STATE OF DELAWARE

DEPARTMENT OF TRANSPORTATION

DESIGN-BUILD PROJECT

for

STATEWIDE PIPE REPLACEMENTS

State Contract # T201607002
Federal Contract # EBROS-2016(26)

RFP

PART 4 SPECIAL PROVISIONS

PART 4 - SPECIAL PROVISIONS

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MEASUREMENT, BASIS OF PAYMENT AND CONSTRUCTION ITEM NUMBERS

The Method of Measurement and Basis of Payment sections in the following Special Provisions are modified to indicate that there will be no separate measurement for any activities or Work performed as part of the Contract. Compensation for performing the Work as outlined in the Special Provision shall be included in the Design-Builder's Lump Sum Contract Price.

Standard Item Number:

The first three digits of the construction item numbers indicates the Section number as described in the Standard Specifications, and all applicable requirements of the Section shall remain effective unless otherwise modified by the Special Provisions. The last three digits of the construction item identifies the item by sequential number under that Section. Sequential numbers for all items covered under Standard Specifications range from 000 to 499. A comprehensive list of construction item numbers can be found in Appendix IV of the Standard Specifications. Additions to this list will be made as required.

Special Provisions Item Number:

The first three digits of the construction items, covered under Special Provisions, indicates the applicable Section number of the Standard Specifications, and shall be governed fully by the requirements of the Special Provisions. The last three digit of the items covered under Special Provisions identifies the item by sequential number. Sequential numbers for Special Provision items, range from 500 to 999.

Examples

Standard Item Number - 202000 Excavation and Embankment

202 Indicates Section Number 000

Indicates Sequential Number

Special Provision Item Number - 202500 Grading and Reshaping Roadway

202 Indicates Section Number 500

Indicates Sequential Number

SPECIAL PROVISION 108C
KEY PERSONNEL QUALIFICATIONS AND REQUIREMENTS

In the qualifications specified below, the word “shall” indicates a required minimum qualification. The word “should” indicates the Delaware Department of Transportation’s preferred qualifications, but such qualification is not a mandatory requirement.

Principal-in-Charge

Shall have a minimum of 20 years of experience in transportation construction projects that included work on projects with similar scope, nature, and complexity as this Project. The Principal-in-Charge shall have served in a similar role on a minimum of one prior project of similar scope, nature, and complexity as this Project.

Construction Project Manager

Shall have a minimum of 15 years of experience in management of transportation construction projects that included work of a similar scope, nature, and complexity as this Project. The Design-Build Construction Project Manager shall have served in a similar role on a minimum of one prior project of similar scope, nature and complexity as this Project. The Design-Builder's Construction Project Manager shall be the Design-Builder’s representative and single point of contact for all project management and administrative activities during execution of the Work.

Construction Superintendent

Shall have a minimum of 10 years of experience in overseeing construction of transportation construction projects that included work of a similar scope, nature, and complexity as this Project. The Design-Build Construction Superintendent shall have served in a similar role on a minimum of one prior project of similar scope, nature and complexity as this Project. The Design-Builder's Construction Superintendent shall be assigned and available on the project site while construction work is being performed and be the Design-Builder’s representative and single point of contact in the field during execution of the Work.

Design Manager

The Design Manager shall be a registered professional Project Manager in the State of Delaware and shall have a minimum of 15 years of experience in transportation design, including coordination of all required Project Managering disciplines. The Design Manager shall have served in a similar role on a project of similar scope, nature, and complexity as this Project. Diverging Diamond experience is desirable but not required.

Roadway Project Manager

The Roadway Project Manager shall be a registered professional Project Manager in the State of Delaware and shall have a minimum of 5 years of experience on roadway design on projects of similar scope, nature, and complexity as this Project. Diverging Diamond experience is desirable but not required.

Environmental and Permits Manager

The Environmental and Permits Manager shall have a minimum of 10 years of experience managing environmental planning, design, permitting and compliance including NEPA, stormwater, drainage, erosion and sediment control on projects of similar scope, nature, and complexity as this Project.

Utility Manager

The Utility Manager shall have a minimum of 10 years of experience managing utility coordination, design and construction on projects of similar scope, nature, and complexity as this Project.

202560 - CONTAMINATED MATERIAL

Description:

Contaminated Material is defined as solids or liquids (including soil) potentially contaminated with a hazardous substance, requiring special handling and/or disposal per state or federal regulation.

This work describes the excavation, removal and treatment/disposal of contaminated materials resulting from project construction including utility and other types of excavation activities in accordance with the locations and notes on the Plans, and as directed by the Engineer or the Department's environmental representative. The Contractor will be notified of the Department's environmental representative at the pre-construction meeting.

Overview of Costs:

Potential contaminated solids may affect contractor's costs as follows;

Additional cost to normal excavation requirements:

-Cost of 8 mil plastic for placement under and over solid contaminated material,

-Maintaining the segregated contaminated solids staging area.

Reduced cost to normal excavation requirements:

-Not required to, or charged for, transport of contaminated material from site.

-Not required to, or charged for, disposal of contaminated soil.

Potential contaminated liquids will affect contractor’s cost as follows;

Additional cost to normal excavation requirements:

-None

Reduced cost to normal excavation requirements:

-None

Construction Methods and Responsibilities:

Contractor's Responsibilities for potential contaminated solids:

The Contractor shall be responsible for providing the appropriate equipment and personnel necessary to excavate, stage, and load contaminated material for off-site disposal, as identified from previous site environmental investigations or identified during construction activities. The work will be performed in accordance with the procedures described in the site specific "Contaminated Material and Water Removal Work Plan" prepared by the Department's environmental representative. The Department will provide a copy of this plan after the project is awarded and before any work begins. The Contractor shall adhere to applicable Occupational Safety and Health standards, Guidelines and/or Laws. This will include compliance with 29 CFR Part 1910.

After award of the Contract, the Contractor shall immediately be responsible for notifying the Department's HAZMAT Program Manager’s office (760-2463) for scheduling coordination with the environmental representative. The contractor shall submit a proposed schedule of work to the Department for review and approval prior to any commencement of work on this site. The Contractor is required to perform to a high standard of workmanship to assure protection of workers, local water supplies, and the environment. The Contractor shall coordinate with the utility companies prior to excavation. The Department's environmental representative shall be present during all phases of work associated with the excavation and removal of potentially contaminated material. Payment will not be made for any work done when a Department approved Inspector or environmental representative is not present to provide environmental oversight.

Specific tasks to be performed by the Contractor will include excavating soil per the project specifications. The Contractor will segregate "contaminated" soil as designated by the Department or their environmental representative, from "clean" soil and place the "contaminated" soil in a designated on-site staging area constructed by the Contractor. At a minimum the staging area needs to be lined with 8-mil plastic and a berm constructed to minimize storm water run-off. The "contaminated" soil will need to be covered by the Contractor at the end of each work day. The Contractor will be responsible for loading contaminated soil onto trucks arranged by the Department's environmental representative on the days the contaminated soil is shipped off-site to a licensed disposal/treatment facility. The Contractor will backfill and compact the excavated area(s) according to the project specifications and payment will be made under that item of the Contract.

Department's Responsibilities:

The Department is responsible for providing and paying; the environmental representative; the transportation of contaminated material for disposal; and the disposal of contaminated material.

The "Contaminated Material and Water Removal Work Plan" will identify; the procedures to be used to excavate and stage the contaminated material; the licensed treatment/disposal facility where the Department will ship the contaminated material; the method the material will be transported to the treatment/disposal facility; and any additional health and safety requirements for site personnel.

The Department's environmental representative will conduct a health and safety briefing prior to commencement of activities on the sites to insure an understanding of all applicable standards, guidelines, laws, procedures, etc. consistent with the successful completion of this type of activity. The Department's environmental representative will conduct air monitoring during any excavation activities at the site to identify and mitigate fire, explosion and vapor hazards.

The Department's environmental representative shall coordinate the excavation activities with all applicable local, state, and federal environmental regulatory agencies. The Department's environmental representative will also oversee the excavation, removal and treatment/disposal of the material in the designated area(s) and perform such tests as field screening for soil contamination utilizing vapor monitoring techniques and collect soil samples for laboratory analysis to meet the requirements of the treatment/disposal facility, DNREC and/or the USEPA. The Department's environmental representative's personnel will subcontract with the disposal/treatment facility to provide transportation and disposal/treatment of all contaminated materials to be removed as part of the project. The Department's environmental representative is responsible for measuring the quantity of contaminated material removed, via certified scale weights, for the Department's records.

Method of Measurement:

The quantity of contaminated material will not be measured.

Basis of Payment:

Payment for Contaminated Materials will be included in the Lump Sum Contract Price. Payment constitutes full compensation for handling contaminated material as described herein and for excavation, constructing and maintaining the segregated soil staging area, placement of the contaminated soil in the staging area, providing plastic and daily covering of the segregated soil staging area, and loading of contaminated soil for removal by the Department.

This item is a contingency item and the Department reserves the right to delete from the Contract. The Contractor shall make no claims for additional compensation because of deletion of the item.

401502 - ASPHALT CEMENT COST ADJUSTMENT

For Sections 304, 401, 402, 403, 404, and 405, payments to the Design-Builder shall be adjusted to reflect increases or decreases in the Delaware Posted Asphalt Cement Price when compared to the Project Asphalt Cement Base Price, as defined in these Special Provisions.

The Delaware Posted Asphalt Cement Price will be issued monthly by the Department and will be the industry posted price for Asphalt Cement, F.O.B. Philadelphia, Pennsylvania. The link for the posting is http://www.deldot.gov/information/business/bids/asphalt_cement_english.shtml.

The Project Asphalt Cement Base Price will be the Delaware Posted Asphalt Cement Price in effect on the date of advertisement.

All deviations of the Delaware Posted Asphalt Cement Price from the Project Asphalt Cement Base Price are eligible for cost adjustment. No minimum increases or decreases or corresponding percentages are required to qualify for cost adjustment.

Actual quantity of asphalt cement qualifying for any Asphalt Cement Cost Adjustment will be computed using the weight of eligible asphalt that is shown on the QA/QC pay sheets as a percentage for the delivered material.

If the mix was not inspected and no QA/QC pay sheet was generated, then the asphalt percentage will be obtained from the job mix formula for that mix ID.

The asphalt percentage eligible for cost adjustment shall only be the virgin asphalt cement added to the mix.

There shall be no separate payment per ton cost of asphalt cement. That cost shall be included in the Lump Sum Contract Price, and Unit Prices listed on Form SOV for those items that contain asphalt cement (mentioned above).

The Asphalt cement cost adjustment will be calculated on grade PG 64-22 asphalt regardless of the actual grade of asphalt used. The Project Asphalt Cement Base Price per ton for the project will be the Delaware Posted Asphalt Cement Price in effect on the date of project advertisement.

If the Design-Builder exceeds the authorized allotted completion time, the price of asphalt cement on the last authorized allotted work day, shall be the prices used for cost adjustment during the time liquidated damages are assessed. However, if the industry posted price for asphalt cement goes down, the asphalt-cement cost shall be adjusted downward accordingly.

NOTE:

Application of Asphalt Cement Cost Adjustment requirements as indicated above shall apply only to those contracts involving items related to bituminous base and pavements, and with bitumen, having a total of 1,000 tons or more of hot-mix bid quantity in case of Sections 401, 402 and 403; and 15,000 gallons or more in case of Sections 304, 404 and 405.

5/05/15

401752 SAFETY EDGE FOR ROADWAY PAVEMENT

Description:

This work consists of the construction of safety edge(s) along bituminous concrete pavement or P.C.C. pavement in accordance with the details and notes on the Plans and as directed by the Project Manager.

Construction Methods:

The safety edge shall not be constructed adjacent to curb or in front of guardrail sections.

In bituminous concrete pavement sections, prior to the construction of the safety edge, the fill or in situ material at the edge of pavement shall be compacted so that it is level with the top of the pavement, prior to the final surface overlay.

In bituminous concrete pavement sections, the Design-Builder shall attach a device to the screed of the paver unit that confines the material at the end of the gate and extrudes the asphalt material in such a way that results in a compacted wedge shape pavement edge of 32 degrees (+/- 2 degrees). Contact shall be maintained between the device and the road shoulder surface. The device shall be manufactured so that it can be easily adjusted to transition at cross roads, driveways and obstructions without stopping the paver unit. The device=s shape shall constrain the asphalt and cause compaction, as well as increase the density of the extruded profile.

In bituminous concrete pavement sections, the Transtech Shoulder Wedge Maker, Carlson Safety Edge End Gate or an approved equal shall be used to produce the safety edge. Contact information for these wedge shape compaction devices is listed below:

Transtech Systems, Inc.
1594 State Street
Schenectady, NY 12304
1-800-724-6306
www.transtechsys.com

or

Carlson Paving Products
18425 50th Ave. E
Tacoma, WA 98446
1-253-278-9426
www.carlsonpavingproducts.com

or an approved equal.

In P.C.C. pavement sections, the paver screed shall be modified to provide a chamfer at the end of the P.C.C. pavement in accordance with the details and notes on the Plans, or as directed by the Project Manager.

Method of Measurement:

Safety Edge will not be measured for payment.

Basis of Payment:

The cost associated with the construction of safety edge(s), including but not limited to the wedge device, preparation and compaction of the fill or in situ material, and placement of the safety edge in accordance with the Plans and Details will be included in the Lump Sum Contract Price. Payment constitutes full compensation for furnishing and installing all materials; for preparation of the pavement and for all labor, tools, Equipment and incidentals required to complete the work as specified and as directed by the Project Manager.

401699 - QUALITY CONTROL/QUALITY ASSURANCE OF BITUMINOUS CONCRETE

.01 Description.

This item shall govern the Quality Control/Quality Assurance Testing for supplying hot-mix asphalt plant materials and constructing hot-mix asphalt pavements.

The Contractor shall be responsible for providing the quality level of materials and construction incorporated into the Contract that will meet the requirements of the Contract. The Contractor shall perform all necessary quality control inspection, sampling, and testing. The Engineer will evaluate all materials and construction for acceptance. The procedures for Quality Control and Acceptance are described in this Section.

.02 Definitions.

- **Acceptable Quality Level (AQL):** That level of percent within limits (PWL) to which the Engineer will consider the work completely acceptable.
- **Acceptance Plan:** Factors that comprise the Engineer's determination of the degree of compliance with contract requirements and value of the product. These factors include the Engineer's sampling, testing, and inspection.
- **Delaware Asphalt Pavement Association (DAPA):** The organization representing the interests of hot-mix asphalt producers and Contractors. The Engineer has a copy of the DAPA officers' names and point(s) of contact.
- **Dispute Resolution:** The procedure used to resolve conflicts resulting from discrepancies between the Engineer's and the Contractor's results of sufficient magnitude to impact payment. The testing will take place at a location and time mutually agreeable by both the Engineer and the Contractor.
- **Full Depth Construction –** Construction of an adequate pavement box on a subgrade and subbase prepared by the contractor
- **Independent Assurance:** An unbiased and independent verification of the Quality Assurance system used, and the reliability of the test results obtained in regular sampling and testing activities. The results of Independent Assurance are not to be directly used as a basis of material acceptance.
- **Job Mix Formula (JMF)/Mixture Identification (ID):** The target values for individual aggregate size gradation percentages and the asphalt percentage, the sources of each of the component materials, the proposed proportions of component materials to be used to meet those target values, the asphalt proportion, and the mixing temperature. The Engineer will assign uniquely individual mixture identification for each JMF submitted and approved.
- **Lower Quality Index (QL):** The index reflecting the statistic related to the lower boundary to which a sample (or sample statistic) may deviate from the target value and still be considered acceptable.
- **Mean:** A statistical measure of the central tendency – the average value.
- **Operational Day:** A day in which the Engineer has approved a lane closure for the Contractor to perform work within an approved MOT plan.
- **Percent Within Limits (PWL):** That amount of material or workmanship that has been determined, by statistical method, to be within the pre-established characteristic boundary(ies).
- **Qualified Laboratory:** A laboratory mutually agreed upon by both DAPA and the Engineer as having proper test equipment that has been calibrated in accordance to AASHTO.
- **Qualified Technician:** Personnel mutually agreed upon by both DAPA and the Engineer as having adequate training, experience, and abilities to perform the necessary testing. The minimum qualifications are either a recognized nationally accredited or certified Superpave testing certificate or been working in hot-mix asphalt testing for at least one year.

- **Quality Assurance (QA):** All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

- **Quality Control (QC):** The sum total of the activities performed by the Contractor in order to assure that the product meets contract requirements.

- **Quality Control (QC) Plan:** The detailed description of the type and frequency of inspection, sampling, and testing deemed necessary to measure and control the various properties governed by the Specifications. The QC Plan must address the actions needed to keep the process in control, detect when the process is going out of control, and responses to correct the situation(s).

- **Quality Level Analysis:** A statistical procedure that provides a method for estimating the percentage of each lot or sublot of material, product, item of construction, or completed construction that may be expected to be within specified tolerances.

- **Standard Deviation:** A term used in statistics to indicate the value calculated from the square root of the difference between the individual measurements in a group and their average. Standard deviation is calculated by taking the square root of the sum of the squares of the differences of each of n values and the mean value, this sum first divided by (n-1).

- **Target Value:** The acceptable value for a controlling characteristic of a product. The JMF will establish each of these values for the material.

- **Test Methods:** Shall be AASHTO test methods. Copies of these test methods shall be available at each qualified laboratory.

- **Upper Quality Index (QU):** The index reflecting the statistic related to the upper boundary to which a sample (or sample statistic) may deviate from the target value and still be considered acceptable.

- **Volumetric Properties:** Air voids, voids in mineral aggregates (VMA), voids filled with asphalt (VFA), and dust to effective asphalt.

.03 Equipment.

(a) Material Production Test Equipment.

The Contractor shall establish, maintain, and operate a qualified testing laboratory at the production plant site of sufficient size and layout that will accommodate the testing operations of both the Contractor and the Engineer. The Contractor shall maintain all the equipment used for handling, preparing, and testing materials in proper operating condition. For any laboratory equipment malfunction, the Contractor shall remedy the situation within one working day or the Engineer may reject production. In the case of an equipment malfunction, and while waiting for repairs to equipment, the Engineer may elect to test the material at either another production facility or the Engineer's laboratory to obtain payment factors.

The following shall be the minimum calibrations for the referenced equipment:

- SUPERPAVE^{R} Gyratory Compactor: once every year; verified once every month by the Engineer.

- Ovens: once every three months, verified once every month.

- Vacuum Container and Gauge (Rice Bowls): once every three months, verified once every month.

- Balances and Scales: once every year, verified once every month.

- Thermometers: once a year; verified once every month.

- Gyratory Compactor molds and base plates: once every year

- Mechanical Shakers: once every year

- Sieve Verifications: once every year

All calibrations shall be documented and on file for review by the Engineer at any time.

(b) Pavement Construction Test Equipment.

The Contractor shall furnish and use in-place density gauges, or coring equipment, or both, as necessary to meet the requirements of these Specifications.

.04 Quality Control (QC) Plan.

(a) Material Production QC.

(1) Job Mix Formula – Material Production.

The Contractor shall submit for approval to the Engineer the job mix formula (JMF) design of the component materials and target characteristic values for each mixture proposed for use. Once the JMF is submitted to the Engineer, the Engineer will have up to three weeks to review the submitted information. However, a provision for a more timely approval is available to the Contractor; first, the Contractor shall submit the proper documentation on Pinepave mixture design software for the Engineer's approval. After that approval from the Engineer, the Contractor shall produce the new mixture for a non-Department project. The Engineer will test the material, by taking three series per the specifications. If the Engineer's test results are within the specifications, then the mixture will be approved by the Engineer for Department projects.

The component materials design shall include designating the source and the expected proportion (within 1 percent for the aggregate components, and within 0.1 percent for the other components) of each component to be used in order to produce workable hot-mix asphalt having the specified properties. For plant component feed adjustments, RAP can be considered in the same manner as an individual aggregate component. The JMF target characteristic values include the mixing temperature range, core temperature range for gyration, the percentage of the asphalt cement component (both total and virgin), and the percentages of the aggregate amounts retained on the sieves to be addressed by the JMF as shown in Table 1.

The Contractor shall provide an ignition oven correction number for each JMF. The Contractor shall also supply to the Engineer weighed material of each JMF so correction numbers can be established for the Engineer's equipment for Dispute Resolution samples.

Prior to starting production of a new mixture, the Contractor shall submit a JMF. For any mixture that has a 20% or greater failure rate on any combined volumetric criteria, the JMF will not be approved for use on Department contracts. In order to be approved, a re-design of the mixture will have to be completed by the Contractor for review and approval by the Engineer. The Contractor shall uniquely title each JMF. The Contractor shall submit test data with each JMF and tests performed by a Qualified Laboratory on representative materials, verifying the adequacy of the design. Refer to the specifications for each mix type in order to determine the design requirements. The JMF sieve percentage values shall conform to the ranges shown in Table 1.

If there is a change in the source of any of the component materials, other than asphalt, if there is a change in the proportions of the aggregate components or the percent passing for each sieve by more than 5 percent from the submitted JMF, or if there is a change in the percentage of the asphalt cement component by 0.2 percent or more, which causes the volumetrics to change from the originally submitted JMF, a new JMF is required. Also, if the asphalt cement target percentage is lowered, all volumetric criteria must still be achieved.

According to the Contractor's QC Plan, the Contractor shall inform the Engineer of any proposed changes to an existing JMF. The Contractor shall notify the Engineer by electronic mail of the proposed changes. The Engineer will reply to the proposed changes within one operational day and notify the Contractor of the effective date of the changes.

Although a new JMF is not required, the Contractor must notify the Engineer of any change in the proportions of the components. This notification shall include the total change made from the approved JMF proportions, and the effective time of the change.

All submitted JMF's shall correspond to the Pinepave mixture design software. The Engineer, for evaluation of the submitted JMF, will use the first three test samples. These test results acquired during production shall be within the following range compared to the submitted JMF on the Pinepave mixture design software: G_{mm}: + / -0.030 and G_{mb}: + / - 0.040

Table 1 - Aggregate Gradation - JMF and Control Point Information

Sieves to be addressed by JMF/Range values are percentages passing by weight

Sieve Size mm (inch)	**4.75 mm**	**4.75mm Range**	**9.5 mm**	**9.5mm Range**	**12.5 mm**	**12.5mm Range**	**19.0 mm**	**19.0mm Range**	**25.0 mm**	**25.0mm Range**
37.5(1.5)	No		No		No		No		Yes	100
25.0(1.0)	No		No		No		Yes	100	Yes	90-100
19.0 (3/4)	No		No		Yes	100	Yes	90-100	Yes	20-90
12.5(1/2)	Yes	100	Yes	100	Yes	90-100	Yes	23-90	Yes	
9.5 (3/8)	Yes	95-100	Yes	90-100	Yes	28-90	Yes		Yes	
4.75(#4)	Yes	90-100	Yes	32-90	Yes		Yes		Yes	
2.36(#8)	Yes		Yes	32-67	Yes	28-58	Yes	23-49	Yes	19-45
(#16)	Yes	30-60	Yes		Yes		Yes		Yes	
(#30)	Yes		Yes		Yes		Yes		Yes	
(#50)	Yes		Yes		Yes		Yes		Yes	
(#100)	Yes		Yes		Yes		Yes		Yes	
.075(#200)	Yes	6-12	Yes	2-10	Yes	2-10	Yes	2-8	Yes	1-7

(2) Process Control – Material Production.

The Contractor shall submit in writing (letter or electronic mail) a QC Plan from each proposed production plant to the Engineer; no hot-mix asphalt material will be accepted until the Engineer approves the QC Plan. This plan must be submitted to the Engineer on an annual basis for review and approval prior to material production. The Engineer will send a signed copy back to the Contractor stating that it is approved. The approved QC Plan shall govern contractor operations.

The following are considered significant violations to the Contractor's QC Plan:

- Using testing equipment that is knowingly out of calibration or is not working properly.
- Reporting false information such as test data, JMF information, or any info requested by DelDOT
- When the Contractor fails to comply to their approved QC Plan in reference to materials testing
- Substantial deviations to AASHTO or DelDOT procedures when running tests, sampling stockpiles, or testing hot mix.
- The use of any material not listed in the JMF.
- The use of the wrong PG graded asphalt.
- If samples fall within the Contractors action points in the QC Plan but the Contractor fails to take the corrective action in the approved QC Plan

If a Contractor is found in violation of any of these items, they will receive a written warning for their first violation. If the Contractor is found in violation a second time on any of the criteria, they will forfeit any bonus from that day's production. If the Contractor is found in violation a third time on any of the criteria, they will receive a five percent (5%) deduction for that day's production. If the Contractor is found in violation a fourth time, the plant will not be approved for production until such time that the Contractor addresses the violation of the QC plan to the satisfaction of the Engineer. If the Engineer approves the changes in advance, the Contractor may make changes to the QC Plan. All changes shall be submitted and approved in writing by the Engineer.

The QC Plan shall include actions that will assure all materials and products will conform to the specifications, whether manufactured or processed by the Contractor, or procured from suppliers, subcontractors, or vendors. The Contractor shall perform the inspection and tests required to substantiate product conformance to contract requirements. The Contractor shall document QC inspections and tests, and provide copies to the Engineer when requested. The Contractor shall maintain records of all inspections and tests for at least one year. The records shall include the date, time, and nature of deficiency or deficiencies found; the quantities of material involved until the deficiency was corrected; and the date, time, and nature of corrective actions taken.

In the QC Plan, the Contractor shall detail the type and frequency of inspection, sampling, and testing deemed necessary to measure and control the various properties of material and construction governed by the Specifications. The QC Plan shall include the following elements as a minimum:

- Production Plant – make, type, capacity, and location.
- Production Plant Calibration – components and schedule; address documentation.
- Personnel – include name and telephone number for the following individuals:
  - Person responsible for quality control.
  - Qualified technician(s) responsible for performing the inspection, sampling, and testing.
  - Person who has the authority to make corrective actions on behalf of the Contractor.
- Testing Laboratory – state the frequency of accuracy checks and calibrations of the equipment used for testing; address documentation.
- Locations where samples will be obtained and the sampling techniques for each test
- Load number of QC samples (1-10 if QA sample is not within trucks 1-10)
- Tests to be performed and their normal frequency; the following, at a minimum, shall be

conducted:

- Mixture Temperature: each of the first five trucks, and each load that is sampled for QC or acceptance testing.
- Gradation analysis of aggregate (and RAP) stockpiles – one washed gradations per week for each aggregate stockpile; RAP: five gradations and asphalt cement contents for dedicated stockpiles where new material is not being added; one gradation and asphalt cement content test per week for stockpiles where material is continually being added to the stockpile.
- Gradation analysis of non-payment sieves
- Dust to effective asphalt calculation
- Moisture content analysis of aggregates – daily.
- Gradation analysis of the combined aggregate cold feed – one per year per mixture.
- Bulk specific gravity and absorption of blended material – one per year per mixture.
- Ignition Oven calibration – one per year per mixture.
- Hot-Bins: one per year per mixture.
- Others, as appropriate.

- Procedures for reporting the results of inspection and tests (include schedule).
- Procedures for dealing with non-compliant material or work.
- Presentation of control charts. The Contractor shall plot the results of testing on individual control charts for each characteristic. The control charts shall be updated within one working day as test results for each sublot become available. The control charts shall be easily and readily accessible at the plant laboratory. The following parameters shall be plotted from the testing:
  - Asphalt cement content.
  - Volumetrics (air voids, voids in mineral aggregates [VMA])
  - Gradation values for the following sieves:
    - 4.75 mm (#4).
    - 2.36 mm (#8).
    - 0.075 mm (#200).
- Operational guidelines (trigger points) to address times when the following actions would be considered:
  - Increased frequency of sampling and testing.
  - Plant control/settings/operations change.
  - JMF adjustment.
  - JMF change (See Section .04(a)(1)).
  - Change in the source of the component materials.

- Calibration of material production equipment (asphalt pump, belt feeders, etc.).
- Rejection of material.

When any point of non-compliance with the QC plan, or material not meeting the Specifications, comes to the attention of either the Contractor or the Engineer, the other party shall be notified immediately, and the Contractor shall take appropriate corrective actions. Failure to take corrective actions immediately shall be cause for rejection of material or work by the Engineer.

(b) Pavement Construction – Process Control.

The Contractor shall perform Quality Control of pavement compaction by testing in-place pavement with a density gauge or by testing cores extracted from the pavement. The use of the nuclear density gauge shall conform to ASTM D2950; the use of other density gauges shall be as per the manufacturer's recommendations and approved by the Engineer. The Contractor may use any method to select locations for the Quality Control.

.05 Acceptance Plan.

(a) Material Production – Tests and Evaluations.

The Engineer will conduct acceptance tests. The Engineer will directly base acceptance on the acceptance test results, the asphalt cement quality, the Contractor's QC Plan work, and the comparisons of the acceptance test results to the QC test results. The Engineer may elect to utilize test results of the Contractor in some situations toward judging acceptance. All acceptance tests shall be performed by qualified technicians at qualified laboratories following AASHTO or DelDOT procedures, and shall be evaluated using Quality Level Analysis.

The Contractor shall supply, capture, and mark samples, as directed, from delivery trucks before the trucks leave the production plant. The sample shall represent the material produced by the Contractor, and shall be of sufficient size to allow the Engineer to complete all required acceptance tests. The Engineer will direct the Contractor when to capture these samples, on a statistically random, unbiased basis, established before production begins each day based upon the anticipated production tonnage. The captured sample shall be from the Engineer specified delivery truck; if the Contractor visually observes the specified delivery truck sample and does not want this sample to be sampled and tested for acceptance, that delivery truck will not be sent to a Department project. The next visually acceptable delivery truck to the Contractor shall be sampled for acceptance testing.

The first sample of the production day will be randomly generated by the Engineer between loads 0 and 12 (0-250 tons). Subsequent samples will be randomly generated by the Engineer on 500-ton sub-lots for the production day. Unacceptable samples may be a basis for rejection of material if the QC plan is not followed as approved for sample retrieval. If the Contractor wishes to perform parallel tests with the Engineer, or to capture samples to be retained for possible Dispute Resolution, each of the samples for these purposes shall be obtained at the same time and location as the acceptance test sample. Either splitting a large sample or getting multiple samples that equally represent the material is acceptable. The Engineer will perform all splitting and handling of samples after they are obtained by the Contractor.

The Engineer will evaluate and accept the material on a lot basis. All the material within a lot shall have the same JMF (mixture ID). The lot size shall be targeted for 2000 tons or a maximum period of three days, whichever is reached first. If the 2000^{th} ton target lot size is achieved during a production day, the lot size shall extend to the end of that production day. The Contractor may interrupt the production of one JMF in order to produce different material; this type of interruption will not alter the determination of the size or limits of material represented by a lot. The Engineer will evaluate each lot on a sublot basis. The size for each sublot shall be 100 to 500 tons and testing for the sub lots will be completed on a daily basis. For each sublot, the Engineer will evaluate one sample.

The target size of sub-lots within each lot, except for the first sample of the production day, is equal-sized 500 ton sub lots and will be based upon anticipated production, however, more or fewer sublots, with differing sizes, may result due to the production schedule and conditions. If the actual production is less than anticipated, and it's determined a sample will not be obtained (based upon the anticipated tonnage), a new sample location will be determined on a statistically random, unbiased basis based upon the new actual production. If the actual

production is going to be 50 tons or greater over the anticipated sub lot production, a new sample location will be determined on a statistically random, unbiased basis based upon the new actual production. The Engineer will combine the evaluation and test results for all of the applicable sublots in order to evaluate each individual lot.

If the Engineer is present, and the quantity exceeds 25 tons, a statistically random sample will be used for analysis. When the anticipated production is less than 100 tons and greater than 25 tons, and the Engineer is not present, the contractor shall randomly select a sample using the Engineer's random location program. The captured sample shall be placed in a suitable box, marked to the attention of the Engineer, and submitted to the Engineer for testing. A box sample shall also be obtained by the contractor at the same time and will be used as the Dispute Resolution sample if requested by the Engineer. The contractor shall also obtain one liquid asphalt sample (1 pint) per grade of asphalt used per day and properly label it with all pertinent information.

The Engineer will conduct the following tests in order to characterize the material for the pavement compaction quality, and to judge acceptance and the pay adjustment for the material:

- AASHTO T312 – Preparing a mixture samples using a gyratory compactor.
- AASHTO T166, Method C (Rapid Method) – Bulk specific gravity of compacted samples.
- AASHTO T308 – Asphalt cement content.
- AASHTO T30 – Aggregate gradations, using samples from the asphalt cement content test.
- AASHTO T209 – Theoretical maximum specific gravity.
- ASTM Provisional Test Method – Rapid Drying of Compacted and Loose Bituminous Asphalt Specimens using Vacuum Drying Method

(b) Pavement Construction – Tests and Evaluations.

The Engineer will directly base acceptance on the compaction acceptance test results, and on the inspection of the construction, the Contractor's QC Plan work, ride smoothness as referenced in the contract documents, lift thickness as referenced in the contract documents, joint quality as referenced in the contract documents, surface texture as referenced in the contract documents, and possibly the comparisons of the acceptance test results to the independent test results. For the compaction acceptance testing, the Engineer will sample the work on a statistically random basis, and will test and evaluate the work using lots.

Prior to paving a road segment, the Contractor shall notify the Engineer of any locations within that road segment that may not be suitable to achieve minimum (93%) compaction due to existing conditions. The Contractor shall schedule and hold a meeting in the field with the Engineer in order to discuss all areas that may potentially be applicable to Table 5a before paving starts. Areas that will be considered for Table 5a will be investigated in accordance to the method described in Appendix B. If this meeting is not held prior to paving, no areas will be considered for Table 5a. Areas of allowable exemptions that will not be cored include the following: partial-depth patch areas, driveway entrances, paving locations of less than 100 tons, areas around manholes and driveway entrances, and areas of paving that are under 400 feet in continuous total length and/or 5 feet in width.

The exempt areas around manholes will be a maximum of 4 feet transversely on either side from the center of the manhole, and 20 feet longitudinally on either side from the center of the manhole. The exempt areas around driveway entrances shall be the entire width of the driveway, and 3 feet from the edge of the longitudinal joint next to the driveway. Areas of exemption that will be cored for informational purposes only shall include: areas where the mat thickness is less than three times the nominal maximum aggregate size as directed by the Engineer, violations of Section 401.08 in the Standard Specifications as directed by the Engineer, and areas shown to contain questionable subgrade properties as proven by substantial yielding under a fully legally loaded truck. Failure to obtain core samples in these areas will result in zero payment for compaction regardless of the exempt status.

The Engineer will evaluate and accept the compaction work on a daily basis. Payment for the compaction will be calculated by using the material production lots as referenced in **.05 Acceptance Plan (a) Material**

Production – Tests and Evaluation and analyzing the compaction results over the individual days covered in the material production lot. The compaction results will be combined with the material results to obtain a payment for this item.

The minimum size of a compaction lot shall be 100 tons. If the compaction lot is between 101 and 1000 tons, the Engineer shall randomly determine four compaction acceptance test locations. If the compaction lot is between 1001 and 1500 tons, the Engineer shall randomly determine six compaction acceptance test locations. If the compaction lot is between 1501 and 2000 tons, the Engineer shall randomly determine eight compaction acceptance test locations. If the compaction lot is greater than 2000 tons, the Engineer shall randomly determine two compaction acceptance test locations per 500 tons.

If a randomly selected area falls within an Engineer approved exemption area, the Engineer will select one more randomly generated location to be tested per the requirements of this Specification. If that cannot be accomplished, or if an entire location has been declared exempt, the compaction testing shall be performed as per these Specifications but a note will be added to the results that the location was an Engineer approved exempt location.

Testing locations will be a minimum of 1.5 feet from the newly placed longitudinal joint and 50 feet from a new transverse joint. If the Contractor chooses to cut companion cores, they shall be located within one foot of the Engineers cores along the longitudinal direction and in-line with the Engineers cores in the longitudinal plane.

Exactly at the locations marked by the Engineer, the Contractor shall cut a core, 6 inches in diameter, through the full lift depth. Cores submitted that are not from the location designated by the Engineer will not be tested and will be paid at zero pay.

The Contractor shall notify the Engineer prior to starting paving operations with approximations of the tonnage to be placed. The Contractor is then responsible for notifying the appropriate Engineer test personnel within 12 hours of material placement. The Engineer will then have 24 hours to mark the core locations. After determination of locations, the Contractor shall complete testing within two operational days of the locations being marked. If the cores are not cut within two operational days, the area in question will be paid at zero pay for compaction testing.

The Contractor shall provide any traffic control required for the structural number investigation, sampling, and testing work at no additional cost to the Department.

The Contractor shall cut each core with care in order to prevent damaging the core. The pavement shall have a maximum temperature of 140ºF when cores are cut from it. Immediately upon removal of a core from the roadway, the Contractor shall adequately label it. The Contractor shall protect the core by supplying a 6-inch plastic concrete cylinder mold, or an approved substitute, and placing the core in it. If more than one core is in the same mold, the Contractor shall place paper between them. The Contractor shall attach a completed QC test record for the representative area to the corresponding core. The Engineer will also complete a test record for areas tested for the QA report and provide to Materials & Research. At the end of every production day, the Contractor shall deliver the cores to the Engineer for testing, processing, and report distribution.

The Contractor shall repair the core hole per Appendix A, Repairing Core Holes in Hot-Mix Asphalt Pavements. Core holes shall be filled immediately. Failure to repair core holes at the time of coring will result in zero pay for compaction testing for the area in question.

The Engineer will conduct the following tests on the applicable portion of the cores in order to evaluate their quality:

- AASHTO T166, Method C (Rapid Method) – to determine the bulk specific gravity of the cores.
- AASHTO T209 – to calculate the theoretical maximum specific gravity and the density of the non-compacted mixtures.
- ASTM Provisional Test Method – Rapid Drying of Compacted and Loose Bituminous Asphalt Specimens using Vacuum Drying Method.

The Engineer will use the average of the last five test values of the same JMF (mixture ID) material at the production plant in order to calculate the average theoretical maximum specific gravity of the cores. The average will be based on the production days test results and as many test results needed from previous days production to have an average of five samples. If there are less than five values available, the Engineer will use the JMF design value in addition to the available values to calculate the average theoretical maximum specific gravity.

.06 Payment and Pay Adjustment Factors.

Contractor shall include the costs for all materials, labor, equipment, tools, and incidentals necessary to meet the requirements of this specification in the bid price per ton for the hot-mix asphalt. Payment to the Contractor for the hot-mix asphalt item(s), including QA/QC procedures, will be included in the Lump Sum Price Proposal.

.07 Dispute Resolution.

Disputes or questions about any test result shall be immediately brought to the attention of the Contractor and the Engineer. When there is a significant alleged discrepancy regarding the Engineer's acceptance test results, the Contractor must claim a dispute within two operational days of the test date. The following dispute resolution procedures will be used.

The Engineer and the Contractor will review the sample quality, the test method, the laboratory equipment, and the laboratory technician. If these factors are not the cause of the dispute, a third party dispute resolution will be used.

For third party resolution testing, it can be either at another Contractor's laboratory, the Engineer's laboratory, or an independent accredited laboratory. Unless otherwise mutually agreed upon by DAPA and the Engineer, the Engineer's qualified laboratory in Dover and qualified personnel shall conduct the necessary testing for third party Dispute Resolution after the Engineer has provided reasonable notice to allow the Contractor to witness this testing.

When disputes over production testing occur, the samples used for Dispute Resolution testing will be those samples the Contractor properly captured, labeled, and stored, as described in the second paragraph of the section of these specifications titled **.05 Acceptance Plan, (a) Material Production – Tests and Evaluations**. If no samples are available, the original testing results will be used for payment calculations.

Dispute Resolution samples for air void content will be heated by a microwave oven.

If there is a discrepancy between the Engineer's acceptance test result and the Contractor's test result, the Contractor may ask for the Dispute Resolution sample to be tested. If the Dispute Resolution sample substantiates the original acceptance test result, the Contractor, after two such Dispute Resolution samples, will be charged a fee of $125 for all further Dispute Resolution cores that substantiate the acceptance test result. If the Dispute Resolution sample substantiates the Contractor's test result, the Contractor will not be charged a fee.

When disputes over compaction core test results occur, the Engineer's acceptance core will be used for the dispute resolution sample. The Contractor will be advised on when the testing will occur as referenced above to witness the testing.

The results of the dispute resolution testing shall replace all of the applicable disputed test results for payment purposes.

Appendix A - Repairing Core Holes in Hot-Mix Asphalt Pavement

Description.

This appendix describes the procedure required to acceptably repair core holes in a bituminous concrete pavement.

Materials and Equipment.

The following material shall be available to complete this work:

- Patch Material –A DelDOT approved High Performance Cold Patch material shall be used.

The following equipment shall be available to complete this work:

- Sponge or other absorbent material – Used to extract water from the hole.
- Compaction Hammer – Shall be mechanical, with a flat, circular tamping face smaller than 6 inches in diameter. The tamping head shall be connected to an electrical, pneumatic, or gasoline driven tamping device.

Construction Method.

After core removal from the hole, remove all excess water from within the hole, and prevent water from re-entering the hole.

Place the patch material in lifts no greater than 3 inches. If the hole is deeper than 3 inches, use two lifts of approximately equal depths so that optimum compaction is achieved. Make sure that the patch surface matches the grade of the existing roadway. Make every effort to achieve the greatest possible compaction

Performance Requirements.

The Engineer will judge the patch on the following basis:

- The patch shall be well compacted
- The patch surface shall match the grade of the surrounding roadway surface.

Basis of Payment.

No measurement or payment will be made for the patching work. The Contractor must gain the Engineer's acceptance of the patching work before the Engineer will accept the material represented by the core.

Appenidx B - Method for Obtaining Cores for Determination of Roadway Structure

The Contractor is responsible for obtaining cores in areas that they propose are eligible for compaction price adjustments according to Table 5a in this specification. Table 5a is not applicable for new full-depth pavement box construction. Cores submitted for this process shall be obtained according to the following process.

1. Contact Materials & Research (M&R) personnel to determine if information about the area is already available. If M&R has already obtained cores in the location that is being investigated, the contractor may opt to use the laboratory information for the investigation and not core the area on their own.

2. If M&R does not have information concerning the section of the roadway, the contractor needs to contact M&R to arrange for verification of coring operations. Arrangements shall be made to allow for an individual from M&R to be on the site when the cores are obtained. Cores will be turned over to M&R for evaluation.

3. The contractor is responsible for providing all traffic control and repairing core holes in accordance to 401699 Appendix A – Repairing Core Holes in Hot-Mix Asphalt Pavements.

4. Cores are to be taken throughout the entire project for the area in question. Cores will be spaced, from the start of the project in increments determined based on field and project specifics. Cores will be evenly distributed throughout the project location. The cores will be taken in the center of the lane in question.

5. Additional cores may be taken at other locations, if surface conditions indicate that there may be a substantial difference in the underlying section. The location of these cores should be documented and submitted to M&R.

6. Cores shall be full depth and include underlying materials. If there is a stone base included in the pavement section, at a minimum 1 core must have information concerning the thickness of the base. This is determined by augering to the subgrade surface.

7. The calculations used to determine the structural capacity of the roadway is as follows. If the contractor finds, upon starting the coring process, that the areas are of greater thickness than applicable to Table 5a, they may terminate the coring process on their own and retract the request.

Structural Number Calculations

Each pavement box material is assigned a structural coefficient based upon AASHTO design guides. The structural coefficient is used to determine the total strength of the pavement section.

Materials used in older pavement sections are assigned lower structural coefficients to compensate for aging of the materials. The coefficients used to determine the structural number of an existing pavement are:

Existing Material	Structural Coefficient
HMA	0.32
Asphalt Treated Base	0.26
Soil Cement	0.16

Existing Material	Structural Coefficient
Surface Treatment (Tar & Chip)	0.10
GABC	0.14
Concrete	0 - 0.7*

* The Structural Coefficient of Concrete is dependent upon the condition of the concrete. Compressive strengths & ASR analysis are used to determine condition – contact the Engineer if this situation arises.

Newly placed materials use a different set of structural coefficients. They are as follows:

New Material	Structural Coefficient
HMA	0.40
Asphalt Treated Base (BCBC)	0.32
Soil Cement	0.20
GABC	0.14

Example:

Location includes placement of a 1.25" Type C overlay on 2.25" Type B. Existing roadway is cored and is shown to consist of 2" HMA on 7" GABC.

Calculation:

For the Type B lift the calculation would be:

Existing HMA	2 * 0.32	= 0.64
GABC	7 * 0.14=	0.98
		1.62

For the Type C lift the calculation would be:

Newly Placed B	2.25 * 0.4 =	0.90
Existing HMA	2 * 0.32=	0.64
GABC	7* 0.14	= 0.98
		2.52

612553- Spray Applied Cementitious Mortar for Pipe, Greater Than 48”

Description:

The work specified herein consists of the repair of culverts by the installation of a cementitious lining centrifugally cast in place for the waterproofing, sealing, structural reinforcement and corrosion protection of existing concrete culvert pipe, corrugated steel culvert pipe, and other material culvert pipe. The centrifugally cast concrete pipe (CCCP) liner should extend over the specified length forming a continuous concrete pipe within a pipe. A Bi-Directional SpinCaster shall be used.

QUALITY ASSURANCE

A. The manufacturer shall have been in the business of manufacturing high performance cement-based repair mortars for over 10 years, maintain a strict quality assurance program in accordance with ISO 9001:2008, offer technical services and provide a representative at the project site for product training, prior to product installation.

DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered to the jobsite in their original, unopened packages, clearly labeled with the manufacturer’s identification, printed instructions and batch code for shelf life and traceability.
B. Store and condition the specified product as per the appropriate product data sheet.
C. For handling instructions, refer to the Material Safety Data Sheet.

Materials:

A. The repair means and methods shall be engineered for depth, diameter, shape, traffic loading, groundwater pressures, and condition of each culvert. A structural design shall be provided for each culvert.
B. This specification requires that no more than 5% fly ash be included in the material composition. This specification also references the following ASTM standards which are made a part hereof by such reference and shall be the latest edition and revision thereof. In the event that there are found to be conflicting requirements between this specification and these referenced documents, this specification will govern.

ASTM C-109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
ASTM C-157	Modified Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
ASTM C-293	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)
ASTM C-309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C-403	Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C-469	Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression, with special attention and adherence to the

	following: the Modulus of Elasticity should be no greater than 5,000,000 psi. (To avoid overly brittle liner)
ASTM C-496	Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C-882	Standard Test Method for Bond Strength of Epoxy Systems Used with Concrete by Slant Shear
ASTM C-666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C-1090	Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout 0 change in 28 days. (Eliminates concern over shrinkage)
ASTM D-4783	Standard Test Methods for Resistance of Adhesive Preparations in Container to Attack by Bacteria, Yeast, and Fungi (Modified)
ASTM C-1202	Standard Test Method for Electrical Indication of Concretes Ability to Resist Chloride Ion Penetration
ASTM C-1315	Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

The materials of the cementitious lining work shall meet the following requirements:

C. Invert Repair Mortar: The material used in the repair of the missing or deteriorated pipe invert shall be an ultra-high strength, high build, abrasion resistant and corrosion resistant mortar, based on advanced cements and additives including rust inhibitors. This material shall be 12,000 PSI. It shall be mixed with the appropriate amount of water to create a self-consolidating free flowing material that develops a high 24-hour compressive strength and adhesion.

The finished, hardened material shall be dense and highly impermeable; the result of a complex formulation of mineral, organic and densifying agents and sophisticated chemical admixtures. Graded quartz sands shall be used to enhance particle packing and further improve the fluidity and hardened density. The composition shall possess excellent thin-section toughness, a high modulus of elasticity in flexure and strong self-bonding capability.

Physical Properties	
Set Time at 70 °F ASTM C-403	
Initial Set	Approx. 150 minutes
Final Set	Approx. 240 minutes
Flexural Strength ASTM C-293	28 day’s min.1200 psi
Compressive Strength ASTM C-109	
24 hours	5,000 psi

28 days	11,500 psi
Split Tensile Strength ASTM C-496	700 psi
Shear Bond ASTM C-882	1,720 psi
Modulus of Elasticity ASTM C-469	
28 days	min. 3.48 10^6 psi
Freeze Thaw ASTM C-666	300 Cycle Pass

D. Pipe Lining Mortar: The pipe lining material shall be a high strength, high build, abrasion resistant and corrosion resistant mortar, based on advanced cements and additives. Per ASTM C-76, in no case, however, shall the proportion of Portland cement, blended with hydraulic cement, or a combination of Portland cement and supplementary cementing materials be less than 470 pounds per cubic yard. When mixed with the appropriate amount of water, a paste-like material which can be sprayed, cast or pumped into areas ¼ inch and larger shall be obtainable. The pipe lining material shall be 8,000 PSI material, or approved equal that has at least five states with DOT approvals which must include NYS DOT. The centrifugal lining system, including Material and SpinCaster manufacturer shall be by the same company.

The hardened, finished liner shall be a dense and highly impermeable pipe within a pipe. The above stated performance shall be achieved by a complex formulation of mineral, organic and densifying agents and sophisticated chemical admixtures including rust inhibitors. Graded quartz sands are to be used to enhance particle packing and further improve the fluidity and hardened density. The resultant composition shall possess excellent thin-section toughness, a high modulus of elasticity in flexure and strong self-bonding capabilities. Fibers are to be added as an aid to the centrifugal casting process, for increased cohesion and to enhance flexural strength.

The water content shall be adjusted to achieve consistencies ranging from plastic to modeling clay. The lining mortar shall be capable of being cast against soil, metals, wood, plastic or other normal construction materials.

The physical properties of the lining mortar shall be as follows:

Physical Properties	
Set Time at 70 °F ASTM C-403	
Initial Set	Approx. 150 minutes
Final Set	Approx. 240 minutes
Compressive Strength ASTM C-109	
24 hours	3,000 psi
28 days	8,000 psi
Modulus of Rupture 28 days	Min 1,340 psi
Split Tensile Strength ASTM C-496	800 psi

Shear Bond ASTM C-882	2,100 psi
Modulus of Elasticity ASTM C-469 28 days	min. 3.56 10^6 psi Not to exceed 5.0 10^6 psi
Chloride Ion Penetration	Less than 75 Coulombs
Freeze Thaw ASTM C-666	300 Cycle Pass

WALL THICKNESS DESIGN

A. The wall thickness design shall be based upon the compressive and bending strength of the liner material The design loading shall be the sum of any changes in the cover depth after the liner's installation and the appropriate highway truck loading for the culvert pipe taking into account the type of soil used for the road's fill and the type of pavement structure (rigid or flexible). The calculated minimum finished thickness of the liner shall be based on a maximum possible crack width of 0.0625-inches with a factor of safety of 2.0.

B. The Liner thickness shall be applied to the thickness specified by the engineer but at no point shall it be less than the required minimum of ½-inch. For structural plate culvert materials, the cover over the projecting bolts shall be a minimum of ½-inch, making the minimum applied thickness for these culverts 1.0-inch. This thickness is to be measured from the I.D. of the pipe, or top of the inward corrugation's crest. . As Per ASTM A979 this thickness is to be measured from the I.D. of the pipe, or top of the inward corrugation's crest. No more than ½ shall be applied in a single pass.

Construction:

A. Safety: The Contractor shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving entering confined spaces.

B. Flow Control: The Contractor, when required, shall provide for the flow of water around the culvert where the rehabilitation is located. The bypass shall be made by damming the line at the upstream end and diverting the flow into an adjacent pipe barrel or by pumping.

C. TV Inspection: Inspection of pipelines shall be performed by experienced personnel trained in locating breaks and obstacles by closed-circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation, and it shall be noted so that these conditions can be corrected. A videotape and suitable log shall be kept for later reference by the owner.

D. Obstruction Removal: It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, dropped joints, roots or collapsed pipe that will prevent installation of the liner. If an internal inspection reveals an obstruction that cannot be removed by conventional cleaning equipment, then the Contractor shall notify the Project Engineer. The Project Engineer may delete the work, or

instruct the Contractor to make a point repair excavation to remove or repair the obstruction. Such excavation shall be approved in writing by the Project Engineer prior to the commencement of the work and shall be considered as a separate pay item.

E. Soil Stabilization: All voids behind the pipe wall must be filled with an engineer approved slurry or chemical grout. Small voids less than one cubic yard shall be included in the per foot price for the pipeline rehabilitation. Voids larger than one cubic yard shall be paid for under a separate bid item by the cubic yard of material required to fill the void to prevent future collapse of the pipeline. The flowable fill minimum compressive strength shall be 400 psi.

F. Infiltration Control: Areas of water seepage shall be sealed off by an approved method. Pools of water shall be removed; however, a dry surface is not required. The Contractor shall patch holes and fill voids in and around existing pipe as directed by the Engineer.

G. Cleaning: It shall be the responsibility of the owner to remove all debris from the sewer. The interior surface shall be cleaned with a high-pressure water-blast sufficient to remove all laitance and loose material and flush debris from the pipe. Upon final inspection the pipe shall be free of sand, dirt and all other laitance that may impeded the placement of the lining material.

Centrifugally Cast Concrete Pipe (CCCP) Installation:

A. Equipment: Mortar mixers, compressors and pumps are standard commercial models. The high-speed, rotating applicator device is used to provide a densely compacted liner of uniform thickness and thorough coverage.

B. Mixing: The Contractor shall combine 50 pounds of the packaged dry mix with the Manufacturer's specified amount of potable water with mixing to be accomplished with a high-speed shear type mixer until proper consistency is obtained. The Contractor shall continue to agitate the mortar to prevent thickening beyond the desired fluidity. The working time is approximately 30 minutes depending upon the ambient conditions.

C. Application: The Contractor shall position the bi-directional rotating casting applicator within the culvert pipe as required by the Manufacturer and commence pumping the mortar. As the mortar begins to be centrifugally cast evenly around the interior, the Contractor shall retrieve the applicator head at the best speed for applying the thickness that has been specified. If the mortar flow is interrupted for any reason, the Contractor shall arrest the retrieval of the applicator head until the mortar flow is restored. Throughout the application process the Contractor shall verify the thickness using an appropriate tool.

D. Hot Weather Application (Above 80°F): The Contractor shall not apply the mortars when the ambient air and/or surface temperature of the culvert pipe is 100° F or higher. Shade the material and prepared the surface to keep it cool.

To extend the working time of the mortar when the ambient air temperature is 80°F or higher, but below 100°F, the Contractor is advised to combine the mortar mix material with cool or ice-cooled water. When working at these elevated temperatures, the Contractor shall make certain that the substrate is saturated surface-dry (SSD) before the mortar lining application begins.

E. Cold Weather Application (Above 45°F): The Contractor shall not apply the mortars when ambient air temperatures are expected to fall below 45°F within 72 hours of placement. Both the ambient air and substrate temperatures must be at least 45°F at the time of placement.

Low substrate and ambient air temperatures will slow down the rate of set and strength development. At temperatures below 65°F, the Contractor is advised to warm the material, water, and substrate. Properly ventilate the area when heating. Protect the new liner from freezing.

F. Curing/Finishing: The Contractor shall use an ASTM C309 conforming curing compound such as 1315 Sealer or other approved equal.

MIXING

Mortar Mixer (Stationary Barrel with Moving Paddles)

A. Provide an adequate number of mortar mixers in good operating condition for uninterrupted placement. Do not exceed one-half the maximum capacity of the mortar mixer.

B. Pre-wet mortar mixer, empty excess water.

C. Start by adding the minimum amount of premeasured potable water to mixer. While mixing, slowly add pipe lining rehabilitation material and mix to a uniform consistency.

D. Mix thoroughly for approximately 3 to 4 minutes. To achieve desired consistency, add

remaining water if necessary. Do not exceed maximum water content as stated on product packaging or an amount that will cause segregation.

E. Do not mix more material than can be placed within the working time of the repair material. Do not retemper the mix by adding additional water.

F. A trial mix should be considered to optimize water content and application ability.

APPLICATION

A. Position spray cast equipment within pipe center and begin pumping material to nozzle. Commence application of material around pipe. As material is cast around pipe, move applicator head accordingly so as to provide the necessary thickness and uniformity specified.

B. Movement of the applicator head may be adjusted at any time to ensure proper coverage, thickness, and uniformity.

C. Coverage thicknesses may be verified at any point during installation to ensure movement rate of applicator head is correct.

D. Placement shall create a continuous monolithic structure with no joints.

CURING

A. Wet cure for 24-48 hours after placement of apply curing compound meeting the requirements of ASTM C 309 immediately after placement.

B. Repair material shall be protected from freezing, hydrostatic pressure, and vibration as recommended by the manufacturer.

Submittals:

All submittals shall conform to the requirements in this and other sections of the Contract Documents. If not required elsewhere, the following minimum submittals shall be required:

REFERENCE SUBMITTALS

Contractor certification

A. Sealed project specific design calculations by third party Consulting PE for lining material thickness and any additional additives or reinforcement materials necessary to achieve project goals set forth by the Project shall be provided prior to award and/or beginning the project
B. The contractor shall have a minimum of five years' experience installing this type of pipe lining system in culverts prior to beginning any project with regards to this specification and/or Statement of Work
C. The contractor must be certified by the manufacturer prior to beginning any project with regards to this specification and/or Statement of Work

MATERIALS DATA SUBMITTALS

A. Repair mortar material; including technical data sheet
B. Lining mortar material; including technical datasheet and third-party testing completed.

Materials Handling:

The bags of the mortar materials shall be stored in a cool, dry location until the Contractor is ready to use the material. .

Quality Assurance and Acceptance:

A minimum of two test cubes of the mortar material shall be taken randomly as directed by the inspector at owner's expense to verify strengths. Thickness can be verified with a wet gage at any random point of the new interior surface. Any areas found to be thinner than the specified minimum shall immediately receive additional material. Visual inspection should verify a leak-free, uniform appearance.

Measurement for Payment:

Payment will be made at the Contract bid price per linear foot, which shall be payment in full for all costs to complete the installation in place, including but not limited to excavation, cleaning, pipe liner, liner reinforcement, fittings, seals, specified joint system, filling embankment voids and backfilling, which shall be compensation in full for all removal, excavation, material and labor costs relative thereto, including restoration of existing structure bottoms.