into the slot, the Contractor must trowel-finish the top surface of the filled slot flush with the existing concrete surface. If the Contract requires diamond grinding, the top surface of the filled slot may be up to 1/4 in higher than the existing PCC pavement surface. If the Contract does not include diamond grinding, the top surface of the filled slot must be level with the existing PCC pavement surface. Regardless of subsequent diamond grinding, do not allow any slots to be underfilled below the existing PCC pavement surface.

The Contractor must apply curing compound before the final set of the mortar in the concrete patching material. Since the concrete patching material is rapid-setting, the curing compound should be applied within 30 min of its placement and finishing operation as referenced in Section 414.04.J of the Standard Specifications.

In accordance with Section 416.04.H of the Standard Specifications, the Contractor must sawcut the new joint within 24 hr, or as directed by the Resident Engineer. However, in accordance with ODOT Standard Drawing PCPR-4, the sawing at the contraction joint of between 3/16" to 5/16" wide must be made after the concrete patch material has set. Since the concrete patching material is rapid-setting, the sawing should be done as soon as possible to avoid damage to the slot patch. Any damage or cracking of the slot concrete patch must be repaired by the Contractor in a manner approved by the Resident Engineer at no additional cost to the Department.

8. Testing Concrete Patching Material

The concrete patching material must be tested once for each 4 hr of production, or at least once a day. Ensure the concrete patching material has a compressive strength of at least 4,000 psi in 6 hr. The Contractor may test for compressive strength up to 24 hr after making the cylinders. If the compressive strengths are not met, cease production, and resubmit a concrete patching material mix design

that meets the compressive strength of at least 4,000 psi in 6 hr requirement. Do not allow the opening lanes to traffic until the patch material achieves a compressive strength of at least 3,000 psi.

D. Safety and Environmental Considerations

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and PCC pavement dowel bar retrofit operation from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, debris from cutting and patching slots, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents, direction, lane, joint location, etc.) and quantities of dowel bar retrofit construction performed.
- Note when the joint sawing and opening to traffic was performed.
- Note compressive strength of concrete patching material at 6 hrs after its installation.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 416.06 of the Standard Specifications, the residency will measure the completed dowel bar retrofit by the Each.

In accordance with ODOT Standard Drawing PCPR-4, payment for the Dowel Bar Retrofit pay item shall only be made for dowels placed by the process of cutting a slot. Dowels placed by drilling and epoxying into the face of a joint, are included in the cost of Full Depth PC Concrete Patch or other relevant pay items in the Contract.

Documentation of the Dowel Bar Retrofit pay item paid by the Each will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the Dowel Bar Retrofit pay item from the list of contract pay items.

b. When documenting a quantity for progressive payment, enter either a descriptive location or the station-to-station extents, preferably both, in the appropriate fields.

c. In the Placed Quantity field, enter the quantity placed that day.

d. In the Remarks bubble enter the Book/Folder/Envelope # to provide the location of the documentation for the calculations (i.e., ticket audit spreadsheet, truck load tickets, etc.), or explain how the quantity was derived (i.e., number of bags multiplied by the weight per bag, certified truck load weight, etc.).

e. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

416.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials which were submitted by the Contractor were utilized on the project. If the previously accepted sources of materials were not utilized on the project, ensure the substituted source is on the QPL. If the substituted source is not on the QPL, contact Materials Division to confirm the status of the source/product approval. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as removing & replacing work, accepting work at a reduced price, etc.

The Contractor must provide a Buy America certification in accordance with Section 106.01.B of the Standard Specifications including all required forms and mill test reports as specified. The Resident Engineer will be responsible for withholding payment for the work until compliance has been determined.

Ensure the sampling and testing rates complied with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. Document the use of approved materials in SiteManager.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantity paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Do not allow traffic on the completed sealed concrete joints until the freshly applied joint sealant is no longer sticky.

Verify all joint sealers/fillers are properly adhered to the concrete joint faces and are withstanding weather and traffic conditions. The Contractor must repair joint sealers/fillers that fail to bond to sawed concrete joint surfaces, at no additional cost to the Department. Verify any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

416 CHECKLIST – DOWEL BAR RETROFIT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proposed products and sources of materials (dowel bars, curing compound, etc.) been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Contractor provided proper material certifications, forms and mill test reports including the Buy America letters from the Contractor and subcontractors for the steel products?					
Have the proposed mix designs for the concrete patching material and mortar been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the mix designs?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the various sources of materials including the ingredients in the concrete patching material mix design?					
Have the requirements for the dowel bars and associated components (diameter, epoxy coating, nonmetallic chairs, nonmetallic cap, foam core board, etc.) been discussed?					
Has the Contractor submitted the equipment list for the proper installation of the dowel bar retrofit?					
Has the minimum ambient temperature (50 °F) requirement stated in the Standard Specifications been discussed with the Contractor?					
Has the layout and dimensions required of the slots in the ODOT Standard Drawing been discussed?					
Does the Contractor have a plan for maintenance of traffic and protection of the dowel bar retrofit operation during its construction?					

Have the requirements for proper curing of the concrete patching material been discussed with the Contractor?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proposed products and sources of materials (joint sealer/filler, etc.) been submitted by the Contractor and reviewed/accepted by the Resident Engineer prior to the dowel bar retrofit operation?					
Has the Contractor submitted Buy America certifications including all required forms, mill test reports and letters as specified prior to installing steel products?					
Have the proposed mix designs for the concrete patching material and mortar been submitted by the Contractor and reviewed/accepted by the Resident Engineer prior to the dowel bar retrofit operation?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the various sources of materials including the ingredients in the concrete patching material mix design?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the sources of materials?					
Have all of the FAST Guide requirements for documenting products on the QPL in SiteManager been performed by the residency?					
Does the Contractor's equipment (gang saw, sandblasting unit, jackhammer less than 30 lb, etc.) meet the specification requirements for the proper dowel bar retrofit operation?					
Is the Contractor sawing slots to the layout and dimensions shown on Std. PCPR-4 within the allowable tolerances?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor removing the concrete from the slots without causing damage to the surrounding existing PCC pavement?					
Are the slots dry and is the ambient temperature at least 50 °F prior to installing the dowel bars?					
Are the slots being effectively cleaned, including sandblasting, by the Contractor?					
Are the dowels, nonmetallic chairs, nonmetallic caps, form release oil and foam core board as required on Std. PCPR-4?					
Is the Contractor maintaining traffic and protecting the dowel bar retrofit operation from traffic during its construction?					
Is the concrete patching material meeting the 4,000 psi compressive strength in 6 hour requirement?					
Is the completed slot concrete patching material being trowel finished up to 1/4" higher than the surrounding PCC pavement surface with no areas left below the surface?					
Is the Contractor applying curing compound on the completed slot concrete patching material?					
Is the completed slot concrete patching material given enough time to cure a prior to sawing the joints and opening to traffic?					
Has the Resident Engineer identified any sections of completed dowel bar retrofit that will require replacement?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Was payment for the work withheld until all required Buy America certifications for the steel products were approved by Materials Division?					
Has the Contractor taken adequate precautions to protect the completed dowel bar retrofit patches from damage?					
Has the residency personnel verified all dowel bar retrofit are properly installed to the dimensions within allowable tolerances and saw cuts of the joints are completed?					
Have all conditions and locations requiring corrective action been successfully remedied to the satisfaction of the Resident Engineer?					
Did the Contractor use the products and sources of materials (joint sealer/filler, etc.) reviewed/accepted by the Resident Engineer for the dowel bar retrofit operation?					
Did the residency personnel perform all of the FAST Guide requirements for documenting products on the QPL in SiteManager?					

SECTION 425 – DIAMOND GRINDING CONCRETE PAVEMENT

425.01 GENERAL

This work consists of grinding portland cement concrete (PCC) pavement to restore drainage and smoothness characteristics to the pavement surface.

425.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Distinguish the limits of the diamond grinding (location, area and thickness) required in the Plans.
- Proper clean-up, collection and disposal of grinding slurry.
- Methods and equipment to be used.
- Acceptable tolerances for elevation, smoothness, texture and grooving.
- Review special provisions, plan notes and ODOT Standard Drawings included in the Contract for diamond grinding concrete pavement (i.e., joint sealing requirements, etc.).
- Contractor's schedule/plan for the work.
- Traffic control during construction and impacts from haul trucks entering/exiting the work zone.
- Joint sealing to be performed after the completion of the diamond grinding operation.
- Clean up and opening to traffic considerations.

B. Acceptance of Materials

None required.

C. Preparatory Work and Contractor Work Plans

Consider the following before the diamond grinding operation begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions, ODOT Standard Drawings and Plan Notes and determine any specific requirements that pertain to the diamond grinding construction. Review the plan Typical Sections and plan notes for the locations of diamond grinding required for the project.

Discuss the method of collection and disposal of the grinding slurry and any limitations in accordance with applicable laws, rules, regulations and ODOT policies.

2. Contractor Proposed Equipment

The Contractor may include the equipment needed to perform the diamond grinding operation in their submittals prior to beginning construction. The various pieces of equipment required include the following:

- Trucks,
- Vacuum, broom and other equipment necessary for clean up, and
- Diamond grinding machine.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 425.03.B of this Manual below.

D. Safety and Environmental Issues

The grinding slurry and residue must be disposed of in accordance with applicable laws, rules, and regulations. Discuss the Contractor's proposed method to distribute the slurry or cuttings on the side-slopes for review and approval by the Resident Engineer, when applicable.

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to ensure no risk to health, safety and property damage,
- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, grinding slurry, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

425.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

None Required.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications. Section 425.03 of the Standard Specifications contains requirements for the grinding machine that will be used for the diamond grinding operation. Additionally, the Contractor will need to use self-propelled stiff bristled broom and other equipment to adequately remove grinding slurry residue and dust prior to opening the area to traffic.

Verify the Contractor's equipment meets the requirements of Sections 425.03 of the Standard Specifications as follows.

1. Diamond Grinding Machine

The Contractor must provide a power driven, self-propelled grinding machine with a series of closely spaced diamond saw blades mounted on a rotating shaft that has the following characteristics:

- Diamond blades designed specifically to smooth and texture PCC pavement.
- An effective wheelbase of at least 12 ft.
- Front of the machine has a set of pivoting tandem bogey wheels, and the rear wheels travel in the track of the cut pavement.
- Capable of cutting or grinding at least 4 ft wide to avoid a seam in the wheel path of a travel lane.
- Center of the grinding head no more than 3 ft ahead of the center of the back wheels.

Do not allow the use of equipment that causes excessive ravels, aggregate fractures, spalls, or cracks, or disturbs transverse and longitudinal joints. The grinding machine needs regular maintenance of the diamond blades (missing or worn teeth), to ensure the surface meets the required surface texture and tolerance.

C. Construction Operations

Diamond grinding of PCC pavement is used as a pavement preservation technique to extend the life of the pavement for the following various reasons:

- Improve poor ride quality from faulted joints.
- Improve surface texture and reestablish friction.
- Noise reduction generated from vehicle tires.
- Improve slab curling, warping and cross-slope issues.

Verify the following complies with Section 425.04 of the Standard Specifications when performing the diamond grinding operation:

1. Grinding Pavement

Identify with the Contractor the areas of the PCC pavement surface shown on the Plans for the diamond grinding operation to be accomplished. The Contractor must grind longitudinally, beginning and ending at lines transverse to the pavement centerline. Ensure the ground pavement surfaces of adjacent sides of transverse joints and cracks are on the same plane. The Department will allow less than 100 percent grinding within specified areas if minor depressions occur in the pavement.

During the diamond grinding operation, ensure the Contractor complies with the following requirements from Section 425.04.A of the Standard Specifications:

- The machine's shape and dimension do not encroach on traffic movement outside the work area.
- The pavement surface grinding produces a uniform, finished surface texture that meets the specified tolerance.
- Eliminate joint and crack faults.
- Maintain a constant cross-slope between the edges of grinding operations to provide positive lateral drainage.
- The grinding of auxiliary or ramp lanes are adequately transitioned from the mainline edge to provide positive drainage and a smooth riding surface.
- Multiple passes are made as necessary to achieve acceptable results.
- Feather-grind adjacent lanes or paved shoulders to maintain motorist safety and proper drainage for pavement grinding deeper than 1/4 in.

2. Surface Texture and Grooving

Ensure the Contractor grinds the pavement surface until it has a uniform appearance, with a texture composed of longitudinal ridges and grooves. The texture and grooves must comply with the following requirements from Section 425.04.A(1) of the Standard Specifications:

- Surface grooves must be from 0.09 in to 0.15 in wide,
- Surface grooves are spaced no greater than 1/8 in apart, and
- Ridge peaks are at least 1/16 in higher than the bottom of the grooves.

The residency project inspector must consistently verify the surface texture meets the dimension requirements specified. The grinding machine needs regular maintenance of the diamond blades, to ensure the surface meets the required surface texture and tolerance. If the Contractor's grinding operation results in out of tolerance grooves and ridges, stop the operation and ensure that corrections are made to the grinding machine and operation to perform an acceptable surface texture before resuming work.

3. Slurry Removal

Ensure the Contractor collects and removes grinding slurry or residue by vacuum or other continuous methods. The slurry must be prevented from flowing across lanes used by traffic or into gutters, drainage inlets or other drainage facilities.

The grinding slurry and residue must be disposed of in accordance with applicable laws, rules, and regulations. Do not allow the Contractor to distribute the slurry on the side-slopes unless the Resident Engineer approves of the disposal method. Cuttings may be disposed of along the side slopes of the roadway shoulders in a

manner approved by the Engineer. Typically, they may be distributed and spread evenly across the side slopes of the roadway while ensuring that none are disposed of within 100 ft of a lake or other body of water or any bridge over a river/creek.

Ensure the Contractor performs a final sweeping before opening the diamond ground PCC pavement to traffic.

4. Pavement Smoothness

Check the Contract for the smoothness special provision, SP430-2QA "Pavement and Bridge Deck Smoothness". When your contract includes the smoothness special provision, follow those requirements for testing, evaluation, correction and pay adjustments. Note that the provision defines exception and exempt areas subject to the smoothness provision; however, the straightedge tolerance requirements from Section 401.04 of the Standard Specifications remain in effect for those exempt areas.

Smoothness pay adjustment deductions that are calculated in accordance with the smoothness special provision in the Contract should be documented on progressive estimates in SiteManager using a Contract Adjustment. The appropriate Contract Adjustment in SiteManager would be:

- Smoothness Adjustment

All deductions should be communicated to the Contractor and applied on a progressive estimate in a timely manner. Any incentive earned by the Contractor for exceptionally smooth pavement, must be documented by change order.

If the Contract does not include the smoothness special provision, there are pavement smoothness requirements in Section 425.04.A(3) of the Standard Specifications pertaining to the diamond ground surface. Ensure the Contractor complies with those requirements, when applicable, as follows:

(a) Profiling Pavement Surface

The Contractor must measure the smoothness of the diamond ground PCC pavement surface with a profilograph with wheels variably spaced in accordance with ASTM E 1274. Profile measurements must be taken on the ground surface in two passes; one at 3 ft and one at 9 ft from the edge of each driving lane. Average the profilograph readings from the two passes to obtain the profile index for each lane.

The Contractor must obtain a profile index of 5 in or less per mile using a 0.2 in blanking width. If the profile index exceeds 5 in per mile, grind individual high points in excess of 0.3 in across the entire lane width.

Additional grinding that is necessary to meet the profile requirements must be performed along lines parallel to the pavement edge to reduce the profile

index to the specified values after grinding individual high points. Grind in neat, rectangular sections with uniform surfaces.

(b) Straight Edge Tolerance

The straightedge tolerance requirements from Sections 401.04 and 425.04.A(3)(b) of the Standard Specifications remain in effect for the diamond ground PCC pavement surface. Test for surface smoothness by placing a 10 ft straightedge between two contacts on the ground surface and measuring the distance from the surface to the bottom of the straightedge. Ensure the maximum distance from the bottom edge of the straightedge to the ground surface does not exceed 1/8 inch in 10 ft. The Contractor must perform additional grinding at locations in excess of 1/8 inch in 10 ft. Additionally, ensure that the elevation difference between adjacent passes does not exceed 1/8 in.

5. Clean-up and Joint Sealing

Ensure the method of collection and disposal of the grinding slurry are performed in accordance with applicable laws, rules, regulations and ODOT policies. A final sweeping must be completed before opening the diamond ground PCC pavement to traffic.

After completing the diamond grinding operation, the joints in the PCC pavement must be sawed, cleaned and sealed in accordance with Section 415 of the Standard Specifications and as required in the Plans.

D. Safety and Environmental Considerations

The grinding slurry and residue must be disposed of in accordance with applicable laws, rules, and regulations. Do not allow the Contractor to distribute the slurry or cuttings on the side-slopes unless the Resident Engineer approves of the disposal method.

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should effectively address the following:

- Providing traffic control during construction to ensure no risk to health, safety and property damage,
- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, grinding slurry, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents, direction, lane, etc.), length & width of area and quantity of diamond grinding performed.
- Note method of disposal of grinding slurry.
- Note when smoothness testing is performed and whether any areas failed to meet the requirements.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 425.05 of the Standard Specifications, the residency will measure the square yards of completed diamond grinding of PCC pavement by the final approved textured surface area regardless of the number of passes necessary to achieve acceptable results. If multiple passes are required to meet the smoothness requirements, the additional passes are the responsibility of the Contractor and will not be measured separately for any additional payment. Minor areas of un-ground pavement within the approved ground surface area will be measured for payment. Feathering that is performed may be included in the measured area if the Resident Engineer determines it was not caused by negligence by the Contractor.

Documentation of the Diamond Grinding Concrete Pavement pay item paid by the Square Yard will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the Diamond Grinding Concrete Pavement item from the list of contract pay items.

b. In the appropriate field, enter the station-to-station extents and a descriptive location.

c. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.

d. In the Remarks bubble, document the method used for calculating the quantity (i.e. spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations, with different dimensions, select the ‘New’ button to create a new row for the selected pay item.

425.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

None required.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantity paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

When your contract includes the smoothness special provision (SP430-2QA "Pavement and Bridge Deck Smoothness"), follow those requirements for testing, evaluation, correction and pay adjustments. For smoothness, pay factors will be applied on an extent by extent basis and applied separately from the adjustments for mix properties. Pay adjustment deductions can be applied by Contract Adjustment in SiteManager. Pay adjustment incentives will require a change order for payment. The calculations for these adjustments will be placed in a Book, Folder or Envelope, or as an attachment to the change order.

C. Protection of the Work

Ensure no deviations are greater than 1/8" in a 10' section in any direction using the straightedge method. Additionally, the Contractor must meet the profile requirements as specified in Section 425.04.A(3) of the Standard Specifications pertaining to the diamond ground surface or the smoothness special provision whichever is applicable. The Contractor must make corrections or additional grinding passes to any deviations in excess of the acceptable tolerance, as approved by the Resident Engineer.

After completing the diamond grinding operation, the joints in the PCC pavement must be sawed, cleaned and sealed in accordance with Section 415 of the Standard Specifications and as required in the Plans.

The Contractor must remove grinding slurry and debris generated from diamond grinding operation. When approved by the Resident Engineer, ensure the Contractor distributed and spread the cuttings evenly across the side slopes of the roadway. Ensure that none of the cuttings are disposed of within 100 ft of a lake or other body of water or any bridge over a river/creek. Ensure the Contractor adequately sweeps the roadway/shoulder to remove all cuttings from the pavement surface.

425 CHECKLIST – DIAMOND GRINDING CONCRETE PAVEMENT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the limits of the diamond grinding required in the Plans been discussed with the Contractor?					
Have the equipment requirements for the diamond grinding machine and the use of stiff bristled brooms and other cleanup equipment been discussed?					
Have the required dimensions for the grooves cut by the grinding machine been discussed?					
Have the acceptable smoothness and surface deviations been discussed?					
Has the method for collection and disposal of the grinding slurry proposed by the Contractor been discussed?					
Does the Contractor have a plan for maintenance and protection of traffic during the diamond grinding operation?					
Does the Contract include the smoothness special provision or do the smoothness requirements in Section 425 pertain to the project?					
Does the Contract include joint sealing to be performed after the completion of the diamond grinding operation?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the Contractor's diamond grinding machine meet the requirements of Section 425.03?					
Are the required dimensions for the grooves cut by the grinding machine being achieved?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the diamond ground surface have a uniform texture that is smooth and complies with the 10' straightedge requirements?					
Are the ground pavement surfaces of adjacent sides of transverse joints and cracks and adjacent passes of the grinding machine on the same plane?					
Does the grinding of auxiliary or ramp lanes adequately transition from the mainline edge to provide positive drainage and a smooth riding surface?					
Is feather grinding required at adjacent lanes or paved shoulders to maintain motorist safety and proper drainage?					
Is the Contractor collecting and removing grinding slurry or residue by vacuum and disposing it in accordance with the applicable rules and regulations?					
Is the ground surface being tested and meeting the smoothness special provision or the smoothness requirements in Section 425 as applicable to the project?					
Is the Contractor sufficiently maintaining traffic during the diamond grinding operation that does not encroach out of the work zone and into the adjacent traffic?					
Is the Contractor sweeping and cleaning the ground surface following the diamond grinding operation prior to opening to traffic?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the diamond ground surface have a uniform texture that is smooth and complies with the 10' straightedge requirements?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Was the ground surface tested for compliance with the smoothness special provision or the smoothness requirements in Section 425 as applicable to the project?					
Were any conditions requiring corrective action (additional passes with the grinding machine, feathering at adjacent lanes or shoulders, etc.) addressed sufficiently by the Contractor?					
Did the Contractor properly dispose of the grinding slurry in accordance with the applicable rules and regulations?					
Did the Contractor properly cleanup the ground surface prior to opening to traffic?					
Did the Contractor proceed with the sawing, cleaning and sealing of PCC pavement joints as required in the Plans?					

SECTION 426 – PRESSURE GROUTING PAVEMENT & POLYURETHANE INJECTION

426.01 GENERAL

This work consists of pumping a fly ash cement grout under portland cement concrete (PCC) pavement or asphalt pavement to fill the voids beneath the pavement and form a hard, insoluble mass. This process is most applicable where water has been allowed to erode the subgrade/embankment under the pavement, creating a void resulting in a loss of support under the pavement.

Some Contracts may include the Special Provision 426-2, "Polyurethane Injection for Pavements". When included, the work consists of injecting polyurethane foam for the following applications:

- Asphalt pavements - repairing full depth cracks (sealing of the crack and sub-sealing of voids).
- PC concrete pavements – slab-jacking/raising and/or sub-sealing/undersealing.
- Bridge approaches - slab-jacking/raising and/or sub-sealing/undersealing.

426.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Method and pay items (pressure grouting or polyurethane injection) required in the Contract.
- Locations to perform the pressure grouting/polyurethane injection operation required in the Plans.
- Proposed sources of material, mix designs and material requirements; including the material proposed for patching the core holes in the pavement.
- Methods and equipment to be used.
- Review special provisions and plan notes included in the Contract for pressure grouting/polyurethane injection pavement item (i.e., SP426-2 for Polyurethane Injection for Pavements).
- Weather limitations for construction.
- Contractor's schedule/plan for the work.
- Traffic control during construction.
- Clean up and curing time required prior to opening to traffic.

B. Acceptance of Materials

Review the Plans and distinguish the pay items included in the contract that pertain to pressure grouting/polyurethane injection pavement. Review the Standard Specifications,

Special Provisions and Plan Notes and determine any special requirements for the work required.

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If the sources of materials and mix designs are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the pressure grouting pavement pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials and mix designs. Resolve any questions or concerns with the submitted sources of materials and mix designs with the Contractor in a timely manner. A written response accepting the proposed sources of materials and mix designs must be sent to the Contractor and kept in the project file.

Resolve any questions or concerns with the submitted sources of materials with the Contractor in a timely manner. A written response accepting the proposed sources of materials should be sent to the Contractor and kept in the project file.

1. Pressure Grouting

Review the material requirements in Section 733.09 of the Standard Specifications that pertain to the ingredients to produce the slurry-type grout (cement, fly ash, admixtures, etc.) required in the Plans. Additionally, there is no reference to the use of fine aggregate in Section 733.09. If the mix design includes fine aggregate, contact the ODOT Materials Division for their evaluation and input.

The Residency will verify that the proposed source of materials for the ingredients to produce the slurry-type grout used in the pressure grouting operation and the material used to patch the core holes submitted by the Contractor is on the ODOT Materials Division Qualified Products List (QPL). Ensure the product name and manufacturer is shown on the relevant QPL. If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

Notify the Contractor if a proposed source/product is not approved for use by the ODOT Materials Division. The Contractor may want to arrange for an alternate source of materials if their proposed source is not on the QPL due to the time necessary for a producer/supplier to obtain approval from the Materials Division to be listed. The policies and procedures to obtain approval of a source for the various products can be found on the Materials Division website (Material Source Qualification).

2. Polyurethane Injection

The polyurethane material proposed by the Contractor must meet the physical characteristics and property requirements of special provision SP426-2. Plan notes in the Plans that specify a specific polyurethane or foam product or different physical characteristics and property requirements than special provision SP426-2 would take precedent over the requirements of the special provision.

C. Preparatory Work and Contractor Work Plans

Consider the following before the pressure grouting operations begin.

1. Contract Plans and Specifications

Review the Plans and distinguish the pay items included in the contract that pertain to pressure grouting/polyurethane injection pavement. Review the Standard Specifications, Special Provisions and Plan Notes and determine any special requirements for the work required.

Review the requirements of the pay items and materials being used and the related tests and acceptance criteria. Ensure the Contractor's proposed equipment complies with the requirements for the pressure grouting/polyurethane injection pavement operation.

2. Weather Limitations

Review the weather limitations and preparation requirements in the Plans and Standard Specifications. Ensure that the Contractor is aware of the minimum ambient and pavement temperatures required to proceed with the pressure grouting/polyurethane injection operation. The ambient temperature must be at least 35 °F and rising and the pavement temperature must be at least 35 °F during the pressure grouting.

There are stringent hole coring and preparation requirements for pressure grouting/polyurethane injection including the locations, dimensions and angle of drilling of the core holes that must be met by the Contractor.

3. Slurry Grout Mix Design for Pressure Grouting Pavement

The Contractor must provide slurry grout material in accordance with Section 733.09 of the Standard Specifications for stabilizing and under-sealing pavements using the pressure grouting method. The slurry grout must consist of a mixture of portland cement, fly ash, and water. The Contractor must submit a mix design for the slurry grout for review and approval by the Resident Engineer. Ensure the components listed in the mix design for the portland cement, fly ash, and admixtures use products and manufacturers that are listed on the relevant ODOT Materials Division Qualified Products List (QPL).

The Contractor must include mix design test results of the slurry grout from an independent laboratory, showing the following:

- Seven day strengths in accordance with ASTM C942.
- Flow cone rate in accordance with the Corps of Engineers Method and ASTM C939.
- Shrinkage and expansion in accordance with ASTM C940 or ASTM C827.

- Initial set time in accordance with ASTM C403 or AASHTO T 197.

Ensure the 7 day strength is at least 800 psi, and the flow cone rate is from 10 to 16 seconds.

D. Safety and Environmental Issues

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and pressure grouting/polyurethane injection operation from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials and grout, debris from coring holes, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

426.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Review the Plans and distinguish the pay items included in the contract that pertain to pressure grouting/polyurethane injection pavement. Review the Standard Specifications, Special Provisions and Plan Notes and determine any special requirements for the work required.

The Contractor should submit its proposed sources of materials and mix designs at the Preconstruction Meeting. If the sources of materials and mix designs are not provided at that meeting, ensure that they are submitted in advance of any work beginning on the pressure grouting/polyurethane injection pavement pay items.

The Resident Engineer must review for acceptance the Contractor's proposed sources of materials and mix designs. Resolve any questions or concerns with the submitted sources of materials and mix designs with the Contractor in a timely manner. A written response accepting the proposed sources of materials and mix designs must be sent to the Contractor and kept in the project file.

During construction, verify that the previously submitted sources of materials are used by the Contractor. If there are any substitutions being used by the Contractor, stop the operation and ensure that the substituted material is acceptable before resuming work.

1. Contractor Proposed Mix Designs for Slurry Grout

Review the material requirements in Section 733.09 of the Standard Specifications that pertain to the ingredients to produce the slurry-type grout (cement, fly ash, admixtures, etc.) required in the Plans. Additionally, there is no reference to the

use of fine aggregate in Section 733.09. If the mix design includes fine aggregate, contact the ODOT Materials Division for their evaluation and input.

Ensure the Contractor has submitted its proposed slurry grout mix design and the material used to patch the core holes in advance of any work beginning on the pressure grouting pavement pay item. The Residency will verify that the proposed sources of materials and products submitted by the Contractor for the ingredients on their slurry grout mix design are on the ODOT Materials Division Qualified Products List (QPL). If a proposed source is not on the QPL, contact Materials Division to confirm the status of the source/product approval.

The Resident Engineer will approve the slurry grout mix design that meets the property requirements in accordance with Section 733.09 of the Standard Specifications. A written response approving the mix designs must be sent to the Contractor and kept in the project file.

2. Polyurethane Injection

The polyurethane material proposed by the Contractor must meet the physical characteristics and property requirements of special provision SP426-2. Plan notes in the Plans that specify a specific polyurethane or foam product or different physical characteristics and property requirements than special provision SP426-2 would take precedent over the requirements of the special provision.

The Resident Engineer will approve the polyurethane material that meets the physical characteristics and property requirements. A written response accepting the polyurethane material must be sent to the Contractor and kept in the project file.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of Section 426.03 of the Standard Specifications. Review any special provisions and plan notes that pertain to the pressure grouting/polyurethane injection pavement pay items.

Verify the Contractor's equipment meets the requirements of Section 426.03 of the Standard Specifications or Special Provision SP426-2 (whichever is appropriate) as follows:

1. Pressure Grouting

Verify the Contractor's equipment meets the requirements of Section 426.03 of the Standard Specifications as follows:

(a) Coring Equipment

Coring equipment must be capable of cutting 2 in diameter holes through the pavement. Ensure there is no damage to the pavement from excessive down pressure on the core. An air compressor and rock drills or other

devices capable of drilling the injection holes through the pavement must be used. Do not allow air-driven or hydraulic impact drills for coring to perform the pressure grouting operation.

(b) Measuring and Proportioning Equipment for Grouting

The Contractor must provide equipment capable of measuring and proportioning grout components by weight. Prepackaged materials may be used as approved by the Resident Engineer.

(c) Batch Mixing Tank and Holding Tank

The Contractor must provide a watertight batch mixing tank with the following characteristics and capabilities:

- A high speed mixer to blend the materials into a homogenous mixture.
- The mixer includes a rotor operating in close proximity to a stator, creating a high shearing action with a mixing speed from 800 rpm to 2,000 rpm.
- The mixing pump continuously circulates the materials through the mixer and the mixing tank.

The Contractor must provide a holding tank with a paddle-type agitator placed between the batch mixing tank and the grout pump for continuous operation. Ensure the agitator maintains complete circulation of the grout to keep it in suspension and remove air bubbles from the mix.

(d) Grout Pump and Discharge Line

The Contractor must provide a grout pump with the following characteristics and capabilities:

- A single action plunger pump with a high-speed backstroke.
- Precise pressure and capacity control valves, to independently preset maximum pressure and flow.
- A pump capacity range from 0 gal/min to 30 gal/min.
- A pressure range from 0 psi to 100 psi.

The Contractor must provide a discharge line with a positive cutoff valve at the nozzle end. Ensure the nozzle remains securely sealed in the cored holes to prevent leaks.

(e) Pavement Monitoring Device

The Contractor must provide pavement-monitoring equipment that determines movement, to prevent lifting pavement or overfilling cracks. A standard Benkelman Beam would accomplish the necessary monitoring.

Other equipment proposed by the Contractor may be used as approved by the Resident Engineer.

2. Polyurethane Injection

Verify the Contractor's equipment meets the requirements of special provision SP426-2 or any pertinent plan notes as follows:

(a) Drilling Equipment

The Contractor must provide a pneumatic drill, capable of drilling 1/2 in to 5/8 in diameter holes.

(b) Pumping Unit

The Contractor must provide a self-contained truck mounted pumping unit capable of storing, proportioning, blending, and injecting the polyurethane formulation into the asphalt pavement joint or under the PC concrete pavement. The equipment must have sufficient capacity and be capable of controlling the amount of polyurethane material injected into the repair area of the asphalt pavement or required rate of rise of the PC concrete pavement.

(c) Pavement Monitoring Equipment

The Contractor must provide a laser leveling unit, straight edge, or stringline to ensure that the asphalt joint area or PC concrete pavement is at an even plane and/or at the required elevation after the completion of the injection operation.

C. Construction Operations

Ensure the Contractor's operation protects the existing pavement from breaking or cracking. The Contractor must repair or replace any damaged pavement, as well as any excessive, uneven and unacceptable pavement movement, resulting from the pressure grouting/polyurethane injection to the satisfaction of the Resident Engineer, at no additional cost to the Department.

Verify the Contractor's construction methods and operations meet the requirements of Section 426.04 of the Standard Specifications or Special Provision SP426-2 (whichever is appropriate) as follows:

1. Pressure Grouting

Verify the following complies with the requirements of Section 426.04 of the Standard Specifications:

(a) Weather Limitations

Ensure that the Contractor is aware of the minimum ambient and pavement temperatures required to proceed with the pressure grouting operation. The ambient temperature must be at least 35 °F and rising and the pavement temperature must be at least 35 °F during the pressure grouting operation.

(b) Coring Holes

In accordance with Section 426.04.C of the Standard Specifications, the Contractor must drill core holes and perform the pressure grouting on the same day, unless otherwise approved by the Resident Engineer.

Temporarily plug irregular or unsatisfactory holes or fill them with grout at no additional cost to the Department.

For PCC pavements, the Contractor must drill 2 in diameter core holes through the pavement in the areas designate in the Plans. The Resident Engineer may modify the pattern and spacing of the holes.

For asphalt pavements, the Contractor must drill core holes at an angle of 45° towards the bottom of the crack, deep enough to penetrate the cavity under the asphalt pavements. At least two core holes must be drilled for each 12 ft wide travel lane, and one hole for every 4 ft of shoulder width. The core holes must be placed from 4 in to 12 in from the crack. The holes may be placed along one side of the crack or alternating along both sides of the crack. The Resident Engineer may modify the hole pattern and spacing. The Resident Engineer will approve the location of the core holes and determine if additional holes are necessary to fill the cracks.

(c) Clearing Holes

The Contractor must clean the holes of debris to provide a passage for the grout after drilling the core holes to the specified depths. The clearing of the holes must be performed within 10 min before injecting the grout.

(d) Pressure Grouting

Ensure the flow rate at the pump head does not exceed 7 gal/min while injecting grout. Ensure the nozzle of the grout discharge hose is adequately secured in the core hole to provide a seal and maintain the grout pressure.

During pumping, watch the pavement monitoring device to prevent excessive lifting of the pavement or rising of the adjacent shoulders. Correct lifted joints as directed by the Resident Engineer. If lifted pavement joints create unsafe conditions for the traveling public, the Contractor must close lanes as necessary to make repairs. Repairs and joint corrections must

be completed to the satisfaction of the Resident Engineer at no additional cost to the Department.

For PCC pavement, ensure the Contractor prevents the nozzle end from extending below the bottom of the PC concrete. The Contractor must continue injecting grout into each core hole until the slab corner lifts from 0.032 in to 0.036 in, or until the pressure at the discharge nozzle exceeds 60 psi. If no slab lift or no pressure buildup occurs, have the Contractor continue injecting grout until the amount of clear grout flowing up through joints or cracks equals the amount of grout injected. Have the Contractor repeat this procedure in other holes to fill voids. If necessary, temporarily plug adjacent core holes during grout injection operation.

For asphalt pavement, the Contractor must continue injecting grout into the core holes until the cracks are filled as required. The Contractor must continue pumping until the amount of clear grout flowing up through joints or cracks equals the amount of grout injected. Have the Contractor repeat this procedure in other holes to fill voids. If necessary, temporarily plug adjacent core holes during grout injection operations.

(e) Permanently Sealing Holes in PC Concrete Pavement

Remove grout from the core holes and fill the holes with a stiff sand-cement mortar made of one part portland cement to three parts fine aggregate (by volume), or a commercial premixed rapid set mixture, as approved by the Resident Engineer. Repair filled holes that ravel or become damaged at no additional cost to the Department.

(f) Regrouting

For PCC pavement, have the Contractor drill new core holes and regrout PC concrete slabs as directed by the Resident Engineer.

For asphalt pavement, have the Contractor drill new core holes and regrout cracks that may require additional filling, as directed by the Resident Engineer. The Contractor must provide excess grout to hand-finish into cracks to fill the voids as directed by the Resident Engineer.

(g) Clean Up and Opening to Traffic

Ensure the Contractor removes deposits of grout on the pavement and shoulder and cleans the pavement surface before allowing traffic on the completed sections. All other debris, bags, and spillage must be removed from the right-of-way each day.

Ensure traffic is restricted from the grouted areas for at least 3 calendar days, or as directed by the Resident Engineer.

2. Polyurethane Injection

The special provision SP426-2 adds language to Section 426 of the Standard Specifications which implies that all relevant requirements in the specifications apply to the polyurethane injection operation. Where there are contradictions in the requirements between the specifications and the special provision, the special provision will take precedent. Plan notes would take precedent over the specifications and special provision.

In accordance with Section 426.04.C of the Standard Specifications, the Contractor must drill core holes and perform the pressure grouting/polyurethane injection on the same day, unless otherwise approved by the Resident Engineer.

Verify the following complies with the requirements of special provision SP426-2 as follows:

(a) Weather Limitations

Ensure that the Contractor is aware of the minimum ambient and pavement temperatures required to proceed with the polyurethane injection operation. Follow the manufacturer's recommendations for the product being used on any minimum temperature requirements.

(b) Profiling Surface and Drilling Injection Holes

Ensure the Contractor develops a profile of the repair area to determine the extent to be raised for the areas designated in the Plans or as directed by the Resident Engineer.

For asphalt pavement, have the Contractor drill a series of 1/2 in diameter holes at 8 ft to 12 ft intervals along the asphalt joint. For PCC pavement, have the Contractor drill a series of 1/2 in diameter holes at 6 ft to 8 ft intervals throughout the PC concrete pavement surface. The exact location of the holes will be determined by the Engineer.

(c) Injection of Polyurethane Material

As the Contractor injects the polyurethane formulation under the slab, ensure they control the amount of rise of the pavement with the pumping unit and the injection gun.

When the injection nozzle is removed from the hole, the Contractor must remove all excessive polyurethane material from the area, and seal the hole with polyurethane material or a quickset concrete patch.

D. Safety and Environmental Considerations

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should effectively address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and pressure grouting/polyurethane injection pavement operation from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials and grout, debris from coring holes, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents, direction, lane, etc.), and quantities of core holes drilled and weight of injection material used in the pressure grouting or polyurethane injection operation.
- Note time traffic was restricted prior to opening work area to traffic.
- Note when smoothness testing is performed and whether any areas failed to meet the requirements.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 426.06 of the Standard Specifications and special provision SP-426-2, there are several pay items that are used to compensate the Contractor for the pressure grouting or polyurethane injection operation, as follows:

- The number of drilled/cored holes will be counted and paid for by the Each as the Cored Holes pay item, unless otherwise noted in the Plans.
- The Tons of Portland Cement and/or Fly Ash will be measured and paid for as the relevant pay item for the completed pressure grouting operation. Do not include the weight of the water (or sand) in the measurements of these pay items.
- The Pounds of polyurethane material will be measured and paid as the Polyurethane Injection For Pavement pay item.

The final quantity for these pay items will be measured and documented as follows:

(a) Each Group Unit of Measure Pay Items

Documentation of the Cored Holes pay item paid by the Each will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate pay item from the list of contract pay items.
2. In the appropriate field, enter the station for each item and a descriptive location.
3. In the Placed Quantity field, enter the quantity (EA) of the item completed.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations, select the 'New' button to create a new row for the selected pay item.

(b) Ton Unit of Measure Pay Items

Documentation of the relevant pressure grouting pavement pay item paid by the Ton will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate pay item from the list of contract pay items.
2. In the appropriate fields, enter both a descriptive location and the station-to-station extents.
3. In the Placed Quantity field, enter the measured quantity (Ton) of the item completed.
4. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

(c) Pound Unit of Measure Pay Items

Documentation of the Polyurethane Injection for Pavement pay item paid by the Pound will be performed within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

1. Select the appropriate pay item from the list of contract pay items.
2. In the appropriate fields, enter both a descriptive location and the station-to-station extents.
3. In the Placed Quantity field, enter the measured quantity (LB) of the item completed.
4. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
5. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

426.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Verify that the previously accepted proposed sources of materials which were submitted by the Contractor were utilized on the project. If the previously accepted sources of materials were not utilized on the project, ensure the substituted source is on the QPL or the polyurethane material meets the physical characteristics and property requirements. If the substituted source is not on the QPL, contact Materials Division to confirm the status of the source/product approval. The use of unapproved materials will require action by the Contractor as directed by the Resident Engineer such as removing & replacing work, accepting work at a reduced price, etc.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantity paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Check that the pressure grouting or polyurethane injection locations are satisfactorily maintained until the project is completed and they are restricted from traffic for at least 3 days or as directed by the Resident Engineer. Ensure all conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

The Contractor must remove debris generated from the pressure grouting/polyurethane operation. Ensure the Contractor adequately sweeps the roadway/shoulder to remove all cuttings from the pavement surface.

426 CHECKLIST – PRESSURE GROUTING PAVEMENT & POLYURETHANE INJECTION

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the locations of the pressure grouting-polyurethane injection required in the Plans been discussed with the Contractor?					
Does the Contract include SP426-2 for polyurethane injection of pavement?					
Are there any plan notes regarding the pressure grouting-polyurethane injection operation that need to be discussed (such as specific material requirements)?					
Have the proposed sources of materials (cement, fly ash, polyurethane, etc.) been submitted by the Contractor and reviewed by the Resident Engineer for acceptance?					
Have the equipment requirements for the blending, pumping and injecting the leveling material been discussed?					
Have the required dimensions and layout of the drilled/cored holes been discussed?					
Have the acceptable smoothness and surface deviations been discussed?					
Has the method for collection and disposal of the debris from coring and pumping been discussed?					
Is the Contractor aware of the requirements that the core holes are to be drilled the same day as installing the pressure grouting-polyurethane injection?					
Does the Contractor have a plan for maintenance and protection of traffic during the pressure grouting-polyurethane injection operation?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the various sources of materials?					

Have the minimum temperature requirements stated in the Standard Specifications been discussed with the Contractor (ambient & pavement at least 35 °F)?					
Have the requirements for pavement restrictions after installation of the pressure grouting-polyurethane injection been discussed with the Contractor?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the Contractor's equipment for the blending, pumping and injecting the leveling material meet the requirements of Section 426.03?					
Have the proposed sources of materials (cement, fly ash, polyurethane, etc.) been submitted by the Contractor and accepted by the Resident Engineer?					
Has the Resident Engineer sent responses to the Contractor on the acceptance/nonacceptance of the various sources of materials?					
Is the Contractor using the sources of materials that have been accepted by the Resident Engineer?					
Is the Contractor performing the pressure grouting-polyurethane injection at the locations required in the Plans?					
Are the required dimensions and layout of the drilled/cored holes being achieved?					
Is the Contractor clearing the cored holes within 10 minutes of injecting the grout/polyurethane?					
Is the Contractor installing the pressure grouting-polyurethane injection the same day the core holes are drilled?					
Are the minimum temperature requirements (ambient & pavement at least 35 °F) being met before the Contractor begins the pressure grouting-polyurethane injection operation?					
Does the levelled pavement surface meet the smoothness and surface deviations requirements?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Are there any locations where the Contractor must regrout/reinject the pavement?					
Is the Contractor collecting and removing the debris from coring and pumping and disposing it in a manner approved by the Resident Engineer?					
Is the Contractor sufficiently maintaining traffic during the pressure grouting-polyurethane injection operation?					
Is the Contractor sweeping and cleaning the levelled pavement surface prior to opening to traffic?					
Is the Contractor restricting traffic from the levelled pavement for at least 3 days after installation of the pressure grouting-polyurethane injection?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the Contractor taken adequate precautions to protect the completed levelled pavement from damage?					
Has the residency personnel verified all levelled pavement surfaces meet the smoothness and surface deviations requirements?					
Did the Contractor use the products and sources of materials (cement, fly ash, polyurethane, etc.) reviewed/accepted by the Resident Engineer for the pressure grouting-polyurethane injection operation?					
Did the Contractor install the pressure grouting-polyurethane injection the same day the core holes were drilled??					
Were all conditions and locations requiring corrective action successfully remedied to the satisfaction of the Resident Engineer?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor properly collect and remove the debris from the coring and pumping operation in a manner approved by the Resident Engineer?					
Did the Contractor properly cleanup the levelled pavement surface prior to opening to traffic?					
Did the Contractor restrict traffic from the levelled pavement for at least 3 days after installation of the pressure grouting-polyurethane injection?					

SECTION 433 – RUBBLIZING PC CONCRETE PAVEMENT

433.01 GENERAL

This work consists of rubblizing and seating existing portland cement concrete pavement (PCC pavement) which is typically performed in advance of placing an overlying hot mix asphalt pavement.

433.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Locations designated for rubblization required in the Plans.
- Review special provisions, plan notes and ODOT Standard Drawings included in the Contract for rubblizing PCC pavement (i.e., specific equipment required, testing requirements, etc.).
- Methods and equipment to be used.
- Test section location selection and evaluation requirements.
- Removal of PCC pavement that cannot be rubblized.
- Acceptance criteria for maximum fractioned particle size after rubblization.
- Acceptance criteria for steel reinforcement that is encountered during rubblization.
- Seating requirements of rubblized PCC pavement.
- Contractor's schedule/plan for the work, including the timely placement of the overlying hot mix asphalt pavement.
- Traffic control during construction.

B. Acceptance of Materials

None required.

C. Preparatory Work and Contractor Work Plans

Consider the following before the rubblizing PCC pavement operation begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions and Plan Notes for requirements governing the rubblizing PCC pavement operation. Some projects may include plan note that require special rubblizing equipment or phasing of the subsequent work following the rubblization. Ensure the Contractor is aware of any specified requirements for the rubblizing PCC pavement operation.

2. Contractor Proposed Equipment

The Contractor may include the equipment needed to perform the rubblizing PCC pavement operation in their submittals prior to beginning construction. The various pieces of equipment required include the following:

- Resonant frequency pavement breaker, and
- Vibratory steel wheel roller.

Ensure the equipment mobilized to the project meets the requirements in the Standard Specifications and Section 433.03.B of this Manual below.

3. Contractor's Proposed Sequence

The Contractor's proposed sequence of operations should address the following:

- Removing any asphalt overlay of the PCC pavement.
- Performing the test section as required in Section 433.04.C of the Standard Specifications.
- Rubblizing the PCC pavement and evaluating results for possible additional effort being required.
- Weather conditions should be considered for the timely placement of the overlying asphalt pavement.

D. Safety and Environmental Issues

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to ensure no risk to health, safety and property damage,
- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt millings, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

433.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

None Required.

B. Equipment and Methods

Ensure the Contractor's equipment complies with the requirements of the Standard Specifications or any project specific plan notes. Section 433.03 of the Standard Specifications contains requirements for the resonant frequency pavement breaker that will be used for the PCC pavement rubblization operation. Additionally, the Contractor will need to use vibratory, steel wheel roller to seat the rubblized pavement.

Verify the Contractor's equipment meets the requirements of Sections 433.03 of the Standard Specifications as follows.

1. Resonant Frequency Pavement Breaker

The Contractor must provide a self-contained, self-propelled, resonant frequency pavement rubblizing unit capable of fracturing the pavement. Ensure the unit produces low amplitude blows of 2,000 lb at a rate of at least 44 cycles per second. The unit must be equipped with a water mist system to suppress dust and a screen to protect vehicles in adjacent lanes from flying chips.

Resonant breakers are more effective at reducing the subsequent pavement particle sizes and deboning the reinforcing steel than typical jackhammer or guillotine style weight dropping pavement breakers. The Resident Engineer may approve the use of an alternate pavement breaker in small, isolated areas that are inaccessible for the resonant breaker.

2. Steel Wheel Roller

The Contractor must use a vibratory, steel wheel roller weighing at least 10 ton to compact the rubblized pavement. Provide a self-propelled unit capable of varying the vibration amplitude and frequency.

C. Construction Operations

The Contractor must continue to operate the resonant frequency pavement rubblizing unit until the existing PCC pavement is broken into acceptable sized particles.

A test section must be performed before the full rubblization operation begins to ensure that the Contractor's equipment and methods will result in an acceptable product. Factors that may be adjusted by the Contractor to achieve acceptable fracturing from the rubblization operation include:

- striking pattern,
- striking energy,
- number of passes,
- speed of operation, and
- frequency rate of unit.

Once the rubblized PCC pavement has been visually accepted by the project residency inspector, the Contractor must properly seat the broken concrete prior to the placement of the overlying asphalt pavement overlay.

Verify the following complies with Section 433.04 of the Standard Specifications when performing the concrete joint sealing operation:

1. General

Any existing asphalt pavement overlay on the PCC pavement must be removed prior to beginning the rubblizing operation. The project plans should address the removal of the asphalt pavement overlay with appropriate plan notes and the relevant pay item.

The Contractor must rubblize and seat the PCC pavement across each full panel width and to the full depth of the existing PCC pavement. Where rubblizing abuts PCC pavement specified to remain on ramps or mainline, the Contractor must cut joints and reinforcement steel/load transfer devices at an existing joint between the PCC pavement to be rubblized and designated to remain.

When required in the Plans, ensure the full asphalt overlay is completed before opening the pavement to traffic except at restricted crossovers and ramp crossings.

To protect underground utilities and drainage facilities while operating the resonant breaker, the Contractor must not exceed a maximum amplitude of 1 in while operating the resonant pavement breaker.

The Contractor must remove asphalt pavement patches with a surface area of at least 1 yd^2 and replace with asphalt patch area with traffic-bound surface course (TBSC) Type E in accordance with Section 402 of the Standard Specification or with materials required on the Plans. Measurement and payment for the TBSC will be in accordance with Section 402.

2. Rubblizing the PC Concrete Pavement

The Contractor must begin rubblizing at the edge of pavement and work toward the centerline of the roadway. If the Plans require rubblizing and placing the asphalt overlay one lane at a time, extend rubblizing of each lane at least 6 in beyond the width of the lane being overlaid.

Any PCC pavement that cannot be rubblized must be removed and the underlying base material excavated 2 ft. The Contractor must replace the removed PCC pavement and base material with compacted Aggregate Base Type A in accordance with Section 303 of the Standard Specifications, unless otherwise shown on the Plans. Measurement and payment for the aggregate base will be in accordance with Section 303.

The steel reinforcement debonded from the pavement during the rubblization operation will be left in place. Any exposed steel must be cut and removed below the surface of the rubblized PCC pavement.

The Contractor must adjust the striking pattern, striking energy, number of passes, or other factors to achieve acceptable fracturing.

(a) Maximum Particle Size and Acceptable Fractioning

Ensure no more than 20 percent of the rubblized PCC pavement material is larger than 6 in, and individual fragments do not exceed 8 in. The Resident Engineer will determine the extent of the breakage based on a visual inspection of the cracks on a dry pavement surface. The use of water to detect additional cracks is not permitted.

The residency project inspector must continuously monitor the effectiveness of the rubblization operation to ensure the Contractor is achieving acceptable fracturing throughout the project.

3. Test Section

Before rubblizing operations begin, the Resident Engineer needs to approve a designated area within the project to be used as a test section. The Contractor must rubblize the test section using a variety of energy and striking patterns and, if necessary, repeat passes until the test section is fractured to meet the maximum particle sizes as specified in Section 433.04.B of the Standard Specifications. The results from the test section breakage should be used as a guide for breaking the PCC pavement on the remainder of the project. If the rubblized fragments exceed the size requirements during the rubblizing operation, the Resident Engineer may direct additional test sections.

4. Seating of Rubblized PC Concrete Pavement

After the rubblization is completed and visually accepted by the residency project inspector, the Contractor must properly seat the broken concrete prior to the placement of the overlying asphalt pavement overlay. The Contractor must perform the seating to compact the rubblized PCC pavement as follows:

- use a steel wheel roller weighing at least 10 tons,
- make at least three passes of total coverage of the rubblized area,
- operate the roller in vibratory mode, and
- do not exceed a maximum speed of 4 mph.

5. Asphalt Pavement Overlay

The Contractor must place the overlying hot mix asphalt leveling or base course as shown on the Plans, following the pavement rubblizing and seating operations. It

is important that the asphalt paving operations commence as soon as practical to minimize the amount of time the rubblized PCC pavement is subject to inclement weather or other adverse conditions (construction traffic, etc.). Ensure the full asphalt overlay is completed before opening the pavement to traffic except at restricted crossovers and ramp crossings, unless otherwise required in the Plans. Measurement and payment for the relevant type of hot mix asphalt will be in accordance with Section 411.

D. Safety and Environmental Considerations

Ensure the Contractor follows its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and the rubblized PCC pavement from damage,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, debris from rubblization, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents, direction, lane, etc.) and quantity of rubblized PCC pavement performed visually accepted by the residency project inspector.
- Note the locations where the test section was performed, and the details of the method used by the Contractor to provide acceptable fractioning of the PCC pavement.
- Note the locations where the seating was performed by the Contractor on the rubblized PCC pavement.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 433.05 of the Standard Specifications, the residency project inspector will measure the square yards of completed rubblizing pavement by the width of the existing PCC pavement and the horizontal length along the centerline of each roadway or ramp that was rubblized. Payment should not be made until the Contractor rubblizes the PCC pavement to acceptable particle sizes and seats or compacts the rubblized pavement as specified. Additionally, if the

Contractor fails to place the overlying hot mix asphalt in a timely manner, consideration should be given to withhold payment until such time as the asphalt overlay commences which will protect the integrity of the rubblized area.

Payment for any asphalt overlay or patching removal, excavation of base material and placement of TBSC or aggregate base material will be done in accordance with the relevant pay items associated with that work.

Documentation of this SY item for Rubblizing Pavement will be performed within the SiteManager / Daily Work Reports / Work Items tab.

a. Select the Rubblizing Pavement item from the list of contract pay items.
b. In the appropriate field, enter the station-to-station extents and a descriptive location.
c. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.
d. In the Remarks bubble, document the method used for calculating the quantity (i.e. spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.
e. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

433.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

None required.

B. Audit Requirements

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantity paid equals the plan quantity. Authorized deviations from plan quantity must be documented by a change order.

C. Protection of the Work

Ensure the full asphalt overlay is completed before opening the rubblized PCC pavement to traffic, unless otherwise required in the Plans.

Verify any conditions and locations requiring corrective action or maintenance have been successfully remedied to the satisfaction of the Resident Engineer.

433 CHECKLIST – RUBBLIZING PC CONCRETE PAVEMENT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the equipment requirements for the resonant pavement breaker (including water misting and protective screen) and steel wheel vibratory rollers been discussed?					
Have the locations for the rubblization been identified from the Plans?					
Has the test section location been designated and agreed to?					
Have the removals of asphalt overlays or asphalt patches in the existing PCC pavement been discussed?					
Has the acceptance criteria for the maximum fractioned particle size after rubblization been discussed?					
Has the acceptance criteria for steel reinforcement that is encountered during rubblization been discussed?					
Does the Contractor have a plan for maintenance and protection of traffic during the rubblization operation?					
Is the Contractor prepared to place the overlying asphalt layer in a timely manner over the rubblized pavement?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the Contractor's resonant pavement breaker (including water misting and protective screen) and steel wheel vibratory rollers meet the requirements of Section 433.03?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Did the Contractor perform the rubblization on a test section in a manner that met the maximum particle size requirements?					
Did the Contractor remove asphalt overlays and asphalt patches in the existing PCC pavement as required in the specifications?					
Is the Contractor performing the rubblization at the locations required in the Plans?					
Is the rubblized pavement meeting the maximum fractioned particle size as required in the specifications?					
Is the Contractor properly addressing the joints between the rubblized pavement and adjacent pavement to remain in place (sawing full-depth including cutting steel)?					
Has the Contractor properly addressed steel reinforcement that is encountered during rubblization as required in the specifications?					
Is the Contractor properly seating and compacting the rubblized pavement as required in the specifications?					
Is the Contractor sufficiently maintaining traffic and protecting traffic during the rubblization operation?					
Is the Contractor prepared to place the overlying asphalt layer in a timely manner over the rubblized pavement?					
Is the Contractor addressing all conditions requiring corrective action or maintenance (size of particles, seating of rubblized pavement, etc.)?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the residency project inspector verified the rubblized pavement meets the maximum fractioned particle size?					
Did the Contractor properly addressed steel reinforcement that was encountered and cut/remove any exposed steel to below the surface of the rubblized pavement?					
Did the Contractor properly seat and compact the rubblized pavement as required in the specifications?					
Is the Contractor sufficiently maintaining traffic and protecting traffic during the rubblization operation?					
Is the Contractor prepared to place the overlying asphalt layer in a timely manner over the rubblized pavement?					
Have all conditions requiring corrective action or maintenance (size of particles, seating of rubblized pavement, etc.) been adequately addressed by the Contractor?					
Has the full thickness of asphalt pavement been place prior to opening the rubblized section of pavement to traffic?					

SECTION 440 – ASPHALT SAFETY EDGE

440.01 GENERAL

This work consists of incorporating a flattened slope along the edge of narrow asphalt pavement shoulders. The asphalt safety edge is a beveled pavement edge to help lessen the severity of roadway departures. When a driver drifts off the paved surface, the safety edge provides greater ease for re-entering the roadway and reduces the risk of oversteering and loss of control of the vehicle.

Safety edge is required on asphalt concrete highway construction (permanent or temporary), on all routes, for all design speeds and types of traffic, when the following conditions exists:

- the roadway is an open section (no curb),
- the increase in pavement thickness is 2" or greater, and
- the paved shoulder width is 4 feet or less.

With the Engineer's approval, the safety edge may be constructed when the paved shoulder width is greater than 4 feet.

440.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Locations where safety edge is required in the Plans.
- Any additional locations proposed for safety edge by the Contractor.
- Review special provisions, plan notes and ODOT Standard Drawings regarding requirements for installation of safety edge.
- Methods (safety edge on each lift or for the full depth on the final lift) and equipment to be used.
- Contractor's schedule/plan for the work.
- Traffic control and maintenance of traffic during construction.

B. Acceptance of Materials

No additional specific material requirements are necessary for the construction of the safety edge. The safety edge will be constructed using the same material used to construct the adjoining pavement or shoulder. The material requirements for the relevant section used to construct the adjoining pavement or shoulder (typically Section 411) of the Standard Specifications are applicable to the material used to construct the safety edge.

C. Preparatory Work and Contractor Work Plans

Consider the following before rumble strip installation work begins.

1. Contract Plans and Specifications

Review the Standard Specifications, Special Provisions, ODOT Standard Drawings and Plan Notes and determine any specific requirements that pertain to the safety edge location and use on your project.

Review the plan Typical Sections and plan notes for the locations of safety edge required for the project. Review the requirements of the ODOT Standard Drawings for proper dimensions and construction details.

2. Contractor Proposed Equipment

The Contractor must equip the paver to ensure a 30 ± 5 degree wedge along the outside edge(s) of the roadway (measured from the horizontal plane) is in place after final compaction of the final surface course. The Contractor must use an approved mechanical device that will:

- apply compactive effort to the asphalt mixture to eliminate objectionable voids as the mixture passes through the wedge device, and
- produce a wedge with a uniform texture, shape, and density while automatically adjusting to varying heights encountered along the roadway shoulder.

D. Safety and Environmental Issues

Discuss with the Contractor its plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction to minimize inconvenience and damage to vehicles during the construction of the asphalt pavement and safety edge,
- Providing skin and eye protection for workers, and
- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place waste or other materials near or in streams or waterways.)

440.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

No additional specific material requirements are necessary for the construction of the safety edge. The safety edge will be constructed using the same material used to construct the adjoining pavement or shoulder. The material requirements for the relevant section used to construct the adjoining pavement or shoulder (typically Section 411) of the Standard Specifications are applicable to the material used to construct the safety edge.

Verify that all sampling, testing and documenting of the test results are conducted as provided in the relevant asphalt paving sections of this Manual.

B. Equipment and Methods

Verify that the equipment used produces the safety edge to the specified slope and dimensions required in the Standard Specifications, Plans and ODOT Standard Drawings.

The Contractor must equip the paver to ensure a 30 ± 5 degree wedge along the outside edge(s) of the roadway (measured from the horizontal plane) is in place after final compaction of the final surface course. The Contractor must use an approved mechanical edging device that will:

- apply compactive effort to the asphalt mixture to eliminate objectionable voids as the mixture passes through the wedge device, and
- produce a wedge with a uniform texture, shape, and density while automatically adjusting to varying heights encountered along the roadway shoulder.

In accordance with ODOT Standard Drawing PSE-2 (Note 5), all safety edges must meet the approval of the Resident Engineer. The Resident Engineer may require proof that the system proposed by the Contractor has been used on previous projects with acceptable results or may require that a test section be constructed prior to the beginning of work to demonstrate that the edge shape and compaction is to the satisfaction of the Resident Engineer.

C. Construction Operations

The asphalt safety edge is a beveled pavement edge to help lessen the severity of roadway departures. When a driver drifts off the paved surface, the safety edge provides greater ease for re-entering the roadway and reduces the risk of oversteering and loss of control of the vehicle. Research and testing have shown that a safety edge with a 30 ± 5 degree wedge provides the recoverable slope that will reduce accidents. Additional information regarding the safety edge can be found at the FHWA's Every Day Counts – Safety Edge website (Safety Edge brochure).

Verify the following complies with Section 440.04 of the Standard Specifications and the relevant ODOT Standard Drawings when constructing the safety edge required in the Plans:

1. Location Requiring Installation of Safety Edge

Review the plan Typical Sections and plan notes for the locations of safety edge required for the project. Typically, safety edge is required on asphalt concrete highway construction (permanent or temporary), on all routes, for all design speeds and types of traffic, when the following conditions exists:

- the roadway is an open section (no curb),

- the increase in pavement thickness is 2" or greater, and
- the paved shoulder width is 4 feet or less.

With the Resident Engineer's approval, the safety edge may be constructed when the paved shoulder width is greater than 4 feet.

Safety edge should not be placed at longitudinal joints in the pavement section.

2. Construction Methods and Requirements

At locations designated for safety edge installation shown in the Plans, the Contractor must attach an edging device (shoe) to the paver screed to confine material at the end gate and extrude the asphalt material in a wedge shape having an angle between 30 ± 5 degrees. Ensure the wedge is compacted sufficiently as to eliminate objectionable voids. Ensure the Contractor's paving operation maintains contact between the edging device and road shoulder surface; and allows automatic transition to crossroads, driveways, and obstructions. The device must be used in a manner to constrain the asphalt head, reducing the area and increasing the density of the extruded profile.

Ensure the subgrade or surface where the safety edge is being placed is adequately prepared for the asphalt pavement placement. Prior to paving the safety edge, the ODOT Standard Drawing PSE-2 (Note 2) requires the Contractor to grade an area 10" wide beginning at the edge of the paved shoulder to provide a level surface free of vegetation.

The safety edge shall be constructed in conjunction with the asphalt concrete pavement or shoulder as a single operation with the use of an edging device (shoe) attached to the asphalt paver screed.

The Resident Engineer may allow short sections of handwork when necessary for transitions at driveways, intersections, interchanges, and bridges.

The Contractor may construct the safety edge shape on each lift of asphalt, or on the full specified depth on the final lift. The method used by the Contractor must meet the approval of the Resident Engineer for acceptable shape and compaction sufficiently as to eliminate objectionable voids.

D. Safety and Environmental Considerations

Ensure the Contractor protects workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction that minimizes delays to the traveling public but also protects the vehicles and HMA surface from damage,
- Providing skin and eye protection for workers, and

- Properly disposing of waste materials, asphalt emulsion, etc. (Do not allow the Contractor to place concrete or other materials near or in streams or waterways.)

Discuss any issues that are not being adequately provided, including properly disposing of waste materials.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Locations (station extents, direction, lane, lift, etc.) of safety edge placed.
- The type of HMA (Superpave Type S3, Superpave Type S4, SMA, RIL, etc.) laid in conjunction with the safety edge.
- Other relevant information related to the placement of the HMA as listed in Section 411.03.E.1 of this Manual.
- Temperatures of the HMA mixture taken throughout the day (recorded in the Daily Laydown Report).
- Receipt of haul tickets (electronic tickets) of Type of HMA placed.
- Receipt of materials certifications and scale or weigher certification.
- Any conditions and locations requiring corrective action or maintenance and individual contacted.

2. Measurement and Payment

In accordance with Sections 440.05 and 440.06 of the Standard Specifications, the asphalt safety edge will not be measured separately for payment. The asphalt material used in the construction of the safety edge will be included in the tons measure and paid for as the relevant asphalt pavement pay item(s). The Contractor should include the cost to construct the safety edge in the unit price bid for the relevant asphalt pavement pay item(s) in the Contract.

440.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

No additional specific material requirements are necessary for the construction of the safety edge. The safety edge will be constructed using the same material used to construct the adjoining pavement or shoulder. The material requirements for the relevant section used to construct the adjoining pavement or shoulder (typically Section 411) of the Standard Specifications are applicable to the material used to construct the safety edge.

Verify that all sampling, testing and documenting of the test results were completed as provided in the relevant asphalt paving sections of this Manual.

B. Audit Requirements

There are no specific audit requirements for the documentation of the installation of the safety edge. The residency project inspector should document through entries on the Daily Work Report the installation of the safety edge each day that it is constructed with the adjoining asphalt pavement construction in the locations required in the Plans.

C. Protection of the Work

Ensure the safety edge is constructed in the locations required in the Plans to the shape specified in the ODOT Standard Drawing. The Contractor must backfill the edge of the asphalt pavement and safety edge locations at the required slope and with the material (soil, TBSC, etc.) in accordance with the Typical Sections shown in the Plans. Ensure the Contractor's equipment used during the backfill operations do not damage the edge of the asphalt pavement.

440 CHECKLIST – ASPHALT SAFETY EDGE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the locations of safety edge required in the Plans been discussed?					
Have the requirements of the ODOT Standard Drawings been reviewed and discussed for the proper dimensions and details for the safety edge?					
Have the equipment requirements for the edging device attached to the asphalt paver screed been discussed?					
Has the Contractor successfully used their proposed edging device on previous ODOT projects?					
Has the method of safety edge installation been discussed with the Contractor (safety edge on each lift or for the full depth on the final lift)?					
Does the Contractor have a plan for maintenance and protection of traffic during the paving operation and safety edge installation?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor installing the safety edge at the locations designated in the Plans?					
Does the safety edge meet the requirements of the ODOT Standard Drawings for the proper dimensions and details?					
Is the Contractor's equipment for the edging device attached to the asphalt paver screed constructing the safety edge to the shape and compaction required?					
Is the Contractor's method of safety edge installation being performed on each lift or for the full depth on the final lift?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor effectively maintaining and protecting traffic during the paving operation and safety edge installation?					
Is the residency project inspector documenting the installation and location of safety edge each day in the Daily Work Report?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Was the safety edge installed at the locations required in the Plans?					
Was the safety edge installed in accordance with the requirements of the ODOT Standard Drawings regarding the proper dimensions and details?					
Did the residency project inspector document the installation of safety edge each day in the Daily Work Report?					
Did the Contractor backfill the edge of the asphalt pavement and safety edge locations at the required slope and with the material (soil, TBSC, etc.) in accordance with the Typical Sections?					
Was there no damage observed at the edge of the asphalt pavement during the Contractor's backfill operations?					
Were any conditions requiring corrective action or maintenance addressed sufficiently by the Contractor?					

CHAPTER 400 – APPENDIX

- Asphalt Laydown Report (example)
- Rumble Strip Memo from Chief Engineer/Traffic Engineer

STATE OF OKLAHOMA

DEPARTMENT OF TRANSPORTATION

DAILY REPORT FOR LAYING OF ASPHALT MIXTURE

Project _____ Contract ID _____ Project # _____ Report # 1

Material _____ Line Item # _____ Specification Item _____ Date _____

A Red Triangle denotes a Cell Comment; read all comments on this sheet then delete this.

Inspector Measurements for Area Calculations

Course	Group	Sta. to Sta. or Location		LF / Rad.	Lane / Exp	Width (ft.)	Thick (in.)	Group 1 Mainline / Shoulder / Ramps S.Y.	Group 1 Tons	Group 2 Drives / Med. Open / Misc. S.Y.	Group 2 Tons	Group 3 Temp. / Detour / X-Over S.Y.	Group 3 Tons
							Daily Totals	0.0	0.00	0.0	0.00	0.0	0.00

Surface Temperature @ Start											
Time											
Mix Temp.											

Weather: AM _____ PM. _____ Temp.Min. _____ Temp.Max. _____

Notes / Descriptions / Misc.

Measure Units	Mainline / Shoulder / Ramps S.Y.	Mainline / Shoulder / Ramps Tons	*Drives* / Med. Open / Misc. S.Y.	*Drives* / Med. Open / Misc. Tons	Temp. / Detour / X-Over S.Y.	Temp. / Detour / X-Over Tons
Total Previous Reports						
Total This Report	0.0	0.00	0.0	0.00	0.0	0.00
Group Job Total	0.0	0.00	0.0	0.00	0.0	0.00
Pounds / SY Required	0.0		0.0		0.0	
Pounds / SY Laid						
Group 1 Daily Yield						

Total Tons Represented This Report 0.00

Line Item Total Tons Placed to Date 0.00

Inspector Signature _____

Inspector

OKLAHOMA DEPARTMENT OF TRANSPORTATION

Traffic Engineering Division
200 N.E. 21st Street
Oklahoma City, OK 73105-3204
www.odot.org

DATE: July 20, 2016

TO: Field Division Engineers

FROM: Casey Shell, Chief Engineer
Harold Smart, Chief Traffic Engineer DG for HS

SUBJECT: **SHOULDER RUMBLE STRIP POLICY – (Replaces all previous revisions)**

SRS Committee Members (2011):

Gary Evans, Casey Shell, David Streb, Faria Emamian, Randy Lee, Shawna Robb, and David Glabas.

SRS Committee Members (2016):

David Glabas, James Farris, and Hebret Bokhru.

Definition Shoulder Rumble Strip (SRS):

A SRS is a longitudinal safety feature installed on a paved roadway shoulder near the outside edge of the travel lane. It is made of a series of milled (or raised) elements intended to alert inattentive drivers (through vibration and sound) that their vehicles have left the travel lane.

Purpose of SRS:

SRS are intended to provide motorists with an audible and tactile warning that they are approaching a decision point of critical importance to their safety or that their motor vehicles have partially or completely left the travel lane. Noise generated as the motor vehicle tires pass over the rumble strip provides an audible warning to the motorist, while vibration induced in the motor vehicle by the rumble strips provides a tactile warning.

Policy:

1. **Shoulder Widths**
   - On standards and/or policies, the types of shoulders shall only be divided into two categories:
     - Equal to 4 feet or less
     - Greater than 4 feet

2. **Distance from the longitudinal joint between the shoulder and driving lane AND width of rumble strip**
    - Equal to 4 feet or less: 3 to 6 inches from joint with a width of 12 inches Greater than 4 feet: 6 to 12 inches from joint with a width of 16 inches.

3. **Gaps for Highway/Roadway Intersections, and Bridges**
    - Where a roadway intersects the highway, the SRS shall be broken across the roadway from the tangent point of one radius to the tangent point of the other radius.
    - SRS shall not be milled or depressed into bridge decks. Discontinue SRS at the approach slab or end of bridge.

4. **Gaps for Highway/Driveway Intersections**
    - Where a driveway intersects the highway, the SRS shall not be broken. There could be exceptions to this policy if the field Division Engineer, or his/her representative, determines the driveway to be a heavily used commercial driveway. If an exception is made, the location and extent of the break is to be determined by the field Division Engineer or his/her representative.

5. **Cyclical Gaps for Bicycles**
    - Gap: The gaps shall be 10 feet long.
    - Length and cycle of rumble strips: The length of the continuous SRS shall be 50 feet, and with a 10 foot gap, this completes a cycle of 60 feet. Immediately following any other gaps (e.g. intersecting roads, etc.) the continuous portion of the 50 foot SRS shall start over. In other words, a 10 foot gap shall not be placed adjacent or very close to, other gaps that occur for other reasons within this policy.

6. **Speed and City Limits**
    - SRS shall not be placed in areas in which the regulatory speed limit is 50 mph or less.

7. **Pavement Thickness and Condition**
    - SRS to be milled on an adequate pavement with pavement thickness not less than 1 1/2 inches; or reviewed on a case by case basis.
    - Lanes with pavement in good condition and no distress; or reviewed on a case by case basis.

8. **Fog Seal**
    - Fog seal shall not be used.

For more information refer to the Standard drawing Sheets RS1-1, RS2-1, and RS3-1 (T-611 to T-613) for more details.

Sources:

FHWA Technical Advisories (T 5040.39, Revision 1), November 7, 2011;
NCHRP Report 641 – Guidance for the Design and Application of Shoulder and Centerline Rumble Strips;
Oklahoma DOT Modification of Rumble Strip Standards (Final), March 25, 2011.

OKLAHOMA DEPARTMENT OF TRANSPORTATION

Traffic Engineering Division
200 N.E. 21st Street
Oklahoma City, OK 73105-3204
www.odot.org

DATE: July 20, 2016

TO: Field Division Engineers

FROM: Casey Shell, Chief Engineer
Harold Smart, Chief Traffic Engineer DG for HS

SUBJECT: **CENTER LINE RUMBLE STRIP POLICY**

CLRS Committee Members:

David Glabas, James Farris, Hebret Bokhru, Buck Miller, and Chad Pendley.

Definition Center Line Rumble Strip (CLRS):

A CLRS is a longitudinal safety feature installed at or near the center line of a paved roadway, between opposing lanes of traffic. It is made of a series of milled (or raised) elements intended to alert inattentive drivers that their vehicles have left the travel lane – through vibration and sound.

Purpose of CLRS:

CLRS is used to alert drivers that they have crossed into the path of oncoming traffic. CLRS have potential to reduce cross-over crashes; for example, head-on and sideswipe crashes. They may also reduce run-off-road (ROR) to the left crashes on two-lane roads. When used in conjunction with shoulder rumble strips (SRS), they may reduce drift-out-of-lane crashes, as both the left and right sides of the travel lane are protected.

Policy:

1. **General**
   - Should be installed along 2-lane and multilane undivided highways (non-interstates and expressways) in rural and some urban areas. Install continuously in passing and non-passing zones.
   - Priority should be given to highways with history of pre-defined crashes, as established by the Strategic Highway Safety Plan (SHSP) or the yearly collision digest.

- CLRS to be milled on an adequate pavement with pavement thickness not less than 1 1/2 inches; or reviewed on a case by case basis.
- Should not be required for highways with ADT less than 1,500, unless supported with history of pre-defined crashes and/or recommended by the field Division Engineer or his/her representative.
- Should be installed on both solid yellow lines of a striped paved median with crosshatch markings, in a three-lane-two-way highway.
- Fog seal shall not be used.

2. **Pavement Widths**
   - Rural 2-lanes, lanes $\geq$ 11 ft. (lanes $\geq$12 ft. where shoulder rumble strips are present).
   - Lanes with pavement in good condition and no distress; or reviewed on a case by case basis.

3. **Profile and spacing of CLRS**
   - CLRS to be 16 inches wide – dimension perpendicular to centerline, and 7 inches long – dimension along the centerline.
   - Install CLRS at 24 inches $\pm$3 inches on center continuously with gaps as required by this policy.

4. **Gaps for Highway/Roadway Intersections, Bridges, and Raised Concrete Islands**
   - Where a roadway intersects the highway, the CLRS shall be broken across the roadway from the tangent point of one radius to the tangent point of the other radius.
   - CLRS shall not be milled or depressed into bridge decks. Discontinue CLRS at the approach slab or end of bridge.
   - CLRS should be discontinued 25 ft. in advance of raised concrete islands.

5. **Gaps for Highway / Driveway Intersections**
   - Where a driveway intersects the highway, the CLRS shall not be broken. There could be exceptions to this policy if the field Division Engineer, or his/her representative, determines the driveway to be a heavily used commercial driveway. If an exception is made, the location and extent of the break is to be determined by the field Division Engineer or his/her representative.

6. **Speed and City Limits**
   - CLRS shall not be placed in areas in which the regulatory speed limit is 50 mph or less.

7. **Pavement Markings**

- Apply pavement markings over the CLRS for normal centerline spacing. The preference to use of multi-polymer, thermoplastic and paint pavement marking will be left to the field Division Engineer, or his/her representative, until ODOT, through studies, determines best pavement markings for CLRS.

For more information refer to the Standard drawing Sheets RS1-1, RS2-1, and RS3-1 (T-611 to T-613) for more details.

Sources:

FHWA Technical Advisories (T 5040.40, Revision 1), November 7, 2011;
NCHRP Synthesis 339 – Centerline Rumble Strips A Synthesis of Highway Practice, 2005;
State Rumble Strip Policy Survey by Minnesota DOT (June 2015); and
Oklahoma DOT Modification of Rumble Strip Standards (Final), March 25, 2011.