FDOT
Florida Department of Transportation
RON DESANTIS
GOVERNOR
605 Suwannee Street
Tallahassee, FL 32399-0450
JARED W. PERDUE, P.E.
SECRETARY

September 27, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: 008
Proposed Specification: **SP0081000 Prosecution and Progress– Liquidated Damages for Failure to Complete the Work.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Special Provision.

The changes are proposed by Taylor Carlquist to comply with F.S. 337.18, the Department shall update the schedule of liquated damages at least once every 2 years.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PROSECUTION AND PROGRESS – LIQUIDATED DAMAGES FOR FAILURE TO COMPLETE THE WORK.
(REV 6-30-22)

SUBARTICLE 8-10.1 and 8-10.2 are deleted and the following substituted:

8-10 Liquidated Damages for Failure to Complete the Work.

8-10.1 Highway Code Requirements Pertaining to Liquidated Damages: Section 337.18, paragraph (2) of the Florida Statutes, requires that the Department adopt regulations for the determination of default and provides that the Contractor pay liquidated damages to the Department for any failure of the Contractor to complete the Contract work within the Contract Time. These Code requirements govern, and are herewith made a part of the Contract.

Liquidated damages for this Contract will be a summation of the damages referenced above and projected lost toll revenues due to failure to timely open the project to revenue-producing traffic.

8-10.2 Amount of Liquidated Damages: Applicable liquidated damages are the sum of the daily rate of $_____ per Calendar Day assessed as projected lost toll revenues for failure to complete the Work within the Contract Time plus the amounts established in the following schedule:

Original Contract Amount	Daily Charge Per Calendar Day
$~~50,000~~299,999 and under	$~~1,015~~980
~~Over~~ $~~30~~50,000 but less than $2,000,000~~250,000~~	$~~1,045~~1,699
$2,00~~5~~0,000 but less than $~~500,000~~5,000,000	$~~1,170~~2,650
$5,000,000 but less than $10,000,000~~2,500,000~~	$~~1,690~~3,819
$10~~2~~,0~~5~~00,000 but less than $20,000,000~~5,000,000~~	$4,687~~2,579~~
$20~~5~~,000,000 but less than $~~10,000,000~~40,000,000	$~~3,756~~7,625
~~$10,000,000 but less than $15,000,000~~	~~$4,344~~
~~$15,000,000 but less than $20,000,000~~	~~$5,574~~
$4~~2~~0,000,000 and over	$10,467~~203~~ plus 0.00005 of any amount over $4~~2~~0 million (Round to nearest whole dollar)

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

July 27, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **105**
Proposed Specification: **SP1050813DB Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Special Provision.

The changes are proposed by Juan Castellanos from the State Materials Office to update the requirements for inspectors assigned to monitor Auger Cast Piles for bridges and non-bridges.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS.
(REV 6-8-22)

ARTICLE 105-8 is expanded by the following.

105-8.13 Geotechnical Foundation Services Personnel For Design Build Projects:

105-8.13.1 General: Provide qualified personnel to design foundations and provide geotechnical analyses and recommendations for the design of roadways and structures for the project. Provide qualified and trained personnel to perform foundation testing, inspection of the construction activities and oversight of the foundation construction operations. Ensure the personnel provided meet the registration and qualification requirements specified herein and these requirements are maintained throughout the duration of the design and construction of the project elements where these personnel are required to work.

Submit qualification statements for the geotechnical, dynamic testing, load testing and non-destructive testing personnel to be used on the project for acceptance by the Engineer. The Department will review these qualification statements, provide comments or request additional information within 15 working days, excluding weekends and Department observed holidays. Do not begin Design or Construction until the qualifications of supervisory personnel have been accepted by the Engineer. Acceptance of the Design-Build Firm's personnel does not relieve the Design-Build Firm of the responsibility for obtaining the required results in the completed work.

105-8.13.2 Geotechnical Foundation Design Engineer of Record (GFDEOR): Provide a Geotechnical Foundation Design Engineer of Record in responsible charge of the geotechnical exploration, analysis, design and recommendations for the roadways and structures on the project. The GFDEOR shall also supervise and certify the constructed foundations. The GFDEOR must be a Professional Engineer registered in the state of Florida and must have a minimum of five years of design experience with the type of foundation proposed for the project. For bridges founded on piles and drilled shafts, the GFDEOR must possess verifiable responsible charge experience in the interpretation and utilization of data from the types of load tests (dynamic, static, Osterberg Cell and/or Statnamic load tests) used on the project on at least three Department bridge projects.

105-8.13.3 Dynamic Testing Engineer (DTE): Provide a Dynamic Testing Engineer in responsible charge of the performance of the dynamic load testing of driven piles, evaluation, signal matching and analysis of the dynamic load test data, the establishment of the production pile lengths (when these are to be determined based on test pile information) and driving criteria. Production pile lengths and driving criteria shall be developed by the same engineering firm, and under the same DTE analyzing the dynamic pile testing data in conjunction with the GFDEOR. The DTE must be a Professional Engineer registered in the state of Florida with responsible charge experience of geotechnical foundation construction engineering and dynamic testing of driven piles for a period of not less than three years including at least three Department bridge projects. This "responsible charge" experience shall include verifiable experience using the test methods that will be utilized on the project. The DTE must have a rank of Intermediate or higher in the PDCA/PDI Dynamic Measurement and Analysis Proficiency Test.

105-8.13.4 Dynamic Testing Operator: Provide a Dynamic Testing Operator (DTO) to perform the dynamic load testing of instrumented piles and test piles in the field. The

DTO must have a rank of Intermediate or higher in the PDCA/PDI Dynamic Measurement and Analysis Proficiency Test. When EDCs will be used to monitor piles and/or test piles, EDC monitoring shall be performed by an operator who has passed EDC Monitoring Certification as evidenced by a Smart Structures valid Certification Card and ID. The operator must have experience in geotechnical foundation construction and dynamic testing of driven piles for a period of not less than two years including at least three Department bridge projects. The experience may have been obtained while working under the supervision of another qualified operator. The Dynamic Testing Operator shall work under the supervision of the DTE.

105-8.13.5 Foundation Inspectors: Provide qualified foundation inspectors, working under the supervision of the GFDEOR, to monitor and record the construction of foundations. Pile Driving inspectors must possess CTQP Pile Driving Inspector qualification. Drilled Shaft inspectors must possess CTQP Drilled Shaft Inspector qualification. Inspectors assigned to monitor Auger Cast Piles (ACP) for bridges must possess CTQP ACP Inspector qualification. Inspectors assigned to monitor the construction of ACP for non-bridge structures must either possess CTQP ACP Inspector qualification, or have completed and passed the Computer based training class for auger cast piles.

105-8.13.6 Pile Driving Superintendents: Use pile driving superintendents or foremen in responsible charge of pile driving operations, with experience in installing driven piles of the type, size and depth proposed for the project and for a period of not less than two years.

105-8.13.7 Drilled Shaft Superintendents: Use drilled shaft superintendents or foremen in responsible charge of drilling operations with experience in installing drilled shafts of the size and depth proposed and for the project for a period of not less than three years.

105-8.13.8 Auger Cast Pile Superintendents: Use auger cast pile superintendents or foremen in responsible charge of auger cast pile installation operations with experience in installing auger cast piles of the size and depth proposed for the project and for a period of not less than one year.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 3, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **SP4550000DB**
Proposed Specification: **SP4550000DB Structures Foundations (Design Build).**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Special Provision.

The changes are proposed by Juan Castellanos from the State Construction Office to ensure H piling are backfilled and do not have lateral stability. Changes to the drilled shaft specifications are necessary to improve the accuracy of the thermal testing results. This will improve safety to our structures by ensuring stability of H piles and integrity of drilled shafts for bridges. These changes are associated with Section 455 of the Standard Specifications.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

STRUCTURES FOUNDATIONS (DESIGN BUILD).
(REV ~~12-22-~~96~~-29~~15-2221~~) (FA ~~1-25-22~~) (FY 2023-24~~7-23~~2)

SECTION 455 is deleted and the following substituted:

SECTION 455
STRUCTURES FOUNDATIONS

Index

A. GENERAL

455-1 General Requirement.

The Contractor may examine available soil samples and/or rock cores obtained during the preliminary soil boring operations at the appropriate District Materials Office or designated storage location.

455-1.1 Monitor Existing Structures: Monitor existing structures in accordance with Section 108.

455-1.2 Excavation: Complete all excavation of the foundations prior to installing piles or shafts unless otherwise authorized by the Engineer. After completing pile/shaft installation, remove all loose and displaced materials from around the piles/shafts, leaving a clean, solid surface. Compact the soil surface on which concrete is to be placed or which will support the forming system for the concrete to support the load of the plastic concrete without settling or causing the concrete to crack, or as shown in the Contract Documents.

455-1.2.1 Abutment (End Bent) Fill: Place and compact the fill before installing end-bent piling/shafts, except when driving specified test piling in end bents or when the Plans show uncased piles through proprietary retaining wall fills.

When installing piles/shafts or casing prior to placing fill, take necessary precautions to prevent displacement of piles/shafts during placing and compacting fill materials within 15 feet of the piles/shafts or casing. Reference and check the position of the piles/shafts or casing at three approximately equal intervals during construction of the embankment.

Place embankment material in 6 inch compacted lifts in the 15 foot area around the piles/shafts or casing. Compact embankment material within the 15 foot area adjacent to the piles/shafts or casing to the required density with compaction equipment weighing less than 1,000 pounds. When installing piles/shafts prior to the completion of the surrounding fills, do not cap them until placing the fills as near to final grade as possible, leaving only the necessary working room for construction of the caps.

When shown in the Plans, provide permanent casings installed prior to placement of the fill, for all drilled shafts through mechanically stabilized fills (for example, behind proprietary retaining walls) for shafts installed after fill placement. Install temporary casings through the completed conventional fill when permanent casings are not required.

Provide permanent casings, if required, before the fill is placed extending a sufficient distance into the existing ground to provide stability to the casings during construction of the abutment fill.

455-1.3 Cofferdams: Construct cofferdams as detailed in the Plans. When cofferdams are not detailed in the Plans, employ a qualified Specialty Engineer to design cofferdams, and to sign and seal the plans and specification requirements. Send the designs to the Engineer for his records before beginning construction.

Provide a qualified diver and a safety diver to inspect the conditions of the foundation enclosure or cofferdam when the Contract Documents require a seal for construction. Equip these divers with suitable voice communications, and have them inspect the foundation enclosure and cofferdam periphery including each sheeting indentation and around each piling or drilled shaft to ensure that no layers of mud or other undesirable materials were left above the bottom of seal elevation during the excavation process. Also have the divers check to make sure the surfaces of the piles or drilled shafts are sufficiently clean to allow bond of the concrete down to the minimum bottom of seal elevation. Ensure that there are no mounds of stone, shell, or unapproved backfill material left after placement and grading. Ensure that the seal is placed as specified and evaluate the adequacy of the foundation soils or rock. Correct any deficiencies found by the divers. Upon completion of inspection by the divers, the Department may also elect to inspect the work before authorizing the Contractor to proceed with subsequent construction operations. Submit a written report by the divers to the Engineer indicating the results of their underwater inspection before requesting authorization to place the seal concrete.

455-1.4 Vibrations on Freshly Placed Concrete (Drilled Shafts and Piers): Ensure that freshly placed concrete is not subjected to peak particle velocities greater than 1.5 inches per second from vibration sources located within 30 feet (from the nearest outside edge of freshly placed concrete to the vibration source) until that concrete has attained its final set as defined by ASTM C403 except as required to remove temporary casings before the drilled shaft elapsed time has expired.

455-2 Static Compression Load Tests.

455-2.1 General: Employ a professional testing laboratory, or Specialty Engineer with prior load test experience on at least three projects, to conduct the load test in compliance with these Specifications, to record all data, and to submit signed and sealed reports of the test results to the Engineer.

Perform the load test by applying a load up to the load required in the Contract Documents or to the failure load, whichever occurs first.

Do not apply test loads to piles sooner than 48 hours (or the time interval shown in the Plans) after driving of the test pile or reaction piles, whichever occurs last.

Do not begin static load testing of drilled shafts until the concrete has attained a compressive strength of 3,400 psi. The Contractor may use high early strength concrete to obtain this strength at an earlier time to prevent testing delays.

Provide all equipment, materials, labor, and personnel required to conduct the load tests, including determination of anchor reaction member depths. In this case, provide a loading apparatus designed to accommodate the maximum load plus an adequate safety factor.

While performing the load test, provide safety equipment, and employ safety procedures consistent with the latest approved practices for this work. Include with these safety procedures, adequate support for the load test plates and jack to prevent them from falling in the event of a release of load due to hydraulic failure, test pile/shaft failure, or any other cause.

455-2.2 Loading Apparatus: Provide an apparatus for applying the vertical loads as described in one of the following:

1. As shown and described in the Contract Documents.

2. As supplied by the Contractor, one of the following devices designed to accommodate a load at least 20% higher than the test load shown in the Plans or described herein for test loads:

a. Load Applied by Hydraulic Jack Acting Against Weighted Box or Platform: Construct a test box or test platform, resting on a suitable support, over the pile, and load it with material with a total weight greater than the anticipated maximum test load. Locate supports for the weighted box or platform at least 6 feet or three pile/shaft diameters, whichever is greater, measured from the edge of the pile or shaft to the edge of the supports. Insert a hydraulic jack with pressure gauge between the test pile or shaft and the underside of the reaction beam, and apply the load to the pile or shaft by operating the jack between the reaction beam and the top of the pile or shaft.

b. Load Applied to the Test Pile or Shaft by Hydraulic Jack Acting Against Anchored Reaction Member: Construct reaction member anchorages in accordance with article 6.3 of ASTM D1143. Attach a girder(s) of sufficient strength to act as a reaction beam to the upper ends of the anchor piles or shafts. Insert a hydraulic jack with pressure gauges between the head of the test pile/shaft and the underside of the reaction beam, and apply the test load to the pile/shaft by operating the jack between the reaction beam and the pile/shaft head.

If using drilled shafts with bells as reaction member anchorages, locate the top of the bell of any reaction shaft anchorage at least three shaft diameters below the bottom of the test shaft.

c. Combination Devices: The Contractor may use a combination of devices (a) and (b), as described above, to apply the test load to the pile or shaft.

d. Other systems proposed by the Contractor and accepted by the Engineer: When necessary, provide horizontal supports for loading the pile/shaft, and space them so that the ratio of the unsupported length to the minimum radius of gyration of the pile does not exceed 120 for steel piles, and the unsupported length to the least cross-section dimension does not exceed 20 for concrete piles or drilled shafts. Ensure that horizontal supports provide full support without restraining the vertical movement of the pile/shaft in any way.

When required by the Contract Documents, apply a horizontal load to the pile/shaft either separately or in conjunction with the vertical load. Apply the load to the test pile/shaft by hydraulic jacks, jacking against Contractor provided reaction devices. After receiving the Engineer's acceptance of the proposed method of load application, apply the horizontal load in increments, and relieve it in decrements as required by the Contract Documents.

455-2.2.1 Modified Quick Test:

1. Loading Procedure: Apply vertical loads concentric with the longitudinal axis of the tested pile/shaft to accurately determine and control the load acting on the pile/shaft at any time. Place the load on the pile/shaft continuously, in increments equal to approximately 5% of the maximum test load specified until approaching the failure load, as indicated by the measuring apparatus and/or instruments. Then, apply increments of approximately 2.5% until the pile/shaft "plunges" or attains the limiting load. The Specialty Engineer may elect to stop the loading increments when the pile/shaft has met the failure criteria or when a settlement equal to 10% of the pile/shaft width or diameter is reached. Apply each load increment immediately after taking and verifying the complete set of readings from all gauges and instruments. Apply each increment of load within the minimum length of time practical, and immediately take the readings. Complete the addition of a load increment and the completion of the readings within 5 to 15 minutes. Hold the maximum applied load for one hour.

Remove the load in decrements of about 10% of the maximum test load. Remove each decrement of load within the minimum length of time practical, and immediately take the readings. Complete the removal of a load decrement and the taking of the readings within 5 to 15 minutes. The Engineer may also require up to two reloading cycles with five loading increments and three unloading decrements. Record the final recovery of the pile/shaft until movement is essentially complete for a period of one hour after the last unload interval.

2. Failure Criteria and Nominal Resistance: Use the criteria described herein to establish the failure load. The failure load is defined as the load that causes a pile/shaft top deflection equal to the calculated elastic compression plus 0.15 inches plus 1/120 of the pile/shaft minimum width or the diameter in inches for piles/shafts 24 inches or less in width, and equal to the calculated elastic compression plus 1/30 of the pile/shaft minimum width or diameter for piles/shafts greater than 24 inches in width. Consider the nominal resistance of any pile/shaft so tested as either the maximum applied load or the failure load, whichever is smaller.

455-2.3 Measuring Apparatus: Provide an apparatus for measuring movement of the test piles/shafts that consists of all of the following devices:

1. Wire Line and Scale: Stretch a wire between two secure supports located at a distance at least:

a. 10 feet from the center of the test pile but not less than 3.5 times the pile diameter or width.

b. 12 feet from the centerline of the shaft to be tested but not less than three shaft diameters.

Locate the wire supports as far as practical from reaction beam anchorages. At over-water test sites, the Contractor may attach the wire line to the sides of the service platform. Mount the wire with a pulley on one support and a weight at the end of the wire to provide constant tension on the wire. Ensure that the wire passes across the face of a scale mounted on a mirror attached to the test pile/shaft so that readings can be made directly from the scale. Use the scale readings as a check on an average of the dial readings. When measuring both horizontal and vertical movement, mount separate wires to indicate each movement, horizontal or vertical. Measure horizontal movements from two reference wires set normal to each other in a horizontal.

2. Wooden Reference Beams and Dial Gauges: Attach wooden reference beams as detailed in the Plans and accepted by the Engineer to independent supports. For piles, install the independent supports at the greater of 3.5 times the pile diameter or width or 10 feet from the centerline of the test pile. For drilled shafts, install independent supports at the greater of three

shaft diameters or 12 feet from the centerline of the shaft to be tested. Locate the reference beam supports as far as practical from reaction beam anchorages. For over-water test sites, the Contractor may attach the reference beams between two diagonal platform supports. Attach dial gauges, with their stems resting either on the top of the pile/shaft or on lugs or similar reference points on the pile/shaft, to the fixed beams to record the movement of the pile/shaft head. Ensure that the area on the pile/shaft or lug on which the stem bears is a smooth surface which will not cause irregularities in the dial readings.

Provide a minimum of four dial gauges, each with 0.001 inch divisions and with 2 inch minimum travel, placed at 90 degree intervals for measuring vertical or horizontal movement.

3. Survey Level: As a check on the dial gauges, determine the elevation of a point near the top of the test pile/shaft (on plan datum) by survey level at each load and unload interval during the load test. Unless accepted otherwise by the Engineer, level survey precision is 0.001 foot. Alternately, the surveyor may read an engineer's 50 scale attached near the pile/shaft head. Determine the first elevation before applying the first load increment; make intermediate readings immediately before a load increment or an unload decrement, and after the final unload decrement that completely removes the load. Make a final reading at the time of the last recovery reading.

For over-water test sites, when shown in the Plans or directed by the Engineer, the Contractor shall, drive an H pile through a 36 inch casing to provide a stable support for the level and to protect it against wave action interfering with level measurements. Provide a suitable movable jig for the surveyor to stand. Use a jig that has a minimum of three legs, has a work platform providing at least 4 feet width of work area around the casing, and is accepted by the Engineer before use. The described work platform may be supported by the protective casing when accepted by the Engineer.

455-2.4 Load Test Instrumentation:

1. General: The intent of the load test instrumentation is to measure the test load on top of the pile/shaft and its distribution between side friction and end bearing to provide evaluation of the preliminary design calculations and settlement estimates and to provide information for final pile/shaft length design. Ensure that the instrumentation is as described in the Contract Documents.

Supply 110 V, 60 Hz, 30 A of AC electric power in accordance with the National Electric Code (NEC) to each test pile/shaft site during the installation of the instrumentation, during the load testing, and during any instrumented set-checks/redrives.

Place all of the internal instrumentation on the rebar cage before installation in the test shaft. Construct the rebar cage at least two days before it is required for construction of the test shaft. Successfully demonstrate the lifting and handling procedures before installing the instrumentation. Place the instrumented rebar cage in one segment without causing damage to the instrumentation.

2. Hydraulic Jack and Load Cell: Provide hydraulic jack(s) of adequate size to deliver the required test load to the pile/shaft unless shown otherwise in the Plans. Before load testing begins, submit a certificate from a reputable testing laboratory showing a calibration of gauge readings for all stages of jack loading and unloading for jacks provided. Ensure that the jack has been calibrated within the preceding six months. Ensure that the accuracy of the gauge is within 5% of the true load.

Provide an adequate load cell accepted by the Engineer that has been calibrated within the preceding six months. Provide an approved electrical readout device for the load cell. Submit a certificate from an independent laboratory showing a calibration of readings for all stages of loading and unloading for load cells furnished by the Contractor and obtain the approval of the Engineer before beginning load testing. Ensure that the accuracy of the load cell is within 1% of the true load.

3. Telltales: When shown in the Contract Documents, install telltales that consist of an unstressed steel rod, greased for reducing friction and corrosion, with appropriate clearance inside a constant-diameter pipe that rests on a flat plate attached to the end of the pipe at the point of interest shown in the Plans. Construct telltales in accordance with the Contract Documents. Install dial gauges reading to 0.001 inch with 1 inch minimum travel as directed by the Specialty Engineer to measure the movement of the telltale with respect to the top of the pile/shaft.

4. Embedded Strain Gauges: Install strain gauges in the test shaft to measure the distribution of the load. Ensure that the type, number, and location of the strain gauges are as shown in the Plans or as directed by the Geotechnical Foundation Design Engineer of Record (GFDEOR). Use strain gauges that are waterproof and have suitable shielded cable that is unspliced within the shaft. In drilled shafts provide sufficient instrumentation to determine side friction components in segments no longer than 5 feet and the end bearing component.

5. Caliper: Provide a caliper tool or system to measure accurately and continuously the shape of test shafts prior to placing concrete.

455-2.5 Support Facilities: Furnish adequate facilities for making load and settlement readings 24 hours per day. Provide such facilities for the instrumented area, and include lighting and shelter from rain, wind, and direct sunlight.

455-2.6 Load Test Personnel Furnished by the Contractor: Provide a certified welder, together with necessary cutting and welding equipment, to assist with the load test setup and to make any necessary adjustments during the load test. Provide personnel to operate the jack, generators, and lighting equipment, and also provide one person with transportation to assist as required during load test setup and conducting of the load tests. Provide qualified personnel, to read the dial gauges, take level measurements, and conduct the load test under the direct supervision of the Specialty Engineer.

455-2.7 Cooperation by the Contractor: Cooperate with the Department, and ensure that the Department has access to all facilities necessary for observation of the conduct and the results of the test.

455-2.8 Required Reports: Submit a static load test report signed and sealed by the Specialty Engineer to the Engineer for review and acceptance, at least three working days, excluding weekends and Department observed holidays, prior to beginning production pile/shaft construction. Include in the report of the load test the following information:

1. A tabulation of the time of, and the amount of, the load and settlement readings, and the load and recovery readings taken during the loading and unloading of the pile/shaft.

2. A graphic representation of the test results, during loading and unloading of pile/shaft top movement as measured by the average of the dial gauge readings, from wireline readings and from level readings.

3. A graphic representation of the test results, when using telltales, showing pile/shaft compression and pile/shaft tip movement.

4. The estimated failure and safe loads according to the criteria described herein.

5. The derived side friction component for each pile/shaft segment, and end bearing component. Include all pertinent test data, analysis and charts used to determine these values.

6. Remarks concerning any unusual occurrences during the loading of the pile/shaft.

7. The names of those making the required observations of the results of the load test, the weather conditions prevailing during the load test, and the effect of weather conditions on the load test.

8. All supporting data including jack and load cell calibrations and certificates and other equipment requiring calibration.

9. All data taken during the load test together with instrument calibration certifications. In addition, submit a report showing an analysis of the results of axial load and lateral load tests in which soil resistance along and against the pile/shaft is reported as a function of deflection.

10. For drilled shafts, include all cross-hole sonic logging results, gamma-gamma density logging results, the results of other integrity tests, caliper measurements data and the pilot holes reports of core borings. Attach this report to the final authorized tip elevations letter in accordance with 455-15.6.

11. For piles, include pile driving records, and dynamic testing data and analysis.

12. Submit a signed & sealed letter to the Department confirming the design assumptions were verified by the load tests before proceeding with production foundation construction.

455-2.9 Disposition of Loading Material: Remove all equipment and materials, which remains the Contractor's property, from the site. Clean up and restore the site to the satisfaction of the Engineer.

455-2.10 Disposition of Tested Piles/Shafts: After completing testing, cut off the tested piles/shafts, which are not to be incorporated into the final structure, and any reaction piles/shafts at an elevation 24 inches below the finished graded surface. Take ownership of the cut-offs and provide areas for their disposal.

B. PILING

455-3 General.

Furnish and install concrete, steel, or wood piling including driving, jetting, preformed pile holes, cutting off, splicing, dynamic load testing, and static load testing of piling. Prior to driving, clearly mark the piles to facilitate inspection. Provide individual straight-line marks at 1-ft intervals numbered at least every 5 ft. Use markers or lumber crayons or paint marks that can be easily observed by the inspector. Ensure marks are spaced uniformly and perpendicular to the face of the pile. Face pile so that the pile markings are easily visible to the pile inspector. Provide inch marks as needed when set checks or practical refusal checks are required.

In the event a pile is broken or otherwise damaged by the Contractor to the extent that the damage is irreparable, in the opinion of the Engineer, the Contractor shall extract and replace the pile at no additional expense to the Department. In the event that a pile is mislocated by the

Contractor, the Contractor shall extract and replace the pile, at no expense to the Department, except when a design change proposed by the Contractor is approved by the Department as provided in 455-5.16.5.

455-4 Classification.

The Department classifies piling as follows:

1. Treated timber piling.
2. Prestressed concrete piling.
3. Steel piling.
4. Test piling.
5. Sheet piling.
    a. Concrete sheet piling.
    b. Steel sheet piling.
6. Polymeric Piles (see Section 471 for requirements).

455-5 General Construction Requirements.

455-5.1 Predrilling of Pile Holes: Predrilled pile holes are either starter holes to the depth described in this Subarticle or holes drilled through embankment/fill material down to the natural ground at no additional cost to the Department. When using low displacement steel piling such as structural shapes, drive them through the compacted fill without the necessity of drilling holes through the fill except when the requirements for predrilling are shown in the Plans. When using concrete or other high displacement piles, drill pile holes through fill, new or existing, to at least the elevation of the natural ground. Use the range of drill diameters listed below for square concrete piles.

12 inch square piles	15 to 17 inches
14 inch square piles	18 to 20 inches
18 inch square piles	22 to 26 inches
20 inch square piles	24 to 29 inches
24 inch square piles	30 to 34 inches
30 inch square piles	36 to 43 inches

For other pile sizes, use the diameter of the drills shown in the Plans or accepted by the Engineer. Accurately drill the pile holes with the hole centered over the Plan location of the piling. Maintain the location and vertical alignment within the tolerances allowed for the piling.

For predrilled holes required through rock or other hard (i.e. debris, obstructions, etc.) materials that may damage the pile during installation, predrill hole diameters approximately 2 inches larger than the largest dimension across the pile cross-section. Fill the annular space around the piles as described in 455-5.10.1 with clean A-3 sand or sand meeting the requirements of 902-3.3.

In the setting of permanent and test piling, the Contractor may initially predrill holes to a depth up to 20% of the test pile length, unless required otherwise by the Engineer or the plans. Predrill holes for production piles in the same manner as the test piles. When installing piles in compacted fill, predrill the holes to the elevation of the natural ground. With prior written authorization from the Engineer, the Contractor may predrill holes to greater depths to

minimize the effects of vibrations on existing structures adjacent to the work or for other reasons the Contractor proposes.

455-5.2 Underwater Driving: Underwater driving is defined as any driving through water which is above the pile head at the time of driving.

When conducting underwater driving, provide a diver equipped with voice communications to aid in placing the hammer back on the pile for required cushion changes or for subsequent redriving, to attach or recover instrumentation, to inspect the condition of the pile, or for other assistance as required.

Select one of the following methods for underwater driving:

1. Accomplish underwater driving using conventional driving equipment and piling longer than authorized so that the piling will extend above the water surface during final driving. When choosing this option, furnish a pile hammer that satisfies the requirements of this Section for use with the longer pile.

2. Accomplish underwater driving using an underwater hammer that meets the requirements of this Section and is accepted by the Engineer. When choosing this option, provide at least one pile longer than authorized at each pile group, extending above the water surface at final driving. At each group location, drive the longer pile first. Evaluate the adequacy of the underwater driving system. Use the pile tip elevation of the longer pile to evaluate the acceptability of the piles driven with the underwater hammer.

3. Accomplish underwater driving using conventional driving equipment with a suitable pile follower. When choosing this option, provide at least one pile longer than required at each pile group, extending above the water surface at final driving. At each group location, drive the full length pile first without using the follower. Perform a dynamic load test on the first pile driven with the follower in each group. Use the pile tip elevation of the longer pile to evaluate the acceptability of the piles driven with the follower.

Prior to use, submit details of the follower to the Engineer along with the information required in 455-10. Include the weight, cross-section details, stiffness, type of materials, and dimensions of the follower.

455-5.3 Pile Hammers: All equipment is subject to satisfactory field performance during and without dynamic testing. Use a variable energy hammer to drive concrete piles. Hammers will be rated based on the theoretical energy of the ram at impact. Supply driving equipment which provides the required normal bearing resistance at a blow count ranging from 3 blows per inch (36 blows per foot) to 10 blows per inch (120 blows per foot) at the end of initial drive, and capable of driving the piles to a resistance equal to at least 1.25 times the nominal bearing resistance, without overstressing the piling in compression or tension and without reaching practical refusal, as defined in 455-5.11.3. When requested, submit to the Engineer all technical specifications and operating instructions related to hammer equipment.

455-5.3.1 Air/steam: Variable energy air/steam hammers shall be capable of providing at least two ram stroke lengths. The short ram stroke length shall be approximately half of the full stroke for hammers with strokes up to 4 feet and no more than 2 feet for hammers with maximum strokes lengths over 4 feet. Operate and maintain air/steam hammers within the manufacturer's specified ranges. Use a plant and equipment for steam and air hammers with sufficient capacity to maintain, under working conditions, the hammer, volume and pressure specified by the manufacturer. Equip the plant and equipment with accurate pressure gauges which are easily accessible. Drive piles with air/steam hammers operating within 10% of the manufacturer's rated speed in blows per minute. Provide and maintain in working order for the

Engineer's use an approved device to automatically determine and display the blows per minute of the hammer.

455-5.3.2 Diesel: Variable energy diesel hammers shall have at least three fuel settings that will produce reduced strokes. Operate and maintain diesel hammers within the manufacturer's specified ranges. Determine the rated energy of diesel hammers using measured ram stroke length multiplied by the weight of the ram for open end hammers and by methods recommended by the manufacturer for closed end hammers.

Provide and maintain in working order an approved device to automatically determine and display ram stroke for open-end diesel hammers.

Equip closed-end (double acting) diesel hammers with a bounce chamber pressure gauge, in good working order, mounted near ground level so it can be easily read. Also, submit to the Engineer a chart, calibrated to actual hammer performance within 30 days prior to initial use, equating bounce chamber pressure to either equivalent energy or stroke for the closed-end diesel hammer to be used.

455-5.3.3 Hydraulic: Variable energy hydraulic hammers shall have at least three hydraulic control settings that provide for predictable energy or equivalent ram stroke. The shortest stroke shall be a maximum of 2 feet for the driving of concrete piles. The remaining strokes shall include full stroke and approximately halfway between minimum and maximum stroke.

Supply hammer instrumentation with electronic read out, and control unit that allows the inspector and Engineer to monitor, and the operator to read and adjust the hammer energy or equivalent ram stroke. When pressure measuring equipment is required to determine hammer energy, calibrate the pressure measuring equipment before use.

455-5.3.4 Vibratory: Vibratory hammers of sufficient capacity (force and amplitude) may be used to drive steel sheet piles and, with acceptance of the Engineer, to drive steel bearing piles a sufficient distance to get the impact hammer on the pile (to stick the pile). The Geotechnical Foundation Design Engineer of Record will determine the allowable depth of driving using the vibratory hammer based on site conditions. However, in all cases, use a power impact hammer for the last 15 feet or more of the final driving of steel bearing piles for bearing determinations after all piles in the bent/pier have been driven with a vibratory hammer. Do not use vibratory hammers to install concrete piles, or to install support or reaction piles for a load test.

455-5.4 Cushions and Pile Helmet:

455-5.4.1 Capblock: Provide a capblock (also called the hammer cushion) as recommended by the hammer manufacturer. Use commercially manufactured capblocks constructed of durable manmade materials with uniform known properties. Do not use wood chips, wood blocks, rope, or other material which permit excessive loss of hammer energy. Do not use capblocks constructed of asbestos materials. Obtain the Engineer's acceptance for all proposed capblock materials and proposed thickness for use. Maintain capblocks in good condition, and replace them when charred, melted, or otherwise significantly deteriorated. Inspect the capblock before driving begins and weekly or at appropriate intervals based on field trial. Replace or repair any capblock which loses more than 25% of its original thickness, in accordance with the manufacturer's instructions, before permitting further driving.

455-5.4.2 Pile Cushion: Provide a pile cushion that is adequate to protect the pile from being overstressed in compression and tension during driving. Use a pile cushion sized so that it will fully fill the lateral dimensions of the pile helmet minus one inch but does not cover

any void or hole extending through the top of the pile. Determine the thickness based upon the hammer-pile-soil system. For driving concrete piles, use a pile cushion made from pine plywood or oak lumber. Do not use materials previously soaked, saturated or treated with oil. Maintain pile cushions in good condition and replace them when charred, splintered, excessively compressed, or otherwise deteriorated to the point it will not protect the pile against overstressing in tension or compression. Protect cushions from the weather, and keep them dry. Do not soak the cushions in any liquid. Provide a new cushion for each pile unless approved otherwise by the Engineer after satisfactory field trial during dynamic testing.

During dynamic load tests, replace the pile cushion when any of the pile stress measurements exceed the maximum allowed pile stress determined by 455-5.12.2. When driving a pile without dynamic testing, replace the pile cushion when the cushion is either compressed more than one-half the original thickness, begins to burn, or as directed by the Engineer after field performance.

Reuse pile cushions in good condition to perform all set-checks and redrives. Use the same cushion to perform the set-check or redrive as was used during the initial driving, unless this cushion is unacceptable due to deterioration, in which case use a similar cushion.

455-5.4.3 Pile Helmet: Provide a pile helmet suitable for the type and size of piling being driven. Use a pile helmet deep enough to adequately contain the required thickness of pile cushion and to assist in maintaining pile-hammer alignment. Use a pile helmet that fits loosely over the pile head and is at least 1 inch larger than the pile dimensions. Use a pile helmet designed so that it will not restrain the pile from rotating.

455-5.5 Leads: Provide pile leads constructed in a manner which offers freedom of movement to the hammer and that have the strength and rigidity to hold the hammer and pile in the correct position and alignment during driving. When using followers, use leads that are long enough and suitable to maintain position and alignment of the hammer, follower, and pile throughout driving.

455-5.6 Followers: When driving using followers, perform dynamic load testing as per 455-5.14. Obtain the Engineer's acceptance for the type of follower, when used, and the method of connection to the leads and pile. Use followers constructed of steel with an adequate cross-section to withstand driving stresses. When driving concrete piles, ensure that the cross-sectional area of the follower is at least 18% of the cross-sectional area of the pile. When driving steel piles, ensure that the cross-sectional area of the follower is greater than or equal to the cross-sectional area of the pile. Provide a pile helmet at the lower end of the follower sized according to the requirements of 455-5.4.3. Use followers constructed that maintain the alignment of the pile, follower, and hammer and still allow the pile to be driven within the allowable tolerances. Use followers designed with guides adapted to the leads that maintain the hammer, follower, and the piles in alignment.

Use information from dynamic load tests described in 455-5.14 to evaluate the adequacy of the follower and to determine pile capacity.

455-5.7 Templates and Ground Elevations: Provide a fixed template, adequate to maintain the pile in proper position and alignment during driving with swinging leads or with semi-fixed leads. The Engineer may allow the use of templates attached to a barge if the Contractor demonstrates satisfactorily that the pile alignment, and the elevation and horizontal position of the template can be maintained during all pile driving operations. Where practical,

place the template so that the pile can be driven to cut-off elevation before removing the template. Ensure that templates do not restrict the vertical movement of the pile.

Supply a stable reference close to the pile, which is satisfactory in the opinion of the Engineer, for determination of the pile penetration. At the time of driving piles, obtain and record elevations of the original ground and template at each pile or pile group location. Note the highest and lowest elevation at each required location and the ground elevation at all piles.

455-5.8 Water Jets: Use jet pumps, supply lines, and jet pipes that provide adequate pressure and volume of water to freely erode the soil. Do not perform jetting without prior approval by the Engineer.

Do not perform jetting in the embankment or for end bents. Where conditions warrant, with approval by the GFDEOR, perform jetting on the holes first, place the pile therein, then drive the pile to secure the last few feet of penetration. Only use one jet for prejetting or jetting through piles constructed with a center jet-hole. Use two jets when using external jets. When jetting and driving, position the jets slightly behind the advancing pile tip (approximately 3 feet or as approved by the GFDEOR. When using water jets in the driving, determine the pile bearing only from the results of driving after withdrawing the jets, except where using jets to continuously eliminate soil resistance through the scour zone, ensure that they remain in place as directed by the GFDEOR and operating during pile bearing determination. Where practical, perform jetting on all piles in a pile group before driving begins. When large pile groups or pile spacing and batter make this impractical, or when the Plans specify a jet-drive sequence, set check a sufficient number of previously driven piles in a pile group to confirm their capacity after completing all jetting.

455-5.9 Penetration Requirements: Measure the penetration of piles from the elevation of the natural ground, the existing surface, the deepest scour elevation shown in the Pile Data Table, or the bottom of excavation, whichever is lowest. When the Contract Documents show a minimum pile tip elevation, drive the tip of the pile to this minimum elevation. The Engineer will accept the bearing of a pile only if the Contractor achieves the required bearing when the tip of the pile is at or below the specified minimum tip elevation and below the bottom of the preformed or predrilled pile hole.

When the Plans do not show a minimum tip elevation, ensure that the penetration is at least 10 feet into firm bearing material or at least 20 feet into soft material unless otherwise permitted by the Engineer. The Engineer may accept a penetration between 15 feet and 20 feet when there is an accumulation of five consecutive feet or more of firm bearing material. Firm bearing material is any material offering a driving resistance greater than or equal to 30 tons per square foot of gross pile area as determined by the Dynamic Load Testing (455-5.12.4). Soft material is any material offering less than these resistances. The gross pile area is the actual pile tip cross-sectional area for solid concrete piles, the product of the width and depth for H piles, and the area within the outside perimeter for pipe piles and voided concrete piles.

Do not drive piles beyond practical refusal. To meet the requirements in this Subarticle, provide penetration aids, such as jetting or preformed pile holes, when piles cannot be driven to the required penetration without reaching practical refusal.

455-5.10 Preformed Pile Holes:

455-5.10.1 Description: Preformed pile holes serve as a penetration aid when all other pile installation methods fail to produce the desired penetration and when authorized by the GFDEOR to minimize the effects of vibrations on adjacent structures. Preformed pile holes are necessary when the presence of rock or strong strata of soils will not permit the installation of

piles to the desired penetration by driving or a combination of jetting and driving, when determined necessary, and authorized by the GFDEOR to minimize the effects of vibrations on adjacent existing structures. Drive all piles installed in preformed pile holes to determine that the bearing requirements have been met.

For preformed holes which are required through material that caves during driving to the extent that the preformed hole does not serve its intended purpose, case the hole from the surface through caving material. After installing the pile to the bottom of the casing, remove the casings unless shown otherwise in the Plans. Determine bearing of the pile after removing the casing unless shown otherwise in the Plans. Fill all voids between the pile and soil remaining after driving through preformed holes with clean A-3 sand or sand meeting the requirements of 902-3.3, after the pile has achieved the required minimum tip elevation, unless grouting of preformed pile holes is shown in the Plans. If pile driving is interrupted during sand placement, drive the pile at least 20 additional blows after filling all of the voids between the pile and soil with sand at no additional cost to the Department.

455-5.10.2 Provisions for Use of Preformed Pile Holes: Preformed pile holes may be used when the Contractor establishes that the required results cannot be obtained when driving the load bearing piles with specified driving equipment, or if jetting is allowed, while jetting the piles and then driving or while jetting the piles during driving.

455-5.10.3 Reasons for Preformed Pile Holes: The Department considers, but does not limit to, the following conditions as reasons for preformed pile holes:

1. Inability to drive piles to the required penetration with driving and jetting equipment.
2. To penetrate a hard layer or layers of rock or strong stratum that the Engineer considers not sufficiently thick to support the structure.
3. To obtain greater penetration into dense (strong) material and into dense material containing holes, cavities or unstable soft layers.
4. To obtain penetration into a stratum in which it is desired to found the structure.
5. To minimize the effects of vibrations or heave on adjacent existing structures.
6. To minimize the effects of ground heave on adjacent piles.

455-5.10.4 Construction Methods: Construct preformed pile holes by drilling or driving and withdrawing a suitable punch or chisel at the locations of the piles. Construct a hole that is equal to or slightly greater than the largest pile dimension for the entire length of the hole and of sufficient depth to obtain the required penetration. Carefully form the preformed hole by using a drill or punch guided by a template or other suitable device, and do not exceed the minimum dimensions necessary to achieve the required penetration of the pile. When the Plans call for grouting the preformed pile holes, provide a minimum pile hole dimension that is 2 inches larger than the largest pile dimension. Construct the holes at the Plan position of the pile and the tolerances in location, and ensure the hole is straight and that the batter is the same as specified for the pile. Loose material may remain in the preformed pile hole if the conditions in 455-5.10.1 are satisfied.

455-5.10.5 Grouting of Pile Holes: Clean and grout preformed pile holes for bearing piles, when the Plans require grouting after driving. Use grout that meets the requirements of 455-40 and 455-42 and has a minimum compressive strength of 3,000 psi at 28 days or as specified in the Plans. Prepare cylinders and perform QC testing in accordance

with 455-43. LOT size and verification will be in accordance with 455-43. Pump the grout through three or more grout pipes initially placed at the bottom of the preformed hole. The Contractor may raise the grout pipes when necessary to prevent clogging and to complete the grouting operations. Maintain the grout pipes below the surface of the previously placed grout. Continue grouting until the grout reaches the ground surface all around the pile. Provide divers to monitor grouting operations when the water depth is such that it is impractical to monitor from the ground surface.

455-5.11 Bearing Requirements:

455-5.11.1 General: Drive piles to provide the bearing required for carrying the loads shown in the Plans. For all types of bearing piles, consider the driving resistance as determined by the methods described herein sufficient for carrying the specified loads as the minimum bearing which is accepted for any type of piles. Determine pile bearing using the method described herein or as shown in the Plans.

For foundations requiring 100% dynamic testing of production piles, ensure each pile has achieved minimum penetration and the minimum required bearing for 6 inches of consecutive driving, or the minimum penetration is achieved, driving has reached practical refusal in firm material and the bearing capacity obtained in all the refusal blows.

For foundations not requiring 100% dynamic testing of production piles, ensure each pile has achieved minimum penetration, the blow count is generally the same or increasing and the minimum required bearing capacity obtained for 24 inches of consecutive driving with less than 1/4 inches rebound per blow, or the minimum penetration is achieved, and driving has reached practical refusal in firm material.

455-5.11.2 Bearing Criteria: For foundations requiring 100% dynamic testing, determine the bearing of all piles using the data received from dynamic load testing equipment utilizing internally or externally mounted sensors according to the methods described in 455-5.12.1.

For foundations not requiring 100% dynamic testing, drive all piles to the blow count criteria established by the GFDEOR and the Dynamic Testing Engineer (DTE) using the methods described herein and presented in the production pile length and driving criteria letter (see 455-5.15.2).

455-5.11.3 Practical Refusal: Practical refusal is defined as 20 blows per inch or less than one inch penetration, with the hammer operating at the highest setting or setting determined by the DTE for driving piles without damage and less than 1/4 inches rebound per blow. Stop driving as soon as the pile has reached practical refusal.

455-5.11.4 Set-checks and Pile Redrive:

1. Set-checks: Set-checks consist of redriving the pile after certain period of time, typically up to 24 hours. Perform set-checks as required and at the waiting periods shown in the Contract Documents. Provide an engineer's level or other suitable equipment for elevation determinations to determine accurate pile penetration during the set-checks. A pile may be accepted when a set-check shows that it has achieved the minimum required pile bearing and has met all other requirements of this Section.

2. Pile Redrive: Pile redrive consists of redriving the pile after the following working day from initial driving to determine time effects, to reestablish pile capacity due to pile heave, or for other reasons.

3. Uninstrumented Set-Checks and Uninstrumented Pile Redrive: Piles may be accepted based on uninstrumented set-checks or uninstrumented pile redrives only when

the piles are redriven for at least 24 inches. In these cases, the piles may be considered to have sufficient bearing resistance when the specified blow count criteria is achieved in accordance with 455-5.11.1 and 455-5.11.2. Unless practical refusal is obtained as defined in 455-5.11.3, set-checks or redrives for piles redriven less than 24 inches must be instrumented for pile acceptance.

4. Instrumented Set-Checks and Instrumented Pile Redrive: Use dynamic load tests using at least 6 hammer blows to determine whether the pile bearing is sufficient. The pile may be considered to have sufficient bearing resistance when dynamic measurements demonstrate the static pile resistance exceeds the required pile resistance for at least one hammer blow and the average static pile resistance during the next five hammer blows exceeds 95% of the required pile resistance. If the pile is advanced farther, the static pile resistance during all subsequent blows must exceed 90% of the required pile resistance.

455-5.11.5 Pile Heave: Pile heave is the upward movement of a pile from its originally driven elevation. Drive the piles in an appropriate sequence to minimize the effects of heave and lateral displacement of the ground. Monitor piles previously driven in a pile group for possible heave during the driving of the remaining piles. Take elevation measurements to determine the magnitude of the movement of piles and the ground surface resulting from the driving process. Redrive all piles that have heaved 1/4 inches or more.

455-5.11.6 Piles with Insufficient Bearing: When the bearing capacity of any pile is less than the required bearing capacity, the Contractor may splice the pile and continue driving or may extract the pile and drive a pile of greater length, or drive additional piles.

455-5.11.7 Optional Soil Set-up approach: If the Contractor so desires, it may consider soil set-up. Production piles that are driven to less than the Nominal Bearing Resistance (NBR) may be accepted based on the anticipated soil setup without set checks on all piles, only if the following criteria are met:

(a) Pile tip penetration satisfies the minimum penetration requirement following 455-5.9.

(b) End of Initial Drive (EOID) resistance exceeds 1.10 times the Factored Design Load for the pile bent/pier, as determined by the dynamic testing or blow count criteria.

(c) The Resistance Factor for computing NBR is taken from the following table:

Resistance Factors for Pile Installation Using Soil Setup (all structures)				
Loading	Design Method	Construction QC Method	Resistance Factor, φ	
			Blow Count Criteria[4]	100% Dynamic Testing[5]
Compression	Davisson Capacity	EDC[1], or PDA and CAPWAP[2]	0.55	0.60
		Static Load Testing[3]	0.65	0.70
		Statnamic Load Testing[3]	0.60	0.65
Uplift	Skin Friction	EDC[1], or PDA and CAPWAP[2]	0.45	0.50
		Static Load Testing[3]	0.55	0.55
1. Using the analysis methods published by Tran et al (2012). 2. Dynamic Load Testing and Signal Matching Analysis.				

3. Used to confirm the results of Dynamic Load Testing and Signal Matching Analysis.
4. Initial drive of production piles using Blow Count Criteria.
5. Initial drive of all piles accepted by results of Dynamic Testing of all blows.

(d) At least one test pile is driven at each bent/pier with a successful set check at the anticipated production pile tip elevations and one of the following sets of dynamic load testing conditions are met at each bent/pier.

1. The bearing of at least 10% of piles in the bent/pier (round up to the next whole number) is confirmed by instrumented set-check, and all test piles and instrumented set-checks demonstrate the pile resistance exceeds the NBR within seven days after EOID

2. The bearing of at least 20% of piles in the bent/pier (round up to the next whole number) is confirmed by instrumented set-check, and all test piles and instrumented set-checks demonstrate the pile resistance exceeds the NBR within 21 days after EOID.

(e) All uninstrumented piles are driven deeper and to a greater EOID resistance than the EOID resistance of all instrumented production piles in the same bent/pier.

455-5.12 Methods to Determine Pile Capacity:

455-5.12.1 General: Dynamic load tests using an externally mounted instrument system and signal matching analyses or embedded gauges will determine pile capacity for all structures or projects unless otherwise shown on the Plans. Notify the Engineer two working days prior to placement of piles within the template and at least one working day prior to driving piles.

455-5.12.2 Wave Equation:

1. General: Use Wave Equation Analysis for Piles (WEAP) programs to evaluate the suitability of the proposed driving system (including the hammer, follower, capblock and pile cushions) as well as to estimate the driving resistance, in blows per 12 inches or blows per inch, to achieve the pile bearing requirements and to evaluate pile driving stresses.

Use Wave Equation Analyses to show the hammer meets the requirements described in 455-5.3.

2. Required Equipment for Driving: Hammer acceptance is solely based on satisfactory field trial including dynamic load test results and Wave Equation Analysis. Supply a hammer system that meets the requirements described in the specifications based on satisfactory field performance.

In the event piles require different hammer sizes, the Contractor may elect to drive with more than one size hammer or with a variable energy hammer, provided the hammer is properly sized and cushioned, will not damage the pile, and will develop the required resistance.

3. Maximum Allowed Pile Stresses:

a. General: The maximum allowed driving stresses for concrete, steel, and timber piles are given below. In the event dynamic load tests show that the hammer will overstress the pile, modify the driving system or method of operation as required to prevent overstressing the pile. In such cases provide additional cushioning, reduce the stroke, or make other appropriate agreed upon changes.

b. Prestressed Concrete Piles: Use the following equations to determine the maximum allowed pile stresses:

$s_{apc} = 0.7 f'_c - 0.75 f_{cpe}$ (1)

$s_{apt} = 6.5(f'_c)^{0.5} + 1.05 f_{cpe}$ (2a) for piles less than 50 feet long

$s_{apt} = 3.25(f'_c)^{0.5} + 1.05 f_{cpe}$ (2b) for piles 50 feet long and greater

$s_{apt} = 500$ (2c) within 20 feet of a mechanical splice

where:

s_{apc}= maximum allowed pile compressive stress, psi
s_{apt}= maximum allowed pile tensile stress, psi
f'_c= specified minimum compressive strength of concrete, psi
f_{cpe}= effective prestress (after all losses) at the time of driving, psi, taken as 0.8 times the initial prestress force divided by the minimum net concrete cross sectional area of the pile (f_{cpe}= 0 for dowel spliced piles).

c. Steel Piles: Ensure the maximum pile compression and tensile stresses measured during driving are no greater than 0.9 times the yield strength (0.9 f_y) of the steel.

d. Timber Piles: Ensure the maximum pile compression and tensile stresses measured during driving are no greater than 3.6 ksi for Southern Pine and Pacific Coast Douglas Fir and 0.9 of the ultimate parallel to the grain strength for piles of other wood.

455-5.12.3 Temporary Piles: Submit for the Engineers review, an analysis signed and sealed by the GFDEOR which establishes the pile lengths for temporary piles. Submit for the Engineer's acceptance, a Wave Equation analysis signed and sealed by the GFDEOR which establishes the driving criteria for temporary piles at least five working days prior to driving temporary production piles. The required driving resistance is equal to the sum of the factored design load plus the scour and down drag resistances shown in the Plans, divided by the appropriate resistance factor or the nominal bearing resistance shown in the Plans, whichever is higher:

The maximum resistance factor is 0.45 when only wave equation analysis is performed. However, a larger resistance factor may be applicable when additional testing is provided by the GFDEOR in accordance with Section 3.5.6 of Volume 1 of the FDOT Structures Manual.

455-5.12.4 Dynamic Load Tests: Dynamic load testing consists of estimating pile capacity by the analysis of electronic data collected from blows of the hammer during driving of an instrumented pile in accordance with 455-5.14.

455-5.12.5 Static Load Tests: Static load testing consists of applying a static load to the pile to determine its capacity. Use the Modified Quick Test Procedure in accordance with 455-2.2.1.

455-5.12.6 Fender Pile Installation: For piles used in fender systems, regardless of type or size of pile, either drive them full length or jet the piles to within 2 feet of cutoff and drive to cutoff elevation to seat the pile. The Engineer will not require a specific driving resistance unless noted in the Plans. Use methods and equipment for installation that do not

damage the piles. If the method or equipment used causes damage to the pile, modify the methods or equipment.

455-5.12.7 Structures Without Test Piles: For structures without 100% dynamic testing or test piles, dynamically test the first pile(s) in each bent or pier at locations shown in the Plans to determine the blow count criteria for the remaining piles. Dynamically test at least 5% of the piles at each bent or pier (rounded up to the next whole number).

455-5.13 Test Piles:

455-5.13.1 General: All test piles will have dynamic load tests. Drive piles of the same cross-section and type as the permanent piles shown in the Plans, in order to determine any or all of the following:

1. Installation criteria for the piles.
2. Nature of the soil.
3. Lengths of permanent piles required for the work.
4. Driving resistance characteristics of the various soil strata.
5. Amount of work necessary to obtain minimum required pile penetration.
6. The ability of the driving system to do the work.
7. The need for point protection.
8. Verify the bearing stratum is of sufficient thickness to prevent punching shear failure.

Because test piles are exploratory in nature, drive them harder (within the limits of practical refusal), deeper, and to a greater bearing resistance than required for the permanent piling. Except for test piles which are to be statically or Statnamically load tested, drive test piles their full length or to practical refusal. Splice test piles which have been driven their full length and have developed only minimal required bearing and proceed with further driving.

As a minimum, unless otherwise accepted by the Engineer, do not cease driving of test piles until obtaining the required bearing capacity continuously, where the blow count is increasing, for 10 feet unless reaching practical refusal first. For test piles which are to be statically or Statnamically load tested, ignore this minimum and drive these piles as anticipated for the production piles.

When test piles attain practical refusal prior to attaining minimum penetration, perform all work necessary to attain minimum penetration and the required bearing. Where practical, use water jets to break the pile loose for further driving. Where jetting is impractical, extract the pile and install a preformed pile hole through which driving will continue. Install instruments on all test piles.

455-5.13.2 Location of Test Piles: Drive all test piles in the position of permanent piles at the designated locations. Ensure that all test piles designated to be statically load tested are plumb. In the event that all the piles are battered at a static load test site, an out-of-position location for driving a plumb pile for the static load test may be selected.

455-5.13.3 Equipment for Driving: Use the same hammer and equipment for driving test piles as for driving the permanent piles. Also use the same equipment to redrive piles.

455-5.14 Dynamic Load Tests: Take dynamic measurements during the driving of piles designated in the Plans. Provide all personnel, materials and equipment for dynamic testing. For concrete piles, install instruments prior to driving and monitor all blows delivered to the pile. For

steel production piles, the Engineer may accept instrumented set checks or redrives. Perform dynamic load tests to evaluate the following:

1. Suitability of the driving equipment, including hammer, capblock, pile cushion, and any proposed follower.
2. Pile capacity.
3. Pile stresses.
4. Energy transfer to pile.
5. Distribution of soil resistance.
6. Soil variables including quake and damping.
7. Hammer-pile-soil system for Wave Equation analyses.
8. Pile installation problems.

Either install embedded gauges in the piles in accordance with Standard Plans, Index 455-003, or attach instruments (strain transducers to measure force and accelerometers to measure acceleration) with bolts to the pile for dynamic testing.

Monitor the stresses in the piles with the dynamic test equipment during driving to ensure the maximum allowed stresses are not exceeded. If necessary, add additional cushioning, replace the cushions, or reduce the hammer stroke to maintain stresses below the maximum allowable. If dynamic test equipment measurements indicate non-axial driving, immediately realign the driving system. If the cushion is compressed to the point that a change in alignment of the hammer will not correct the problem, add cushioning or change the cushion.

Drive the pile to the required penetration and resistance.

Do not use a cold diesel hammer for a set-check. Generally, warm up the hammer by driving another pile or applying at least 20 blows to a previously driven pile or to timber mats placed on the ground.

455-5.15 Pile Lengths:

455-5.15.1 Test Pile Length: Provide the length of test piles shown in the Plans or as directed by the GFDEOR.

455-5.15.2 Production Pile Length

The production pile lengths shall be the lengths determined by the DTE and the GFDEOR based on all information available before the driving of the permanent piles, including, but not limited to, information gained from the driving of test piles, dynamic load testing, static load testing, supplemental soil testing, etc. When authorized by the Department, soil freeze information obtained during set checks and pile redrives may be used to determine authorized pile lengths for sites with extreme soil conditions.

After completion of the test pile program, production pile lengths and driving criteria shall be established in a letter signed and sealed jointly by the DTE and the GFDEOR. The letter will contain an itemized list of authorized pile lengths as well as the blow count criteria for acceptance of the pile, minimum penetrations, maximum strokes, criteria to replace cushions and any other conditions and limitations deemed appropriate for the safe installation of the piles. Use these lengths for furnishing the permanent piling for the structure. At least two working days, excluding weekends and Department observed holidays, prior to beginning of production pile driving, submit the letter and load test reports to the Engineer including the following electronic files (Windows compatible): dynamic testing date data, signal matching data and results, and Wave Equation data and results.

If there are no test piles, provide the Production Pile Order Lengths in the Pile Data Table on the Structure Plans.

455-5.16 Allowable Driving Tolerances:

455-5.16.1 General: Meet the tolerances described in this Subarticle for the piles that are free standing without lateral restraint (after the template is removed). After the piles are driven, do not move the piles laterally to force them to be within the specified tolerances, except to move battered piles laterally to overcome the dead load deflections caused by the pile's weight. When this is necessary, submit calculations signed and sealed by a Specialty Engineer to the Engineer that verify the amount of dead load deflection prior to moving any piles.

455-5.16.2 Position: Ensure that the final position of the pile head at cut-off elevation is no more than 3 inches, or 1/6 of the diameter of the pile, whichever is less, laterally in the X or Y coordinate from the Plan position indicated in the Plans.

455-5.16.3 Axial Alignment: Ensure that the axial alignment of the driven piles does not deviate by more than 1/4 inches per foot from the vertical or batter line indicated in the Plans.

455-5.16.4 Elevation: Ensure that the final elevation of the pile head is no more than 1-1/2 inches above, or more than 4 inches below, the elevation shown in the Plans, however in no case shall the pile be embedded less than 8 inches into the cap or footing.

For fender piles, cut off piles at the elevation shown in the Plans to a tolerance of plus 0.0 inches to minus 2.0 inches using sawing or other means as accepted by the Engineer to provide a smooth level cut.

455-5.16.5 Deviation from Above Tolerances: Have the Contractor's Engineer of Record perform an evaluation of the as built foundation to determine whether a foundation redesign or an increase in the loading requirements of the piles is needed. Include the signed and sealed evaluation as part of the certification package submitted in accordance with 455-5.19. If the evaluation indicates the foundation or the pile load requirements must be modified, propose a redesign to incorporate out of tolerance piles into pile caps or footings, at no expense to the Department. Submit signed and sealed redesign drawings and computations to the Engineer for review and acceptance. Do not begin any proposed construction until the redesign has been reviewed and accepted by the Engineer, excepted as noted in 455-5.20.

455-5.17 Disposition of Pile Cut-offs, Test Piles, and Load Test Materials:

455-5.17.1 Pile Cut-offs:

Take ownership of any unused cut-off lengths remaining and remove them from the right-of-way. Provide areas for their disposal.

455-5.17.2 Test Piles: Cut off, or build-up as necessary, test piles, and leave them in place as permanent piles. Extract and replace test piles driven in permanent position and found not suitable for use. Pull, or cut off at an elevation 2 feet below the ground surface or bottom of proposed excavation, test piles driven out of permanent position, and dispose of the removed portion of the test pile.

When test piles are required to be driven in permanent pile positions, the Contractor may elect to drive the test pile out of position provided that a replacement pile is furnished and driven in the position that was to be occupied by the test pile. Unless otherwise directed in the Plans or by the Engineer, retain ownership of test piles that are pulled or cut off and provide areas for their disposal.

455-5.18 Recording: Inspect and record all the pile installation activities, including but not limited to handling, jetting, predrilling, preforming and driving on the Department's Pile Driving Record form. Steel piles and dynamically tested concrete piles in accordance with 455-5.14 will not require inspection during handling. Keep a pile driving log for each pile installed

whether it is, or is not, instrumented. Within one working day after completing the installation of a pile, submit the Pile Driving Record to the Engineer.

455-5.19 Foundation Certification Packages: Submit certification packages of pile foundations to the Engineer prior to Pile Verification Testing. A separate Foundation Certification Package must be submitted for each foundation unit. A foundation unit is defined as all the piles within one bent or pier for a specific bridge for each phase of construction. Each Foundation Certification Package shall contain an original certification letter signed and sealed by the GFDEOR certifying the piles have the required axial capacity including compression and uplift, lateral stability, pile integrity, settlements will not affect the functionality of the structure, and that the inspection of the pile installation was performed under the supervision of the GFDEOR. The package shall also include all pile driving logs, EDC records, all supplemental dynamic testing raw data and analyses for the foundation unit, and the signed and sealed evaluation performed to address out of tolerance piles in accordance with 455-5.16.5. The certification shall not be contingent on any future repair or testing, or any approval by the Engineer.

For foundation units where all piles are dynamically load tested by the same DTE, the foundation certification package may be prepared by the DTE, and the DTE may sign and seal the foundation layout and pile data table to reflect as-built conditions if the DTE is prequalified under the appropriate category in Florida Administrative Code (F.A.C.) 14-75.

455-5.20 Verification: One working day, excluding weekends and Department observed holidays, after receipt of the Foundation Certification Package, the Engineer will determine whether a pile in that foundation unit will be selected for verification testing. Based on its review of the certification package, the Engineer may or may not choose a pile for verification testing in any or all foundation units. For the pile selected by the Engineer for verification testing, the Engineer will provide the dynamic load test equipment and personnel for the Pile Verification Testing. Provide the driving equipment and pile driving crew for the Pile Verification Testing and provide support as needed to prepare the piles for testing. The Engineer will provide the results of the verification testing and identify additional needs for verification testing within one working day of testing.

If the capacity or integrity of any pile is found to be deficient, the Engineer will reject the entire certification package for the foundation unit, and the Contractor shall:

1. Correct the deficiency;
2. Correct the process that led to the deficiency;
3. Demonstrate to the Engineer that the remainder of the piles in the foundation unit are acceptable, including additional dynamic load tests to verify pile capacity and integrity, and;
4. Recertify the foundation unit.

One working day, excluding weekends and Department observed holidays, after receipt of the recertification, the Engineer shall then determine whether additional verification testing is required in that foundation unit. If the capacity or integrity of a verification pile is found to be deficient, additional cycles of deficiency correction and verification testing shall be completed until no more pile capacity or integrity deficiencies are detected or the design is modified accordingly. Piles shall not be cut-off nor bent/pier caps placed prior to successful completion of the Pile Verification Testing Program for that foundation unit. In case of disagreement of dynamic testing results, the Engineer's results will be final and will be used for acceptance.

On land foundation units or water foundation units when the pile cutoff is at least six feet above mean high water, the Contractor may cut-off piles prior to a complete submittal of the Certification Package or to a successful completion of the Pile Verification Testing Program at its own risk. If any piles in a foundation unit are cut-off prior to the submittal of a certification package or completion of the Pile Verification Testing Program and the Engineer determines that verification testing is required, the Contractor shall perform, at no expense to the Department, any work and labor required to expose any pile selected for verification to allow the installation of the instruments in dry conditions and to provide references and access to the Engineer for such testing. Piles experiencing damage during the verification testing or requiring build-up after the verification shall be repaired by the Contractor at no expense to the Department. No pile bent/cap shall be poured prior to successful completion of the Pile Verification Testing Program for that foundation unit or notification by the Engineer that no verification will be required.

455-6 Timber Piling.

455-6.1 Description: Drive timber piles of the kind and dimensions specified in the Plans at the locations and to the elevations shown in the Plans.

455-6.2 Materials: Meet the timber piling requirements of Section 953. Treat the piles according to the applicable provisions of Section 955. Treat all cuts and drilled holes in accordance with 470-3.

455-6.3 Preparation for Driving:

455-6.3.1 Caps: Protect the heads of timber piles during driving, using a cap of approved type, that will distribute the hammer blow over the entire cross-section of the pile. When necessary, cut the head of the pile square before beginning pile driving.

455-6.3.2 Collars: Provide collars or bands to protect piles against splitting and brooming at no expense to the Department.

455-6.3.3 Shoes: Provide piles shod with metal shoes, of a design satisfactory to the Engineer, at no expense to the Department. Shape pile tips to receive the shoe and install according to the manufacturer's directions.

455-6.4 Storage and Handling: Store and handle piles in the manner necessary to avoid damage to the piling. Take special care to avoid breaking the surface of treated piles. Do not use cant dogs, hooks, or pike poles when handling and storing the piling.

455-6.5 Cutting Off: Saw off the tops of all timber piles at the elevation indicated in the Plans. Saw off piles which support timber caps to the exact plane of the superimposed structure so that they exactly fit. Withdraw and replace broken, split, or misplaced piles.

455-6.6 Build-ups: The Engineer will not permit splices or build-ups for timber piles. Extract piles driven below Plan elevation and drive a longer pile.

455-6.7 Pile Heads:

455-6.7.1 Piles with Timber Caps: On piles wider than the timber caps, dress off the part of the pile head projecting beyond the sides of the cap to a slope of 45 degrees. Coat the cut surface with the required preservative and then place a sheet of copper, with a weight of 10 ounces per square foot or greater, meeting the requirements of ASTM B370. Provide a cover measuring at least 4 inches more in each dimension greater than the diameter of the pile. Bend the cover down over the pile and fasten the edges with large head copper nails or three wraps of No. 12 copper wire.

455-6.7.2 Fender and Bulkhead Piles: Paint the heads of fender piles and of bulkhead piles with preservative and then cover with copper as provided above for piles supporting timber caps.

455-7 Prestressed Concrete Piling.

455-7.1 Description: Provide prestressed concrete piles that are manufactured, cured, and driven in accordance with the Contract Documents. Provide piles full length without splices when transported by barge or the pile length is less than or equal to 120 feet. When piles are transported by truck and the pile length exceeds 120 feet or the maximum length for a 3-point pick-up according to Standard Plans, Index 455-001, and splicing is desired, provide minimal splices. Include the cost of the splices in the cost of the pile.

455-7.2 Manufacture: Fabricate piles in accordance with Section 450. When embedded gauges will be used for dynamic load testing, supply and install in square prestressed concrete piles in accordance with Standard Plans Index 455-003. Ensure the embedded gauges are installed by personnel approved by the manufacturer.

455-7.3 Storage and Handling:

455-7.3.1 Time of Driving Piles: Drive prestressed concrete piles at any time after the concrete has been cured in accordance with Section 450, and the concrete compressive strength is equal to or greater than the specified 28-day compressive strength.

455-7.3.2 Storage: Support piles on adequate dunnage both in the prestress yard and at the job site in accordance with the locations shown in the Standard Plans to minimize undue bending stresses or creating a sweep or camber in the pile.

455-7.3.3 Handling: Handle and store piles in the manner necessary to eliminate the danger of fracture by impact or of undue bending stresses in handling or transporting the piles from the forms and into the leads. In general, lift concrete piles by means of a suitable bridge or slings attached to the pile at the locations shown in the Standard Plans. Construct slings used to handle piles of a fabric material or braided wire rope constructed of six or more wire ropes which will not mar the corners or the surface finish of the piles. Do not use chains to handle piles. During transport, support concrete piles at the lifting locations shown in the Standard Plans or fully support them throughout 80% or more of their length. In handling piles for use in salty or brackish water, exercise special care to avoid damaging the surface and corners of the pile. If an alternate transportation support arrangement is desired, submit calculations, signed and sealed by the Specialty Engineer, for acceptance by the Engineer prior to transporting the pile. Calculations must show that the pile can be transported without exceeding the bending moments calculated using the support locations shown in the Plans.

455-7.4 Cracked Piles: The Engineer will reject any pile that becomes cracked in handling to the point that a transverse or longitudinal crack extends through the pile, shows failure of the concrete as indicated by spalling of concrete on the main body of the pile adjacent to the crack, which in the opinion of the Engineer will not withstand driving stresses, or becomes damaged during installation. The Engineer will not reject any pile for the occasional minor surface hairline cracking caused by shrinkage.

Do not drive piling with irreparable damage, which is defined as any cracks that extend through the pile cross-sectional area that are, or will be, below ground or water level at the end of driving. Remove and replace broken piles or piles cracked to the extent described above at no expense to the Department. The Engineer will accept cracks less than 0.005 inches which do not extend through the pile. Using approved methods, cut off and splice or build-up to

cut-off elevation piles with cracks greater than 0.005 inches at the pile head or above ground or water level, and piles with cracks above ground or water level which extend through the cross-sectional area of the pile. The Engineer, at his discretion, may require correction of pile damage or pile cracks by cutting down the concrete to the plane of sound concrete below the crack and rebuilding it to cut-off elevation, or the Engineer may reject the pile. Extract and replace rejected piles that cannot be repaired, at no expense to the Department.

Take appropriate steps to prevent the occurrence of cracking, whether due to handling, transporting or driving.

455-7.5 Preparation for Transportation: Cut strands flush with the surface of the concrete using an abrasive cutting blade before transporting the piles from the casting yard.

Cut and patch the metal lifting devices in accordance with 450-9.2.1.

455-7.6 Method of Driving: Unless otherwise directed, drive piles by a hammer or by means of a combination of water jets and hammer when jetting is allowed. When using jets in combination with a hammer, withdraw the jets and drive the pile by the hammer alone to secure final penetration and to rigidly fix the tip end of the pile. Keep jets in place if they are being used to continuously eliminate the soil resistance in the scour zone.

455-7.7 Extensions and Build-ups Used to Increase Production Lengths:

455-7.7.1 General: Where splices, extensions and build-ups for concrete piles are necessary, construct them in accordance with Standard Plans, Index 455-002.

These requirements are not applicable to specially designed piling. Make splices for special pile designs as shown in the Plans.

455-7.7.2 Extensions to be Driven or Those 21 feet or Longer: Construct extensions to be driven or extensions 21 feet or longer in length in accordance with the details shown in the Plans and in a manner including the requirements, sequences, and procedures outlined below:

1. Cast a splice section in accordance with Section 450 with the dowel steel in the correct position and alignment.
2. Drill dowel holes using an approved steel template that will position and align the drill bit during drilling. Drill holes a minimum of 2 inches deeper than the length of the dowel to be inserted.
3. Clean the drilled dowel holes by inserting a high-pressure air hose to the bottom of the hole and blowing the hole clean from the bottom upward. Eliminate any oil, dust, water, and other deleterious materials from the holes and the concrete surfaces to be joined.
4. Place forms around joints between the pile sections.
5. Mix the adhesive components in accordance with the manufacturer's directions. Do not mix sand or any other filler material with the epoxy components unless it is prepackaged by the manufacturer for this specific purpose. Use adhesives meeting the requirements of Section 926 for Type B Epoxy Compounds.
6. After ensuring that all concrete surfaces are dry, fill the dowel holes with the adhesive material.
7. Insert the dowels of the spliced section into the adhesive filled holes of the bottom section and position the spliced section so that the axes of the two sections are in concentric alignment and the ends of the abutting sections are spaced 1/2 inches apart. The Contractor may use small steel spacers of the required thickness provided they have 3 inches or more of cover after completing the splice. Fill the space between the abutting sections completely with the adhesive.

8. Secure the spliced sections in alignment until the adhesive is cured in accordance with the manufacturer's directions for the time appropriate with the prevailing ambient temperatures. Do not utilize the crane to secure the pile extension during the adhesive cure time. Utilize alignment braces to maintain the proper pile alignment during the epoxy cure time.

9. After curing is completed, remove alignment braces and forms and clean and dress the spliced area to match the pile dimensions.

When dowel splices need to be driven, perform dynamic instrumentation during the driving of each dowel spliced pile to monitor and control the stresses and to verify the splicing integrity. Replace any damaged pile splices in accordance with 455-3. Provide the Engineer 48 hours advance notification prior to driving spliced piles.

455-7.7.3 Precast Reinforced Non-Drivable Build-ups less than 21 feet: Construct precast reinforced non-drivable build-ups less than 21 feet in accordance with the requirements of this Subarticle, Section 346, and Section 400. Provide the same material for the form surfaces for precast build-ups as was used to form the prestressed piles. Use concrete of the same mix as used in the prestressed pile and dimension the cross-section the same as piling being built up. Install build-ups as specified in 455-7.7.2(2) through 455-7.7.2(9). Apply to the build-ups the same surface treatment or sealant applied to the prestressed piles.

455-7.8 Pre-Planned Splices: Construct splices in accordance with the dowel splice method contained in the Standard Plan Indexes or using proprietary splices which are listed on the Department's Approved Product List (APL). Splice test piles in the same manner as the production piles. Include in the pile installation plan, the chosen method of splicing and the approximate locations of the splice. Generally, place the splice at approximately the midpoint between the estimated pile tip and the ground surface, considering scour if applicable. Stagger the splice location between adjacent piles by a minimum of 10 feet. Obtain the Engineer's approval prior to constructing any pile sections. Construct piles which are to be spliced using the dowel splice with preformed dowel holes in the bottom section and embedded dowels in the upper section.

When dowel splices need to be driven, perform dynamic instrumentation during the driving of each dowel spliced pile to monitor and control the stresses and verify the splicing integrity. Replace any damaged pile splices in accordance with 455-3. Provide the Engineer 48 hours advance notification prior to driving spliced piles.

. Mechanical pile splices must be capable of developing the following capacities in the pile section unless shown otherwise in the Plans and capable of being installed without damage to the pile or splice:

1. Compressive strength = (Pile Cross sectional area) x (28-day concrete strength)

2. Tensile Strength = (Pile Cross sectional area) x 900 psi

Table 455-1

Pile Size (inches)	Bending Strength (kip-feet)
18	245
20	325
24	600
30	950

455-7.9 Pile Cut-offs: After the completion of driving, cut piles off which extend above the cut-off elevation with an abrasive saw. Make the cut the depth necessary to cleanly cut through the prestressed strands. Take ownership and dispose of cut-off sections not used elsewhere as allowed by this Section.

455-8 Steel Piling.

455-8.1 Description: Furnish, splice, drive, and cut off structural steel shapes to form bearing piles. Include in this work the preparation of a smooth and square pile top meeting the requirements of ASTM A252 or API 5L prior to driving, installation of structural steel bracing by bolting or welding, construction of splices and the filling of pipe piles with the materials specified in 455-8.9.

455-8.2 Material: For the material in steel piles, pile bracing, scabs, wedges, and splices, meet the requirements of Section 962.

455-8.3 Pile Splices: Order and use the full authorized pile length where practicable. Do not splice to obtain authorized lengths less than 40 feet except when shown in the Plans. Locate all splices in the authorized pile length in portions of the pile expected to be at least 15 feet below the final ground surface after driving. When it is not practicable to provide authorized pile lengths longer than 40 feet in a single length, use no more than one field splice per additional 40 feet of authorized pile length. Shop splices may be used to join single lengths of pile which are at least 20 feet in length. One shorter segment of pile may be used to achieve the authorized pile length when needed.

Where the pile length authorized is not sufficient to obtain the required bearing value or penetration, order an additional length of pile and splice it to the original length.

Make all splices in accordance with details shown in the Plans and in compliance with the general requirements of AWS D1.1 or American Petroleum Institute Specification 5L (API 5L).

455-8.4 Welding: Make all welded connections to steel piles by electric arc welding, in accordance with details shown in the Plans and in compliance with the general requirements of AWS D1.5. Electroslag welding is not permitted. Welds will be inspected by visual methods.

455-8.5 Pile Heads and Tips: Cut off all piles at the elevation shown in the Plans. If using a cutting torch, make the surface as smooth as practical.

Where foundation material is so dense that the Contractor cannot drive the pile to the required penetration and firmly seat it without danger of crumpling the tip, reinforce the tips with cast steel point protectors. Construct point protectors in one piece of cast steel meeting the requirements of ASTM A27, Grade 65-35 heat treated to provide full bearing for the piles. Attach points by welding according to the recommendations of the manufacturer.

455-8.6 Pile Bent Bracing Members: Place structural steel sway and cross bracing, and all other steel tie bracing, on steel pile bents and bolt or weld in place as indicated in the Plans. Where piles are not driven into position in exact alignment as shown in the Plans, furnish and place fills and shims as required to square and line up faces of flanges for cross bracing.

455-8.7 Coating: Coat exposed parts of steel piling, wedging, bracing, and splices in accordance with the provisions for coating structural steel as specified in Section 560.

455-8.8 Storage and Handling: While handling or transporting the piles from the point of origin and into the leads, store and handle in the manner necessary to avoid damage due to bending stresses. In general, lift steel piles by means of a suitable bridge or a sling attached to the

pile at appropriate points to prevent damage. Lift the pile from the horizontal position in a manner that will prevent damage due to bending of the flanges and/or web.

455-8.9 Filling Pipe Piles: Ensure closed-end pipe piles are watertight. When required by the Plans, fill pipe piles with the specified materials. Use clean concrete sands and concrete meeting the requirements of Section 346. Place concrete in open ended pipes containing water using methods in accordance with 455-15.9 with modified tremie and pump line sizes. Concrete may be placed directly into pipes which are dry. Construct and place reinforcement cages in accordance with 455-16, except the minimum number of spacers per level is three. Reinforcement cages may be installed before concrete placement or after concrete placement is completed if proper alignment and position is obtainable.

455-9 Sheet Piling.

455-9.1 Description: Leave permanent piling in place as part of the finished work and remove temporary piling after each construction phase unless otherwise authorized by the Engineer.

455-9.2 Materials: Meet the following requirements:

Concrete	Section 346
Bar Reinforcement	Section 931
Prestressing Reinforcement	Section 933
Steel Sheet Piles*	Section 962

*For temporary steel sheet piles meet the requirements specified in the Plans.

455-9.3 Steel Sheet Piling: Drive steel sheet piling and cut off true to line and grade. Install steel sheet piling with a suitable hammer. Remove and replace any section damaged during handling and installation at no additional expense to the Department.

455-9.3.1 Method of Installation: Where rock or strong material is encountered such that the sheet piles cannot be set to grade by driving, remove the strong material by other acceptable means, such as excavation and backfilling, drilling or by punching.

455-9.4 Concrete Sheet Piling:

455-9.4.1 Description: Ensure that concrete sheet piling is of prestressed concrete construction and manufactured, cured, and installed in accordance with the requirements of the Contract Documents.

455-9.4.2 Manufacture of Piles: Ensure that the piles are fabricated in accordance with Section 450.

455-9.4.3 Method of Installation: Jet concrete sheet piling to grade where practical. Use a minimum of two jets. Provide water at the nozzles of sufficient volume and pressure to freely erode material adjacent to the piles. Where encountering rock or strong material, such that the sheet piles cannot be set to grade by jetting, remove the strong materials by other acceptable means, such as excavation and backfilling, drilling or by punching with a suitable punch.

455-9.4.4 Grouting and Caulking: Concrete sheet piles are generally detailed to have tongues and grooves on their lower ends, and double grooves on their upper ends. Where so detailed, after installation, clean the grooves of all sand, mud, or debris, and fully grout the grooves. Use approved plastic bags (sheaths) which will meet the shape and length of the groove to be grouted to contain the plastic grout within the double grooves. Provide grout composed of one part cement and two parts sand. Use clean A-3 sand or sand meeting the requirements of Section 902 in this grout. In lieu of sand-cement grout, the Contractor may use concrete meeting

the requirements of Section 347, using small gravel or crushed stone coarse aggregate. Deposit the grout through a grout pipe placed within a watertight plastic sheath (bag) extending the full depth of the double grooves and which, when filled, completely fills the slot formed by the double grooves.

455-9.5 Storage and Handling: Handle and store all sheet piles in a manner to prevent damage. Handle long sheet piles with fabric slings or braided wire rope constructed of six or more wire ropes placed at appropriate lift points to prevent damage due to excessive bending.

455-10 Pile Installation Plan (PIP).

455-10.1 General: At the preconstruction conference or at least 15 days prior to driving the first pile, submit a Pile Installation Plan for review by the Engineer. The PIP shall be used to govern all pile installation activities. In the event that deviations from the PIP are observed, the Engineer may perform Independent Verification Testing/Review of the Contractor's equipment, procedures, personnel and PIP at any time during production pile driving. If, as determined by the Engineer, pile driving equipment, procedures and/or personnel for the PIP is deemed inadequate to consistently provide undamaged driven piling meeting the contract requirements, the Contractor's PIP acceptance may be withdrawn pending corrective actions. Production driving shall then cease and not restart until corrective actions have been taken and the PIP re-accepted.

Ensure the Pile Driving Installation Plan information includes the following:

1. List and size of proposed equipment including cranes, barges, driving equipment, jetting equipment, compressors, and preformed pile hole equipment on the Department's Pile Driving Installation Plan Form (Form No. 700-020-01). Include manufacturer's data sheets on hammers.
2. Methods to determine hammer energy in the field for determination of pile capacity. Include in the submittal necessary charts and recent calibrations for any pressure measuring equipment.
3. Detailed drawings of any proposed followers.
4. Detailed drawings of templates.
5. Details of proposed load test equipment and procedures, including recent calibrations of jacks and required load cells.
6. Sequence of driving of piles for each different configuration of pile layout.
7. Details of proposed features and procedures for protection of existing structures.
8. Required shop drawings for piles, cofferdams, etc.
9. Methods and equipment proposed to prevent displacement of piles during placement and compaction of fill within 15 feet of the piles.
10. Methods to prevent deflection of battered piles due to their own weight and to maintain their as-driven position until casting of the pile cap is complete.
11. Proposed pile splice locations and details of any proprietary splices anticipated to be used.
12. Methods and equipment proposed to prevent damage to voided or cylinder piles due to interior water pressure.
13. Name and experience record of pile driving superintendent or foreman in responsible charge of pile driving operations. Ensure the pile driving superintendent or

foreman in responsible charge of the pile driving operations has the experience requirements of 105-8.13 installing driven piles of the size and depth shown in the Plans.

14. The names of the CTQP qualified inspectors assigned to inspect the pile installation. If the Dynamic Testing Engineer is also a CTQP qualified pile driving inspector and is able to perform both operations, then an additional pile driving inspector is not required when driving piles using embedded sensors.

15. The quality control processes to ensure the required capacity is achieved in all piles. Include in the PIP the steps and analyses that would be performed when driving conditions change (such as unanticipated tip elevations, hammer modifications, presence of temporary piles and structures, preforming, changes, etc.).

16. The name and contact information for the single representative of the Contractor, independent of field operations personnel, to resolve to the Engineer's satisfaction conflicts in the driving procedures or interpretations of the driving criteria. This person shall be available within two hours notice, and shall have the authority to refer issues to higher levels (corporate, if needed).

17. A letter from the GFDEOR certifying concurrence with the PIP.

Notify the Engineer of any test pile driving and production pile driving at least 1 week prior to beginning the installation operations of any pile.

455-10.2 Acceptance of the Pile Installation Plan: The Engineer will evaluate the PIP for conformance with the Contract Documents. Within five working days, excluding weekends and Department observed holidays, after receipt of the plan, the Engineer will notify the Contractor of any comments and additional information required and/or changes that may be necessary to satisfy the Contract Documents. Submit changes and respond to the Engineer's comments and allow at least two working days, excluding weekends and Department observed holidays, for the Engineer to review the revised PIP.

All equipment and procedures are subject to satisfactory field performance. Make required changes to correct unsatisfactory field performance. The Engineer will give final acceptance after the Contractor makes necessary modifications. Do not make any changes in the driving system after acceptance without a revised PIP with concurrence of the GFDEOR and acceptance by the Engineer. A hammer repaired on site or removed from the site and returned is considered to have its performance altered (efficiency increased or decreased), which is considered a change in the driving system. Perform a dynamic load test in accordance with 455-5.14 on the first pile driven with this hammer to confirm the driving criteria is still appropriate at no additional compensation.

Acceptance of the PIP by the Engineer does not relieve the Contractor of the responsibility to perform the work in accordance with the Contract Documents. The Engineer's acceptance is not a guarantee that the chosen methods and equipment are capable of obtaining the required results; this responsibility lies with the Contractor.

ARTICLE 455-11 is deleted:

455-12 Basis of Payment.

Contract Price includes all labor, equipment and materials required for furnishing, installing, and certifying completed pile foundations, in place and accepted. No separate payment will be made for any items of work associated with the construction of piling. No additional payment or adjustments will be made for set-checks, re-drives, dynamic load tests, pile

instrumentations, splice installations and driving, build-ups, pile extractions, preformed holes or other associated activities.

C. DRILLED SHAFTS

455-13 Description.

Construct drilled shaft foundations consisting of reinforced concrete drilled shafts.

455-14 Materials.

455-14.1 Concrete: Use concrete meeting the requirements of Section 346, unless otherwise shown in the Plans.

455-14.2 Reinforcing Steel: Meet the reinforcing steel requirements of Section 415.

455-14.3 Polymer Slurry: Use a product listed on the Department's Approved Product List (APL) meeting the requirements of 932-5.

455-15 Construction Methods and Equipment.

455-15.1 General Requirements:

455-15.1.1 Templates: When drilling from a barge, provide a fixed template, adequate to maintain shaft position and alignment during all excavation and concreting operations. Do not use floating templates (attached to a barge). When the Contractor fails to properly maintain shaft position and alignment without use of a template when drilling on land, provide a fixed template, adequate to maintain shaft position and alignment during all excavation and concreting operations.

455-15.1.2 Drilled Shaft Installation Plan (DSIP): At the preconstruction conference or at least 15 days prior to constructing the first drilled shaft, submit a Drilled Shaft Installation Plan (DSIP) for review and acceptance by the Engineer. The DSIP will be used to govern all drilled shaft construction activities. In the event that deviations from the DSIP are observed, the Engineer may perform Independent Verification Testing/Review of the Contractor's equipment, procedures and personnel at any time during production drilled shaft construction. If, as determined by the Engineer, drilled shaft construction equipment, procedures or personnel is deemed inadequate to consistently provide drilled shafts meeting the contract requirements, the Contractor's DSIP may be withdrawn pending corrective actions. All drilled shaft construction activities shall then cease and not restart until corrective actions have been taken and the DSIP has been re-accepted.

Include in the DSIP the following details:

1. Name and experience record of drilled shaft superintendent or foreman in responsible charge of drilled shaft operations. Ensure the drilled shaft superintendent or foreman in responsible charge of the drilled shaft operations has the experience requirements of 105-8.13 installing drilled shafts of the size and depth shown in the Plans using the following methods:

   a. Wet Method (mineral and polymer slurry),
   b. Casings up to the length shown in the Plans,
   c. Shaft drilling operations on water under conditions as shown in the Plans.

2. List and size of proposed equipment, including, but not limited to, cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry

pumps, core sampling equipment, tremies or concrete pumps, and casings and equipment to install and remove casing.

3. Details of sequence of construction operations and sequence of shaft construction in bents or shaft groups.

4. Details of shaft excavation methods, including casing installation procedures.

5. Details of slurry, including proposed methods to mix, circulate, desand, test methods, and proposed CTQP certified technicians that will perform and document the fluid tests.

6. Details of proposed methods to clean the shaft excavation.

7. Details of shaft reinforcement, including methods to ensure centering/required cover, cage integrity during placement, placement procedures, cage support, and tie downs.

8. Details of concrete placement, including elapsed concrete placement times and proposed operational procedures for concrete tremie or pump, including initial placement, raising during placement, and overfilling of the shaft concrete. Include provisions to ensure proper final shaft cutoff elevation.

9. Details of casing removal when removal is required, including minimum concrete head in casing during removal.

10. Required submittals, including shop drawing and concrete design mixes.

11. Details of any required load tests, including equipment and procedures, and recent calibrations for any jacks or load cells.

12. Proposed Cross-Hole Sonic Logging (CSL) and Thermal Integrity Testing for Drilled (TITDS) Specialty Engineer to supervise field testing and report the test results.

13. Methods and equipment proposed to prevent displacement of casing and/or shafts during placement and compaction of fill.

14. Provide the make and model of the shaft inspection device, if applicable, and procedures for visual inspection.

15. Details of environmental control procedures used to prevent loss of slurry or concrete into waterways or other protected areas.

16. Proposed schedule for test shaft installation, load tests and production shaft installation.

17. For drilled shafts for constructed using polymer slurry, identify the polymer slurry-, the pH and proposed viscosity ranges and a description of the mixing method to be used. Submit the contact information for the manufacturer's representative available for immediate contact during shaft construction and the representative's schedule of availability.

18. Methods to identify and remediate drilled shaft deficiencies.

19. Names of the CTQP qualified inspectors assigned to inspect the drilled shaft installation.

20. The name and contact information for the single representative of the Contractor, independent of field operations personnel, to resolve to the Engineer's satisfaction, conflicts in the drilled shaft installation procedures. This person shall be available

within two hours notice, and shall have the authority to refer issues to higher levels (corporate, if needed).

21. Procedure for grouting non-destructive testing access tubes.

22. A letter from the GFDEOR certifying concurrence with the DSIP.

23. Other information shown in the Plans or requested by the Engineer.

455-15.1.2.1 Acceptance of the Drilled Shaft Installation Plan (DSIP): The Engineer will evaluate the DSIP for conformance with the Contract Documents. Within five working days, excluding weekends and Department observed holidays, after receipt of the plan, the Engineer will notify the Contractor of any comments and additional information required and/or changes that may be necessary to meet the above requirements and satisfy the Contract Documents. The Engineer will reject any part of the plan that does not meet specifications, plans or has the potential to affect the integrity of adjacent structures or negatively affect the environmental conditions. Submit changes agreed upon for reevaluation. The Engineer will notify the Contractor within two working days, excluding weekends and Department observed holidays, after receipt of proposed changes of their acceptance or rejection. All equipment and procedures are subject to trial and satisfactory performance in the field.

Acceptance by the Engineer does not relieve the Contractor of the responsibility to perform the work in accordance with the Contract Documents. The Engineer's acceptance is not a guarantee that the chosen methods and equipment are capable of obtaining the required results, this responsibility lies with the Contractor.

455-15.1.3 General Methods & Equipment: Perform the excavations required for the shafts, through whatever materials encountered, to the dimensions and elevations shown in the Contract Documents, using methods and equipment suitable for the intended purpose and the materials encountered. Provide drilling tools with a diameter not smaller than one inch of the shaft diameter required in the Plans. Provide equipment capable of constructing shafts supporting bridges to a depth equal to the deepest shaft shown in the Plans plus 15 foot or plus three times the shaft diameter, whichever is greater, except when the Plans require equipment capable of constructing shafts to a deeper depth. Provide equipment capable of constructing shafts supporting sign, signal, lighting and ITS structures to a depth equal to the deepest shaft shown in the Plans plus 5 feet.

Construct drilled shafts according to the Contract Documents using generally either the dry method, wet method, casing method, or permanent casing method as necessary to produce sound, durable concrete foundation shafts free of defects. Use the permanent casing method only when required by the Plans. When the Plans describe a particular method of construction, use this method. When the Plans do not describe a particular method, propose a method on the basis of its suitability to the site conditions and submit it for acceptance by the Engineer.

Set a suitable temporary removable surface casing from at least 1 foot above the ground surface to at least 1-1/2 shaft diameters below the ground surface to prevent caving of the surface soils and to aid in maintaining shaft position and alignment. Do not use a temporary casing larger than 12 inches of the shaft diameter. Fill the oversized temporary casing with drilled shaft concrete at no additional expense to the Department. Withdraw the surface casing after concrete placement.

For drilled shafts installed to support sign, signal, lighting and ITS structures, provide temporary surface casings from at least 1 foot above the ground surface to at least 5 feet below the ground surface. For sign, signal, lighting and ITS structures foundations located within permanent sidewalks or within 5 feet of curb sections, provide temporary surface casings from no lower than the top of sidewalk to at least 5 feet below the ground surface.

For drilled shafts installed to support sign, signal, lighting and ITS structures, do not attempt to excavate the shaft using plain water or natural slurry. Do not attempt to excavate the shaft using dry construction method unless specifically indicated in the Plans or approved by the Engineer.

455-15.2 Dry Construction Method: Use the dry construction method only at sites where the ground water table and soil conditions, generally stiff to hard clays or rock above the water table, make it feasible to construct the shaft in a relatively dry excavation and where the sides and bottom of the shaft are stable and may be visually inspected prior to placing the concrete.

In applying the dry construction method, drill the shaft excavation, remove accumulated seepage water and loose material from the excavation and place the shaft concrete in a relatively dry excavation.

Use the dry construction method only when shaft excavations, as demonstrated in a test hole, have 12 inches or less of seepage water accumulated over a four-hour period, the sides and bottom remain stable without detrimental caving, sloughing, or swelling for a four hour period, and the loose material and water can be satisfactorily removed prior to inspection and prior to placing concrete. Use the wet construction method or the temporary casing construction method for shafts that do not meet the requirements for the dry construction method.

455-15.3 Wet Construction Method: Use the wet construction method at all sites where it is impractical to provide a dry excavation for placement of the shaft concrete.

The wet construction method consists of keeping the shaft excavation filled with fluid (mineral slurry, polymer slurry, natural slurry or water), desanding and cleaning the slurry and final cleaning of the excavation by means of a bailing bucket, air lift, submersible pump or other suitable devices and placing the shaft concrete (with a tremie or concrete pump extending to the shaft bottom) which displaces the water or slurry during concreting of the shaft excavation.

Where drilled shafts are located in open water areas, construct the shafts by the wet method using exterior casings extending from above the water elevation into the ground to protect the shaft concrete from water action during placement and curing of the concrete. Install the exterior casing in a manner that will produce a positive seal at the bottom of the casing so that there is no intrusion or extrusion of water or other materials into or from the shaft excavation.

455-15.4 Temporary Casing Construction Method: Use the temporary casing method at all sites where it is inappropriate to use the dry or wet construction methods without the use of temporary casings other than surface casings. In this method, the casing is advanced prior to excavation and withdrawn after concrete placement. When a formation is reached that is nearly impervious, seal in the nearly impervious formation. Proceed with drilling as with the wet method to the projected depth. Proceed with the placement of the concrete as with the dry method. In the event seepage conditions prevent use of the dry method, complete the excavation and concrete placement using wet methods.

Where drilling through materials having a tendency to cave, advance the excavation by drilling in a mineral or polymer slurry. In the event that a caving layer or layers

are encountered that cannot be controlled by slurry, install temporary removable casing through such caving layer or layers. The Engineer may require overreaming to the outside diameter of the casing. Take whatever steps are required to prevent caving during shaft excavation including installation of deeper casings. If electing to remove a casing and replace it with a longer casing through caving soils, backfill the excavation. The Contractor may use soil previously excavated or soil from the site to backfill the excavation. The Contractor may use other acceptable methods which will control the size of the excavation and protect the integrity of the foundation soils to excavate through caving layers.

Before withdrawing the casing, ensure that the level of fresh concrete is at such a level that the fluid trapped behind the casing is displaced upward. As the casing is withdrawn, maintain the level of concrete within the casing so that fluid trapped behind the casing is displaced upward out of the shaft excavation without mixing with or displacing the shaft concrete.

The Contractor may use the casing method, when accepted by the Engineer, to construct shafts through weak caving soils that do not contribute significant shaft shear resistance. In this case, place a temporary casing through the weak caving soils before beginning excavation. Conduct excavation using the dry construction method where appropriate for site conditions and the wet construction method where the dry construction method is not appropriate. Withdraw the temporary casing during the concreting operations unless the Engineer accepts otherwise.

455-15.5 Permanent Casing Construction Method: Use the permanent casing method when required by the Plans. In this method, place a casing to the prescribed depth before beginning excavation. If the Contractor cannot attain full penetration, the Contractor may excavate through the casing and advance the casing until reaching the desired penetration.

Construct the shaft in accordance with 455-15.4 except for cutting the casing off at the prescribed elevation upon reaching the proper construction sequence and leaving the remainder of the casing in place.

455-15.5.1 Temporary Extension of Permanent Casing: When the wet method does not provide enough support to excavate and clean the drilled shaft extension below the permanent casing tip elevations shown in the Plans, the permanent casing may be temporarily extended to an elevation deeper than the tip elevation at no additional expense to the Department. The rock socket length must be extended as specified in 455-15.7 and the casing raised to the original casing tip elevation shown in the Plans after the concrete placement. Include details of this procedure in the DSIP for the Engineer's review and approval.

455-15.5.2 Temporary Casing to Stabilize Excavation below Permanent Casing: To stabilize the excavation below the permanent casing tip elevation, a temporary casing inside an oversized permanent casing may be used at no additional expense to the Department. The permanent casing must have an inside diameter no more than 6 inches larger than the drilled shaft diameter specified in the Plans.

The following requirements apply:

1. Excavate and clean the materials from inside the permanent casing. Ensure all materials are removed from the inside wall of the permanent casing.
2. Install the temporary casing prior to excavating below the permanent casing tip elevation. The temporary casing must have a minimum internal diameter equal to the shaft diameter required in the Plans.

3. If the temporary casing is advanced deeper than the minimum top of rock socket elevation as shown in the Plans, or the top of rock elevation if deeper, extend the rock socket length in accordance with 455-15.7.

4. Place concrete in accordance with 455-15.9.3 through the temporary casing. Do not allow concrete to fall or overflow into the annular space between the temporary and permanent casing.

5. After placement of the concrete, remove the temporary casing in accordance with 455-15.4, 455-15.7 and 455-17. During withdrawal of the temporary casing, maintain adequate concrete head in both the temporary and permanent casings to avoid breaching, caving, or contamination of the concrete.

Include details of this procedure in the DSIP for the Engineer's review and approval.

455-15.6 Excavations: When pilot holes and/or load tests are performed, the GFDEOR shall use the pilot hole and load test results when load tests are performed to determine the production tip elevations and/or the installation criteria of the drilled shafts. Drilled shaft construction shall not begin until the proposed shaft tip elevations are accepted by the Engineer.

455-15.6.1 Pilot Hole: When pilot holes are shown in the Plans core a pilot hole, prior to shaft excavation, in accordance with ASTM D2113 Standard Practice for Rock Core Drilling and Sampling of Rock for Site Excavation and the Department's Soils & Foundations Handbook using a double or triple wall core barrel through part or all of the shaft, to a minimum depth of 3 times the diameter of the drilled shaft below the tip elevation shown in the Plans. Prior to excavating load test shafts, provide pilot holes to a minimum depth of three times the diameter of the drilled shaft below the tip elevation designed for these shafts. For test holes, provide pilot holes prior to excavation, to a minimum depth of 5 feet below the tip of the test hole.

455-15.6.2 Cores: Take cores to determine the character of the material directly below the shaft excavation when pilot borings are not performed at the shaft location. Provide equipment to retrieve the core from a depth of 5 times the diameter of the drilled shaft below the bottom of the drilled shaft excavation in accordance with ASTM D2113 Standard Practice for Rock Core Drilling and Sampling of Rock for Site Excavation. Cut the cores with an acceptable core barrel to a minimum depth of 3 times the diameter of the drilled shaft below the bottom of the drilled shaft excavation after completing the shaft excavation, as directed by the Engineer.

For cores or pilot holes, use only a double or triple wall core barrel designed:

1. to cut a core sample from 4 inches to 6 inches in diameter, at least 5 feet in length, and,

2. so that the sample of material cored can be removed from the shaft excavation and the core barrel in an undisturbed state.

When called for in the Plans and approved by the Engineer, substitute Standard Penetration Tests (SPT) using a drill rig equipped with an automatic hammer for coring.

Provide areas for the disposal of unsuitable materials and excess materials as defined in 120-5 that are removed from shaft excavations, and dispose of them in a manner meeting all environmental requirements.

Furnish the additional drilled shaft concrete over the theoretical amount required to complete filling any excavations for shafts which are larger than required by the Plans or authorized by the Engineer, at no expense to the Department.

455-15.6.3 Production Shaft Tip Elevations: After completion of load tests, pilot holes, rock cores and lab testing, the GFDEOR shall submit the required minimum rock socket lengths and shaft tip elevations to the Engineer in a signed and sealed letter for review and acceptance. This letter shall include the assumptions and geotechnical parameters used, the report of core borings of all pilot holes, rock core records, lab testing, load test reports prepared in accordance with 455-2.11, and numerical analysis and calculations. Submit this letter at least three working days, excluding weekends and Department observed holidays, prior to beginning production shaft construction. Additional data or analysis may be required by the Engineer.

Production shaft lengths may be based on the load transfer characteristics measured during the load test. End bearing characteristics may be based on load test results if the properties of the material below the tips of the production shafts meet or exceed the strength of the materials below the tip of the test shaft. If the theoretical bearing strength of the material below the tips of the production shafts is less than the theoretical bearing strength of the materials below the tip of the test shaft, the production shafts shall be extended to meet design capacity by side shear only, unless the end bearing resistance of the weaker material is verified by additional load testing.

455-15.7 Casings: Ensure that casings are metal, of ample strength to withstand handling and driving stresses and the pressure of concrete and of the surrounding earth materials, and that they are smooth and water tight. Ensure that the inside diameter of casing is not less than the specified size of shaft except as provided below. The Department will not allow extra compensation for concrete required to fill an oversize casing or oversize excavation.

The Engineer will allow the Contractor to supply casing with an outside diameter equal to the specified shaft diameter (O.D. casing) provided additional shaft length is supplied at the shaft tip. Determine the additional length of shaft required by the following relationship:

$$Additional\ \ Length = \frac{(D_1 - D_2)L}{D_2}$$

where:

D_1= casing inside diameter specified = shaft diameter specified
D_2= casing inside diameter provided ($D_2 = D_1$ minus twice the wall thickness).
L= authorized shaft length below ground for temporary casing methods or below casing for permanent casing methods.

Bear all costs relating to this additional length including but not limited to the cost of extra excavation, extra concrete, and extra reinforcing steel.

Install and remove casing by rotating, exerting downward pressure, or with a vibratory hammer, unless otherwise shown in the Contract Documents. Remove all casings from shaft excavations except those used for the Permanent Casing Method. Ensure that the portion of casings installed under the Permanent Casing Method of construction below the shaft cut-off elevation remains in position as a permanent part of the drilled shaft. When casings that are to be removed become bound in the shaft excavation and cannot be practically removed, submit a proposed redesign to the Engineer for review and acceptance.

If temporary casing is advanced deeper than the minimum top of rock socket elevation shown in the Plans or actual top of rock elevation if deeper, withdraw the casing from the rock socket and overream the shaft. If the temporary casing cannot be withdrawn from the

rock socket before final cleaning, extend the length of rock socket below the authorized tip elevation one-half of the distance between the minimum top of rock socket elevation or actual elevation if deeper, and the temporary casing tip elevation.

Form drilled shafts extending through a body of water with permanent casings. When the shaft extends above ground or a body of water, the Contractor may form the exposed portion with removable casing, unless otherwise specified in the Plans. Remove the portion of metal casings between an elevation 2 feet below the lowest water elevation or 2 feet below ground whichever is higher and the top of shaft elevation after the concrete is cured. Remove casings to expose the concrete as required above in a manner which will not damage the drilled shaft concrete. Dismantle removable casings in accordance with the provisions of 455-17.5.

When practical, do not start the removal until completing all concrete placement in the shaft. Extract casing at a slow, uniform rate with the pull in line with the axis of the shaft. Withdraw temporary casings while the concrete remains fluid.

When conditions warrant, the Contractor may pull the casing in partial stages. Maintain a sufficient head of concrete above the bottom of the casing to overcome the hydrostatic pressure of water outside the casing. At all times maintain the elevation of the concrete in the casing high enough to displace the drilling slurry between the outside of the casing and the edge of the hole while removing the casing.

Expandable or split casings that are removable are not permitted for use below water.

455-15.8 Slurry and Fluid in Excavation:

455-15.8.1 General: Thoroughly premix the slurry in a mixing tank with clean fresh water prior to introduction into the shaft excavation. Introduce slurry before the excavation advances below the bottom of the casing. Ensure that the percentage of polymer or mineral admixture used to make the suspension is such as to maintain the stability of the shaft excavation. Provide adequate water or slurry tanks to perform the work in accordance with these Specifications. The Engineer will not allow excavated pits on projects requiring slurry tanks without the written permission of the Engineer. Take the steps necessary to prevent the slurry from “setting up” in the shaft, including but not limited to agitation, circulation, and adjusting the composition and properties of the slurry. Provide suitable offsite disposal areas and dispose of all waste slurry in a manner meeting all requirements pertaining to pollution.

For shafts to support sign, signal, lighting and ITS structures, polymer slurry may be mixed in the casing portion, in accordance with the APL approved instructions if the following conditions are met:

1. Contractor tests and verifies the polymer slurry meets the property requirements of 455-15.8.3, before continuing the excavation below the casing.
2. Polymer mix continues to be added as required below the bottom of the casing, to maintain the slurry properties during the excavation within compliance of 455-15.8.3.
3. Slurry sampling and testing is performed at intervals not exceeding one hour, in the middle of the excavation depth at the time of testing to verify the properties are maintained within compliance throughout the excavation.
4. If failing to demonstrate the properties are maintained within compliance of 455-15.8.3, discontinue this mixing method and use a slurry pre-mixed in a tank.

Provide a CTQP qualified drilled shaft inspector to perform control tests using suitable apparatus on the slurry mixture to determine the slurry and fluid properties as specified in sub-articles 455-15.8.2 to 455-15.8.4.

Measure the viscosity of the freshly mixed slurry regularly as a check on the quality of the slurry being formed using an approved measuring device.

Perform tests from the fluid in the excavation to determine density, viscosity, and pH value to establish a consistent working pattern, taking into account the mixing process and blending of freshly mixed slurry and previously used slurry. Repeat tests to determine density, viscosity, and pH value at intervals not exceeding 2 hours during the first 8 hours slurry is in use and every 4 hours thereafter, including overnight, until concrete placement. Perform density, viscosity and pH tests again when the excavation reaches the midpoint. When the contractor operations require the shaft excavation to be interrupted and performed in multiple shifts, the continuous testing may be waived if the excavation at the time of suspension of the operations is not deeper than the bottom of the casing provided.

For shafts to support sign, signal, lighting, and ITS structures up to 5 ft diameter and up to 40 ft in depth, when the contractor operations require the shaft to be constructed in multiple shifts, the continuous testing may be waived if the excavation at the time of operations suspension is not deeper than the bottom of the casing provided, or if all the conditions below are met:

1. The shaft location does not pose a safety risk to the public, adjacent lane, utility pole, or any structure, if the excavation fails.

2. Slurry testing is performed at the time of suspending operations and at a time not exceeding 12 hours after that or at the time the operations resume whichever comes first. Testing shall be performed at intervals not exceeding 2 hours for the first 8 hours after resuming operations and every 4 hours thereafter.

3. Slurry testing shall be performed on at least two samples each time, one sample approximately three feet from the bottom and one sample from the middle of the excavation depth at the time the operations were suspended. The results must indicate the polymer slurry meets the viscosity requirements of 455-15.8.3. If this requirement is not met, do not continue without testing for more than 4 hours including the time periods between shifts.

4. The contractor performs soundings of the fluid level, at intervals of 15 minutes or longer, that demonstrate the fluid level is stable over two consecutive soundings.

5. If when resuming operations, slurry does not meet density, pH, or both, adjust the slurry to meet all property requirements of 455-15.8.3. Re-test slurry to verify properties meet the requirements, before resuming operations. Continue testing the slurry every 4 hours after resuming operations until completion of the excavation.

The Department may perform comparison tests as determined necessary during the mineral and polymer slurry operations.

If, at any time in the opinion of the Engineer, the wet construction method fails to stabilize the excavation discontinue this method of construction, backfill the excavation and submit modifications in procedure or alternate means of construction for approval.

455-15.8.2 Mineral Slurry: When mineral slurry is used in an excavation, use only processed attapulgite or bentonite clays with up to 2% (by dry weight) of added polymer. Use mineral slurry having a mineral grain size such that it will remain in suspension and having viscosity and gel characteristics to transport excavated material to a screening system. Use a percentage and specific gravity of the material to make a suspension able to maintain the stability of the excavation and to allow proper placement of concrete. Ensure that the material used to make the slurry is not detrimental to concrete or surrounding ground strata. During construction,

maintain the level of the slurry at a height sufficient to prevent caving of the hole. In the event of a sudden significant loss of slurry such that the slurry level cannot be maintained by adding slurry to the hole, backfill the excavation and delay the construction of that foundation until an alternate construction procedure has been approved.

Perform the following tests on the mineral slurry supplied to and in the shaft excavation and ensure that the results are within the ranges stated in the table below:

Table 455-2		
Item to be measured	Range of Results at 68ºF fluid temperature	Test Method
Density	64 to 73 lb/ft^3 (in fresh water environment) 66 to 75 lb/ft^3 (in salt water environment)	Mud density balance: FM 8-RP13B-1
Viscosity	30 to 40 seconds	Marsh Cone Method: FM 8-RP13B-2
pH	8 to 11	Electric pH meter or pH indicator paper strips: FM 8-RP13B-4
Sand Content	4% or less	FM 8-RP13B-3

The Contractor may adjust the limits in the above table when field conditions warrant as successfully demonstrated in a test hole or with other methods approved by the Engineer. The Engineer must approve all changes in writing before the Contractor can continue to use them.

During construction, maintain the level of mineral slurry in the shaft excavation within the excavation and at a level not less than 4 feet above the highest expected piezometric water elevation along the depth of a shaft.

455-15.8.3 Polymer Slurry: A representative of the manufacturer must be on-site or available for immediate contact to assist and guide the construction of the first three drilled shafts at no additional cost to the Department. This representative must also be available for on-site assistance or immediate contact if problems are encountered during the construction of the remaining drilled shafts. Use polymer slurry only if the soils below the casing are not classified as organic, and the pH of the fluid in the hole can be maintained in accordance with the manufacturer's recommendations.

Perform the following tests on the polymer slurry supplied to and in the shaft excavation and ensure that the results are maintained within the ranges stated in the table below:

Table 455-3 Mixed Polymer Slurry Properties		
Item to be measured	Range of Results at 68ºF fluid temperature	Test Method
Density	62 to 65 lb/ft^3 (fresh water) 64 to 67 lb/ft^3 (salt water)	Mud density balance: FM 8-RP13B-1
Viscosity: for bridges and main structure foundations	50 seconds to upper limit- defined by the APL	Marsh Cone Method: FM 8-RP13B-2
Viscosity: for miscellaneous structure foundations	50 seconds to upper limit recommended by the manufacturer based on soil type	March Cone Method: FM 8-RP13B-2
pH	Range published by the manufacturer for materials excavated	Electric pH meter or pH indicator paper strips: FM 8-RP13B-4
Sand Content	0.5% or less	FM 8-RP13B-3

Premix polymer slurry in accordance with the manufacturer's published procedures. Do not mix in the excavation as a means to prepare slurry. When approved by the GFDEOR, adjustments to slurry properties can be made in the excavation.

During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole and which should not be lower than 4 feet above the highest expected piezometric water elevation along the depth of the shaft.

Ensure the method of disposal meets the requirements of local authorities.

455-15.8.4 Fluid in Excavation at Time of Concrete Placement: When any fluid is present in any drilled shaft excavation, including shafts to support sign, signal, lighting and ITS structures, the applicable test methods and reporting requirements described in 455-15.8.1, 455-15.8.2 and 455-15.8.3 apply to tests of fluid in the shaft prior to placing the concrete.

When mineral slurries are used, ensure the properties at the time of concrete placement are within the acceptable ranges indicated in 455-15.8.2. When polymer slurries are used ensure the properties of the polymer slurry are within the following acceptable ranges at the time of concrete placement:

Table 455-4 Polymer Slurry Properties at Time of Concrete Placement		
Item to be measured	Range of Results at 68ºF fluid temperature	Test Method
Density	62 to 65 lb/ft^3 (fresh water) 64 to 67 lb/ft^3 (salt water)	Mud density balance: FM 8-RP13B-1
Viscosity	50 seconds to upper limit defined by the APL	Marsh Cone Method: FM 8-RP13B-2

Table 455-4 Polymer Slurry Properties at Time of Concrete Placement		
Item to be measured	Range of Results at 68ºF fluid temperature	Test Method
pH	Range published by the manufacturer for materials excavated	Electric pH meter or pH indicator paper strips: FM 8-RP13B-4
Sand Content	0.5% or less	FM 8-RP13B-3

Test samples of the fluid in the shaft from within 1 inch of the base of the shaft and from the middle of the shaft height for shafts up to 60 feet in depth. Test samples of the fluid in the shaft from within 1 inch of the base of the shaft and at intervals not exceeding 30 feet up the shaft for shafts deeper than 60 feet. Use a sampling tool designed to sample over a depth range of 12 inches or less. Take whatever action is necessary prior to placing the concrete to bring the fluid within the specification and reporting requirements, outlined in the tables in 455-15.8.2 and 455-15.8.3, except as follows:

The Engineer will not require tests for pH or viscosity, nor require the fluid to meet the minimum density specified in 455-15.8.2 and 455-15.8.3 when neither polymer nor mineral slurry has been introduced into the shaft excavation.

455-15.9 Tremies and Pumps:

455-15.9.1 General: The requirements of the applicable provisions of Section 400 will apply when using a tremie or a pump to place drilled shaft concrete.

455-15.9.2 Dry Excavations: Ensure that the tremie for depositing concrete in a dry drilled shaft excavation consists of a tube of solid construction, a tube constructed of sections which can be added and removed, or a tube of other accepted design. The Contractor may pass concrete through a hopper at the top of the tube or through side openings as the tremie is retrieved during concrete placement. Support the tremie so that the free fall of the concrete is less than 5 feet at all times. If the free falling concrete causes the shaft excavation to cave or slough, control the movement of concrete by reducing the height of free fall of the concrete and/or reducing the rate of flow of concrete into the excavation.

455-15.9.3 Wet Excavations: Construct the tremie or pump line used to deposit concrete beneath the surface of water so that it is water-tight and will readily discharge concrete. Construct the discharge end of the tremie or pump line to prevent water intrusion and permit the free flow of concrete during placement operations. Ensure that the tremie or pump line has sufficient length and weight to rest on the shaft bottom before starting concrete placement.

During placement operations, ensure that the discharge end of the tremie or pump line is within 6 inches of the bottom of the shaft excavation until at least 10 feet of concrete has been placed. Ensure the discharge end of the tremie or pump line is continuously embedded at least 10 feet into the concrete after 10 feet of concrete has been placed and until the casing is overpoured sufficiently to eliminate all contaminated concrete. Ensure that the free fall of concrete into the hopper is less than 5 feet at all times. Support the tremie so that it can be raised to increase the discharge of concrete and lowered to reduce the discharge of concrete. Do not rapidly raise or lower the tremie to increase the discharge of the concrete. Maintain a continuous flow of concrete and a positive pressure differential of the concrete in the tremie or pump line at all times to prevent water or slurry intrusion into the shaft concrete.

455-15.10 Excavation and Drilling Equipment:

455-15.10.1 General: All shaft excavation is unclassified shaft excavation. Overream the drilled shaft sidewall when necessary. These terms are defined in 455-15.10.2, 455-15.10.3, and 455-15.10.4, respectively.

Use excavation and drilling equipment having adequate capacity, including power, torque, and crowd (downthrust), and excavation and overreaming tools of adequate design, size, and strength to perform the work shown in the Plans or described herein. When the material encountered cannot be drilled using conventional earth augers and/or underreaming tools, provide special drilling equipment, including but not limited to rock augers, core barrels, rock tools, air tools, blasting materials, and other equipment as necessary to continue the shaft excavation to the size and depth required. In the event blasting is necessary, obtain all necessary permits. The Contractor is responsible for the effects of blasting on already completed work and adjacent structures. The Engineer must approve all blasting.

455-15.10.2 Unclassified Shaft Excavation: Unclassified shaft excavation is defined as all processes required to excavate a drilled shaft of the dimensions shown in the Contract Documents to the depth indicated in the Plans plus 15 feet or plus 3 shaft diameters, whichever is deeper, completed and accepted. Include in the work all shaft excavation, whether the material encountered is soil, rock, weathered rock, stone, natural or man-made obstructions, or materials of other descriptions.

455-15.10.3 Unclassified Extra Depth Excavation: Unclassified extra depth excavation is defined as all processes required to excavate a drilled shaft of plan dimensions which is deeper than the limits defined as unclassified shaft excavation.

455-15.10.4 Drilled Shaft Sidewall Overreaming: Drilled shaft sidewall overreaming is defined as the unclassified excavation required to roughen its surface or to enlarge the drilled shaft diameter due to softening of the sidewalls or to remove excessive buildup of slurry cake when slurry is used. Increase the shaft radius a minimum of 1/2 inch and a maximum of 3 inches by overreaming. The Contractor may accomplish overreaming with a grooving tool, overreaming bucket, or other suitable equipment.

Meet the limit for depth of sidewall overreaming into the shaft sidewall material and the elevation limits between which sidewall overreaming is required.

455-15.11 Inspection of Excavations:

455-15.11.1 Dimensions and Alignment: Provide equipment for checking the dimensions and alignment of each permanent shaft excavation. Determine the dimensions and alignment of the shaft excavation under the observation and direction of the Department. Generally, check the alignment and dimensions by any of the following methods as necessary:

1. Check the dimensions and alignment of dry shaft excavations using reference stakes and a plumb bob. Verify that the bottom of the hole is level.

2. Check the dimensions and alignment of casing when inserted in the excavation.

3.Use an acceptable caliper system

4. Insert any casing, rod or pipe assembly, or other device used to check dimensions and alignment into the excavation to full depth.

455-15.11.2 Depth: Generally, reference the depth of the shaft during drilling to appropriate marks on the Kelly bar or other suitable methods. Measure final shaft depths with a suitable weighted tape or other accepted methods after final cleaning.

455-15.11.3 Shaft Inspection Device (SID): Furnish all power and equipment necessary to inspect the bottom conditions of a drilled shaft excavation for bridge foundations

and to measure the thickness of bottom sediment or any other debris using a SID. Provide a means to position and lower the SID into the shaft excavation to enable the bell housing to rest vertically on the bottom of the excavation. Continuously videotape the inspection of each drilled shaft excavation after final cleaning. Clearly identify in the recordings by audio or other means, the location and items being observed.

Furnish a SID meeting the following requirements:

1. A remotely operated, high resolution, color video camera sealed inside a watertight bell housing.

2. Provides a clear view of the bottom inspection on a video monitor at the surface in real time.

3. Provides a permanent record of the entire inspection with voice annotation on a quality DVD with a resolution of not less than 720 x 480.

4. Provides a minimum field of vision of 110 square inches, with at least two graduated measuring devices to record the depth of sediment on the bottom of the shaft excavation to a minimum accuracy of 1/2 inch and a length greater than 1-1/2 inches.

5. Provides sufficient lighting to illuminate the entire field of vision at the bottom of the shaft in order for the operator and inspector to clearly see the depth measurement scale on the video monitor and to produce a clear recording of the inspection.

6. Provides a regulated compressed air or gas system to precisely adjust the drilling fluid level within the bell housing, and a pressurized water system to assist in determination of bottom sedimentation depth

Obtain the Engineer's approval of the device in advance of the first inspection contingent on satisfactory field performance. Notify the Engineer for approval before a different device is used for any subsequent inspection.

455-15.11.4 Shaft Cleanliness Requirements: Adjust cleaning operations so a minimum of 50% of the bottom of each shaft will have less than 1/2 inches of sediment at the time of placement of the concrete. Ensure the maximum depth of sedimentary deposits or any other debris at any place on the bottom of the shaft excavation does not exceed 1-1/2 inches. Determine shaft cleanliness by visual inspection for dry shafts. For bridge foundations, use a shaft inspection device for wet shafts. For drilled shaft foundations for sign, signal, lighting and ITS structures the use of a weighted tape is permitted to verify level and clean hole bottom conditions at the time of concrete placement.

When using slurry, meet the requirements of 455-15.8 at the time of concrete placement.

455-15.11.4.1 Exceptions for Shafts for Sign, Signal, Lighting and ITS Structures: Ensure the depth of sedimentary deposits or other debris does not exceed 1 inch over the bottom of the shaft when installing drilled shafts to support sign, signal, lighting and ITS structures.

455-15.11.5 Time of Excavation: Overream the sidewalls of any unclassified excavation work using mineral slurry lasting more than 36 hours (measured from the beginning of excavation for all methods except the Temporary or Permanent Casing Method, which begins at the time excavation begins below the casing) before placement of the concrete. Ensure that the minimum depth of overreaming the shaft sidewall is 1/2 inch and the maximum depth is 3 inches. Provide any overreaming required at no expense to the Department when exceeding the 36-hour limit.

When using mineral slurry, adjust excavation operations so that the maximum time that slurry is in contact with the bottom 5 feet of the shaft (from time of drilling to concreting) does not exceed 12 hours. If exceeding the 12-hour time limit, overream the shaft socket or the full shaft when socket is not specified, at no additional expense to the Department prior to performing other operations in the shaft.

455-16 Reinforcing Steel Construction and Placement.

455-16.1 Cage Construction and Placement: Completely assemble and place as a unit the cage of reinforcing steel, consisting of longitudinal bars, ties, and cage stiffener bars, immediately after the Drilled Shaft Inspector inspects accepts the shaft excavation and immediately prior to placing concrete. Tie all intersections of drilled shaft reinforcing steel with cross ties or "figure 8" ties. Use double strand ties, ties with larger tie wire, U-bolts, or similar when necessary.

455-16.2 Splicing Cage: If the bottom of the constructed shaft elevation is lower than the bottom of the shaft elevation in the Plans, extend a minimum of one half of the longitudinal bars required in the upper portion of the shaft the additional length. Continue the tie bars for the extra depth, spaced on 2-foot centers, and extend the stiffener bars to the final depth. The Contractor may lap splice these bars or use unspliced bars of the proper length. Do not weld bars to the planned reinforcing steel unless shown in the Contract Documents.

For drilled shafts supporting sign, signal, lighting, and ITS structures, if the shaft cleaning operations result in excavating below the required tip elevation, the reinforcing steel cage does not need to be extended. The reinforcing steel cage may be spliced to rest on the bottom of the excavation or suspended in place from the top.

455-16.3 Support, Alignment, and Tolerance: Tie and support the reinforcing steel in the shaft so that the reinforcing steel will remain within allowable tolerances as specified in 455-20 and Section 415.

Ensure concentric spacing for the entire length of the cage. As a minimum, use centering devices consisting of wheels or other approved noncorrosive spacing devices within 3 feet of the bottom, within 6 feet of the top, and intervals not exceeding 10 feet along the cage length. Do not use block or wire type spacers. Ensure no permanent metallic elements will be within the concrete cover space. Use a minimum of one spacer per 30 inches of circumference of cage with a minimum of four at each level. Provide spacers at the bottom of the drilled shaft reinforcing cage as required to maintain the proper position of the cage.

For shafts to support sign, signal, lighting and ITS structures, when a casing with an inside diameter (I.D.) larger than the required shaft diameter is used, provide, within the portion of the oversized casing, centering devices specially dimensioned or other means to ensure the shaft, the cage and the upright are concentric. Provide spacers within 3 feet of the bottom and at intervals not exceeding 10 feet along the reinforcement, with a minimum of two levels of spacers below the bottom of the casing.

Check the elevation of the top of the steel cage before and after placing the concrete. If the cage is not within the specified tolerances, correct, and submit a revised DSIP to the Engineer for approval. Do not construct additional shafts until receiving approval from the Engineer.

455-16.4 Nondestructive Integrity Testing Access Tubes: Install access tubes full length in all drilled shafts from the tip of shaft to a point high enough above top of shaft to allow Thermal Integrity Testing for Drilled Shafts (TITDS) and Cross-Hole Sonic Logging (CSL)

testing, but not less than 30 inches above the top of the drilled shaft, ground surface or water surface, whichever is higher. Equally space tubes around circumference of drilled shaft. Securely tie access tubes to the inside of the reinforcing cage and align tubes to be parallel to the vertical axis of the center of the cage. Access tubes from the top of the reinforcing cage to the tip of the shaft shall be NPS 1-1/2 Schedule 40 black iron or black steel (not galvanized) pipe. Access tubes above the top of the reinforcing cage may be the same black iron or black steel pipe or Schedule 40 PVC pipe. Ensure that the access tubes are free from loose rust, scale, dirt, paint, oil and other foreign material. Couple tubes as required with threaded couplers, such that inside of tube remains flush. Seal the bottom and top of the tubes with threaded caps. The tubes, joints and bottom caps shall be watertight. Seal the top of the tubes with lubricated, threaded caps sufficient to prevent the intrusion of foreign materials. Stiffen the cage sufficiently to prevent damage or misalignment of access tubes during the lifting and installation of the cage. Exercise care in removing the caps from the top of the tubes after installation so as not to apply excess torque, hammering or other stress which could break the bond between the tubes and the concrete.

Provide the following number (rounded up to the next whole number of tubes) and configuration of access tubes in each drilled shaft based on the diameter of the shaft.

Table 455-5		
Shaft Diameter	Number of Tubes Required	Configuration around the inside of Circular Reinforcing Cage
36 to 48 inches	4	90 degrees apart
Greater than 48 inches	1 tube per foot of Shaft Diameter	360 degrees divided by the Number of Tubes

Insert simulated or mock probes in each access tube prior to concreting to ensure the serviceability of the tube. Fill access tubes with clean potable water and recap prior to concreting. Repair or replace any leaking, misaligned or unserviceable tubes as in a manner acceptable to the Engineer prior to concreting.

For method shafts for bridge foundations, in addition to the access tubes, provide embedded thermal wires equally spaced around the reinforcing cage.

For drilled shaft foundations requiring anchor bolts, verify access tubes will not interfere with anchor bolt installation before excavating the shaft. When access tube locations conflict with anchor bolt locations, move the access tube location plus or minus 2 inches along the inner circumference of the reinforcing cage.

For drilled shafts supporting sign, signal, lighting and ITS structures, if the shaft cleaning operations result in excavating below the required tip elevation, the access tubes do not need to be extended. If the reinforcing steel cage is suspended in place from the top rather than resting on the bottom of the excavation, clearly mark the top of shaft location on each tube.

When called for in the Contract Documents, provide embedded thermal wires and equipment to allow TITDS in accordance with ASTM D7949 Method B.

455-17 Concrete Placement.

455-17.1 General: Place concrete in accordance with the applicable portions of Sections 346 and 400, 455-15.2, 455-15.3, 455-15.4, 455-15.5, 455-15.8, 455-15.9, and the requirements herein.

Place concrete as soon as possible after completing all excavation, cleaning the shaft excavation, inspecting and finding it satisfactory, and immediately after placing reinforcing steel. Continuously place concrete in the shaft to the top of the casing. Continue placing concrete after the casing is full until good quality concrete is evident at the top of the casing. Place concrete through a tremie or concrete pump using accepted methods. After the shaft is overpoured sufficiently to eliminate all contaminated concrete, additional concrete may be added to the shaft without the use of a tremie or pump in accordance with Section 400.

If the pressure head is lost during concrete placement for any reason, perform integrity testing at no expense to the Department.

Immediately after concreting, check the water levels in the CSL access tubes and refill as necessary. If tubes become unserviceable, core new holes in the drilled shaft as directed by the Engineer.

455-17.2 Placement Time Requirements: The elapsed time for placing drilled shaft concrete includes the concrete mixing and transit time, the concrete placement time, the time required to remove any temporary casing that causes or could cause the concrete to flow into the space previously occupied by the casing, and the time to insert any required column steel, bolts, weldments, etc. The elapsed time begins at the time the first truck load placed in the shaft is batched. Maintain a minimum slump of 5 inches throughout the elapsed time. Use materials to produce and maintain the required slump through the elapsed time that meets the class of concrete specified. Provide slump loss tests that demonstrate to the Engineer that the concrete will maintain a 5 inch or greater slump for the anticipated elapsed time before beginning drilled shaft construction.

455-17.3 Forms: When the top of shaft elevation is above ground or above water, form the portion of the shaft above ground and the portion of the shaft above water with a removable form or another suitable method to the dimensions shown in the Plans.

When the shaft extends above the ground through a body of water, the Contractor may form the portion through the water with removable forms except when the Permanent Casing Method is specified.

455-17.4 Riser Blocks: The Contractor may cast a riser block of equal diameter as the column and of a maximum height of 6 inches at the top of the completed shaft. When this option is chosen, extend any dowel steel above the top of shaft an additional 6 inches.

455-17.5 Curing: Cure the top surface in accordance with the applicable provisions of Section 400 and construct any construction joint area as shown in the Plans. Protect portions of drilled shafts exposed to a body of water from the action of water by leaving the forms in place for a minimum of seven days after casting the concrete. The Contractor may remove forms prior to seven days provided the concrete strength has reached 2,500 psi or greater as evidenced by cylinder breaks.

455-17.6 Non-Destructive Testing of Drilled Shaft Integrity:

455-17.6.1 Thermal Integrity Testing for Drilled Shafts (TITDS): Perform all TITDS testing in accordance with ASTM D7949. Test method shafts, load test shafts and all drilled shafts in bridge bents or piers considered nonredundant in the Plans, using TITDS. For all other drilled shafts supporting bridges and sign, signal, lighting and ITS structures, perform TITDS on any shaft suspected of containing defects. The Engineer may select shafts for TITDS based on observations in the field or the review of the drilled shaft logs.

Engage a qualified Specialty Engineer to supervise the TITDS. The qualified TITDS Specialty Engineer must have a minimum six-month experience of TITDS and

have a Florida Licensed Professional Engineer and supervise the collection and interpretation of data. The individual performing the TITDS in the field must work for the Specialty Engineer firm and have a minimum of six months experience of TITDS. The Contractor shall provide all necessary access and assistance to the TITDS Specialty Engineer to satisfactorily perform the testing.

After acceptance of production shafts by the Engineer, remove all water from the access tubes or core holes and fill the tubes or core holes with a structural non-shrink grout meeting the requirements of Section 934 from the bottom via tremie tube. Place the grout utilizing enough pressure to fill the tubes or core holes completely.

If the Contractor determines at any time during the non-destructive testing and evaluation of the drilled shaft that the drilled shaft should be replaced, no further testing or evaluation of that shaft is required.

455-17.6.1.1 Equipment: Furnish TITDS test equipment in accordance with ASTM D7949 as follows:

1. Provide thermal probes with four orthogonally oriented infrared sensors able to be used in 1.5 inch I.D. pipes.
2. Provide a computer based TITDS data acquisition system for display of signals during data acquisition.
3. Provide a computer based TITDS data acquisition system for display of signals during data acquisition.
4. Provide an air compressor and power supply with sufficient pressure to air lift the water from the access tubes.

455-17.6.1.2 Procedure: For non-bridge structures, p~~P~~erform TITDS testing between the minimum and maximum times shown below after the batching time of the first truck load placed in the drilled shaft, unless otherwise accepted by the Engineer.

Table 455-6		
Shaft Diameter (inches)	Minimum time (hours)	Maximum time (hours)
36-48	24	54
49-60	24	72
61-72	24	72
73-84	24	90
85-120	24	108

The Contractor may propose modifications in the above table for site specific and special concrete mix conditions, as demonstrated from lab and field testing and instrumentation. The Engineer must approve all changes to the testing times prior to the Contractor using them.

For bridges, prior to production drilled shaft and load test drilled shaft installation, perform TITDS in accordance with ASTM D7949 Method B to determine the temperature variability and time to peak temperature for each project specific concrete mix. Obtain temperature measurements at least every 15 minutes during curing on the method shafts piles. Submit the TITDS results within three working days of performing the tests, in accordance with 455-17, including the proposed temperature peak time established from the TITDS. The Engineer will review the results of the test and concur with the proposed peak time or revise it. After the peak time is established for each mix, perform TITDS in accordance with

ASTM D7949 Method A on production drilled shafts and load test shafts, within the following times after batching the first truck:

Minimum time (hours)= Peak time (hours) – 8

Maximum time (hours)= Peak time (hours) + 4D

Where:

D= Drilled shaft diameter in ft.

Peak time: Time after batching the first truck load that was placed in the drilled shaft, at which the maximum temperature is observed.

Furnish information regarding the shaft, tube lengths and depths, construction dates, and other pertinent shaft installation observations and details to the Department at the time of testing. Verify access tube lengths and their condition in the presence of the Department, at the end of concrete placement. If the access tubes do not provide access over the full length of the shaft, repair the existing tube(s) or core additional hole(s), as directed by the Engineer, at no additional cost to the Department.

Just prior to inserting the thermal probe, remove water from the access tubes. Store the removed water in an insulated container for later replacement. Allow the thermal probe to acclimate in accordance with the equipment manufacturer recommendations. Continuously record temperatures at depth intervals of 3.0 inches or less from the top to the bottom of each access tube. Repeat the test at each access tube until two sets of data from the same access tube provide similar results. Return the warm water to the access tubes immediately after the testing has been completed.

Immediately report any potential defects indicated by lower temperature anomalies to the Engineer.

455-17.6.1.3 Required TITDS Reports: Submit the TITDS data and analysis to the Engineer in a signed and sealed report, together with all electronic data, within 48 hours of testing. The report shall include as minimum the following items:

1. Graphs displaying all temperature measurements and average temperature versus depth.

2. Indication of unusual temperatures, including cooler local deviations from the average at any depth from the overall average over the entire length.

3. A graph displaying the average temperature and theoretical temperature versus depth.

4. Variations in temperature between access tubes which may indicate variations in cage alignment.

5. When ASTM D7949 method B is used, include a chart indicating the variability of t~~T~~emperature vs. time, for all wires and the average. Submit the peak time in hours for the average temperature of the wires.

~~5~~6. The calculated radius of the shaft throughout the entire depth.

~~6~~7. Calculated concrete cover throughout the entire depth.

~~7~~8. Shaft Details, Probe Details, Environmental Details, Tube Run Selection and Shaft Adjustment Data that show the measurements, inputs and adjustments to the data. Screen captures of these pages from the “TIP Reporter” software will be acceptable.

~~8~~9. A conclusion stating whether the tested shaft is free from integrity defects, meets the minimum concrete cover and diameter requirements by the specifications and the cage is properly aligned. When anomalies are detected, include in the report a three-dimensional rendering of the shape of the shaft.

455-17.6.1.4 Evaluation of TITDS Test Results: Drilled shafts not meeting the minimum cover and diameter requirements, or having integrity defects, are not acceptable without an engineering analysis.

455-17.6.1.5 Coring and/or Repair of Drilled Shafts: If a drilled shaft is unacceptable based on the TITDS tests and other testing, or problems observed during drilled shaft construction, core the shaft to allow further evaluation and repair, or replace the shaft. If coring to allow further evaluation of the shaft and repair is chosen, one or more core samples shall be taken from each unacceptable shaft for full depth of the shaft or to the depth directed by the GFDEOR. The GFDEOR shall determine, with concurrence of the Engineer, the number, location, and diameter of the cores based on the results of the TITDS. Keep an accurate log of cores. Properly mark and place the cores in a crate showing the shaft depth at each interval of core recovery. Deliver the cores to the GFDEOR and submit the coring log to the Engineer. Perform strength testing by an AASHTO certified lab on portions of the cores that exhibit questionable concrete as determined by the GFDEOR. If the TITDS and coring indicate the shaft is defective, propose remedial measures for approval by the Engineer. Such improvement may consist of, but is not limited to correcting defective portions of the shaft, providing straddle shafts to compensate for capacity loss, or providing a replacement shaft. Repair all detected defects and conduct post repair integrity testing using horizontal and offset CSL testing and 3-D tomographic imaging as described in 455-17.6.2. Engage a Specialty Engineer to perform gamma-gamma density logging calibrated to 1-1/2 inch black iron access tubes, prior to and after the repair is performed, to verify the integrity of the shaft outside the reinforcing cage in the same locations where the repair was required. When straddle shafts or replacement shafts are used to correct a deficient foundation perform TITDS in accordance with 455-17.6.1 through 455-17.6.3 to verify integrity of these shafts. Submit all results to the Engineer within five days of test completion for acceptance. Perform all work described in this sub-article at no additional cost to the Department, and with no increase in Contract Time.

455-17.6.2 Cross Sonic Logging (CSL) and Tomography: When required by the Engineer perform CSL testing in accordance with ASTM D6760. Engage a qualified Specialty Engineer to perform the CSL testing. The qualified CSL Specialty Engineer must be a Professional Engineer in the State of Florida and have a minimum six-month experience of CSL testing, supervising the collection of CSL data and interpretation of CSL results. The individual performing the CLS testing in the field must work for the Specialty Engineer firm and have a minimum of six months experience of six months of CSL testing. The Contractor shall provide all necessary access and assistance to the CSL Specialty Engineer to satisfactorily perform the testing.

When a shaft contains four tubes, test every possible tube combination. For shafts with five or more tubes, test all pairs of adjacent tubes around the perimeter, and one-half of the remaining number of tube combinations, as chosen by the Engineer. Pull the probes simultaneously, starting from the bottoms of the tubes, over an electronic depth measuring device. Perform the CSL tests with the source and receiver probes in the same horizontal plane. Continuously record CSL signals at depth intervals of 2-1/2 inches or less from the bottom of the tubes to the top of each shaft. Remove all slack from the cables prior to pulling to provide

accurate depth measurements in the CSL records. When the measurements indicate a 30% or greater reduction in velocity between one or more pairs take one or two concrete cores to allow further evaluation and repair, or replace the shaft as directed by the Engineer. Determine the location of the concrete cores by performing 3D tomographic analysis using the CSL measurements. The core depths shall be at least 5 feet deeper than the bottom of the anomaly determined by the 3D tomography analysis or full depth if the anomaly is within 5 feet of the bottom of the shaft. The Engineer may accept a drilled shaft without rock cores if an EAR demonstrates that the anomaly does not affect the structural and the geotechnical axial capacity, the structural and geotechnical lateral stability, the settlement behavior of the shaft, and that the anomaly will not impact the durability of the foundation.

When repairs are done, perform CSL measurements in all tube pair combinations with the source and receiver running at the same horizontal plane and at the vertical offsets of 45 degrees above and below. Perform all measurements including the offset measurements from the point where the higher probe is at least 5 feet below the lower limit of the repaired zone to the point where the lower probe is at least 5 feet above the upper limit of the repaired zone. Offset measurements must be as follows: plus 45 degrees (source below receiver) and minus 45 degrees (source above receiver). Use the measurements of these two offsets in combination with the horizontal measurements to perform the 3D tomography. Provide the CSL measurements, CSL logs and 3D tomographic analysis at no additional cost to the Department.

After acceptance of production shafts by the Engineer, fill the tubes or core holes with a structural non-shrink grout in accordance with 455-17.6.1.

If the Contractor determines at any time during the non-destructive testing and evaluation of the drilled shaft that the drilled shaft should be replaced, no further testing or evaluation of that shaft is required.

455-17.6.2.1 Required CSL Reports: Present the CSL data and analysis results to the Engineer in a signed and sealed report. Include CSL logs with analyses of first pulse arrival time (FAT) versus depth and pulse energy/amplitude versus depth. Present a CSL log for each tube pair tested with any defect zones identified on the logs and discussed in the test report as appropriate. When offset measurements are required, perform 3D tomographic analysis using all offset data, and include color coded 3D tomographic images in the report.

455-17.6.2.2 Evaluation of Cross-Hole Sonic Logging Testing: Drilled shafts with velocity reduction exceeding 30% are not acceptable without an engineering analysis.

455-17.6.2.3 Coring and/or Repair of Drilled Shafts: If a drilled shaft is unacceptable based on the CSL Testing and tomographic analyses and other testing, core the shaft to allow further evaluation and repair, or replace the shaft in accordance with 455-17.6.1.5.

If repairs are performed or additional shafts installed to correct a deficient foundation, conduct integrity testing and submit the results to the Engineer in accordance with 455-17.6.1.5.

455-18 Method Shafts.

The Engineer will use the construction of method shafts (test holes) to determine if the methods and equipment used by the Contractor are sufficient to produce a shaft excavation meeting the requirements of the Contract Documents. During method shaft excavations, the Engineer will evaluate the ability to control dimensions and alignment of excavations within tolerances; to seal the casing into impervious materials; to control the size of the excavation under caving conditions by the use of slurry or by other means; to properly clean the completed

shaft excavation; to construct excavations in open water areas; to determine the elevation of ground water; to place reinforcing steel and concrete meeting the requirements of these Specifications within the prescribed time frame; and to execute any other necessary construction operation. Revise the methods and equipment as necessary at any time during the construction of the method shaft when unable to satisfactorily carry out any of the necessary operations described above or when unable to control the dimensions and alignment of the shaft excavation within tolerances.

Successfully construct method shafts out of permanent position at the location shown in the Plans. Ensure the diameter and depth of the method shafts are the same diameter and maximum depth as the production drilled shafts. When there are shafts both on land and in water, successfully construct a method shaft for each condition. When there is more than one size of drilled shaft, perform a method shaft for the largest diameter for each condition. Reinforce the method shaft unless otherwise directed in the Contract Documents. Conduct integrity tests on each shaft, using both cross-hole sonic logging and TITDS test methods. Fill the method shaft with concrete in the same manner production drilled shafts will be constructed. Backfill method shafts which are not filled with concrete with suitable soil in a manner satisfactory to the Engineer. Leave concreted method shafts in place, except remove the top of the shaft to a depth of 2 feet below the finished graded surface. Use the same procedure for shafts constructed in water. Restore the disturbed areas at the sites of method shafts drilled out of position as nearly as practical to their original condition. When the Contractor fails to demonstrate to the Engineer the adequacy of his methods or equipment, and alterations are required, make appropriate modifications and provide additional method shafts at no expense to the Department. Make no changes in methods or equipment after initial acceptance without the consent of the Engineer.

A separate method shaft is not required for drilled shafts installed under sign, signal, lighting and ITS structures. The first production shaft will serve as a method shaft for determining acceptability of the installation method.

455-19 Test Bells.

Test bells are no longer used.

455-20 Construction Tolerances.

Meet the following construction tolerances for drilled shafts:

1. Ensure that the top of the drilled shaft is no more than 3 inches laterally in the X or Y coordinate from the position indicated in the Plans.

2. Ensure that the vertical alignment of the shaft excavation does not vary from the alignment shown in the Plans by more than 1/4 inches per foot of depth.

3. After placing all the concrete, ensure that the top of the reinforcing steel cage is no more than 6 inches above and no more than 3 inches below plan position.

4. Ensure that the reinforcing cage is concentric with the shaft within a tolerance of 1-1/2 inches. Ensure that concrete cover is a minimum of 4-1/2 inches unless shown otherwise in the Plans.

5. Ensure that the minimum diameter of the drilled shaft is not smaller than the specified diameter minus 1 inch. All casing diameters shown in the Plans refer to I.D. (inside diameter) dimensions. However, the Contractor may use casing with an outside diameter equal to the specified shaft diameter if the extra length described in 455-15.7 is provided. In this case, ensure that the I.D. of the casing is not smaller than the specified shaft diameter minus 1 inch.

The Contractor may elect to provide a casing larger in diameter than shown in the Plans to facilitate meeting this requirement. When conditions are such that a series of telescoping casings are used, provide the casing sized to maintain the minimum shaft diameters listed above.

6. Except when a butting or encroaching within a sidewalk, ensure that the top elevation of the drilled shaft concrete has a tolerance of plus 1 inch and minus 3 inches from the top of shaft elevation shown in the Plans.

7. When abutting or encroaching within a sidewalk, ensure that the top elevation of the drilled shaft is flush with the sidewalk surface.

8. The dimensions of casings are subject to American Petroleum Institute tolerances applicable to regular steel pipe.

9. Use excavation equipment and methods designed so that the completed shaft excavation will have a flat bottom. Ensure that the cutting edges of excavation equipment are normal to the vertical axis of the equipment within a tolerance of plus or minus 3/8 inches per foot of diameter.

455-21 Drilled Shaft Excavations Constructed out of Tolerance.

Do not construct drilled shaft excavations in such a manner that the concrete shaft cannot be completed within the required tolerances. The Contractor may make corrections to an unacceptable drilled shaft excavation by any combination of the following methods:

1. Overdrilling the shaft excavation to a larger diameter to permit accurate placement of the reinforcing steel cage with the required minimum concrete cover.

2. Increasing the number and/or size of the steel reinforcement bars.

When the tolerances are not met, the Contractor may propose a redesign to incorporate shafts installed out of tolerance into caps or footings. Incorporate shafts installed out of tolerance at no expense to the Department. Ensure the Contractor's Engineer of Record performs any redesign and signs and seals the redesign drawings and computations. Do not begin any proposed construction until the redesign has been reviewed and accepted by the Engineer.

Backfill any out of tolerance shafts in an accepted manner when necessary until the redesign is complete and accepted. Furnish additional materials and work necessary, including engineering analysis and redesign, to effect corrections of out of tolerance drilled shaft excavations at no expense to the Department.

455-22 Recording, Certification and Verification.

455-22.1 Recording: Inspect and record all the drilled shaft operations. Keep a set of drilled shaft logs for each drilled shaft including test holes, load test shafts and production shafts. Use the Department's Drilled Shaft Log forms to record the information. Submit to the Engineer drilled shaft logs and concrete logs within 24 hours of concrete placement. The documentation shall include the drilled shaft installation procedures, actual dimensions and quantities of the materials used, fluid testing results, bottom cleanliness inspection results, sequencing, as well as any problems encountered during construction and concrete placement. Allow two working days, excluding weekends and Department observed holidays, for the Department to review the data and determine whether shafts will be selected for CSL integrity testing. Perform CSL testing on any shaft selected by the Department at this stage in accordance with 455-17.

455-22.2 Foundation Certification Packages: Submit certification packages of drilled shaft foundations to the Engineer prior to Verification Testing. Each Foundation Certification Package shall include a letter signed and sealed by the GFDEOR certifying the drilled shafts

have the required axial capacity, torsional capacity, uplift capacity, overturning and lateral stability, integrity deficiencies have been corrected, settlements will not affect the functionality of the structure, and that the inspection of the drilled shaft installation was performed under the supervision of the GFDEOR. Include all shaft excavation and concreting logs, videos of visual shaft bottom inspections, all TITDS and CSL reports and electronic data, gamma-gamma testing reports, slurry test data, supplemental testing data, analyses for the foundation unit and the concrete strength test results of the lots sampled. The certification shall not be contingent on any future repair or testing, or any approval by the Engineer. Submit a separate Foundation Certification Package for each foundation unit. A foundation unit is defined as all the shafts within one bent or pier for a specific bridge for each phase of construction. For sign, signal, lighting and ITS structures, a foundation unit is defined as all the shafts within one intersection/interchange, for each phase of an intersection/interchange or all the shafts included in the structure.

455-22.3 Verification: The Engineer reserves the right to observe and perform verification testing on any drilled shafts during any phases of the foundation operation.

Provide safe access and cooperate with the Engineer for verification of the drilled shafts, both during construction of shafts and after submittal of the certification package. The Engineer may verify the bottom cleanliness by over the shoulder review of the Contractor's visual inspection methods and/or by independent means. The Engineer may verify properties of drilling fluid at the time of concreting.

Within one working day, excluding weekends and Department observed holidays, of receipt of the Foundation Certification Package, the Engineer will examine the Certification Package and determine whether shafts in that foundation unit will be selected for Verification Testing. The Engineer may select every shaft for Verification Testing if defects are suspected, or choose not to require verification testing on any or all foundation units. The Engineer will provide equipment and personnel as needed for Verification Testing. Methods used for Verification Testing of a completed shaft are at the discretion of the Engineer and may include coring, cross-hole sonic logging, gamma-gamma density logging, low-strain dynamic integrity testing, or other methods.

After Verification Testing for a foundation unit is performed, the Engineer will provide the results within five working days, excluding weekends and Department observed holidays. Integrity testing access tubes shall not be grouted and construction of footings, caps, columns or any superstructure elements shall not occur until the Engineer has notified the Contractor that additional Verification Testing is not required.

If any shaft is found to be deficient, correct the deficiency (i.e. repair or replace the shaft) and/or modify the design to compensate for the deficiency. After the deficiency is corrected, retest and recertify the shaft. The Engineer may then perform additional Verification Testing. In case of disagreement of test results, the Engineer's results will be final and used for determination of acceptance.

ARTICLE 455-23 is deleted:

455-24 Basis of Payment.

Contract Price includes all labor, equipment and materials required for furnishing, installing, and certifying drill shaft foundations, in place and accepted. No separate payment will be made for any items of work associated with construction of drill shaft foundations.

D. SPREAD FOOTINGS

455-25 Description.

Construct reinforced concrete spread footing foundations, including dewatering when necessary, excavating to the required limits, compacting the underlying soil as required, and constructing seals when required.

455-26 General Requirements.

Meet the following requirements for all spread footings:

1. Perform excavations, including the removal of all material, of whatever nature, necessary for the construction of spread footings. As used herein, the term "soil" shall constitute any material, whether soil, rock, or other materials.

2. Slope excavations as required, or support them with sheeting, and shore them if necessary, to provide a safe excavation that is adequate for construction purposes and that will adequately protect any existing adjacent structures.

3. Ensure that the foundation soils are firm, stable, and meet or exceed the design bearing and compressibility requirements before constructing the footings or any required seals. The Department may elect to use any type of tests to evaluate the foundation soils that is appropriate in the opinion of the Engineer. Cooperate with the Engineer in the evaluation of the foundation soils, and assist the Engineer as necessary to provide access to the site.

4. Modify the elevation of the bottom of footings or seals and the depth of over-excavation shown in the Plans as may be necessary to secure a satisfactory foundation.

5. Place all spread footing concrete in the dry.

Provide safe access and cooperate with the Engineer to perform verification of the spread footing construction.

455-26.1 Foundation Certification Packages:

Submit two copies of a letter signed and sealed by the GFDEOR to the Engineer certifying each spread footing has the required axial, lateral and torsional capacity, overturning stability and integrity; and settlement will not affect the functionality of the structure. A separate Foundation Certification Package must be submitted for each foundation unit. A foundation unit is defined as a spread footing. Spread footings must be certified and the certification accepted before continuing with the construction of any structural element above the foundation unit. Correct all integrity problems and non compliance issues prior to submitting the certification packages. The certification shall not be contingent on any future repair or testing, or any approval by the Engineer.

Within one working day, excluding weekends and Department observed holidays, after receipt of the Foundation Certification Package, the Engineer will examine the records and determine the acceptability of the shallow foundation.

455-27 Monitor Existing Structures.

Monitor existing structures in accordance with Section 108.

455-28 Dewatering.

The Contractor is responsible for the design, installation, and operation of an adequate dewatering system to dewater excavations for spread footings. Use a well point or well system. Submit a dewatering plan to the Engineer for his records before beginning construction.

Use well points or wells where the piezometric water level is above an elevation 3 feet below the bottom of the excavation. Maintain the water table 3 feet or more below the maximum depth of excavation. Provide continuous dewatering until completing construction of the footing and backfill the excavation at least 3 feet above the piezometric water table elevation. In the event of a dewatering failure, determine the effects of such a failure on the foundation soils, and take whatever corrective measures are required at no additional expense to the Department. When discontinuing dewatering, decrease the rate of pumping, allowing the water level to rise slowly. Use a rate, in feet per hour, that the water table is allowed to rise equal to the total number of feet the water table was lowered, divided by ten hours or a rate of 1 foot per hour, whichever is less.

Install one piezometer well approximately every 15 feet of footing perimeter. Provide a minimum of two piezometers at locations within 2 feet from the outside of the footing perimeter. Install piezometer wells to a depth at least 10 feet below the bottom of footing elevation. Measure water elevation in the piezometer wells prior to excavation and at 12-hour intervals between excavation and discontinuation of dewatering. Maintain the piezometers in working condition throughout the dewatering process, and repair or replace them when damaged at no expense to the Department.

455-29 Excavations

If the excavation must be carried deeper than shown in the Plans to obtain a satisfactory foundation, revise the Plans.

455-29.1 Dry Excavations: Dry excavations are excavations that can be completed without the need to lower the piezometric water level. Perform dry excavations when the piezometric water level at the time of construction is and, in the opinion of the Engineer, will remain at least 3 feet below the bottom of the authorized excavation or over-excavation. Demonstrate to the Engineer that a stable excavation can be made without dewatering. Make adequate provisions to divert surface runoff and to collect and remove any water entering the excavation.

Excavate to the bottom of footing, to the over-excavation limits shown in the Plans or as required for forming. Save any suitable materials for backfill. Provide areas for the disposal of all unsuitable materials, and dispose of them in a satisfactory method. Compact the foundation soils below the footing as described herein before constructing the footing.

455-29.2 Dewatered Excavations: Dewatered excavations are excavations made after first lowering the piezometric water level with wellpoints or wells. Perform dewatering as described in 455-28. Excavate in the dry after lowering of the water table.

When dewatering is required, the Contractor may excavate within 3 feet of the ground water table before dewatering begins if the dewatering system is operating and the Contractor has demonstrated that the water level has been lowered to and maintained at acceptable limits. Where large excavations require stage lowering of the water table (additional wellpoint systems installed at lower elevations), the Contractor may continue excavating as long as the water elevation is maintained at least 3 feet below the excavation.

Ensure that surface runoff is diverted from the excavation. Compact the foundation soils as shown in the Plans or as described herein before constructing the footing.

455-29.3 Wet Excavations: Wet excavations are excavations made below the existing water table without prior dewatering. When the Plans show a cofferdam and seal, perform the

excavation in the wet. Maintain the water level during excavation at or above the water level outside the cofferdam.

Place the seal directly upon the foundation soils or rock when using wet excavations. Do not compact foundation soils for wet excavations. Ensure that the foundation soils or rock are disturbed as little as practical. Remove all loose or disturbed materials before placing the seal concrete.

455-30 Fill or Backfill.

In all excavations, including over-excavations below the footing, use only fill or backfill materials considered Select in accordance with Standard Plans, Index 120-001. Ensure the material is free of rubble, debris, or rocks that would prevent uniform placement and compaction. Ensure the material below the top of the footing is free of Recycled Asphalt Pavement (RAP). Perform sampling and testing in accordance with 120-10.1.4, except replace FM 1-T99 with FM 1-T180.

455-31 Compaction and Density Requirements.

Compact the bottom of the excavation with suitable equipment. Compact the soil beneath footing excavation (whether dug to the bottom of footing or over-excavated) to a density not less than 95% of the maximum density as determined by FM 1-T180 for a minimum depth of 2 feet below the bottom of the excavation or to the depth shown in the Plans before backfilling begins. For every 500 feet of excavation or isolated compaction operation, perform two Quality Control (QC) density tests with a 12 inch depth of measurement: one QC density test with the gauge placed at an elevation of 1 foot below the bottom of the excavation and one QC density test with the gauge placed at the bottom of the excavation in accordance with FM 1-T238. Compact the backfill in footing excavations which have been over-excavated to a density not less than 95% of the maximum density as determined by FM 1-T180. Ensure that the maximum lift thickness after compaction does not exceed 6 inches. For every 500 feet of backfill or isolated compaction operation, perform at least one QC density test. The Engineer will conduct one density verification test per every four QC test with a minimum of one density test below the bottom of the excavation and one density test in the backfill. Verification comparison criteria and resolution procedures will be in accordance with 120-10.4 except replace FM 1-T99, with FM 1-T180.

For compaction, use a suitable heavy vibratory roller with a static drum weight of at least 4 tons. Compact each lift to the required density. Also, compact the final lift below the footing with a suitable sled vibratory compactor to remove any upper disturbance caused by the drum roller. When conditions require use of smaller compaction equipment, obtain the Engineer's acceptance for the equipment, and reduce the lift thickness to achieve the required density.

Perform backfilling to the existing surface or finished graded surface, as required by the Plans in the immediate vicinity by suitable mechanical compactors weighing less than 1,000 pounds. The Contractor may compact backfill located more than 15 feet away from the exterior periphery of the footing with heavier compactors. Do not place backfill on the footing until the Engineer has given permission and until the concrete is at least seven days old.

When the plans indicate spread footing abutments on mechanically stabilized earth (MSE) walls, place and compact the backfill material underneath the footing in accordance with the requirements of 548-8.5. Meet the density requirements of 548-9.4.

455-32 Forming.

Form spread footings if it cannot be demonstrated that the natural soil or rock is strong enough to prevent caving during construction. For forms, meet the applicable requirements of 400-5. When forms are not required, meet the requirements of 400-5.4.4.

455-33 Materials.

455-33.1 Concrete: Meet the requirements of Section 346.

455-33.2 Reinforcing Steel: Meet the requirements of Section 415. For spread footing reinforcing steel, use Grade 60.

455-34 Reinforcing Steel Placement.

Place and fasten reinforcing steel for footings according to the applicable provisions of 415-5.

455-35 Concrete Placement.

455-35.1 Placement: Place all footing concrete in the dry and according to the applicable provisions of Section 400. Do not construct joints in footings.

455-35.2 Finish: After placing and consolidating the concrete, strike-off the top surface to the grades shown in the Contract Documents, leaving the surface smooth and free of undesirable cavities and other defects. Do not provide a special finish unless the footing will be visible after construction, in which case, meet the applicable provisions of Section 400.

455-35.3 Curing: Provide continuous-moisture-curing for footings. For cover materials, use clean sand, sawdust, or other materials accepted by the Engineer. Continuously wet the cover materials for a period of 72 hours.

ARTICLE 455-36 is deleted:

455-37 Basis of Payment.

Contract Price includes all labor, equipment and materials required for furnishing, installing, and certifying the completed foundations, in place and accepted. No separate payment will be made for any items of work associated with spread footing construction.

E. STRUCTURES (OTHER THAN BRIDGE) FOUNDATIONS-AUGER CAST PILES

455-38 Description.

Furnish and install auger cast piles (ACP) or augered cast-in-place (ACIP) piles used for structural support, other than bridge foundations.

ACP piles are defined as a foundation made by rotating a hollow-stem auger into the ground to the required pile depth with sufficient crowd (downward thrust) to prevent mining of the soil. A fluid cement grout is injected through the auger shaft under continuous positive pressure as the auger is being withdrawn. A reinforcing steel cage, as specified, is inserted into the column of fluid grout following the completion of grout placement.

455-39 General Requirements.

455-39.1 Contractor's Operations: Submit an Auger Cast Pile Installation Plan in accordance with 455-47. Prior to the start of production piles, demonstrate to the satisfaction of the Engineer, the dependability of the equipment, techniques, and source of materials by construction of a demonstration pile.

Provide safe access and cooperate with the Engineer to perform verification of the auger cast pile installation.

455-39.2 Monitor Existing Structures: Monitor existing structures in accordance with Section 108.

455-40 Materials.

Meet the following material requirements:

Portland Cement and Blended Cement	Section 921
Supplementary Cementitious Materials	Section 929
Fine Aggregate (Sand)*	Section 902
Admixtures	Section 924
Water	Section 923
Fluidifier**	ASTM C 937
Reinforcing Steel	Section 415

* The Engineer will only permit Silica Sand except as provided in 902-5.2.3.
** The fluidifier shall not contain chlorides.

455-41 Grout Mix Proportions.

Use a grout mix consisting of a mixture of cementitious materials, admixtures, sand and water. Proportion and mix to produce a grout capable of maintaining the solids in suspension without appreciable bleed water which may be pumped without difficulty and fill open voids in the adjacent soils and rock. The grout mix may include a fluidifier used in accordance with the manufacturer's technical representative. Proportion these materials to produce a hardened grout of the required strength.

455-42 Mixing and Pumping Cement Grout.

Meet the following requirements:

1. Only use pumping equipment accepted by the Engineer in the preparation and handling of the grout. Before using the mixers, remove all oil or other rust inhibitors from the mixing drums, stirring mechanisms, and other portions of the equipment in contact with the grout.

2. Use a quantity of water and mixing time that will produce a homogenous grout having an efflux of not less than 21 seconds, when tested with a flow cone in accordance with ASTM D6449. Reject loads with efflux of less than 21 seconds. Notify the production facility to adjust the mix design. Calibrate the flow cone in accordance with ASTM D6449. Conduct the calibration initially before its first use and as directed by the Engineer, when there is a question of the flow cone's accuracy.

Technicians performing the efflux test must take the Auger Cast Pile course and pass the final examination to be qualified to test for any auger cast pile installations in the field. Assist the Engineer in verifying the technicians meet these requirements.

Conduct test for efflux time at the beginning of each day's grouting operation and as directed by the Engineer to ensure the Specification requirements are met.

3. Mix the grout at least one minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 2.5 hours at grout temperatures below 70ºF; two hours for temperatures from 70°F to 100ºF. Do not place grout when its temperature exceeds 100ºF. If there is a lapse in the operation of grout injection, recirculate the grout through the pump, or through the mixer drum or agitator.

4. Use mixers capable of combining components into a thoroughly mixed and uniform mass, free from balls or lumps and capable of discharging the grout with a satisfactory degree of uniformity. The Engineer's acceptance of grout mixers and all other equipment will be contingent on proper performance during construction of the demonstration pile and subsequent production work.

5. Use a screen no larger than 3/4 inch mesh between the mixer and pump to remove large particles which might clog the injection system.

6. Use a positive displacement piston type grout pump equipped with a pressure gauge, capable of developing displacing pressures at the pump not less than 350 psi. The pump must be appropriately sized to the pile diameter. Provide a grout pressure gage in clear view of the equipment operator. Provide a second pressure gauge near the drill rig where it can be observed by the Engineer.

7. Accurately monitor the volume and pressure of the grout flow. Provide a pump stroke counter in good working condition on the grout pump. Perform a calibration test of the pumping equipment, prior to construction of the demonstration piles, to determine the average volume of grout for every pump stroke, in accordance with FM 5-612. When the Contractor's installation procedure includes priming the grout pump, grouting lines or auger conduit after drilling the hole, perform a priming demonstration to determine the minimum number of pump strokes required to deliver fresh grout throughout the entire system and flow from the grout injection hole at the bottom of the auger. Perform this grout priming demonstration prior to any calibration test.

The Engineer may require additional pump calibrations and priming demonstrations when the pump is repaired, a different pump is used, when the length of the grout lines or hollow auger lengths increase from previous piles for which priming demonstrations were performed and at any time the Engineer determines the grout pump performance may have changed.

455-43 Testing Cement Grout.

Prepare three 4 inches x 8 inches cylinders for each LOT in accordance with ASTM C31, except pour grout in a single lift into cylinders molds without rodding. Plastic properties in accordance with ASTM C31 are not required. A LOT is defined as the lesser of 50 cubic yards of cement grout placed or one day of pile placement. Prepare three additional QC "hold" cylinders on the LOT selected by the Engineer for Verification. Provide curing facilities for all QC and Verification test cylinders in accordance with ASTM C31. Test the cylinders at 28 days, in accordance with ASTM C39.

When one of the three QC cylinders from a LOT is lost, missing, damaged or destroyed, determination of compressive strength will be made by averaging the remaining two cylinders. If more than one QC cylinder from a LOT is lost, missing, damaged or destroyed, core the structure at no additional expense to the Department to determine the compressive strength. Acceptance of LOT may be based on verification data at the discretion of the Engineer. Obtain the approval of

the Engineer to core, and of the core location prior to coring. Repair core holes after samples are taken with a product meeting the approval of the Engineer, at no additional cost to the Department.

For each QC cylinder that is lost, missing, damaged or destroyed, payment for that LOT will be reduced by $750.00 per 1,000 psi of the specified design strength [Example: For f'_c=5,500 psi, and the loss of two auger cast pile grout QC cylinders that have no verification data will require the element to be cored and a pay reduction will be assessed (5,500 psi / 1,000 psi) x $750 x 2 = $8,250]. This reduction will be in addition to any pay adjustment for low strength.

The Engineer will cast three verification cylinders and three "hold" cylinders from one of every four consecutive Lots, randomly selected. The Engineer will compare QC and Verification results in accordance with Section 346. If the results do not compare, the Engineer will initiate a Resolution Investigation in accordance with Section 346

Personnel making/curing grout cylinders shall be certified as ACI Concrete Field Testing Technician Grade I. Personnel performing tests on hardened properties of grout, such as strength determination of cylinders or beams, shall be certified as ACI Concrete Strength Testing Technician.

All low strength cement grout accepted by the Engineer will be subject to reduced payment as follows: $0.80 per cubic yard for each 10 psi of strength test value below the specified minimum strength. The Engineer will use the average compressive strength of the LOT tests for the computation of this pay reduction.

The Engineer will compute the volume of grout for which the reduction will be applied as 115% of the theoretical volume of the auger cast pile diameter required in the Contract Documents. Reduction in pay will be applied to the entire length of all piles containing low strength cement grout, in any quantity. The quantity of cement grout affected by the payment reduction may exceed the quantity of cement grout contained in the LOT.

When a cement grout acceptance strength test falls more than 500 psi below the specified minimum strength, perform one of the following:

1. Remove and replace the piles affected fully or partially by the low strength LOT at no additional cost to the Department, or

2. Submit a structural analysis performed by the Contractor's Engineer of Record. If the results of the analysis, approved by the Department, indicate adequate strength to serve the intended purpose with adequate durability, the concrete may remain in place.

Otherwise, abandon and install additional piles to the foundation, or remove and replace the piles affected fully or partially by the low strength LOT of grout at no additional cost to the Department. When installing additional piles to resolve the strength deficiency, submit a foundation redesign to add piles into pile caps or footings, at no expense to the Department in accordance with 455-46.

455-44 Pile Installation.

Meet the following requirements:

1. Locate the piles as shown on the drawings.

2. Should soft, compressible muck, organics, clay or other unsuitable materials (non A-1, A-3, A-2-4 or limestone materials) be encountered, remove the unsuitable material to a maximum depth of 5 feet and a radial distance around the pile centerline of two pile diameters unless otherwise indicated in the Plans. Backfill with clean granular backfill materials (A-1, A-3,

A-2-4), placed and compacted in maximum 12 inch lifts to at least 95% of maximum dry density as determined by FM 1-T180. Complete this work to the Engineer's satisfaction prior to ACP construction. Should more than 5 feet depth or excessive quantities of unsuitable material be encountered, submit a revised design to the Engineer for review and acceptance prior to proceeding with pile construction.

3. Provide continuous auger flighting from the bottom of the pile to the top of ground at the time of drilling with no gaps or other breaks except for connections. Ensure the auger flights are uniform in diameter throughout its length, and of the diameter specified for the piles less a maximum of 3%. Provide augers with a distance between flights of approximately half the diameter of the auger.

4. Use augers with the grout injection hole located at the bottom of the auger tip below the cutting teeth, and with pile auger leads containing a bottom guide.

5. Construct piles of the length and diameter shown on the Plans.

6. Clearly mark the auger leads to facilitate monitoring of the incremental drilling and grout placement. Provide individual foot marks with 5 foot increments highlighted and clearly visible. Provide a clear reference mark on the moving auger assembly to facilitate accurately monitoring the vertical movement of the auger.

7. Place piles by rotating a continuous flight hollow shaft auger into the ground at a continuous rate that prevents removal of excess soil. Stop advancement after reaching the predetermined depth.

8. Should auger penetration to the required depth prove difficult due to hard materials/refusal, the pile location may be predrilled, upon concurrence by the GFDEOR and acceptance of the Engineer, through the obstruction using appropriate drilling equipment, to a diameter no larger than 1/2 the prescribed finish diameter of the ACP. Commence ACP grouting immediately upon reaching the required tip elevation to minimize ground loss and soil relaxation.

9. Plug the injection hole at the bottom of the auger prior to advancing into the ground.

10. Pump the grout with sufficient pressure as the auger is withdrawn to completely fill the auger hole, preventing hole collapse and to cause the lateral penetration of the grout into soft or porous zones of the surrounding soil or rock. Prior to commencing withdrawal of the auger, establish a head of at least 5 feet of grout by pumping a volume of grout equivalent to 5 feet of pile volume. Do not include the volume or strokes required to prime the grout pumping system in the volume required to build this initial head. Maintain this head of at least 5 feet of grout above the injection point around the perimeter of the auger to displace and remove any loose material from the hole. Maintain positive rotation of the auger at least until placement of the grout.

11. Once the grout head has been established, greatly reduce the speed of rotation of the auger and commence extraction at a rate consistent with the pump discharge. Maintain extraction at a steady rate to prevent a locked-in auger, necking of the pile, or a substantially reduced pile section. Ensure grout starts flowing out from the hole when the cutting head is at least 5 feet below the ground surface. Place a minimum volume of grout in the hole of at least 115% of the column of the auger hole from a depth of 5 feet to the tip. Place a minimum volume of grout in the hole of at least 105% of the column of the auger hole from the ground surface to a depth of 5 feet. Do not include any grout needed to create surplus grout head in the volume of grout placed into the hole. If the grout does not flow out from the hole when the cutting head is

at least 5 feet below the ground surface, redrill the pile. If grouting is interrupted for any reason, reinsert the auger by drilling at least 5 feet below the tip of the auger when the interruption occurred, and then regrout.

Use this method of placement at all times. Do not depend on the stability of the hole without the earth filled auger.

12. Assume responsibility for the grout volume placed. If less than 115% of the theoretical volume of grout is placed in any 5 foot increment (100% in the top 5 foot increment), redrill 10 feet below that increment, or to the tip of the pile, whichever is less and resume pumping, followed by controlled removal and grout injection.

13. Furnish and install the reinforcing steel and anchoring bolts as shown in the Contract Documents. For ACP for miscellaneous structures and low clearance post options for noise walls, use wheels or other approved noncorrosive spacing devices within 3 feet of the bottom, within 3 feet of the top, and intervals not exceeding 10 feet along the pile to ensure concentric spacing for the entire length of the cage. Do not use block or wire type spacers. Use a minimum of one spacer per 30 inches of circumference or perimeter of cage with a minimum of three at each level. For noise wall ACP in which the full reinforcement is attached to the post, spacing devices within 3 ft of the top of the pile are not required.

14. Use reinforcement that is without kinks or nonspecified bends, free of mud, oil or other coatings that could adversely affect the bond. Make splices in reinforcement as shown on the Contract Documents, unless otherwise accepted by the Engineer. Place the required steel reinforcement while the grout is still fluid, and immediately after finishing grouting and clearing it from any contaminating material. Install the steel cage into the grout by its own weight or manually. Do not use a mechanical equipment or tool to impact the steel cage or to force it into the grout. If the steel cage cannot be placed completely following this procedure, remove the cage, redrill and regrout the pile.

15. Leave any temporary supports of/for items placed into a grouted pile (reinforcement template, anchor bolt template, precast column supports, etc.) in place for a minimum of 12 hours after completion of the pile. Do not place wall panels or other significant loads, before the grout has set a minimum of seven days or reached the 28-day strength.

455-45 Construction Tolerances.

Locate piles as shown on the Plans. Locate pile centers to an accuracy of plus or minus 3 inches. Ensure that the top of pile elevation is within plus or minus 3 inches of the Plan elevation. Ensure the tolerances of 534-5.1 can be met.

455-46 Unacceptable Piles.

Repair or replace unacceptable piles and/or modify the design to compensate for the deficiency at no cost to the Department. Unacceptable piles are defined as piles that fail for any reason, including but not limited to the following: piles placed out of position or to improper elevation; piles with reduced cross section, contaminated grout, lack of grout consolidation (honeycombed), or deficient grout strength; and piles with reinforcement, anchor devices or other components cast or placed into the fluid grout out of position. When the Engineer determines that a pile is unacceptable, the Contractor may propose a foundation redesign to add piles to the foundation, at no expense to the Department. The Contractor’s Engineer of Record must perform any redesign, and sign and seal the redesign drawings and calculations. Do not

begin any proposed construction until the redesign has been reviewed and approved by the Engineer.

455-47 Auger Cast Pile Installation Plan (ACPIP).

No later than 15 days before ACP construction begins, submit the ACPIP for acceptance by the Engineer. The ACPIP shall govern all ACP construction activities. In the event that deviations from this installation plan are observed, the Department may perform Independent Verification Testing/Review of the Contractor's equipment, procedures, personnel and ACP construction at any time during ACP construction. If, as determined by the Department, construction equipment, procedures and/or personnel is deemed inadequate to consistently provide auger cast piles meeting the contract requirements, the Contractor's ACPIP acceptance may be withdrawn pending corrective actions. All ACP construction activities shall then cease and not restart until corrective actions have been taken and the ACPIP has been re-accepted.

Provide the following detailed information on the ACPIP:

1. Name and experience record of ACP superintendent or foreman in responsible charge of ACP operations. Place a person in responsible charge of day to day ACP operations meeting the experience requirements of 105-8.13 constructing ACP similar to those described in the Contract Documents. The Engineer will give final acceptance subject to satisfactory performance in the field.
2. List and size of the proposed equipment, including cranes, augers, concrete pumps, mixing equipment etc.
3. Details of grout mixing procedures and proposed pump calibration procedures.
4. Details of pile installation methods.
5. Details of reinforcement placement and method of centering in pile, including details of all temporary supports for reinforcement, anchor bolts, precast columns, etc.
6. Details of how and by whom the grout volumes will be determined, monitored and documented.
7. Required submittals, including shop drawings and cement grout design mixes.
8. Equipment and procedures for visual inspection, and any methods to identify and remediate auger cast pile deficiencies.
9. Name of the inspectors assigned to monitor the installation of the auger cast piles, including evidence of the inspectors having taken and passed the CTQP computer based training course for auger cast piles.
10. Other information requested by the Engineer.
11. A letter from the GFDEOR certifying concurrence with the ACPIP.

The Engineer will evaluate the ACPIP for conformance with the Contract Documents. Within five working days after receipt of the plan, excluding weekends and Department observed holidays, the Engineer will notify the Contractor of any comments and additional information required and/or changes that may be necessary to satisfy the Contract Documents. The Engineer will reject any part of the plan that is unacceptable. Submit changes agreed upon for reevaluation. The Engineer will notify the Contractor within two working days, excluding weekends and Department observed holidays, after receipt of proposed changes of their acceptance or rejection. All equipment and procedures are subject to trial and satisfactory performance in the field. Acceptance by the Engineer does not relieve the Contractor of the responsibility to perform the work in accordance with the Contract Documents. The Engineer's

acceptance is not a guarantee that the chosen methods and equipment are capable of obtaining the required results, this responsibility lies with the Contractor.

455-48 Inspection and Records.

Monitor and record pile installation utilizing the most recent version of the Department Auger Cast-In-Place Pile Installation Record form.

ARTICLE 455-49 is deleted:

455-50 Basis of Payment.

Contract Price includes cost of all labor, equipment and materials required for furnishing, installing, and certifying the completed auger cast pile foundations, in place and accepted. No separate payment will be made for any items of work associated with auger cast pile construction.

455-51 Foundation Certification Packages

Submit two copies of a letter signed and sealed by the GFDEOR to the Engineer certifying each foundation unit has the required axial capacity, lateral stability and integrity, settlements will not affect the functionality of the structure, and that the inspection of the auger cast pile installation was performed under the supervision of the GFDEOR. A separate Foundation Certification Package must be submitted for each foundation unit. The foundation unit is defined as a group of piles per wall segment or per full wall. Every ACP must be certified and the certification accepted before continuing with the construction of any structural element over the foundation unit. Each Foundation Certification Package shall include all ACP logs, the Department spreadsheet properly completed for every ACP and the grout strength test results of the lots sampled. Correct all integrity problems and noncompliance issues prior to submitting the certification packages. The certification shall not be contingent on any future repair or testing, or any approval by the Engineer. Within three working days, excluding weekends and Department observed holidays, after receipt of the Foundation Certification Package, the Engineer will examine the records and determine the acceptability of the auger cast piles. The Engineer will reject any certification package that is incomplete or indicates noncompliance with the specifications without the issue being corrected to the satisfaction of the Engineer.

If any ACP is found to be deficient, correct the deficiency (i.e. repair or replace the ACP) and/or modify the design to compensate for the deficiency. In case of disagreement of test results, the Engineer's results will be final and used for determination of acceptance.

After meeting the time requirements of 455-44(15), the Contractor may place panels prior to a complete submittal of the Certification Package at their own risk. If the Engineer determines that verification testing is needed, the Contractor will perform all work and provide all labor, at no additional cost to the Department, necessary to allow access to the piles requiring verification. Replace or redesign and reconstruct, to the satisfaction of the Engineer, any foundation found to be unacceptable after submittal of the certification packages or after verification testing, at no cost to the Department.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 26, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **005**
Proposed Specification: **REVISED 0050104 Control of the Work.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Ben Goldsberry from the Structures Design Office to provide consistency with policy updated made to FDM 266 for prefabricated steel truss pedestrian bridge. The changes are associated with Section 460

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTROL OF THE WORK
(REV 9~~7~~-26~~5~~-22)

SUBARTICLE 5-1.4.1 is deleted and the following substituted:

5-1.4 Shop Drawings:

5-1.4.1. Definitions: In addition to the definitions below, also refer to Section 1, Definitions and Terms.

1. Bracing: Temporary structural member(s) placed between beams, girders, piles, precast columns, etc. to provide stability during construction activities.

2. Construction Affecting Public Safety: Construction that may jeopardize public safety such as structures and construction operations spanning over or adjacent to functioning vehicular roadways, pedestrian walkways, railroads, navigable waterways and walls supporting fill sections or excavations immediately adjacent to functioning roadways. Construction Affecting Public Safety may also apply to the construction or demolition of a bridge with continuous beams or girders if traffic is being placed under one of the spans within the unit. It does not apply to those areas of the site outside the limits of normal public access. Adjacent as used above applies to any project or property where normal construction operations could impact functioning vehicular roadways, pedestrian walkways, railroads, and navigable waterways.

3. Contractor Originated Designs: Items which the Contract Documents require the Contractor to design, detail and incorporate into the permanent works.

4. Detailer: The steel detailer that prepares the steel shop drawings for the fabrication, geometry and fit-up for all steel members in accordance with the Plans.

5. Falsework: Any temporary construction work used to support the permanent structure until it becomes self-supporting. Falsework includes steel or timber beams, girders, columns, bracing, piles and foundations, and any proprietary equipment including modular shoring frames, post shores, and adjustable horizontal shoring.

6. Formwork: Any structure or mold used to retain plastic or fluid concrete in its designated shape until it hardens. Formwork may be comprised of common materials such as wood or metal sheets, battens, soldiers and walers, ties, proprietary forming systems such as stay-in-place metal forms, and proprietary supporting bolts, hangers and brackets. Formwork may be either permanent formwork requiring a shop drawing submittal such as stay-in-place metal or concrete forms or may be temporary formwork which requires certification by the Specialty Engineer for Construction Affecting Public Safety and for Major and Unusual Structures.

7. Major and Unusual Structures: Bridges of complex design. Generally, this includes the following types of structures:

a. Bridges with an individual span longer than 300 feet.
b. Structurally continuous superstructures with spans over 150 feet.
c. Steel box and plate girder bridges.
d. Concrete or steel straddle piers and straddle pier caps.
e. Steel truss bridges including proprietary pedestrian steel truss spans ~~that utilize proprietary designs~~not satisfying the Category 1 conditions of FDOT Design Manual 266.4.

f. Concrete segmental, post-tensioned girder bridges and post-tensioned substructures.

g. Cable stayed, extradosed or suspension bridges.

h. Arch bridges.

i. Tunnels.

j. All movable bridges (including specifically structural, electrical and mechanical components).

k. Rehabilitation, widening, lengthening or jacking of any of the above structures.

8. Permanent Works: All the permanent structures and parts thereof required of the completed Contract.

9. QA/QC Shop Drawing Check Prints: The Engineer of Record is responsible for conducting a review of all shop drawings regardless of whether the shop drawing is originated by the Engineer of Record or by others. QA/QC Shop Drawing Check Prints shall consist of highlighting items that the EOR is able to verify based on the EOR's plans and design information on each sheet reviewed. Each sheet shall be initialed by the reviewer. QA/QC Shop Drawing Check Prints shall be submitted to the Department along with the stamped Shop Drawing.

10. Scaffolding: An elevated work platform used to support workers, materials and equipment, but not intended to support the structure.

11. Shop Drawings: A shop drawing is a drawing or set of drawings produced by the contractor, supplier, manufacturer, subcontractor, or fabricator for prefabricated components. Shop drawings also include all working drawings, erection plans, associated trade literature, material cut-sheets, calculations, schedules, erection manuals, geometry control manuals and other manuals and similar documents submitted by the Contractor to define some portion of the project work. The type of work includes both permanent and temporary works as appropriate to the project.

12. Shoring: A component of falsework such as horizontal, vertical or inclined support members. In this Section, this term is interchangeable with falsework.

13. Special Erection Equipment: Includes launching gantries, beam and winch equipment, form travelers, segment lifters, beam shifters, erection trusses, launching noses or similar items made purposely for construction of the structure. It does not apply to commonly available proprietary construction equipment such as cranes.

14. Temporary Works: Any temporary construction work necessary for the construction of the permanent works. This includes but is not limited to bracing, falsework, formwork, scaffolding, shoring, stability towers, strong-backs, counterweights, temporary earthworks, sheeting, cofferdams, and special erection equipment.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 8, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **008**
Proposed Specification: **0080703 Prosecution and Progress.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Olivia Townsend from the State Construction Office to add provisions for extension of contract time for delays to work operations in the railroad right of way due to lack of railroad protective services.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PROSECUTION AND PROGRESS
(REV 8-24-22)

SUBARTICLE 8-7.3 is deleted and the following substituted:

8-7.3 Adjusting Contract Time:

8-7.3.1 Increased Work: The Department may grant an extension of Contract Time when it increases the Contract amount due to overruns in original Contract items, adds new work items, or provides for unforeseen work. The Department will base the consideration for granting an extension of Contract Time on the extent that the time normally required to complete the additional designated work delays the Contract completion schedule.

8-7.3.2 Contract Time Extensions: The Department may grant an extension of Contract Time when a controlling item of work is delayed by factors not reasonably anticipated or foreseeable at the time of bid. The Department may allow such extension of time only for delays occurring during the Contract Time period or authorized extensions of the Contract Time period. When failure by the Department to fulfill an obligation under the Contract results in delays to the controlling items of work, the Department will consider such delays as a basis for granting a time extension to the Contract.

Whenever the Engineer suspends the Contractor's operations, as provided in 8-6, for reasons other than the fault of the Contractor, the Engineer will grant a time extension for any delay to a controlling item of work due to such suspension. The Department will not grant time extensions to the Contract for delays due to the fault or negligence of the Contractor.

The Department does not include an allowance for delays caused by the effects of inclement weather or suspension of Contractor's operations as defined in 8-6.4, in establishing Contract Time. The Engineer will continually monitor the effects of weather and, when found justified, grant time extensions on either a bimonthly or monthly basis. The Engineer will not require the Contractor to submit a request for additional time due to the effects of weather.

The Department will grant time extensions, on a day for day basis, for delays caused by the effects of rains or other inclement weather conditions, related adverse soil conditions or suspension of operations as defined in 8-6.4 that prevent the Contractor from productively performing controlling items of work resulting in:

1. The Contractor being unable to work at least 50% of the normal work day on pre-determined controlling work items; or
2. The Contractor must make major repairs to work damaged by weather, provided that the damage is not attributable to the Contractor's failure to perform or neglect; and provided that the Contractor was unable to work at least 50% of the normal workday on pre-determined controlling work items.

When the Department grants a time extension due to rains or other inclement weather, the Contractor shall submit any objection to the additional time in writing within ten calendar days from receipt of written notice from the Engineer. Failure to submit a written appeal within ten calendar days from receipt of the written notice shall constitute a waiver of any and all rights to appeal the Department's decision at a later time.

No additional compensation will be made for delays caused by the effects of inclement weather.

The Department will consider the delays in delivery of materials or component equipment that affect progress on a controlling item of work as a basis for granting a time extension if such delays are beyond the control of the Contractor or supplier. Such delays may include an area-wide shortage, an industry-wide strike, or a natural disaster that affects all feasible sources of supply. In such cases, the Contractor shall submit substantiating letters from a representative number of manufacturers of such materials or equipment clearly confirming that the delays in delivery were the result of an area-wide shortage, an industry-wide strike, etc. No additional compensation will be made for delays caused by delivery of materials or component equipment.

The Department will not consider requests for time extension due to delay in the delivery of custom manufactured equipment such as traffic signal equipment, highway lighting equipment, etc., unless the Contractor submits documentation that he placed the order for such equipment in a timely manner, the delay was caused by factors beyond the manufacturer's control, and the lack of such equipment caused a delay in progress on a controlling item of work. No additional compensation will be paid for delays caused by delivery of custom manufactured equipment.

The Department will consider the effect of utility relocation and adjustment work on job progress as the basis for granting a time extension only if all the following criteria are met:

1. Delays are the result of either utility work that was not detailed in the Plans, or utility work that was detailed in the Plans but was not accomplished in reasonably close accordance with the schedule included in the Contract Documents.

2. Utility work actually affected progress toward completion of controlling work items.

3. The Contractor took all reasonable measures to minimize the effect of utility work on job progress, including cooperative scheduling of the Contractor's operations with the scheduled utility work at the preconstruction conference and providing adequate advance notification to utility companies as to the dates to coordinate their operations with the Contractor's operations to avoid delays.

The Department will consider requests for time extension due to delay in work operations within the limits of the railroad right-of-way, the adjoining 15 feet, or determined by the Railroad or Department to be able to potentially foul the tracks regardless of distance from railroad right-of-way on job progress as the basis for granting a time extension only if all the following criteria are met:

1. Delays are due to a lack of availability of Railroad protective services as required by 7-11.4.

2. Work within the limits of the railroad right-of-way or the adjoining 15 feet actually impacted progress toward completion of controlling work items.

3. The Contractor took all reasonable measures to minimize the effect of work operations within the limits of the railroad right-of-way or the adjoining 15 feet on job progress, including compliance with all provisions of 7-11.4 and 5-12, and cooperative scheduling of the Contractor's operations.

As a condition precedent to an extension of Contract Time the Contractor must submit to the Engineer:

A preliminary request for an extension of Contract Time must be submitted in writing to the Engineer within ten calendar days after the commencement of a delay

to a controlling item of work. If the Contractor fails to submit this required preliminary request for an extension of Contract Time, the Contractor fully, completely, absolutely and irrevocably waives any entitlement to an extension of Contract Time for that delay. In the case of a continuing delay only a single preliminary request for an extension of Contract Time will be required. Each such preliminary request for an extension of Contract Time shall include as a minimum the commencement date of the delay, the cause of the delay, and the controlling item of work affected by the delay.

Furthermore, the Contractor must submit to the Engineer a request for a Contract Time extension in writing within 30 days after the elimination of the delay to the controlling item of work identified in the preliminary request for an extension of Contract Time. Each request for a Contract Time extension shall include as a minimum all documentation that the Contractor wishes the Department to consider related to the delay, and the exact number of days requested to be added to Contract Time. If the Contractor contends that the delay is compensable, then the Contractor shall also be required to submit with the request for a Contract Time extension a detailed cost analysis of the requested additional compensation. If the Contractor fails to submit this required request for a Contract Time extension, with or without a detailed cost analysis, depriving the Engineer of the timely opportunity to verify the delay and the costs of the delay, the Contractor waives any entitlement to an extension of Contract Time or additional compensation for the delay.

Upon timely receipt of the preliminary request of Contract Time from the Contractor, the Engineer will investigate the conditions, and if it is determined that a controlling item of work is being delayed for reasons beyond the control of the Contractor the Engineer will take appropriate action to mitigate the delay and the costs of the delay. Upon timely receipt of the request for a Contract Time extension the Engineer will further investigate the conditions, and if it is determined that there was an increase in the time or the cost of performance of the controlling item of work beyond the control of the Contractor, then an adjustment of Contract Time will be made, and a monetary adjustment will be made, excluding loss of anticipated profits, and the Contract will be modified in writing accordingly.

The existence of an accepted schedule, including any required update(s), as stated in 8-3.2, is a condition precedent to the Contractor having any right to the granting of an extension of Contract Time or any monetary compensation arising out of any delay. Contractor failure to have an accepted schedule, including any required update(s), for the period of potential impact, or in the event the currently accepted schedule and applicable updates do not accurately reflect the actual status of the project or fail to accurately show the true controlling or non-controlling work activities for the period of potential impact, will result in any entitlement determination as to time or money for such period of potential impact being limited solely to the Department’s analysis and identification of the actual controlling or non-controlling work activities. Further, in such instances, the Department’s determination as to entitlement as to either time or compensability will be final, unless the Contractor can prove by clear and convincing evidence to a Disputes Review Board that the Department’s determination was without any reasonable factual basis.

FDOT
Florida Department of Transportation
RON DESANTIS
GOVERNOR
605 Suwannee Street
Tallahassee, FL 32399-0450
JARED W. PERDUE, P.E.
SECRETARY

September 27, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: 008
Proposed Specification: **0081000 Prosecution and Progress.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Taylor Carlquist to comply with F.S. 337.18, the Department shall update the schedule of liquated damages at least once every 2 years.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PROSECUTION AND PROGRESS
(REV 6-30-22)

ARTICLE 8-10 is deleted and the following is substituted:

8-10 Liquidated Damages for Failure to Complete the Work.

8-10.1 Highway Code Requirements Pertaining to Liquidated Damages: Section 337.18, paragraph (2) of the Florida Statutes, requires that the Department adopt regulations for the determination of default and provides that the Contractor pay liquidated damages to the Department for any failure of the Contractor to complete the Contract work within the Contract Time. These Code requirements govern, and are herewith made a part of the Contract.

8-10.2 Amount of Liquidated Damages: Applicable liquidated damages are the amounts established in the following schedule:

Original Contract Amount	Daily Charge Per Calendar Day
$299,999~~50,000~~ and under	$980~~868~~
~~Over~~ $305~~0~~,000 but less than $2,005~~0~~,000	$1,699~~882~~
$2,00~~5~~0,000 but less than $5,000,000	$2,650~~1,197~~
$5,000,000 but less than $10~~2~~,0~~5~~00,000	$3,819~~1,694~~
$10~~2~~,~~5~~000,000 but less than $~~5~~20,000,000	$4,687~~2,592~~
$20~~5~~,000,000 but less than $~~4~~10,000,000	$7,625~~3,786~~
~~$10,000,000 but less than $15,000,000~~	~~$4,769~~
~~$15,000,000 but less than $20,000,000~~	~~$5,855~~
$~~4~~20,000,000 and over	$10,467~~9,214~~ plus 0.00005 of any amount over $~~4~~20 million (Round to nearest whole dollar)

The Engineer may approve adjustments to the liquidated damages amounts in accordance with the Construction Project Administration Manual (CPAM) provided all contract work is complete.

8-10.3 Determination of Number of Days of Default: For all contracts, regardless of whether the Contract Time is stipulated in calendar days or working days, the Engineer will count default days in calendar days.

8-10.4 Conditions under which Liquidated Damages are Imposed: If the Contractor or, in case of his default, the surety fails to complete the work within the time stipulated in the Contract, or within such extra time that the Department may have granted then the Contractor or, in case of his default, the surety shall pay to the Department, not as a penalty, but as liquidated damages, the amount so due as determined by the Code requirements, as provided in 8-10.2.

8-10.5 Right of Collection: The Department has the right to apply, as payment on such liquidated damages, any money the Department owes the Contractor.

8-10.6 Allowing Contractor to Finish Work: The Department does not waive its right to liquidated damages due under the Contract by allowing the Contractor to continue and to finish the work, or any part of it, after the expiration of the Contract Time.

8-10.7 Completion of Work by Department: In the case of a default of the Contract and the completion of the work by the Department, the Contractor and his surety are liable for the

liquidated damages under the Contract, but the Department will not charge liquidated damages for any delay in the final completion of the Department's performance of the work due to any unreasonable action or delay on the part of the Department.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 27, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: 008
Proposed Specification: **0081000DB Prosecution and Progress.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Design Build Supplemental Specification.

The changes are proposed by Taylor Carlquist to comply with F.S. 337.18, the Department shall update the schedule of liquated damages at least once every 2 years.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PROSECUTION AND PROGRESS
(REV 7-7-22)

ARTICLE 8-10 is deleted and the following substituted:

8-10 Liquidated Damages for Failure to Complete the Work.

8-10.1 Highway Code Requirements Pertaining to Liquidated Damages: Section 337.18, paragraph (2) of the Florida Statutes, requires that the Department adopt regulations for the determination of default and provides that the Contractor pay liquidated damages to the Department for any failure of the Contractor to complete the Contract work within the Contract Time. These Code requirements govern, and are herewith made a part of the Contract.

8-10.2 Amount of Liquidated Damages: Applicable liquidated damages are the amounts established in the following schedule:

Original Contract Amount	Daily Charge Per Calendar Day
$299,999~~50,000~~ and under	$~~1,015~~980
~~Over~~ $~~50,000~~300,000 but less than $~~250,000~~2,000,000	$~~1,045~~1,699
$~~250,000~~2,000,000 but less than $5,000,000	$~~1,170~~2,650
$5,000,000 but less than $~~2,500,000~~10,000,000	$~~1,690~~3,819
~~$2,500,000 but less than $5,000,000~~	~~$2,579~~
~~$5,000,000 but less than $10,000,000~~	~~$3,756~~
$10,000,000 but less than $20~~15~~,000,000	$~~4,344~~4,687
$20~~15~~,000,000 but less than $40~~20~~,000,000	$~~5,574~~7,625
$4~~2~~0,000,000 and over	$10~~,203~~,467 plus 0.00005 of any amount over $4~~2~~0 million (Round to nearest whole dollar)

8-10.3 Determination of Number of Days of Default: For all Contracts, regardless of whether the Contract Time is stipulated in calendar days or working days, the Engineer will count default days in calendar days.

8-10.4 Conditions under which Liquidated Damages are Imposed: If the Contractor or, in case of his default, the surety fails to complete the work within the time stipulated in the Contract, or within such extra time that the Department may have granted then the Contractor or, in case of his default, the surety shall pay to the Department, not as a penalty, but as liquidated damages, the amount so due as determined by the Code requirements, as provided in 8-10.2.

8-10.5 Right of Collection: The Department has the right to apply, as payment on such liquidated damages, any money the Department owes the Contractor.

8-10.6 Allowing Contractor to Finish Work: The Department does not waive its right to liquidated damages due under the Contract by allowing the Contractor to continue and to finish the work, or any part of it, after the expiration of the Contract Time.

8-10.7 Completion of Work by Department: In the case of a default of the Contract and the completion of the work by the Department, the Contractor and his surety are liable for the liquidated damages under the Contract, but the Department will not charge liquidated damages for any delay in the final completion of the Department's performance of the work due to any unreasonable action or delay on the part of the Department.

FDOT

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 27, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **102**
Proposed Specification: **REVISED 1020100 Maintenance of Traffic.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by James McGinnis from the Office of Roadway Design to update the language to provide clarification. The revision is associated with spec revision 9900200 Temporary Traffic Control Device Materials.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

MAINTENANCE OF TRAFFIC.
(REV 910-1527-22)

Section 102 is deleted and the following substituted:

102-1 Description.

Maintain traffic within the limits of the project for the duration of the construction period, including any temporary suspensions of the work. Construct and maintain detours. Provide facilities for access to residences, businesses, etc., along the project. Furnish, install and maintain traffic control and safety devices during construction. Furnish and install work zone pavement markings for maintenance of traffic (MOT) in construction areas. Provide any other special requirements for safe and expeditious movement of traffic specified in the Temporary Traffic Control Plans. MOT includes all facilities, devices and operations as required for safety and convenience of the public within the work zone.

Do not maintain traffic over those portions of the project where no work is to be accomplished or where construction operations will not affect existing roads. Do not obstruct or create a hazard to any traffic during the performance of the work, and repair any damage to existing pavement open to traffic.

102-2 Materials.

Meet the following requirements:

Raised Pavement Marker Adhesive*	Section 706970
Temporary Raised Pavement Markers	Section 990
Paint*	Section 710971
Pavement Marking Materials*	Section 971
Temporary Raised Pavement Markers*	Section 990
Removable Tape	Section 990
Glass Spheres	Section 971
Temporary Traffic Control Device Materials*	Section 990
Retroreflective and Nonreflective Sheeting for Temporary Traffic Control Devices*	Section 994

* Use products listed on the Department's APL.

102-2.1 Temporary Traffic Control Devices: Use only the materials meeting the requirements of Section 990, Section 994, Standard Plans and the Manual on Uniform Traffic Control Devices (MUTCD).

102-2.2 Detour: Provide all materials for the construction and maintenance of all detours.

102-2.3 Commercial Materials for Driveway Maintenance: Provide materials of the type typically used for base, including reclaimed asphalt pavement (RAP) material, and having stability and drainage properties that will provide a firm surface under wet conditions.

102-3 Specific Requirements.

102-3.1 Beginning Date of Contractor's Responsibility: Maintain traffic starting the day work begins on the project or on the first day Contract Time is charged, whichever is earlier.

102-3.2 Worksite Traffic Supervisor: Provide a Worksite Traffic Supervisor who is responsible for initiating, installing, and maintaining all temporary traffic control devices as described in this Section and the Contract Documents. Provide all equipment and materials needed to set up, take down, and maintain temporary traffic control, and handle traffic-related situations. Use approved alternate Worksite Traffic Supervisors when necessary.

The Worksite Traffic Supervisor must meet the personnel qualifications specified in Section 105.

The Worksite Traffic Supervisor is to perform the following duties:

1. On site direction of all temporary traffic control on the project.
2. Is on site during all set up and take down, and performs a drive through inspection immediately after set up.
3. Is on site during all nighttime operations ensuring proper temporary traffic control.
4. Immediately corrects all safety deficiencies and corrects minor deficiencies that are not immediate safety hazards within 24 hours.
5. Is available on a 24 hour per day basis and present at the site within 45 minutes after notification of an emergency situation and is prepared to respond to maintain temporary traffic control or to provide alternate traffic arrangements.
6. Conducts daily daytime and weekly nighttime inspections of projects with predominately daytime work activities, and daily nighttime and weekly daytime inspections of projects with predominantly nighttime work activities of all traffic control devices, traffic flow, pedestrian, bicyclist, and business accommodations.

Advise the project personnel of the schedule of these inspections and give them the opportunity to join in the inspection as deemed necessary.

The Department may disqualify and remove from the project a Worksite Traffic Supervisor who fails to comply with the provisions of this Section. The Department may temporarily suspend all activities, except traffic, erosion control and such other activities that are necessary for project maintenance and safety, for failure to comply with these provisions.

102-3.3 Lane Closures: Approval for all lane closures, mobile operations, and traffic pacing operations is required. Submit routine requests to the Engineer 14 ~~fourteen~~ calendar days in advance of planned lane closures, mobile operations, and traffic pacing operations. For unforeseen events that require cancelling or rescheduling lane closures, mobile operations, and traffic pacing operations, revise the lane closure request as soon as possible.

102-3.3.1 Traffic Pacing: In addition to dates and locations, include a pacing plan outlining the expected equipment and number of traffic control officers required, the proposed traffic pacing lengths and durations, the available existing egresses in the event of an emergency, and a contingency plan in the event of an equipment failure.

102-3.4 Pedestrian and Bicycle Accommodations: Provide accommodations for pedestrians as shown in the Temporary Traffic Control (TTC) plans or as directed by the Engineer. Accommodate pedestrians with a safe, accessible travel path around work sites separated from mainline traffic in compliance with the Americans with Disabilities Act (ADA) Standards for Transportation Facilities (i.e., stable, firm, slip-resistant, and free of any obstruction or hazards such as holes, debris, mud, construction equipment, and stored material. When a work operation requires a sidewalk or pedestrian way closure for ~~-~~60 minutes or greater, provide a pedestrian detour or temporary pedestrian way. Provide and maintain pedestrian detours and temporary pedestrian ways that are ADA-compliant as described above~~-~~.

Provide appropriate signs for advanced notification of sidewalk closures and marked detours. Only approved pedestrian longitudinal channelizing devices may be used to close or delineate a pedestrian walkway.

Provide accommodations for the closure of bicycle facilities (i.e., marked bicycle lanes or paved outside shoulders 4 feet or greater in width on non-limited access roadways) as shown in the TTC plans or as directed by the Engineer.

Existing businesses in work areas are to be provided with adequate entrances for vehicular and pedestrian traffic during business hours.

102-4 Alternative Temporary Traffic Control Plan.

The Contractor may propose an alternative Temporary Ttraffic Ceontrol Pplan (TTCP) to the plan presented in the Contract Documents. The Contractor's Engineer of Record must sign and seal the alternative TTCPplan and submit to the Engineer. Prepare the alternative TTCP in conformance with and in the form outlined in the current version of the FDOT Design Manual. Indicate in the plan Provide a TTCP foreach phase of activities. Take responsibility for identifying and assessing any potential impacts to a utility that may be caused by the alternate TTCP proposed by the Contractor, and notify the Department in writing of any such potential impacts to utilities.

For projects with nighttime lane closure restrictions where paving is expected to extend into the winter months, the Contractor may propose an alternative TTCP allowing for daytime lane closures for friction course paving. The alternative TTCP must be a lane closure analysis based on actual traffic counts and prepared in accordance with the FDOT Design Manual.

The Engineer's approval of the alternate TTCP does not relieve the Contractor of sole responsibility for all utility impacts, costs, delays or damages, whether direct or indirect, resulting from Contractor initiated changes in the design or construction activities from those in the original Contract Specifications, Design Plans (including TCPs) or other Contract Documents and which effect a change in utility work different from that shown in the Utility Plans, joint project agreements or utility relocation schedules.

The Department reserves the right to reject any alternative TTCP. Obtain the Engineer's written approval before beginning work using an alternativete TTCP. The Engineer's written approval is required for all modifications to the alternative TTCP. The Engineer will only allow changes to the TTCP in an emergency without the proper documentation.

The Contractor may propose to extend lane closure times up to one hour in advance of the lane closure start times shown in the Plans for the following conditions:

1. Limited Access roadways with a traffic count of less than 1,300 vehicles per hour per lane
2. Arterials and Collector roadways with a traffic count of less than 1,550 vehicles per hour per lane.

To determine traffic count, record the number of vehicles in the direction of the closure during a 15-minute period. Multiply the number of vehicles by four and divide by the number of lanes in the direction of the closure.

102-5 Traffic Control.

102-5.1 MUTCD: Comply with the requirements in Part 6 of the MUTCD.

102-5.21 Standards:Temporary Traffic Control Plan: The Temporary Traffic Control Plan (TTCP) is the portion of the Plans describing the measures to be used for conveying road users through the work zone. Use the TTCP to maintain traffic for the duration of the work.

For situations or field conditions not addressed by the TTCP follow the Standard Plans. For all other applications, comply with the MUTCD and Standard Plans, Index 102-600. Device location or the number of devices, may be adjusted as recommended by the Work Zone Traffic Supervisor and approved by the Engineer.

~~FDOT Standard Plans are the minimum standards for the use in the development of all TCPs. The MUTCD, Part VI is the minimum national standard for traffic control for highway construction, maintenance, and utility operations. Follow the basic principles and minimum standards contained in these documents for the design, application, installation, maintenance, and removal of all traffic control devices, warning devices and barriers which are necessary to protect the public and workers from hazards within the project limits.~~

102-5.~~2~~3 Maintenance of Roadway Surfaces: Maintain all lanes that are being used for the MOT, including those on detours and temporary facilities, under all weather conditions. Keep the lanes reasonably free of dust, potholes and rutting. Provide the lanes with the drainage facilities necessary to maintain a smooth riding surface under all weather conditions.

102-5.~~3~~4 Number of Traffic Lanes: Maintain one lane of traffic in each direction. Maintain two lanes of traffic in each direction at existing four (or more) lane cross roads, where necessary to avoid undue traffic congestion. Do not allow traffic control and warning devices to encroach on lanes used for MOT.

The Engineer may allow the Contractor to restrict traffic to one-way operation for short periods of time provided that the Contractor employs adequate means of traffic control and does not unreasonably delay traffic. When a construction activity requires restricting traffic to one-way operations, locate the flaggers within view of each other when possible. When visual contact between flaggers is not possible, equip them with 2-way radios, official, or pilot vehicles, or use traffic signals.

102-5.~~4~~5 Crossings and Intersections: Provide and maintain adequate accommodations for intersecting and crossing traffic. Provide signing for the control of traffic entering and leaving work zones by way of intersecting crossroads to make drivers aware of work zone conditions. Do not block or unduly restrict any median opening, road or street crossing the project unless approved by the Engineer. Before beginning any construction, submit to the Engineer the names and phone numbers of persons that can be contacted when signal operation malfunctions.

102-5.~~5~~6 Access for Residences and Businesses: Provide continuous access to all residences and all places of business.

102-5.~~6~~7 Protection of the Work from Damage~~Injury~~ by Traffic: Where traffic would damage~~be injurious to~~ a base course, surface course, or structure constructed as a part of the work, control~~maintain~~ all traffic to remain outside the limits of such areas until the potential for damage ~~injury~~ no longer exists.

102-5.~~7~~8 Flagger: Provide flaggers to control traffic when traffic in both directions must use a single lane and in other situations as required.

102-5.~~8~~9 Conflicting Pavement Markings: Remove all existing pavement markings (paint, tape, thermoplastic, raised pavement markers, etc.) that conflict with temporary paths of vehicles, bicycles or pedestrians when the conflict will exceed 24 hours. Use any method, other than paint or sprayed asphalt, approved by the Engineer to remove existing pavement markings. Remove conflicting pavement markings using a method that will not damage the surface texture of the pavement and which will eliminate the previous marking pattern regardless of weather and light conditions.

Remove all pavement markings that will conflict with "the next phase of operation" for vehicle, bicycle, and pedestrian paths as described above, before opening to vehicle or bicycle traffic or use by pedestrians.

Cost for removing conflicting pavement markings (paint, tape, thermoplastic, raised pavement markers, etc.) to be included in Maintenance of Traffic, lump sum.

102-5.109 Vehicle and Equipment Visibility: Equip all pickups and automobiles used on the project with a minimum of one Class 2 warning light that meets the Society of Automotive Engineers Recommended Practice SAE J595, dated November 1, 2008, or SAE J845, dated December 1, 2007, and incorporated herein by reference. Existing lights that meet SAE J845, dated March, 1992, or SAE J1318, dated April, 1986, may be used to their end of service life. The warning lights must be a high intensity amber or white rotating, flashing, oscillating or strobe light. Lights must be unobstructed by ancillary vehicle equipment such as ladders, racks or booms and be visible 360 degrees around the vehicle. If the light is obstructed, additional lights will be required. The lights must be operating when the vehicle is in a work area where a potential hazard exists, when operating at less than the average speed for the facility while performing work activities, making frequent stops or called for in the Plans or Standard Plans.

Equip all other vehicles and equipment with a minimum of 4 square feet of retroreflective sheeting or warning lights.

102-5.101 No Waiver of Liability: Conduct operations in such a manner that no undue hazard results due to the requirements of this Article. The procedures and policies described herein in no way acts as a waiver of any terms of the liability of the Contractor or his surety.

102-5.121 Work Zone Speed: Use the work zone speed in the TTCP. When field conditions warrant work zone speeds different from those in the TTCP, submit signed and sealed documentation to justify reducing the work zone speed limit to the Engineer for approval, or the Engineer may request the District Traffic Operation Engineer to investigate the need.

Sign work zone speed reductions in accordance with Standard Plans, Index 102-600 and the TTCP.

102-5.1342 Limited Access Temporary Openings: When required by the Contract Documents, **c**onstruct temporary openings in accordance with the Standard Plans. Submit a written request identifying the specific locations within the project limits to the Engineer.

Locate temporary openings in areas with adequate sight distance. Do not locate temporary openings with 1.5 miles of interchanges or within 2000 feet of the acceleration-deceleration lanes at rest areas, median openings, other access openings, or other highway service areas. Do not remove existing guardrail or barrier for temporary openings.

Use temporary pavement for the acceleration-deceleration lane surface of the temporary opening. Commercial material may be used for the driveway surface of the temporary opening. Install a gate at the limited access fence and keep the gate locked when the temporary opening is not in use.

Do not use temporary openings to transport materials to or from any other project.

Failure to comply with this Section and the Standard Plans, 102 Series shall be cause for the Engineer to terminate usage of the temporary opening. When the temporary opening is no longer needed, remove immediately and restore the area to pre-construction condition.

102-6 Detours.

102-6.1 General: Construct and maintain detour facilities wherever it becomes necessary to divert traffic, including pedestrians and bicyclists, from any existing facility, or wherever construction operations block the flow of traffic.

102-6.2 Construction: Plan, construct, and maintain detours for the safe passage of traffic in all conditions of weather. Provide the detour with all facilities necessary to meet this requirement.

~~Where pedestrian facilities are detoured, blocked or closed during the work, provide safe alternate accessible routes through or around the work zone meeting the requirements of the ADA Standards for Transportation Facilities. When temporary walkway surfaces and ramps are required to be constructed, ensure surfaces are stable, firm, slip resistant, and kept free of any obstructions and hazards such as holes, debris, mud, construction equipment and stored materials.~~ Install detectable warnings on temporary ramps in accordance with Section 522.

When the Plans call for the Department to furnish detour bridge components, construct the pile bents in accordance with the Plans, unless otherwise authorized by the Engineer.

Provide two Contractor representatives, who will be directly involved in the erection of Department-owned temporary bridging, to attend a mandatory one-day training session to be conducted at the Department's storage facility. No bridging will be released to the Contractor prior to the completion of this training.

Submit the following: company name, phone number, office address, project contact person, names of the representatives who will attend the training described above, project number, detour bridge type, bridge length, span length, location and usage time frames, to the Engineer at least 30 calendar days before the intended pick-up date, to obtain the storage facility location and list of components for the project. Upon receipt, the Engineer will, within 10 calendar days submit an approved material list to the Contractor and the appropriate Department storage yard.

Submit the name of the representative with authority to pick up components, to the Engineer at least 10 calendar days before the proposed pick-up date. The Department is not obligated to load the bridge components without this notice. Take responsibility and sign for each item loaded at the time of issuance.

Provide timber dunnage, and transport the bridge components from the designated storage facility to the job site. Unload, erect, and maintain the bridge, then dismantle the bridge and load and return the components to the designated storage facility.

Notify the Engineer in writing at least 10 calendar days before returning the components. Include in this notice the name of the Contractor's representative authorized to sign for return of the bridge components. The yard supervisor is not obligated to unload the bridge components without this notice.

The Department will provide equipment and an operator at the Department's storage facility to assist in loading and unloading the bridge components. Furnish all other labor and equipment required for loading and unloading the components.

The Department's representative will record all bridge components issued or returned on the Detour Bridge Issue and Credit Ticket. The tickets must be signed by a Department and a Contractor representative, after loading or unloading each truck to document the quantity and type of bridging issued or returned.

Bind together all bridge components to be returned in accordance with the instructions given by the storage facility. The yard supervisor will repack components that are not packed in compliance with these instructions. Upon request, written packing instructions will be made available to the Contractor, before dismantling of the bridge for return to the Department's storage facility.

Assume responsibility for any shortage or damage to the bridge components. Monies due the Contractor will be reduced at the rate of $35.00 per hour plus materials for repacking, repairs or replacement of bridge components.

The skid resistance of open steel grid decking on the detour bridge may decrease gradually after opening the bridge to traffic. The Department will furnish a pneumatic floor scabbler machine for roughening the roadway surface of the detour bridge decking. Provide an air compressor at the job site with 200 cubic feet per minute capacity, 90 psi air pressure for the power supply of the machine, and an operator. Transport the scabbler machine to and from the Department's structures shop. Repair any damage to the scabbler machine caused by operations at no expense to the Department. Perform scabbling when determined necessary by the Engineer. The Department will pay for the cost of scabbling as Unforeseeable Work in accordance with 4-4.

Return the bridge components to the designated storage facility beginning no later than 10 calendar days after the date the detour bridge is no longer needed, the date the new bridge is placed in service, or the date Contract Time expires, whichever is earliest. Return the detour bridging at an average of not less than 200 feet per week. Upon failure to return the bridge components to the Department within the time specified, compensate the Department for the bridge components not returned at the rate of $5.00 per 10 feet, per day, per bridge, for single lane; and $10.00 per 10 feet, per day, per bridge, for dual lane until the bridge components are returned to the Department.

102-6.3 Construction Methods: Select and use construction methods and materials that provide a stable and safe detour facility. Construct the detour facility to have sufficient durability to remain in good condition, supplemented by maintenance, for the entire period that the detour is required.

102-6.4 Removal of Detours: Remove detours when they are no longer needed and before the Contract is completed. Take ownership of all materials from the detour and dispose of them, except for the materials on loan from the Department with the stipulation that they are returned.

102-6.5 Detours Over Existing Roads and Streets: When the Department specifies that traffic be detoured over roads or streets outside the project area, do not maintain such roads or streets. However, maintain all signs and other devices placed for the purpose of the detour.

102-6.6 Operation of Existing Movable Bridges: The Department will maintain and operate existing moveable bridges that are to be removed by the Contractor until such time as they are closed to traffic. During this period, make immediate repairs of any damage to such structures caused by use or operations related to the work at no expense to the Department, but do not provide routine repairs or maintenance. In the event that use or operations result in damage to a bridge requiring repairs, give such repairs top priority to any equipment, material, or labor available.

102-6.7 Special Detour: A special detour is defined as a diversion or lane shift for vehicular traffic that requires temporary pavement.

102-6.8 Pedestrian or Bicycle Special Detour: A pedestrian or bicycle special detour is defined as a temporary pedestrian or bicycle way that requires temporary pavement or other stable, firm, slip-resistant surface.

102-7 Traffic Control Officer.

Provide uniformed law enforcement officers, including marked law enforcement vehicles, to assist in controlling and directing traffic in the work zone when the following types of work is necessary on projects:

1. When directing traffic/overriding the signal in a signalized intersection.
2. When nighttime mobile operations are ~~Standard Plans, Index 102-607 is~~ used on freeway facilities (interstates, toll roads, and expressways) ~~at nighttime~~ for work within the travel lane.
3. When ~~Standard Plans, Index 102-655 t~~Traffic p~~P~~acing is called for in the TTCP~~Plans~~ or approved by the Engineer.
4. When pulling conductor/cable above an open traffic lane on limited access facilities, when called for in the TTCP~~Plans~~ or approved by the Engineer.
5. When ~~Standard Plans, Index 102-625~~ a Temporary Road Closure ~~5 Minutes or Less~~ is used.
6. When performing lane closures during nighttime operations on roadways with posted speed limits 55 mph or greater.

At no additional cost to the Department, traffic control officers may be used for operations other than those listed above.

The Department will not consider any claim arising from the failure of a traffic control officer to be present or available on the project. A noncompensable time extension may be granted when a state or local emergency requires all area law enforcement officers to be on-duty and not available for hire.

102-8 Driveway Maintenance.

102-8.1 General: Ensure that each residence and business has safe, stable, and reasonable access.

102-8.2 Construction Methods: Place, level, manipulate, compact, and maintain the material, to the extent appropriate for the intended use.

As permanent driveway construction is accomplished at a particular location, the Contractor may salvage and reuse previously placed materials that are suitable for reuse on other driveways.

102-9 Temporary Traffic Control Devices.

102-9.1 General: Use only devices that are listed on the APL ~~.~~ and use in conformance with the APL drawings. Immediately remove or cover, using any method of covering approved by the Engineer, any existing or temporary devices (e.g., signs) that do not apply to current conditions.

The use of NCHRP Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features devices purchased prior to January 1, 2020 is permitted on projects let prior to January 1, 2030. All devices manufactured or purchased on or after January 1, 2020, must be MASH compliant in accordance with Section 990.

The APL number is to be permanently marked on the device at a readily visible location. Sheeting used on devices and pavement markings are exempt from this requirement.

Notify the Engineer in writing of any scheduled operation that will affect traffic patterns or safety sufficiently in advance of commencing such operation to permit review of the plan for the proposed installation of temporary traffic control devices.

Assign an employee the responsibility of maintaining the position and condition of all temporary traffic control devices throughout the duration of the Contract. Keep the Engineer advised at all times of the identification and means of contacting this employee on a 24-hour basis.

Maintain temporary traffic control devices in the correct position, properly oriented, clearly visible and clean, at all times. All applicable temporary traffic control devices must meet the classification category of Acceptable as defined in the American Traffic Safety Services Association (ATSSA) Quality Guidelines for Temporary Traffic Control Devices and Features. Temporary concrete barriers must meet the classification category of Acceptable defined in the Department's Temporary Concrete Barrier Evaluation Guide, which may be viewed at the following URL: https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/programmanagement/implemented/urlinspecs/files/docs/default-source/content-docs/programmanagement/implemented/urlinspecs/files/temporaryconcretebarrierguide.pdf.pdf?sfvrsn=343b4c97_10. Pedestrian Llongitudinal Cchannelizing Ddevices (LCDs) must meet the classification category of Acceptable as defined in the Pedestrian LCD Evaluation Guide, which may be viewed at the following URL: https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/programmanagement/implemented/urlinspecs/files/lcdevaluationguide.pdf?sfvrsn=166e0f16_2. Immediately repair, replace or clean damaged, defaced or dirty devices. Traffic control devices must not be cleaned while installed/used. Use of warning lights on any temporary traffic control device is prohibited, with the exception of the trailer mounted portable regulatory signs.

Employ an approved independent Channelizing Device Supplier (CDS) to provide and maintain the condition of the following non-fixed channelizing devices: drums, cones, vertical panels, barricades, temporary tubular markers, and pedestrian longitudinal channelizing devices. Cones may be provided and maintained by the Contractor.

The CDS shall not be affiliated with the Contractor and must be approved by the Department. Department approved CDSs are listed on the State Construction Office website. CDSs seeking inclusion on the list must meet the requirements of 102-9.1.1. The CDS shall submit a monthly certification on letterhead that the channelizing devices mentioned above installed/used within the work zone meet classification category of Acceptable as defined in the Pedestrian LCD Evaluation Guide and the ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features. The CDS shall submit the monthly certification on letterhead for channelizing devices installed/used within the work zone. The CDS certification shall include the following statement, "I certify that I have provided and maintained the following devices <list devices covered under the certification> in accordance with Pedestrian LCD Evaluation Guide and the ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features." If the Contractor chooses to provide and maintain cones, the Contractor must submit a monthly Contractor certification on letterhead that all cones installed/used within the work zone meet acceptable standards as outlined in the ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features. The Contractor certification shall include the following statement, "I certify that I have provided and maintained cones in accordance with the ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features."

102-9.1.1 Approved Independent Channelizing Device Supplier (CDS) Requirements: Submit the following documents to the State Construction Office for review and approval

1. A letter on company letterhead signed and dated by the owner of the company or company officer with the following information and statements:

a. The company's owners, stockholders, and officers.

b. A statement declaring that the company will not perform as a CDS on any project where there is common ownership, directly or indirectly, between the company and the Contractor.

c. A statement declaring that the company will furnish and maintain the condition of all channelizing devices with the exception of cones as required in 102-9.1 with its own forces.

d. A statement declaring at least five years of experience in providing channelizing device supplier services, with its own inventory of channelizing devices.

e. On a separate sheet, list a sample project history of the company's experience as a channelizing device supplier for the five years declared in item 1(d) above including the following information:

1. Project name and number and a brief description of CDS work performed,
2. Beginning and ending date of CDS project activities,
3. Location of project (city, state),
4. Monetary amount of CDS work on project,
5. Owner of project, contact person and phone number with area code,
6. Name of Contractor (client) that the work was performed for and phone number with area code.

2. A maintenance plan for approval by the Department that outlines the frequency and methods for maintaining the condition of all channelizing devices, except cones owned and maintained by the Contractor, installed/used in the work zone.

102-9.2 Work Zone Signs: ~~Furnish, install, maintain, remove and relocate signs in~~ Use work zone signs in accordance with the TTCP~~Plans~~ and Standard Plans~~, Index 102-600~~.

102-9.2.1 Post Mounted Signs: Meet the requirements of 990-8.

102-9.2.2 Portable Signs: Portable signs may be used when the work zone condition will be in place for 24 hours or less, or as approved by the Engineer.~~Use only approved systems, which includes sign stands and attachment hardware (nuts, bolts, clamps, brackets, braces, etc.), meeting the vendor requirements specified on the APL drawings~~.

102-9.2.3 Barrier~~-~~ Mounted Signs: If post mounting criteria cannot be achieved ~~in accordance with Standard Plans, Index 102-600~~ and a barrier or traffic railing exists, attach work zone signs to barrier or traffic railing in accordance with the Standard Plans~~use temporary sign criteria provided in Standard Plans, Index 700-012 or Index 700-013~~. Use Standard Plans, Index 700-012 only when mounting the sign to the top of the barrier or traffic railing places the sign panel closer than two feet from the traveled way.

102-9.3 Business Signs: Use business ~~Provide and place~~ signs in accordance with the ~~Plans~~ TTCP and Standard Plans~~, Index 102 series~~. Furnish signs having retroreflective sheeting meeting the requirements of Section 990.

102-9.4 Channelizing Devices: Use~~Furnish, install, maintain, remove and relocate~~ channelizing devices in accordance with the TTCP, ~~Plans and~~ Standard Plans, and MUTCD.

102-9.4.1 ~~Retroreflective Collars for Traffic~~ Cones: Use cones in active work zones where workers are present.

Use cone collars at night designed to properly fit the taper of the cone when installed. Collars may be removeable or attached permanently. Place the upper 6-inch collar a uniform 3-1/2 inches distance from the top of the cone and the lower 4-inch collar a uniform 2 inches distance below the bottom of the upper 6-inch collar.

~~Use collars for traffic cones listed on the APL that meet the requirements of Section 990. Use cone collars at night designed to properly fit the taper of the cone when installed. Place the upper 6 inch collar a uniform 3-1/2 inches distance from the top of the cone and the lower 4 inch collar a uniform 2 inches distance below the bottom of the upper 6 inch collar.~~

~~Collars must be capable of being removed for temporary use or attached permanently to the cone in accordance with the manufacturer's recommendations. Provide a white sheeting having a smooth outer surface and that has the property of a retroreflector over its entire surface.~~

102-9.4.2 .Pedestrian Longitudinal Channelizing Devices (LCDs): Use LCDs listed on the APL for pedestrian use and meeting the requirements of Section 990 and the Standard Plans. Pedestrian LCDs must be interlocked except for the stand-alone unit placed perpendicular to a sidewalk. Ballast pedestrian LCDs as shown on the APL. ~~For pedestrian LCDs requiring internal ballasting, an indicator that clearly identifies the proper ballast level will be required. For pedestrian LCDs requiring external ballasting, the ballasting methods must be detailed in the APL drawings including ballasting type and minimum weight.~~

Ensure that joints on the pedestrian LCDs are free of sharp edges and have a maximum offset of 1/2 inch in any plane.

102-9.5 Temporary Barrier: Use~~Furnish, install, maintain, remove and relocate~~ temporary barrier in accordance with the TTCP ~~Plans~~ and Standard Plans. Obtain and use precast temporary concrete barrier from a manufacturing plant that is on the Department's Production Facility Listing. Temporary concrete barrier must meet the material and construction requirements of Section 521 unless noted otherwise in the Standard Plans. Proprietary temporary concrete, steel, or water filled barrier used must be listed on the APL.

The maximum allowable height increase between consecutive temporary barrier units in the direction of traffic is one ~~1~~ inch.

Temporary barrier must comply with Standard Plans, Index 102-100 or 102-120. Install temporary barriers as either anchored or freestanding as shown in the TTCP~~Plans~~ or the Standard Plans. An anchored unit is defined as having at least one stake or bolt into the underlying pavement or bridge deck. All other units, including those with keeper pins, are considered freestanding.

Remove temporary asphalt pads and repair all attachment scars to permanent structures and pavements after barrier removal. Make necessary repairs due to defective material, work, or Contractor operations at no cost to the Department. Restore barrier damaged by the traveling public within 24 hours after notification as authorized by the Engineer.

Trailer mounted barriers listed on the APL may be used~~-~~ in lieu of temporary barriers or positive protection at the option of the Contractor. Trailer mounted barriers listed on the APL must have an FHWA eligibility letter and be successfully crash tested in accordance with MASH TL-3 criteria. All trailer mounted barriers must be equipped with an APL listed

truck mounted attenuator, an APL listed vehicle mounted arrow board and vehicle warning lights in accordance with this Section.

102-9.5.2.1 Temporary Barrier Meeting the Requirements of Standard Plans, Index 102-120 and 102-110: Ensure the marking requirements of the respective Index are met.

102-9.56.12.21: Proprietary Precast Temporary Concrete Barrier Fabricated prior to 2005: Submit a certification stating that all unmarked barrier units meet the requirements of the Specifications and the Standard Plans. Certifications will be project specific and non-transferable.

102-9.5.12.23 Proprietary Precast Temporary Concrete Barrier Fabricated in 2005 or later: Ensure each barrier unit has permanent clear markings, showing the manufacture date, serial number, manufacturer's name or symbol, and the APL number. Label the markings on a plate, plaque, or cast in the unit. Proprietary barrier fabricated prior to 2016 and marked with the "INDX 521" in lieu of the APL number will be permitted.

102-9.5.21.43 Temporary Concrete Barrier Repair: Before beginning the repair, remove all laitance, loose material, and any other deleterious matter to sound concrete or a minimum depth of one inch. Additionally, when reinforcing bars, inserts or weldments are exposed, remove the concrete to provide a minimum one-inch clearance all around. Fill the repair area with an approved high performance concrete repair material in accordance with 930-5 and the manufacturer's recommendations. Restore surfaces and edges to the original dimensions and shape of the barrier.

Repairs are not allowed on barrier units that have one or more of the following deficiencies: structural cracking or cracks that exist through the entire cross-section; unit-to-unit connection assemblies or anchor slots are broken or no longer in a fixed position.

Do not paint repaired barriers.

102-9.6 Barrier Delineators: UseInstall barrier delineators on top of temporary barriers and vehicular LCDs in accordance with the Standard Plans and meeting the requirements of Section 705.

102-9.7 Temporary Glare Screen: Use temporary glare screens listed on the APL that meet the requirements of Section 990. Furnish, install, maintain, remove and relocate glare Use screen systems in conjunction with temporary barrier at locations identified in the Plans.

The anchorage of the glare screen to the barrier must be capable of safely resisting an equivalent tensile load of 600 pounds per foot of glare screen, with a requirement to use a minimum of three fasteners per barrier section.

When glare screen is utilized on temporary barrier, barrier delineators will not be required.

102-9.8 Temporary Crash Cushion (Redirective or Gating): Furnish, install, maintain and subsequently remove Use temporary crash cushions in accordance with the details and notes shown in the TTCP Plans, Standard Plans, and requirements of the pre-approved alternatives listed on the APL.

Temporary crash cushions can be either new or used functionally sound refurbished devices. Performance of intended function is the only condition for acceptance. All metallic components must be galvanized in accordance with Section 967.

Anchor abutting temporary barrier in accordance the Standard Plans or APL drawings, as required. Bidirectional installations must have a transition panel installed between the crash cushion and the abutting barrier. Delineate the crash cushion in accordance with

Section 544. Maintain the crash cushions until their authorized removal. Do not place any materials or equipment within the length of the crash cushion.

Remove temporary asphalt or concrete pads and repair all attachment scars to permanent structures and pavements after crash cushion removal. Make necessary repairs due to defective material, work, or Contractor operations at no cost to the Department. Restore crash cushions damaged by the traveling public within 24 hours after notification as authorized by the Engineer.

102-9.9 Temporary Guardrail: Use~~Furnish~~ temporary guardrail in accordance with the TTCP~~Plans~~ and Standard Plans. Install the temporary guardrail in accordance with ~~Meet~~ the ~~requirements of~~ Section 536.

102-9.10 Trailer Mounted Devices:

102-9.10.1~~2~~ Arrow Board: Use~~Furnish~~ arrow boards in accordance with the TTCP, Standard Plans, and that meet the requirements of Section 990. ~~as required by the Plans and Standard Plans to advise approaching traffic of lane closures or shoulder work.~~ Ensure that the arrow board display panel is raised to a fully upright position and is fully visible to motorists. Use Type B arrow boards ~~may be used~~ on roadways with an existing posted speed of 45 MPH or less ~~low to intermediate speed (0 mph to 50 mph) facilities or~~ for maintenance and mobile ~~or moving~~ operations on any speed facility. Use Type C arrow boards ~~must be used~~ for all other operations on roadways with an existing posted speed of 50 MPH or greater, ~~high speed (50 mph and greater) facilities~~ and may be substituted for Type B arrow boards on any speed facility.

102-9.10.3~~1~~ Portable Changeable Message Sign (PCMS): Use PCMSs or truck mounted changeable message signs in accordance with the TTCP, Standard Plans and ~~that meet the requirements of~~ Section 990 ~~as required by the Plans and Standard Plans~~ to supplement other temporary traffic control devices used in work zones. Ensure that the PCMS display panel is raised to a fully upright position and is fully visible to motorists. Reduce the intensity of the flashers when using PCMS at night. Use PCMS with a minimum letter height of 18 inches. For facilities with posted speed limits of 45 mph or less, PCMS with a minimum letter height of 12 inches may be used.

For roadways with speed limits greater than 45 mph, the message displayed on the PCMS must be unobstructed from 800 feet. For roadways with speed limits of 45 mph or less, the message displayed must be unobstructed from 650 feet.

Messages must have no more than two phases. The display time for each phase must be at least two seconds but no more than three seconds. The sum of the display time must be a maximum of six seconds.

102-9.10.4~~2~~ Portable Regulatory Signs (PRS): Use~~Furnish~~ PRSs in accordance with the TTCP, Standard Plans, and. ~~that meet the requirements of~~ Section 990. ~~as required by the Plans and Standard Plans.~~ Ensure that the PRS sign panel is raised to a fully upright position and is fully visible to motorists.

Activate portable regulatory signs only during active work activities and deactivate when no work is being performed.

102-9.10.5~~3~~ Radar Speed Display Unit (RSDU): Use ~~Furnish~~ RSDUs in accordance with the TTCP, Standard Plans and ~~that meet the requirements of~~ Section 990 ~~as required by the Plans and Standard Plans~~ to inform motorists of the posted speed and their actual speed. Ensure that the RSDU display panel is mounted in accordance with the manufacturer's recommendations.

Activate the radar speed display unit only during active work activities and deactivate when no work is being performed.

102-9.114 Temporary Signalization and Maintenance: Provide and maintain temporary signals and ~~maintain~~ signalization at existing, temporary, and new intersections including, but not limited to, the following:

1. Installation of temporary poles and span wire assemblies as shown in the TTCP~~Plans~~,
2. Temporary portable traffic signals as shown in the TTCP~~Plans~~,
3. Adding or shifting signal heads,
4. Trouble calls,
5. Maintaining intersection and coordination timing and preemption devices. Coordination timing will require maintaining functionality of system communications.

Phase and time signals in accordance with the Plans. Obtain approval from the District Traffic Operations Engineer for any timing changes that are either reoccurring or last longer than 24 -hours.

Restore any loss of operation within 12 -hours after notification. Provide alternate temporary traffic control until the signalization is restored.

Provide temporary pedestrian signalization in accordance with the TTCP, and maintain pedestrian signalization at existing, temporary, and new intersections.

Provide traffic signal equipment that meets the requirements of the Standard Plans and 603-2. The Engineer may approve used signal equipment if it is in acceptable condition. Replacement components for traffic signal cabinet assemblies will be provided by the maintaining agency.

~~**102-9.11 Portable Changeable Message Sign (PCMS):** Use PCMSs or truck mounted changeable message signs that meet the requirements of Section 990 as required by the Plans and Standard Plans to supplement other temporary traffic control devices used in work zones. Ensure that the PCMS display panel is raised to a fully upright position and is fully visible to motorists. Reduce the intensity of the flashers when using PCMS at night. Use PCMS with a minimum letter height of 18 inches. For facilities with posted speed limits of 45 mph or less, PCMS with a minimum letter height of 12 inches may be used.~~

~~For roadways with speed limits greater than 45 mph, the message displayed on the PCMS must be unobstructed from 800 feet. For roadways with speed limits of 45 mph or less, the message displayed must be unobstructed from 650 feet.~~

~~Messages must have no more than two phases. The display time for each phase must be at least two seconds but no more than three seconds. The sum of the display time must be a maximum of six seconds.~~

102-9.11.1 Temporary Signals for Lane Closures on Two-Lane, Two-Way Roadways: Temporary signals may be used, at the Contractor's option, as an alternate to flaggers for lane closure operations on two-lane, two-way roadways in accordance with Standard Plans, Index 102-606. The Contractor's Engineer of Record must provide the signal timing for the temporary signals. The District Traffic Operations Engineer must approve the installation and timing of temporary signals prior to beginning work. Adjust timing based on changing field conditions as approved by the Worksite Traffic Supervisor. Submit to the Engineer any timing changes that are reoccurring or last longer than 24 hours for District Traffic Operations Engineer's approval Temporary signals can either be portable signals or span wire signals . Provide two signal faces for each approach.

102-9.125 Temporary Traffic Detection and Maintenance: Provide temporary traffic detection and maintenance at existing, temporary, and new signalized intersections. Provide temporary traffic detection equipment listed on the APL. Restore any loss of detection within 12 hours. Ensure 90% accuracy per signal phase, measured at the initial installation and after any lane shifts, by comparing sample data collected from the detection system with ground truth data collected by human observation. Collect the sample and ground truth data for a minimum of five minutes during a peak and five minutes during an off-peak period with a minimum three detections for each signal phase. Perform the test in the presence of the Engineer.

102-9.136 Truck Mounted Attenuators and Trailer Mounted Attenuators: Furnish, operate and maintain APL listed Use truck mounted and trailer mounted attenuators in accordance with the manufacturer's recommendations and Standard Plans.

For existing posted speeds of 50 mph or greater, use either truck mounted attenuators or trailer mounted attenuators that meet TL-3 criteria. For existing posted speeds of 45 mph or less, use either truck mounted attenuators or trailer mounted attenuators that meet TL-2 or TL-3 criteria.

Attenuators will not be paid for separately. Include the cost of the truck with either a truck mounted attenuator or a trailer mounted attenuator in Maintenance of Traffic, lump sum. Payment includes all costs, including furnishing, operating maintaining and removal when no longer required, and all materials, labor, tools, equipment and incidentals required for attenuator maintenance.

102-9.147 Temporary Raised Rumble Strip Set: Use temporary raised rumble strips per the manufacturer's recommendations and in accordance with Standard Plans, Index 102-603.

The temporary raised rumble strip type may be either a removable striping type or a portable type. Use a consistent type and color throughout the work zone.

102-9.158 Automated Flagger Assistance Devices (AFAD): Furnish, install, maintain, remove, and relocate AFADs in accordance with the Plans, Standard Plans, Index 102-603, and APL vendor drawings.

Position AFADs where they are clearly visible to oncoming traffic. AFADs may be placed on the centerline if they have been successfully crash tested in accordance with MASH TL-3 criteria. A gate arm is required in accordance with Section 990 if a single AFAD is used on the shoulder to control one direction of traffic.

The devices may be operated either by a single flagger at one end of the traffic control zone, from a central location, or by a separate flagger near each device location. Use only flaggers trained in accordance with Section 105 and in the operation of the AFAD. When in use, each AFAD must be in view of, and attended at all times by, the flagger operating the device.

Provide two flaggers on-site and use one of the following methods in the deployment of AFADs:

1. Place an AFAD at each end of the temporary traffic control zone, or
2. Place an AFAD at one end of the temporary traffic control zone and a flagger at the opposite end.

A single flagger may simultaneously operate two AFADs as described in (1) or a single AFAD as described in (2) if all of the following conditions are met:

1. The flagger has an unobstructed view of the AFAD(s),
2. The flagger has an unobstructed view of approaching traffic in both directions,

3. In the event of an AFAD malfunction, restore normal flagging operations with flaggers or immediately cease the flagging operation and reopen the roadway.

AFADs may be either a remotely controlled Stop/Slow AFAD mounted on either a trailer or a movable cart system, or a remotely controlled Red/Yellow Lens AFAD.

Illuminate the flagging station when the AFAD is used at night. When the AFAD is not in use, remove or cover signs and move the AFAD device outside the clear zone or shield it with a barrier.

AFADs will not be paid for separately. AFADs may be used as a supplement or an alternate to flaggers in accordance with the Plans, Standard Plans, Index 102-603, and the APL vendor drawings. Include the cost for AFADs in Maintenance of Traffic, Lump Sum.

102-9.169 Temporary Lane Separator: ~~Furnish, install, maintain, remove and relocate~~ Use temporary lane separators (asphalt or portable) in accordance with the TTCP~~Plans~~ and Standard Plans~~, Index 102-600~~.

When using portable temporary lane separators, a~~A~~nchor the portable temporary lane separator with a removable anchor bolt. Use epoxy on bridge decks where anchoring is not allowed. Remove the epoxy from the bridge deck by hydroblasting or other method approved by the Engineer.

Repair any damage to the existing pavement caused by the removal of temporary lane separator.

102-9.1721 Type III Barricades: Use type III barricades in accordance with the TTCP and Standard Plans. Ensure stripes are sloping downward in the direction road users are to pass. Mount sign panels in accordance with the manufacturer's instructions. Do not place ballast on any rails, or higher than 13 inches above the driving surface. Do not splice the retroreflective sheeting.

102-10 Work Zone Pavement Marking.

102-10.1 Description: Furnish and install work zone pavement markings for MOT in construction areas and in close conformity with the lines and details shown in the Plans and Standard Plans.

Centerlines, lane lines, edge lines, stop bars, standard crosswalks, and turn arrows will be required in work zones prior to opening the road to traffic.

102-10.2 Painted Pavement Markings:

102-10.2.1 General: Use painted pavement markings meeting the requirements of Section 710. Use standard paint unless otherwise identified in the Plans or approved by the Engineer.

102-10.3 Removable Tape:

~~**102-10.3.1 General:** Use removable tape listed on the APL as shown in the Plans and meeting the requirements of 990-4.~~

102-10.3.12 Application: Apply removable tape with a mechanical applicator to provide pavement lines that are neat, accurate and uniform. Equip the mechanical applicator with a film cut-off device and with measuring devices that automatically and accumulatively measure the length of each line placed within an accuracy tolerance of plus or minus 2%. Ensure removable tape adheres to the road surface. Removable tape may be placed by hand on short sections, 500 feet or less, if it is done in a neat accurate manner.

102-10.3.23 Retroreflectivity: Apply white and yellow removable tape pavement markings that will attain an initial retroreflectivity of not less than 300 mcd/lx·m^2 for

white and not less than 250 mcd/lx·m^2 for yellow markings. Black portions of contrast tapes and black masking tapes must have a retroreflectance of less than 20 mcd/lx·m^2.

Measure, record and certify on the Department approved form and submit to the Engineer, the retroreflectivity of white and yellow removable tape pavement markings in accordance with FM 5-541.

102-10.3.34 Removability: Provide removable tape capable of being removed from bituminous concrete and portland cement concrete pavement intact or in substantially large strips after being in place for a minimum of 90 days, either manually or by a mechanical roll-up device, at temperatures above 40ºF, without the use of heat, solvents, grinding or blasting.

102-10.4 Temporary Raised Pavement Markers (RPMs): Use Class B RPMs except for work that consists of ground-in rumble strips at centerline locations. For ground-in rumble strips at centerline locations, use temporary RPMs in accordance with Section 710. ~~Provide only temporary RPMs listed on the APL.~~ Install all markers in accordance with the manufacturer's recommendations, the Standard Plans, and Section 706. After initial installation, replace broken or missing temporary RPMs in locations where more than three consecutive temporary RPMs are broken or missing at no expense to the Department.

102-11 Method of Measurement.

102-11.1 General: Devices installed/used on the project on any calendar day or portion thereof, within the Contract Time, including time extensions which may be granted, will be paid for at the Contract unit price for the applicable pay item. Include the cost of any work that is necessary to meet the requirements of the Contract Documents for MOT under Maintenance of Traffic, lump sum when separate payment is not provided.

102-11.2 Traffic Control Officers: The quantity to be paid for traffic control officers will be at the Contract unit price per hour (4 hour minimum) for the actual number of officers certified to be on the project site, including any law enforcement vehicles and all other direct and indirect costs. Payment will be made only for those traffic control officers specified in the Plans and authorized by the Engineer.

102-11.3 Special Detours: When a special detour is shown in the Plans, the work of constructing, maintaining, and subsequently removing such detour facilities will be paid for under Special Detour, lump sum. However, traffic control devices, warning devices, barriers, signing, pavement markings, and restoration to final configuration will be paid for under their respective pay items.

102-11.4 Commercial Material for Driveway Maintenance: The quantity to be paid for will be the certified volume, in cubic yards, of all materials authorized by the Engineer, acceptably placed and maintained for driveway maintenance. The volume, which is authorized to be reused, and which is acceptably salvaged, placed, and maintained in other designated driveways will be included again for payment. Commercial Material used for Temporary Openings will not be included for separate payment.

102-11.5 Work Zone Signs: The number of temporary post-mounted signs (temporary regulatory, warning and guide) certified as installed/used on the project will be paid for at the Contract unit price for work zone signs. When multiple signs are located on single or multiple posts, each sign panel will be paid individually. Signs greater than 20 square feet and detailed in the Plans will be paid for under Maintenance of Traffic, lump sum.

Temporary portable signs (excluding mesh signs) and vehicular mounted signs will be included for payment under work zone signs, only if used in accordance with the Standard Plans.

The number of temporary barrier mounted signs (temporary regulatory, warning and guide) certified as installed/used on the project will be paid for at the Contract unit price for barrier mounted work zone signs.

Work zone signs may be installed fourteen days prior to the start of Contract Time with the approval of the Engineer and at no additional cost to the Department.

102-11.6. Business Signs: The number of business signs certified as installed/used on the project will be paid for at the Contract unit price for business signs.

102-11.7 Channelizing Devices: The number of drums, vertical panels, and Type I, Type II, or direction indicator barricades, certified as installed/used on the project meeting the requirements of Standard Plans, Index 102-600 and have been properly maintained will be paid for at the Contract unit prices for channelizing device.

Payment for drums, vertical panels, and Type I, Type II, and direction indicator barricades will be paid per each per day.

Payment for vehicular LCDs will be paid as the length in feet installed divided by the device spacing for barricades, vertical panels, and drums and certified as installed/used on the project meeting the requirements of Standard Plans, Index 102-600 and have been properly maintained will be paid for at the Contract unit price for channelizing device.

Payment for pedestrian LCDs, certified as installed/used on the project and properly maintained, will be paid per linear foot per day. Placement of pedestrian LCDs at locations not shown in the TTCP~~Plans~~, or not authorized by the Engineer, will be at the Contractor's expense. Payment for pedestrian LCD mounted signs will be made under Work Zone Signs~~, per each per day~~.

Payment will not be made for channelizing devices unsatisfactorily maintained, as determined by the Engineer. Payment will be made for each channelizing device that is used to delineate trailer mounted devices. Payment will be made for channelizing devices delineating portable changeable message signs during the period beginning 14 working days before Contract Time begins as authorized by the Engineer.

102-11.8 Temporary Barrier: The quantity to be paid for will be the length, in feet, of freestanding units or anchored units certified as installed/used on the project. The quantity to be paid for relocating barrier will be based on the relocated installation type. No separate payment will be made for the asphalt pad. For freestanding units transitioned to a crash cushion, the cost of anchoring the transition units will be included in the cost of the temporary crash cushion in accordance with 102-11.11.

102-11.9 Barrier Delineators: No separate payment will be made for barrier delineators installed on top of temporary barrier ~~and vehicular LCDs~~. Include the cost for barrier delineators in the cost of the barrier ~~or vehicular LCD~~.

102-11.10 Temporary Glare Screen: The certified quantity to be paid for will be determined by the number of sections times the nominal length of each section.

102-11.11 Temporary Crash Cushions: No separate payment will be made for the concrete or asphalt pad.

102-11.11.1 Redirective: The quantity to be paid for will be the number of temporary crash cushions (redirective) certified as installed/used and maintained on the project, including anchoring of temporary barrier necessary for transition to the crash cushion and delineation.

102-11.11.2 Gating: The quantity to be paid for will be the number of temporary crash cushions (gating) certified as installed/used and maintained on the project, including anchoring of temporary barrier necessary for transition to the crash cushion and delineation.

102-11.12 Temporary Guardrail: The quantity to be paid for will be the length, in feet, of temporary guardrail constructed and certified as installed/used on the project. The length of a run of guardrail will be determined as a multiple of the nominal panel lengths.

102-11.13 Arrow Board: The quantity to be paid at the contract unit price will be for the number of arrow boards certified as installed/used on the project on any calendar day or portion thereof within the Contract Time.

102-11.14 Portable Changeable Message Sign: The quantity to be paid at the Contract unit price will be for the number of PCMSs or truck mounted changeable message signs certified as installed/used on the project on any calendar day or portion thereof within the Contract Time. Payment will be made for each portable changeable message sign that is used during the period beginning 14~~fourteen~~ working days before Contract Time begins as authorized by the Engineer.

102-11.15 Portable Regulatory Signs: The quantity to be paid for will be the number of portable regulatory signs certified as installed/used on the project on any calendar day or portion thereof within the Contract Time, will be paid for the Contract unit price for portable regulatory sign.

102-11.16 Radar Speed Display Unit: The quantity to be paid for will be the number of radar speed display units certified as installed/used on the project on any calendar day or portion thereof within the Contract Time, will be paid for the Contract unit price for radar speed display unit.

102-11.17 Temporary Signalization and Maintenance: For existing intersections, the certified quantity to be paid for will be the number of signalized intersections per day for the full duration of the Contract. For temporary intersections, the certified quantity to be paid for will be the number of signalized intersections per day for the duration of the temporary intersection. No separate payment will be made for temporary signalization and maintenance at new intersections.

102-11.18 Temporary Traffic Detection and Maintenance: For existing intersections, the certified quantity to be paid for will be the number of signalized intersections per day beginning the day Contract Time begins and ending on the day the permanent detection is operational and the final lane configuration is in place. For temporary and new intersections, the certified quantity to be paid for will be the number of signalized intersections per day beginning the day the temporary detection is functional and ending the day: the permanent detection is operational and the final lane configuration is in place for a new intersection; or, when the detection is removed for a temporary intersection.

102-11.19 Work Zone Pavement Markings: Painted pavement markings will be paid as specified in 710-10. The quantity of removable tape to be paid for solid, 10'-30' skip, 3'-9' dotted, 6'-10' dotted, and 2'-4' dotted lines will be the length, in gross miles, authorized and acceptably applied under this Section and certified as installed/used on the project. The quantity of removable tape to be paid for transverse lines will be the length, in linear feet, authorized and acceptably applied under this Section and certified as installed/used on the project. The quantity of removable tape to be paid for pavement messages, symbols, and arrows will be per each, authorized and acceptably applied under this Section and certified as installed/used on the project. The quantity of temporary RPMs to be paid will be the number of RPMs authorized and acceptably applied. No separate payment will be made for the cost of removing conflicting pavement markings. Payment for removing conflicting pavement markings (paint, tape,

thermoplastic, raised pavement markers, etc.) will be included in Maintenance of Traffic, lump sum.

102-11.20 Temporary Raised Rumble Strips: The quantity to be paid for will be the number of calendar days, or portions thereof, that temporary raised rumble strips are certified as installed/used on the project within the Contract Time. ~~The number of strips used must meet the requirements of Standard Plans, Index 102-603.~~ No adjustment will be made to the per day measurement for the number of strips or sets used, or for the number of times the sets are relocated.

102-11.21 Temporary Lane Separator: The quantity to be paid for will be the field measure, in feet, of temporary lane separator certified as installed/used on the project, including drainage gaps, completed and accepted. The cost of any pavement repairs due to removal is included in the cost of Maintenance of Traffic, lump sum.

102-11.22 Temporary Signals for Lane Closures on Two-Lane, Two-Way Roadways: The quantity to be paid for will be the number of temporary signals per day installed/used at the locations shown in the TTCP~~Plans~~. Temporary signals installed/used at the Contractor's option as an alternative to flaggers will be included in Maintenance of Traffic, lump sum.

102-11.23 Temporary Highway Lighting: When temporary highway lighting is required by the Plans, the work of constructing, maintaining, and removing the temporary highway lighting, including all materials and any necessary design work, will be paid for under temporary highway lighting, lump sum.

102-11.24 Pedestrian or Bicycle Special Detours: When a pedestrian or bicycle special detour is shown in the Plans, the work of constructing, maintaining, and subsequently removing such detour facilities will be paid for under pedestrian or bicycle special detour, lump sum. However, traffic control devices, warning devices, barriers, signing, pavement markings, and restoration to final configuration will be paid for under their respective pay items.

102-11.25 Type III Barricades: The number of type III barricades certified as installed/used on the project will be paid for at the Contract unit price for type III barricades.

102-11.26 Limited Access Temporary Openings: Include all construction, maintenance, removal, and restoration costs of temporary openings in Maintenance of Traffic, lump sum. No separate payment will be made for commercial material, gates, or fence.

102-12 Submittals.

102-12.1 Submittal Instructions: Prepare a certification of quantities, using the Department's current approved form, for certified MOT payment items for each project in the Contract. Submit the certification of quantities to the Engineer. The Department will not pay for any disputed items until the Engineer approves the certification of quantities.

102-12.2 Contractor's Certification of Quantities: Request payment by submitting a certification of quantities no later than Twelve O'clock noon Monday after the estimate cut-off date or as directed by the Engineer, based on the amount of work done or completed. Ensure the certification consists of the following:

1. Contract Number, FPID Number, Certification Number, Certification Date and the period that the certification represents.
2. The basis for arriving at the amount of the progress certification, less payments previously made and less an amount previously retained or withheld. The basis will include a detail breakdown provided on the certification of items of payment in accordance with 102-13. After the initial setup of the MOT items and counts, the interval for recording the counts will be

made weekly on the certification sheet unless there is a change. This change will be documented on the day of occurrence. Some items may necessitate a daily interval of recording the counts.

102-13 Basis of Payment.

102-13.1 Maintenance of Traffic (General Work): When an item of work is included in the proposal, price and payment will be full compensation for all work and costs specified under this Section except as may be specifically covered for payment under other items.

102-13.2 Traffic Control Officers: Price and payment will be full compensation for the services of the traffic control officers.

102-13.3 Special Detours: Price and payment will be full compensation for providing all detour facilities shown in the Plans and all costs incurred in carrying out all requirements of this Section for general MOT within the limits of the detour, as shown in the Plans.

102-13.4 Commercial Materials for Driveway Maintenance: Price and payment will be full compensation for all work and materials specified for this item, including specifically all required shaping and maintaining of driveways.

102-13.5 Work Zone Signs: Price and payment will be full compensation for all work and materials for furnishing signs, supports and necessary hardware, installation, relocating, maintaining, covering, and removing signs.

102-13.6. Business Signs: Price and payment will be full compensation for all materials and labor required for furnishing, installing, relocating, maintaining, and removing the signs as well as the cost of installing any logos provided by business owners.

102-13.7 Channelizing Devices: Prices and payment will be full compensation for furnishing, installing, relocating, maintaining and removing the channelizing devices.

102-13.8 Temporary Barrier: Price and payment will be full compensation for furnishing, installing, maintaining, and removing the barrier and asphalt pad. When called for, temporary barrier (relocate) will be full compensation for relocating the barrier.

102-13.9 Temporary Glare Screen: Price and payment will be full compensation for furnishing, installing, maintaining, and removing the glare screen certified as installed/used on the project. When called for, glare screen (relocate) will be full compensation for relocating the glare screen.

102-13.10 Temporary Crash Cushion (Redirective or Gating): Price and payment will be full compensation for furnishing, installing, maintaining, and removing crash cushions, object markers, and concrete or asphalt pads.

102-13.11 Temporary Guardrail: Price and payment will be full compensation for furnishing all materials required for a complete installation, including end anchorage assemblies and any end connections to other structures and for installing, maintaining and removing guardrail.

102-13.12 Arrow Board: Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing arrow boards.

102-13.13 Portable Changeable Message Sign: Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing portable changeable message signs.

102-13.14 Portable Regulatory Signs: Price and payment will be full compensation for furnishing, installing, relocating, operating, maintaining and removing a completely functioning system as described in these Specifications.

Payment will include all labor, materials, incidentals, repairs and any actions necessary to operate and maintain the unit at all times that work is being performed or traffic is being affected by construction and/or MOT operations.

102-13.15 Radar Speed Display Unit: Price and payment will be made only for a completely functioning system as described in these Specifications. Payment will include all labor, hardware, accessories, signs, and incidental items necessary for a complete system. Payment will include any measurements needed to ensure that the unit conforms to all Specification requirements.

Payment will include all labor, materials, incidentals, repairs and any actions necessary to operate and maintain the unit at all times that work is being performed or traffic is being affected by construction and MOT operations. Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing radar speed display unit.

102-13.16 Temporary Signalization and Maintenance: Price and payment will constitute full compensation for furnishing, installing, operating, maintaining and removing temporary traffic control signals including all equipment and components necessary to provide an operable traffic signal. Payment will be withheld for each day at each intersection where the temporary signalization is not operational within 12 hours after notification.

102-13.17 Temporary Traffic Detection and Maintenance: Price and payment will constitute full compensation for furnishing, installing, operating, maintaining and removing temporary traffic detection including all equipment and components necessary to provide an acceptable signalized intersection. Take ownership of all equipment and components. Payment will be withheld for each day at each intersection where the temporary detection is not operational within 12 hours after notification.

102-13.18 Work Zone Pavement Markings: Price and payment will be full compensation for all work specified including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

Removable tape or durable paint may be substituted for standard paint at no additional cost to the Department.

Payment for temporary RPMs used to supplement line markings will be paid for under temporary raised pavement markers. Install these RPMs as detailed in the Standard Plans.

102-13.19 Temporary Raised Rumble Strips: Price and payment will be full compensation for all work and materials described in this Section, including all cleaning and preparing of surfaces, disposal of all debris, furnishing of all materials, application, curing, removal, reinstalling and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work.

102-13.20 Temporary Lane Separator: Price and payment will be full compensation for all work specified in this Section.

102-13.21 Temporary Signals for Lane Closures on Two-Lane, Two-Way Roadways: Price and payment will be full compensation for furnishing, installing, operating, maintaining and removing temporary traffic signal including all equipment and components necessary to provide an operable portable traffic signal.

102-13.22 Temporary Highway Lighting: Price and payment will be full compensation for providing all temporary highway lighting shown in the Plans.

102-13.23 Pedestrian or Bicycle Special Detours: Price and payment will be full compensation for providing all pedestrian or bicycle special detours shown in the Plans.

102-13.24 Type III Barricades: Prices and payment will be full compensation for furnishing, installing, relocating, maintaining and removing the type III barricades.

102-13.25 Payment Items: Payment will be made under:

Item No. 102- 1-	Maintenance of Traffic - lump sum.
Item No. 102- 2-	Special Detour - lump sum.
Item No. 102- 3-	Commercial Material for Driveway Maintenance - per cubic yard.
Item No. 102- 4-	Pedestrian or Bicycle Special Detour - lump sum.
Item No. 102- 14-	Traffic Control Officer - per hour.
Item No. 102- 30-	Temporary Highway Lighting - lump sum.
Item No. 102- 60-	Work Zone Sign - per each per day.
Item No. 102- 61-	Business Sign - each.
Item No. 102- 62-	Barrier Mounted Work Zone Sign – per each per day
Item No. 102- 71-	Temporary Barrier - per foot.
Item No. 102- 75-	Temporary Lane Separator - per foot
Item No. 102- 73-	Temporary Guardrail - per foot.
Item No. 102- 74-	Channelizing Devices
Item No. 102- 76-	Arrow Board - per each per day.
Item No. 102- 78-	Temporary Raised Pavement Markers - each.
Item No. 102- 81-	Temporary Crash Cushion, Gating - per location.
Item No. 102- 89-	Temporary Crash Cushion, Redirective - per location.
Item No. 102- 94-	Glare Screen - per foot.
Item No. 102- 99-	Portable Changeable Message Sign - per each per day.
Item No. 102-104-	Temporary Signalization and Maintenance - per intersection per day.
Item No. 102-107-	Temporary Traffic Detection and Maintenance - per intersection per day.
Item No. 102-115-	Type III Barricade - per each per day.
Item No. 102-120-	Temporary Signal for Lane Closures on Two-Lane, Two-Way Roadways – per each per day.
Item No. 102-150-	Portable Regulatory Sign - per each per day.
Item No. 102-150-	Radar Speed Display Unit - per each per day.
Item No. 102-909-	Temporary Raised Rumble Strips - per day.
Item No. 102-913-	Removable Tape.
Item No. 710-	Painted Pavement Markings.
Item No. 711-	Thermoplastic Pavement Markings.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 18, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **102**
Proposed Specification: **1020900 Maintenance of Traffic.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matthew Dewitt to clarify performance requirements for temporary traffic detection and to include requirements for Contractor maintenance of existing and new ITS infrastructure throughout the project extents.
Please review and transmit your comments, if any, within two weeks.

Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

MAINTENANCE OF TRAFFIC.
(REV 7-14-22)

ARTICLE 102-9.15 is deleted and the following substituted:

102-9 Temporary Traffic Control Devices.

102-9.1 General: Use only devices that are listed on the APL. Immediately remove or cover, using any method of covering approved by the Engineer, any existing or temporary devices that do not apply to current conditions.

The use of NCHRP Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features devices purchased prior to January 1, 2020 is permitted on projects let prior to January 1, 2030. All devices manufactured or purchased on or after January 1, 2020, must be MASH compliant in accordance with Section 990.

The APL number is to be permanently marked on the device at a readily visible location. Sheeting used on devices and pavement markings are exempt from this requirement.

Notify the Engineer in writing of any scheduled operation that will affect traffic patterns or safety sufficiently in advance of commencing such operation to permit review of the plan for the proposed installation of temporary traffic control devices.

Assign an employee the responsibility of maintaining the position and condition of all temporary traffic control devices throughout the duration of the Contract. Keep the Engineer advised at all times of the identification and means of contacting this employee on a 24 hour basis.

Maintain temporary traffic control devices in the correct position, properly oriented, clearly visible and clean, at all times. All applicable temporary traffic control devices must meet the classification category of Acceptable as defined in the American Traffic Safety Services Association (ATSSA) Quality Guidelines for Temporary Traffic Control Devices and Features. Temporary concrete barriers must meet the classification category of Acceptable defined in the Department's Temporary Concrete Barrier Evaluation Guide, which may be viewed at the following URL: https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/programmanagement/implemented/urlinspecs/files/docs/default-source/content-docs/programmanagement/implemented/urlinspecs/files/temporaryconcretebarrierguide.pdf.pdf?sfvrsn=343b4c97_10. Pedestrian longitudinal channelizing devices (LCDs) must meet the classification category of Acceptable as defined in the Pedestrian LCD Evaluation Guide, which may be viewed at the following URL: https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/programmanagement/implemented/urlinspecs/files/lcdevaluationguide.pdf?sfvrsn=166e0f16_2. Immediately repair, replace or clean damaged, defaced or dirty devices. Traffic control devices must not be cleaned while installed/used. Use of warning lights on any temporary traffic control device is prohibited, with the exception of the trailer mounted portable regulatory signs.

Employ an approved independent Channelizing Device Supplier (CDS) to provide and maintain the condition of the following non-fixed channelizing devices: drums, cones, vertical panels, barricades, temporary tubular markers, and pedestrian longitudinal channelizing devices. Cones may be provided and maintained by the Contractor.

The CDS shall not be affiliated with the Contractor and must be approved by the Department. Department approved CDSs are listed on the State Construction Office website.

CDSs seeking inclusion on the list must meet the requirements of 102-9.1.1. The CDS shall submit a monthly certification on letterhead that the channelizing devices mentioned above installed/used within the work zone meet classification category of Acceptable as defined in the Pedestrian LCD Evaluation Guide and the ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features. The CDS shall submit the monthly certification on letterhead for channelizing devices installed/used within the work zone. The CDS certification shall include the following statement, "I certify that I have provided and maintained the following devices <list devices covered under the certification> in accordance with Pedestrian LCD Evaluation Guide and the ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features." If the Contractor chooses to provide and maintain cones, the Contractor must submit a monthly Contractor certification on letterhead that all cones installed/used within the work zone meet acceptable standards as outlined in the ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features. The Contractor certification shall include the following statement, "I certify that I have provided and maintained cones in accordance with the ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features."

102-9.1.1 Approved Independent Channelizing Device Supplier (CDS)

Requirements: Submit the following documents to the State Construction Office for review and approval

1. A letter on company letterhead signed and dated by the owner of the company or company officer with the following information and statements:

a. The company's owners, stockholders, and officers.

b. A statement declaring that the company will not perform as a CDS on any project where there is common ownership, directly or indirectly, between the company and the Contractor.

c. A statement declaring that the company will furnish and maintain the condition of all channelizing devices with the exception of cones as required in 102-9.1 with its own forces.

d. A statement declaring at least five years of experience in providing channelizing device supplier services, with its own inventory of channelizing devices.

e. On a separate sheet, list a sample project history of the company's experience as a channelizing device supplier for the five years declared in item 1(d) above including the following information:

1. Project name and number and a brief description of CDS work performed,
2. Beginning and ending date of CDS project activities,
3. Location of project (city, state),
4. Monetary amount of CDS work on project,
5. Owner of project, contact person and phone number with area code,
6. Name of Contractor (client) that the work was performed for and phone number with area code.

2. A maintenance plan for approval by the Department that outlines the frequency and methods for maintaining the condition of all channelizing devices, except cones owned and maintained by the Contractor, installed/used in the work zone.

102-9.2 Work Zone Signs: Furnish, install, maintain, remove and relocate signs in accordance with the Plans and Standard Plans, Index 102-600.

102-9.2.1 Post Mounted Signs: Meet the requirements of 990-8.

102-9.2.2 Portable Signs: Use only approved systems, which includes sign stands and attachment hardware (nuts, bolts, clamps, brackets, braces, etc.), meeting the vendor requirements specified on the APL drawings.

102-9.2.3 Barrier Mounted Signs: If post mounting criteria cannot be achieved in accordance with Standard Plans, Index 102-600 and a barrier or traffic railing exists, use temporary sign criteria provided in Standard Plans, Index 700-012 or Index 700-013. Use Standard Plans, Index 700-012 only when mounting the sign to the top of the barrier or traffic railing places the sign panel closer than two feet from the traveled way.

102-9.3 Business Signs: Provide and place signs in accordance with the Plans and Standard Plans, Index 102 series. Furnish signs having retroreflective sheeting meeting the requirements of Section 990.

102-9.4 Channelizing Devices: Furnish, install, maintain, remove and relocate channelizing devices in accordance with the Plans and Standard Plans.

102-9.4.1 Retroreflective Collars for Traffic Cones: Use collars for traffic cones listed on the APL that meet the requirements of Section 990. Use cone collars at night designed to properly fit the taper of the cone when installed. Place the upper 6 inch collar a uniform 3-1/2 inches distance from the top of the cone and the lower 4 inch collar a uniform 2 inches distance below the bottom of the upper 6 inch collar.

Collars must be capable of being removed for temporary use or attached permanently to the cone in accordance with the manufacturer's recommendations. Provide a white sheeting having a smooth outer surface and that has the property of a retroreflector over its entire surface.

102-9.4.2 Pedestrian Longitudinal Channelizing Devices (LCDs): Use LCDs listed on the APL for pedestrian use and meeting the requirements of Section 990 and the Standard Plans. Pedestrian LCDs must be interlocked except for the stand-alone unit placed perpendicular to a sidewalk. For pedestrian LCDs requiring internal ballasting, an indicator that clearly identifies the proper ballast level will be required. For pedestrian LCDs requiring external ballasting, the ballasting methods must be detailed in the APL drawings including ballasting type and minimum weight.

Ensure that joints on the pedestrian LCDs are free of sharp edges and have a maximum offset of 1/2 inch in any plane.

102-9.5 Temporary Barrier: Furnish, install, maintain, remove and relocate temporary barrier in accordance with the Plans and Standard Plans. Obtain and use precast temporary concrete barrier from a manufacturing plant that is on the Department's Production Facility Listing. Temporary concrete barrier must meet the material and construction requirements of Section 521 unless noted otherwise in the Standard Plans. Proprietary temporary concrete, steel, or water filled barrier used must be listed on the APL.

The maximum allowable height increase between consecutive temporary barrier units in the direction of traffic is 1 inch.

Temporary barrier must comply with Standard Plans, Index 102-100 or 102-120. Install temporary barriers as either anchored or freestanding as shown in the Plans or the Standard Plans. An anchored unit is defined as having at least one stake or bolt into the underlying pavement or bridge deck. All other units, including those with keeper pins, are considered freestanding.

Remove temporary asphalt pads and repair all attachment scars to permanent structures and pavements after barrier removal. Make necessary repairs due to defective material,

work, or Contractor operations at no cost to the Department. Restore barrier damaged by the traveling public within 24 hours after notification as authorized by the Engineer.

Trailer mounted barriers listed on the APL may be used at the option of the Contractor. Trailer mounted barriers listed on the APL must have an FHWA eligibility letter and be successfully crash tested in accordance with MASH TL-3 criteria. All trailer mounted barriers must be equipped with an APL listed truck mounted attenuator, an APL listed vehicle mounted arrow board and vehicle warning lights in accordance with this Section.

102-9.5.2.1 Temporary Barrier Meeting the Requirements of Standard Plans, Index 102-120 and 102-110: Ensure the marking requirements of the respective Index are met.

102-9.6.2.2: Proprietary Precast Temporary Concrete Barrier Fabricated prior to 2005: Submit a certification stating that all unmarked barrier units meet the requirements of the Specifications and the Standard Plans. Certifications will be project specific and non-transferable.

102-9.5.2.3 Proprietary Precast Temporary Concrete Barrier Fabricated in 2005 or later: Ensure each barrier unit has permanent clear markings, showing the manufacture date, serial number, manufacturer's name or symbol, and the APL number. Label the markings on a plate, plaque, or cast in the unit. Proprietary barrier fabricated prior to 2016 and marked with the "INDX 521" in lieu of the APL number will be permitted.

102-9.5.2.4 Temporary Concrete Barrier Repair: Before beginning the repair, remove all laitance, loose material, and any other deleterious matter to sound concrete or a minimum depth of one inch. Additionally, when reinforcing bars, inserts or weldments are exposed, remove the concrete to provide a minimum one inch clearance all around. Fill the repair area with an approved high performance concrete repair material in accordance with 930-5 and the manufacturer's recommendations. Restore surfaces and edges to the original dimensions and shape of the barrier.

Repairs are not allowed on barrier units that have one or more of the following deficiencies: structural cracking or cracks that exist through the entire cross-section; unit-to-unit connection assemblies or anchor slots are broken or no longer in a fixed position.

Do not paint repaired barriers.

102-9.6 Barrier Delineators: Install barrier delineators on top of temporary barrier and vehicular LCDs meeting the requirements of Section 705.

102-9.7 Temporary Glare Screen: Use temporary glare screens listed on the APL that meet the requirements of Section 990. Furnish, install, maintain, remove and relocate glare screen systems in conjunction with temporary barrier at locations identified in the Plans.

The anchorage of the glare screen to the barrier must be capable of safely resisting an equivalent tensile load of 600 pounds per foot of glare screen, with a requirement to use a minimum of three fasteners per barrier section.

When glare screen is utilized on temporary barrier, barrier delineators will not be required.

102-9.8 Temporary Crash Cushion (Redirective or Gating): Furnish, install, maintain and subsequently remove temporary crash cushions in accordance with the details and notes shown in the Plans, Standard Plans, and requirements of the pre-approved alternatives listed on the APL.

Temporary crash cushions can be either new or used functionally sound refurbished devices. Performance of intended function is the only condition for acceptance. All metallic components must be galvanized in accordance with Section 967.

Anchor abutting temporary barrier in accordance the Standard Plans or APL drawings, as required. Bidirectional installations must have a transition panel installed between the crash cushion and the abutting barrier. Delineate the crash cushion in accordance with Section 544. Maintain the crash cushions until their authorized removal. Do not place any materials or equipment within the length of the crash cushion.

Remove temporary asphalt or concrete pads and repair all attachment scars to permanent structures and pavements after crash cushion removal. Make necessary repairs due to defective material, work, or Contractor operations at no cost to the Department. Restore crash cushions damaged by the traveling public within 24 hours after notification as authorized by the Engineer.

102-9.9 Temporary Guardrail: Furnish temporary guardrail in accordance with the Plans and Standard Plans. Meet the requirements of Section 536.

102-9.10 Arrow Board: Furnish arrow boards that meet the requirements of Section 990 as required by the Plans and Standard Plans to advise approaching traffic of lane closures or shoulder work. Ensure that the arrow board display panel is raised to a fully upright position and is fully visible to motorists. Type B arrow boards may be used on low to intermediate speed (0 mph to 50 mph) facilities or for maintenance or moving operations on any speed facility. Type C arrow boards must be used for all other operations on high-speed (50 mph and greater) facilities and may be substituted for Type B arrow boards on any speed facility.

102-9.11 Portable Changeable Message Sign (PCMS): Use PCMSs or truck mounted changeable message signs that meet the requirements of Section 990 as required by the Plans and Standard Plans to supplement other temporary traffic control devices used in work zones. Ensure that the PCMS display panel is raised to a fully upright position and is fully visible to motorists. Reduce the intensity of the flashers when using PCMS at night. Use PCMS with a minimum letter height of 18 inches. For facilities with posted speed limits of 45 mph or less, PCMS with a minimum letter height of 12 inches may be used.

For roadways with speed limits greater than 45 mph, the message displayed on the PCMS must be unobstructed from 800 feet. For roadways with speed limits of 45 mph or less, the message displayed must be unobstructed from 650 feet.

Messages must have no more than two phases. The display time for each phase must be at least two seconds but no more than three seconds. The sum of the display time must be a maximum of six seconds.

102-9.12 Portable Regulatory Signs (PRS): Furnish PRSs that meet the requirements of Section 990 as required by the Plans and Standard Plans. Ensure that the PRS sign panel is raised to a fully upright position and is fully visible to motorists.

Activate portable regulatory signs only during active work activities and deactivate when no work is being performed.

102-9.13 Radar Speed Display Unit (RSDU): Furnish RSDUs that meet the requirements of Section 990 as required by the Plans and Standard Plans to inform motorists of the posted speed and their actual speed. Ensure that the RSDU display panel is mounted in accordance with the manufacturer’s recommendations.

Activate the radar speed display unit only during active work activities and deactivate when no work is being performed.

102-9.14 Temporary Signalization and Maintenance: Provide temporary signals and maintain signalization at existing, temporary, and new intersections including, but not limited to, the following:

1. Installation of temporary poles and span wire assemblies as shown in the Plans,
2. Temporary portable traffic signals as shown in the Plans,
3. Adding or shifting signal heads,
4. Trouble calls,
5. Maintaining intersection and coordination timing and preemption devices. Coordination timing will require maintaining functionality of system communications.

Restore any loss of operation within 12 hours after notification. Provide alternate temporary traffic control until the signalization is restored.

Provide temporary pedestrian signalization in accordance with the TTCP, and maintain pedestrian signalization at existing, temporary, and new intersections.

Provide traffic signal equipment that meets the requirements of the Standard Plans and 603-2. The Engineer may approve used signal equipment if it is in acceptable condition. Replacement components for traffic signal cabinet assemblies will be provided by the maintaining agency. For temporary signals used for lane closure operations on two-lane, two-way roadways meet the requirements in 102-9.20.

102-9.15 Temporary Traffic Detection and Maintenance: Provide and maintain temporary traffic detection ~~and maintenance~~ at existing, temporary, and new signalized intersections. Ensure that vehicle detectors and systems can detect vehicles in each movement on each approach and call the correct vehicle phase when vehicle demand is present. Ensure adjacent lanes and opposing movements do not place false calls. Provide temporary pedestrian detection in accordance with the TTCP, and maintain pedestrian detection at existing, temporary, and new intersections. Ensure pedestrian detectors call the correct pedestrian phase when pedestrian demand is present.

Provide temporary traffic detection equipment listed on the APL.

Restore any loss of detection within 12 hours. If permanent traffic detection cannot be restored within 12 hours, provide temporary detection.

Ensure 90% accuracy per signal phase, measured at the initial installation and after any lane shifts, by comparing sample data collected from the detection system with ground truth data collected by human observation. Collect the sample and ground truth data for a minimum of five minutes during a peak and five minutes during an off-peak period with a minimum three detections for each signal phase. Perform the test in the presence of the Engineer.

102-9.16 Existing ITS Maintenance: Provide maintenance at existing ITS locations. Diagnose any loss of functionality within 8 hours. Restore any loss of functionality within 24 hours. The Engineer may extend the allowable downtime beyond 24 hours. Configure and install Department furnished equipment as necessary. Ensure that all stand-alone functions of replaced ITS devices are tested as detailed in the Contract Documents and as approved by the Engineer. Perform the test in the presence of the Engineer.

102-9.~~16~~ 17 Truck Mounted Attenuators and Trailer Mounted Attenuators: Furnish, operate and maintain APL listed truck mounted and trailer mounted attenuators in accordance with the manufacturer's recommendations.

For posted speeds of 50 mph or greater, use either truck mounted attenuators or trailer mounted attenuators that meet TL-3 criteria. For posted speeds of 45 mph or less, use either truck mounted attenuators or trailer mounted attenuators that meet TL-2 or TL-3 criteria.

Attenuators will not be paid for separately. Include the cost of the truck with either a truck mounted attenuator or a trailer mounted attenuator in Maintenance of Traffic, lump sum. Payment includes all costs, including furnishing, operating maintaining and removal when no longer required, and all materials, labor, tools, equipment and incidentals required for attenuator maintenance.

102-9.~~17~~ 18 Temporary Raised Rumble Strip Set: Use temporary raised rumble strips per the manufacturer's recommendations and in accordance with Standard Plans, Index 102-603.

The temporary raised rumble strip may be either a removable striping type or a portable type. Use a consistent type and color throughout the work zone.

102-9.~~18~~ 19 Automated Flagger Assistance Devices (AFAD): Furnish, install, maintain, remove, and relocate AFADs in accordance with the Plans, Standard Plans, Index 102-603, and APL vendor drawings.

Position AFADs where they are clearly visible to oncoming traffic. AFADs may be placed on the centerline if they have been successfully crash tested in accordance with MASH TL-3 criteria. A gate arm is required in accordance with Section 990 if a single AFAD is used on the shoulder to control one direction of traffic.

The devices may be operated either by a single flagger at one end of the traffic control zone, from a central location, or by a separate flagger near each device location. Use only flaggers trained in accordance with Section 105 and in the operation of the AFAD. When in use, each AFAD must be in view of, and attended at all times by, the flagger operating the device.

Provide two flaggers on-site and use one of the following methods in the deployment of AFADs:

1. Place an AFAD at each end of the temporary traffic control zone, or
2. Place an AFAD at one end of the temporary traffic control zone and a flagger at the opposite end.

A single flagger may simultaneously operate two AFADs as described in (1) or a single AFAD as described in (2) if all of the following conditions are met:

1. The flagger has an unobstructed view of the AFAD(s),
2. The flagger has an unobstructed view of approaching traffic in both directions,
3. In the event of an AFAD malfunction, restore normal flagging operations with flaggers or immediately cease the flagging operation and reopen the roadway.

AFADs may be either a remotely controlled Stop/Slow AFAD mounted on either a trailer or a movable cart system, or a remotely controlled Red/Yellow Lens AFAD.

Illuminate the flagging station when the AFAD is used at night. When the AFAD is not in use, remove or cover signs and move the AFAD device outside the clear zone or shield it with a barrier.

AFADs will not be paid for separately. AFADs may be used as a supplement or an alternate to flaggers in accordance with the Plans, Standard Plans, Index 102-603, and the APL vendor drawings. Include the cost for AFADs in Maintenance of Traffic, Lump Sum.

102-9.~~19~~ 20 Temporary Lane Separator: Furnish, install, maintain, remove and relocate temporary lane separator in accordance with the Plans and Standard Plans, Index 102-600. Anchor the portable temporary lane separator with a removable anchor bolt. Use

epoxy on bridge decks where anchoring is not allowed. Remove the epoxy from the bridge deck by hydroblasting or other method approved by the Engineer. Repair any damage to the existing pavement caused by the removal of temporary lane separator.

102-9.~~20~~ 21 Temporary Signals for Lane Closures on Two-Lane, Two-Way Roadways: Furnish, install, maintain, remove, and relocate temporary signals for lane closure operations on two-lane, two-way roadways at the locations shown in the Plans. Temporary signals may be used, at the Contractor's option, as an alternate to flaggers for lane closure operations on two-lane, two-way roadways in accordance with Standard Plans, Index 102-606. Temporary signals can either be portable signals or span wire signals and must be listed on the APL. Provide two signal faces for each approach.

102-9.~~21~~ 22 Type III Barricades: Use type III barricades in accordance with the TTCP and Standard Plans. Ensure stripes are sloping downward in the direction road users are to pass. Mount sign panels in accordance with the manufacturer's instructions. Do not place ballast on any rails, or higher than 13 inches above the driving surface. Do not splice the retroreflective sheeting.

ARTICLE 102-11 is deleted and the following substituted:

102-11 Method of Measurement.

102-11.1 General: Devices installed/used on the project on any calendar day or portion thereof, within the Contract Time, including time extensions which may be granted, will be paid for at the Contract unit price for the applicable pay item. Include the cost of any work that is necessary to meet the requirements of the Contract Documents for MOT under Maintenance of Traffic, lump sum when separate payment is not provided.

102-11.2 Traffic Control Officers: The quantity to be paid for traffic control officers will be at the Contract unit price per hour (4 hour minimum) for the actual number of officers certified to be on the project site, including any law enforcement vehicles and all other direct and indirect costs. Payment will be made only for those traffic control officers specified in the Plans and authorized by the Engineer.

102-11.3 Special Detours: When a special detour is shown in the Plans, the work of constructing, maintaining, and subsequently removing such detour facilities will be paid for under Special Detour, lump sum. However, traffic control devices, warning devices, barriers, signing, pavement markings, and restoration to final configuration will be paid for under their respective pay items.

102-11.4 Commercial Material for Driveway Maintenance: The quantity to be paid for will be the certified volume, in cubic yards, of all materials authorized by the Engineer, acceptably placed and maintained for driveway maintenance. The volume, which is authorized to be reused, and which is acceptably salvaged, placed, and maintained in other designated driveways will be included again for payment. Commercial Material used for Temporary Openings will not be included for separate payment.

102-11.5 Work Zone Signs: The number of temporary post-mounted signs (temporary regulatory, warning and guide) certified as installed/used on the project will be paid for at the Contract unit price for work zone signs. When multiple signs are located on single or multiple posts, each sign panel will be paid individually. Signs greater than 20 square feet and detailed in the Plans will be paid for under Maintenance of Traffic, lump sum.

Temporary portable signs (excluding mesh signs) and vehicular mounted signs will be included for payment under work zone signs, only if used in accordance with the Standard Plans.

The number of temporary barrier mounted signs (temporary regulatory, warning and guide) certified as installed/used on the project will be paid for at the Contract unit price for barrier mounted work zone signs.

Work zone signs may be installed fourteen days prior to the start of Contract Time with the approval of the Engineer and at no additional cost to the Department.

102-11.6. Business Signs: The number of business signs certified as installed/used on the project will be paid for at the Contract unit price for business signs.

102-11.7 Channelizing Devices: The number of drums, vertical panels, and Type I, Type II, or direction indicator barricades, certified as installed/used on the project meeting the requirements of Standard Plans, Index 102-600 and have been properly maintained will be paid for at the Contract unit prices for channelizing device.

Payment for drums, vertical panels, and Type I, Type II, and direction indicator barricades will be paid per each per day.

Payment for vehicular LCDs will be paid as the length in feet installed divided by the device spacing for barricades, vertical panels, and drums and certified as installed/used on the project meeting the requirements of Standard Plans, Index 102-600 and have been properly maintained will be paid for at the Contract unit price for channelizing device.

Payment for pedestrian LCDs, certified as installed/used on the project and properly maintained, will be paid per linear foot per day. Placement of pedestrian LCDs at locations not shown in the Plans, or not authorized by the Engineer, will be at the Contractor's expense. Payment for pedestrian LCD mounted signs will be made under Work Zone Signs, per each per day.

Payment will not be made for channelizing devices unsatisfactorily maintained, as determined by the Engineer. Payment will be made for each channelizing device that is used to delineate trailer mounted devices. Payment will be made for channelizing devices delineating portable changeable message signs during the period beginning 14 working days before Contract Time begins as authorized by the Engineer.

102-11.8 Temporary Barrier: The quantity to be paid for will be the length, in feet, of freestanding units or anchored units certified as installed/used on the project. The quantity to be paid for relocating barrier will be based on the relocated installation type. No separate payment will be made for the asphalt pad. For freestanding units transitioned to a crash cushion, the cost of anchoring the transition units will be included in the cost of the temporary crash cushion in accordance with 102-11.11.

102-11.9 Barrier Delineators: No separate payment will be made for barrier delineators installed on top of temporary barrier and vehicular LCDs. Include the cost for barrier delineators in the cost of the barrier or vehicular LCD.

102-11.10 Temporary Glare Screen: The certified quantity to be paid for will be determined by the number of sections times the nominal length of each section.

102-11.11 Temporary Crash Cushions: No separate payment will be made for the concrete or asphalt pad.

102-11.11.1 Redirective: The quantity to be paid for will be the number of temporary crash cushions (redirective) certified as installed/used and maintained on the project,

including anchoring of temporary barrier necessary for transition to the crash cushion and delineation.

102-11.11.2 Gating: The quantity to be paid for will be the number of temporary crash cushions (gating) certified as installed/used and maintained on the project, including anchoring of temporary barrier necessary for transition to the crash cushion and delineation.

102-11.12 Temporary Guardrail: The quantity to be paid for will be the length, in feet, of temporary guardrail constructed and certified as installed/used on the project. The length of a run of guardrail will be determined as a multiple of the nominal panel lengths.

102-11.13 Arrow Board: The quantity to be paid at the contract unit price will be for the number of arrow boards certified as installed/used on the project on any calendar day or portion thereof within the Contract Time.

102-11.14 Portable Changeable Message Sign: The quantity to be paid at the Contract unit price will be for the number of PCMSs or truck mounted changeable message signs certified as installed/used on the project on any calendar day or portion thereof within the Contract Time. Payment will be made for each portable changeable message sign that is used during the period beginning fourteen working days before Contract Time begins as authorized by the Engineer.

102-11.15 Portable Regulatory Signs: The quantity to be paid for will be the number of portable regulatory signs certified as installed/used on the project on any calendar day or portion thereof within the Contract Time, will be paid for the Contract unit price for portable regulatory sign.

102-11.16 Radar Speed Display Unit: The quantity to be paid for will be the number of radar speed display units certified as installed/used on the project on any calendar day or portion thereof within the Contract Time, will be paid for the Contract unit price for radar speed display unit.

102-11.17 Temporary Signalization and Maintenance: For existing intersections, the certified quantity to be paid for will be the number of signalized intersections per day for the full duration of the Contract. For temporary intersections, the certified quantity to be paid for will be the number of signalized intersections per day for the duration of the temporary intersection. No separate payment will be made for temporary signalization and maintenance at new intersections.

102-11.18 Temporary Traffic Detection and Maintenance: For existing intersections, the certified quantity to be paid for will be the number of signalized intersections per day beginning the day Contract Time begins and ending the day the permanent detection is operational and the final lane configuration is in place. For temporary and new intersections, the certified quantity to be paid for will be the number of signalized intersections per day beginning the day the temporary detection is functional and ending the day: the permanent detection is operational and the final lane configuration is in place for a new intersection; or, when the detection is removed for a temporary intersection.

102-11.19 Existing ITS Maintenance: For existing ITS locations, the certified quantity to be paid for will be the number of calendar days from Contract Time start to Final Acceptance.

102-11.~~19~~ 20 Work Zone Pavement Markings: Painted pavement markings will be paid as specified in 710-10. The quantity of removable tape to be paid for solid, 10'-30' skip, 3'-9' dotted, 6'-10' dotted, and 2'-4' dotted lines will be the length, in gross miles, authorized and acceptably applied under this Section and certified as installed/used on the project. The quantity of removable tape to be paid for transverse lines will be the length, in linear feet, authorized and acceptably applied under this Section and certified as installed/used on the project. The quantity of removable tape to be paid for pavement messages, symbols, and arrows will be per each,

authorized and acceptably applied under this Section and certified as installed/used on the project. The quantity of temporary RPMs to be paid will be the number of RPMs authorized and acceptably applied.

102-11.~~20~~ 21 Temporary Raised Rumble Strips: The quantity to be paid for will be the number of calendar days, or portions thereof, that temporary raised rumble strips are certified as installed/used on the project within the Contract Time. The number of strips used must meet the requirements of Standard Plans, Index 102-603. No adjustment will be made to the per day measurement for the number of strips or sets used, or for the number of times the sets are relocated.

102-11.~~21~~ 22 Temporary Lane Separator: The quantity to be paid for will be the field measure, in feet, of temporary lane separator certified as installed/used on the project, including drainage gaps, completed and accepted. The cost of any pavement repairs due to removal is included in the cost of Maintenance of Traffic, lump sum.

102-11.~~22~~ 23 Temporary Signals for Lane Closures on Two-Lane, Two-Way Roadways: The quantity to be paid for will be the number of temporary signals per day installed/used at the locations shown in the Plans. Temporary signals installed/used at the Contractor's option as an alternative to flaggers will be included in Maintenance of Traffic, lump sum.

102-11.~~23~~ 24 Temporary Highway Lighting: When temporary highway lighting is required by the Plans, the work of constructing, maintaining, and removing the temporary highway lighting, including all materials and any necessary design work, will be paid for under temporary highway lighting, lump sum.

102-11.~~24~~ 25 Pedestrian or Bicycle Special Detours: When a pedestrian or bicycle special detour is shown in the Plans, the work of constructing, maintaining, and subsequently removing such detour facilities will be paid for under pedestrian or bicycle special detour, lump sum. However, traffic control devices, warning devices, barriers, signing, pavement markings, and restoration to final configuration will be paid for under their respective pay items.

102-11.~~25~~ 26 Type III Barricades: The number of type III barricades certified as installed/used on the project will be paid for at the Contract unit price for type III barricades.

102-11.~~26~~ 27 Limited Access Temporary Openings: Include all construction, maintenance, removal, and restoration costs of temporary openings in Maintenance of Traffic, lump sum. No separate payment will be made for commercial material, gates, or fence.

ARTICLE 102-13 is deleted and the following substituted:

102-13 Basis of Payment.

102-13.1 Maintenance of Traffic (General Work): When an item of work is included in the proposal, price and payment will be full compensation for all work and costs specified under this Section except as may be specifically covered for payment under other items.

102-13.2 Traffic Control Officers: Price and payment will be full compensation for the services of the traffic control officers.

102-13.3 Special Detours: Price and payment will be full compensation for providing all detour facilities shown in the Plans and all costs incurred in carrying out all requirements of this Section for general MOT within the limits of the detour, as shown in the Plans.

102-13.4 Commercial Materials for Driveway Maintenance: Price and payment will be full compensation for all work and materials specified for this item, including specifically all required shaping and maintaining of driveways.

102-13.5 Work Zone Signs: Price and payment will be full compensation for all work and materials for furnishing signs, supports and necessary hardware, installation, relocating, maintaining and removing signs.

102-13.6. Business Signs: Price and payment will be full compensation for all materials and labor required for furnishing, installing, relocating, maintaining, and removing the signs as well as the cost of installing any logos provided by business owners.

102-13.7 Channelizing Devices: Prices and payment will be full compensation for furnishing, installing, relocating, maintaining and removing the channelizing devices.

102-13.8 Temporary Barrier: Price and payment will be full compensation for furnishing, installing, maintaining, and removing the barrier and asphalt pad. When called for, temporary barrier (relocate) will be full compensation for relocating the barrier.

102-13.9 Temporary Glare Screen: Price and payment will be full compensation for furnishing, installing, maintaining, and removing the glare screen certified as installed/used on the project. When called for, glare screen (relocate) will be full compensation for relocating the glare screen.

102-13.10 Temporary Crash Cushion (Redirective or Gating): Price and payment will be full compensation for furnishing, installing, maintaining, and removing crash cushions and concrete or asphalt pads.

102-13.11 Temporary Guardrail: Price and payment will be full compensation for furnishing all materials required for a complete installation, including end anchorage assemblies and any end connections to other structures and for installing, maintaining and removing guardrail.

102-13.12 Arrow Board: Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing arrow boards.

102-13.13 Portable Changeable Message Sign: Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing portable changeable message signs.

102-13.14 Portable Regulatory Signs: Price and payment will be full compensation for furnishing, installing, relocating, operating, maintaining and removing a completely functioning system as described in these Specifications.

Payment will include all labor, materials, incidentals, repairs and any actions necessary to operate and maintain the unit at all times that work is being performed or traffic is being affected by construction and/or MOT operations.

102-13.15 Radar Speed Display Unit: Price and payment will be made only for a completely functioning system as described in these Specifications. Payment will include all labor, hardware, accessories, signs, and incidental items necessary for a complete system. Payment will include any measurements needed to ensure that the unit conforms to all Specification requirements.

Payment will include all labor, materials, incidentals, repairs and any actions necessary to operate and maintain the unit at all times that work is being performed or traffic is being affected by construction and MOT operations. Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing radar speed display unit.

102-13.16 Temporary Signalization and Maintenance: Price and payment will constitute full compensation for furnishing, installing, operating, maintaining and removing temporary traffic control signals including all equipment and components necessary to provide an operable traffic signal. Payment will be withheld for each day at each intersection where the temporary signalization is not operational within 12 hours after notification.

102-13.17 Temporary Traffic Detection and Maintenance: Price and payment will constitute full compensation for furnishing, installing, operating, maintaining and removing temporary traffic detection including all equipment and components necessary to provide an acceptable signalized intersection. Take ownership of all equipment and components. Payment will be withheld for each day at each intersection where the temporary detection is not operational within 12 hours after notification.

102-13.18 Existing ITS Maintenance: Price and payment will constitute full compensation for diagnosing, troubleshooting, configuring, installing, operating, maintaining, and removing existing ITS devices including all auxiliary equipment and device components. Payment will be withheld for each day where the ITS device is not operational within the allowable downtime, beginning at the time of notification. Payment will not be withheld for days of delay when the Department or Maintaining Agency is unable to furnish the replacement ITS device to the Contractor.

102-13.~~18~~ 19 Work Zone Pavement Markings: Price and payment will be full compensation for all work specified including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

Removable tape or durable paint may be substituted for standard paint at no additional cost to the Department.

Payment for temporary RPMs used to supplement line markings will be paid for under temporary raised pavement markers. Install these RPMs as detailed in the Standard Plans.

102-13.~~19~~ 20 Temporary Raised Rumble Strips: Price and payment will be full compensation for all work and materials described in this Section, including all cleaning and preparing of surfaces, disposal of all debris, furnishing of all materials, application, curing, removal, reinstalling and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work.

102-13.~~20~~ 21 Temporary Lane Separator: Price and payment will be full compensation for all work specified in this Section.

102-13.~~21~~ 22 Temporary Signals for Lane Closures on Two-Lane, Two-Way Roadways: Price and payment will be full compensation for furnishing, installing, operating, maintaining and removing temporary traffic signal including all equipment and components necessary to provide an operable portable traffic signal.

102-13.~~22~~ 23 Temporary Highway Lighting: Price and payment will be full compensation for providing all temporary highway lighting shown in the Plans.

102-13.~~23~~ 24 Pedestrian or Bicycle Special Detours: Price and payment will be full compensation for providing all pedestrian or bicycle special detours shown in the Plans.

102-13.~~24~~ 25 Type III Barricades: Prices and payment will be full compensation for furnishing, installing, relocating, maintaining and removing the type III barricades.

102-13.~~25~~ 26 Payment Items: Payment will be made under:

Item No. 102- 1- Maintenance of Traffic - lump sum.

Item No. 102- 2-	Special Detour - lump sum.
Item No. 102- 3-	Commercial Material for Driveway Maintenance - per cubic yard.
Item No. 102- 4-	Pedestrian or Bicycle Special Detour - lump sum.
Item No. 102- 14-	Traffic Control Officer - per hour.
Item No. 102- 30-	Temporary Highway Lighting - lump sum.
Item No. 102- 60-	Work Zone Sign - per each per day.
Item No. 102- 61-	Business Sign - each.
Item No. 102- 62-	Barrier Mounted Work Zone Sign – per each per day
Item No. 102- 71-	Temporary Barrier - per foot.
Item No. 102- 75-	Temporary Lane Separator - per foot
Item No. 102- 73-	Temporary Guardrail - per foot.
Item No. 102- 74-	Channelizing Devices
Item No. 102- 76-	Arrow Board - per each per day.
Item No. 102- 78-	Temporary Raised Pavement Markers - each.
Item No. 102- 81-	Temporary Crash Cushion, Gating - per location.
Item No. 102- 89-	Temporary Crash Cushion, Redirective - per location.
Item No. 102- 94-	Glare Screen - per foot.
Item No. 102- 99-	Portable Changeable Message Sign - per each per day.
Item No. 102-104-	Temporary Signalization and Maintenance - per intersection per day.
Item No. 102-107-	Temporary Traffic Detection and Maintenance - per intersection per day.
Item No. 102-ABC-	Existing ITS Maintenance – per day
Item No. 102-115-	Type III Barricade - per each per day.
Item No. 102-120-	Temporary Signal for Lane Closures on Two-Lane, Two-Way Roadways – per each per day.
Item No. 102-150-	Portable Regulatory Sign - per each per day.
Item No. 102-150-	Radar Speed Display Unit - per each per day.
Item No. 102-909-	Temporary Raised Rumble Strips - per day.
Item No. 102-913-	Removable Tape.
Item No. 710-	Painted Pavement Markings.
Item No. 711-	Thermoplastic Pavement Markings.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **102**
Proposed Specification: **1021113 Maintenance of Traffic.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Olivia Townsend from the State Construction Office to modify the method of measurement to allow payment for trailer mounted devices for up to two inactive days as authorized by the Engineer. Changes also include provisions for pay for additional inactive due inclement weather.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

MAINTENANCE OF TRAFFIC
(REV 2-17-22)

SUBARTICLE 102-11.14 is deleted and the following substituted:

102-11.13 Arrow Board: The quantity to be paid at the contract unit price will be for the number of arrow boards certified as installed/used on the project on any calendar day or portion thereof within the Contract Time. Payment will be made for up to two inactive days where the arrow board is used on the two days preceding and following the inactive days as authorized by the Engineer. Payment for additional days may be authorized by the Engineer due to inclement weather.

SUBARTICLE 102-11.14 is deleted and the following substituted:

102-11.14 Portable Changeable Message Sign: The quantity to be paid at the Contract unit price will be for the number of PCMSs or truck mounted changeable message signs certified as installed/used on the project on any calendar day or portion thereof within the Contract Time. Payment will be made for each portable changeable message sign that is used during the period beginning fourteen working days before Contract Time begins as authorized by the Engineer. Payment will be made for up to two inactive days where the portable changeable message sign is used on the two days preceding and following the inactive days as authorized by the Engineer. Payment for additional days may be authorized by the Engineer due to inclement weather.

SUBARTICLE 102-11.15 is deleted and the following substituted:

102-11.15 Portable Regulatory Signs: The quantity to be paid for will be the number of portable regulatory signs certified as installed/used on the project on any calendar day or portion thereof within the Contract Time, will be paid for the Contract unit price for portable regulatory sign. Payment will be made for up to two inactive days where the portable regulatory sign is used on the two days preceding and following the inactive days as authorized by the Engineer. Payment for additional days may be authorized by the Engineer due to inclement weather.

SUBARTICLE 102-11.16 is deleted and the following substituted:

102-11.16 Radar Speed Display Unit: The quantity to be paid for will be the number of radar speed display units certified as installed/used on the project on any calendar day or portion thereof within the Contract Time, will be paid for the Contract unit price for radar speed display unit. Payment will be made for up to two inactive days where the radar speed display unit is used on the two days preceding and following the inactive days as authorized by the Engineer. Payment for additional days may be authorized by the Engineer due to inclement weather.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 8, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **105**
Proposed Specification: **1050100 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Dino Jameson from the State Materials Office to add language to record QC density test results into the Earthwork Records System section of the Department's database.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS
(REV 7-28-22)

ARTICLE 105-1 is deleted and the following substituted:

105-1 General.

105-1.1 Quality Control Documentation:

105-1.1.1 Submission of Materials Certification and Reporting Test Results: Submit certifications prior to placement of materials. Report test results at completion of the test and meet the requirements of the applicable Specifications.

105-1.1.2 Databases: Obtain access to the Department's databases prior to testing and material placement. Database access information is available through the Department's website. Enter all required and specified documentation and test results into the Department's databases.

105-1.1.3 Worksheets: Make available to the Department, when requested, worksheets used for collecting test information. Ensure the worksheets at a minimum contain the following:

1. Project Identification Number,
2. Time and Date,
3. Laboratory Identification and Name,
4. Training Identification Numbers (TIN) and initials,
5. Record details as specified within the test method.

105-1.1.4 Earthwork Records System: Record QC test results directly into the Earthwork Records System (ERS) section of the Department's database. If authorized by the Engineer due to ERS inaccessibility in the field, collect the data in the field on Department approved forms and enter the data in the ERS section of the Department's database. Submit the original forms by uploading into the Department's database.

105-1.2 Inspections to Assure Compliance with Acceptance Criteria:

105-1.2.1 General: The Department is not obligated to make an inspection of materials at the source of supply, manufacture, or fabrication. Provide the Engineer with unrestricted entry at all times to such parts of the facilities that concern the manufacture, fabrication, or production of the ordered materials. Bear all costs incurred in determining whether the material meets the requirements of these Specifications.

105-1.2.2 Quality Control (QC) Inspection: Provide all necessary inspection to assure effective QC of the operations related to materials acceptance. This includes but is not limited to sampling and testing, production, storage, delivery, construction and placement. Ensure that the equipment used in the production and testing of the materials provides accurate and precise measurements in accordance with the applicable Specifications. Maintain a record of all inspections, including but not limited to, date of inspection, results of inspection, and any subsequent corrective actions taken. Make available to the Department the inspection records, when requested.

105-1.2.3 Notification of Placing Order: Order materials sufficiently in advance of their incorporation in the work to allow time for sampling, testing and inspection. Notify the Engineer prior to placing orders for materials.

Submit to the Engineer a fabrication schedule for all items requiring commercial inspection at least 30 days before beginning fabrication. These items include steel

bridge components, moveable bridge components, pedestrian bridges, castings, forgings, structures erected either partially or completely over the travelled roadway or mounted on bridges as overhead traffic signs (some of these may be further classified as cantilevered, overhead trusses, or monotubes) or any other item identified as an item requiring commercial inspection in the Contract Documents.

SUBARTICLE 105-8.2 is deleted and the following substituted:

105-8.2 Quality Control (QC) Manager: Designate a QC Manager who has full authority to act as the Contractor's agent to institute any and all actions necessary to administer, implement, monitor, and as necessary, adjust quality control processes to ensure compliance with the Contract Documents. The QC Manager must speak and understand English. The QC Manager must be on-site at the project on a daily basis or always available upon four hours' notice. Ensure that the QC Manager is qualified as such through the Construction Training and Qualification Program. The QC Manager and the Superintendent must not be the same individual.

Under the direction of the QC Manager, ensure that the QC test data is entered into the Department's database on a daily basis. Use Department approved programs to generate the plots for the ~~Earthwork Records System (~~ERS~~)~~. Maintain all QC related reports and documentation for a period of three years from final acceptance of the project. Make copies available for review by the Department upon request.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 5, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **105**
Proposed Specification: **1050404 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Tim Counts to include Sections 2.4 and 3.5 of the Materials Manual Volume II and updated the language to be consistent with recent changes to CTQM Chapter 4.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS
(REV 10-1-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Polymer Slurry shall meet the requirements of Section 2.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/implemented/URLinSpecs/Section24V2.shtm.

Producers of Asphalt Binder shall meet the requirements of Section 3.5, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/implemented/URLinspecs/Section35V2.shtm.

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm. https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Specialty Engineers preparing, submitting, and implementing Mass Concrete Control Plans shall meet the requirements of Section 9.4 Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section94V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

SUBARTICLE 105-8.7.3 is deleted and the following substituted:

105-8.7.3 Qualified Testing Technicians: Ensure that the testing technicians have the following certifications, as appropriate:

1. ACI Concrete Field Testing Technician Grade I, for personnel performing concrete plastic property tests and ACI Self-Consolidating Concrete Testing Technician if testing self-consolidating concrete (SCC).
2. ACI Concrete Strength Testing Technician, for personnel performing tests on hardened properties of concrete.

SUBARTICLE 105-8.8 is deleted and the following substituted:

105-8.8 Prestressed Concrete Plant Quality Control (QC) Personnel: Obtain personnel certifications from Department accredited training providers. The list of Department approved courses and their accredited providers is available on the SMO website at the following URL:https://www.fdot.gov/materials/administration/resources/training/structural/concrete-prestressed.shtm.

Ensure each prestressed concrete plant has an onsite production manager, an onsite plant QC manager, a plant engineer, and adequate onsite ~~QC inspectors/technicians~~QC testing personnel to provide complete QC inspections and testing.

105-8.8.1 Plant QC Manager: Ensure the plant QC manager ~~for QC~~ has at least five years of related experience and the following certifications:

1. ACI Concrete Field Testing Technician Grade I certification.
2. PCI QC Personnel Certification Level III.
3. CTQP Prestressed Concrete Field Inspector/Technician certificate.~~Certificate of completion of Section 450 Specification examination~~

105-8.8.2 QC Inspector/Technician: Ensure that the QC inspector/technician has the following certifications:

1. ACI Concrete Field Testing Technician Grade I certification.
2. PCI QC Personnel Certification Level II.
3. CTQP Prestressed Concrete Field Inspector/Technician certificate~~Certificate of completion of Section 450 Specification examination~~.

105-8.8.3 QC Concrete Central Mix Testing Technician:~~**1 Additional Requirements for Quality Control (QC) Personnel of Prestressed Manufacturing Facilities:**~~

~~**105-8.8.1.1 Testing Personnel:**~~ Ensure that QC testing personnel ~~technicians~~ meet the requirement of 105-8.7.3.

~~**105-8.8.4**~~**1.2 Batch Plant Operator:** Ensure that the batch plant operator meets the requirement of 105-8.7.4.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 1, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section **105**
Proposed Specification: **1050404MM34V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated June 16, 2022, to the Materials Manual for Section 3.4, Volume II, Asphalt Emulsion. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS
(REV 6-16-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Asphalt Emulsion shall meet the requirements of Section 3.4 Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/implemented/URLinSpecs/Section34V2.shtm.

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:

https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 1, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section **105**
Proposed Specification: **1050404MM62V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated June 16, 2022, to the Materials Manual for Section 6.2, Volume II, Precast Concrete Pipe. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS
(REV 6-16-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.
~~https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.~~

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 8, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section **105**
Proposed Specification: **1050404MM63V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated June 17, 2022, to the Materials Manual for Section 6.3, Volume II, Precast Concrete Drainage Structures and Box Culverts. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS
(REV 6-17-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.
~~https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.~~

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

July 28, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section **105**
Proposed Specification: **1050404MM81V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated June 8, 2022, to the Materials Manual for Section 8.1, Volume II, Precast/Prestressed Concrete Products. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS
(REV 6-8-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
~~https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.~~
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 7, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section **105**
Proposed Specification: **1050404MM82V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated June 17, 2022, to the Materials Manual for Section 8.2, Volume II, Incidental Precast Concrete Products. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS
(REV 6-17-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.
~~https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.~~

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **105**
Proposed Specification: **1050404MM84V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated July 22, 2022, to the Materials Manual for Section 8.4, Volume II, Self-Consolidating Concrete (SCC) For Precast/Prestressed Concrete Products. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS
(REV 7-22-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.
~~https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm~~

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.

https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **105**
Proposed Specification: **1050404MM86V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated July 22, 2022, to the Materials Manual for Section 8.6, Volume II, Flowing Concrete For Precast/Prestressed Concrete Products. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS.
(REV 7-22-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.
~~https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.~~

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.

https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **105**
Proposed Specification: **1050404MM92V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated July 7, 2022, to the Materials Manual for Section 9.2, Volume II, Structural Concrete Production Facilities Guide. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS
(REV 7-7-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.
~~https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.~~

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.

https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 18, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section **105**
Proposed Specification: **1050404MM93V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated July 22, 2022, to the Materials Manual for Section 9.3, Volume 2, Concrete Pavement Production Facilities Guide. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS.
(REV 7-22-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.
~~https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.~~

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 11, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section **105**
Proposed Specification: **1050404MM94V2 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are sending you proposed revisions, dated August 1, 2022, to the Materials Manual for Section 9.4, Volume II, Mass Concrete Plan. These revisions were proposed by the State Materials Office.

Use the temporary link in the attached document to access the redlined version and provide comments.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS.
(REV 8-1-22)

SUBARTICLE 105-4.4 is deleted and the following substituted:

105-4.4 Compliance with the Materials Manual:

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section84V2.shtm.

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section86V2.shtm.

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Specialty Engineers preparing, submitting, and implementing Mass Concrete Control Plans shall meet the requirements of Section 9.4 Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section94V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 8, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **105**
Proposed Specification: **1050807 Contractor Quality Control General Requirements.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Thomas Frank from the State Materials Office to include the American Concrete Pipe Association (ACPA) Concrete Pipe/Precast Box Culvert Batch Plant Operator certification as an option for dry-cast concrete production.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS.
(REV 6-2-22)

SUBARTICLE 105-8.7.4 is deleted and the following substituted:

105-8.7.4 Concrete Batch Plant Operator: Ensure that the concrete batch plant operator has a CTQP Concrete Batch Plant Operator Certification. As an alternative, the Department will accept the following certifications:

a. Precast Concrete Structures Association (PCSA) Batch Plant Operator,

b. NRMCA Certified Concrete Technologist Level 3, or

c. NRMCA Plant Manager Certification.

For dry cast concrete pipe and dry cast drainage structures/box culverts, the Department will accept American Concrete Pipe Association (ACPA) Concrete Pipe/Precast Box Culvert Batch Plant Operator or Quality School Certification.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 7, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **320**
Proposed Specification: **3200300 Hot Mix Asphalt - Plant Methods and Equipment.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Richard Hewitt to allow the contractor to use electronic ticketing (e-ticketing) for asphalt in lieu of paper tickets. This revision is associated with proposed 3300201. The additional changes are proposed by Wayne Rilko to change the time period for truck scale checks and revise maximum binder temperature in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

HOT MIX ASPHALT - PLANT METHODS AND EQUIPMENT.
(REV ~~7~~9-~~25~~6-22)

ARTICLE 320-3 is deleted and the following substituted:

320-3 Requirements for All Plants.

320-3.1 General: Design, manufacture, coordinate, and operate the asphalt plant in a manner that will consistently produce a mixture within the required tolerances and temperatures specified.

320-3.2 Asphalt Plant Ticketing Systems: Use either a paper ticketing system or an electronic ticketing (E-Ticketing) system.

320-3.2.1 Electronic Weigh Systems for Paper Ticketing: Equip the asphalt plant with an electronic weigh system that has an automatic printout, is certified every six months by an approved certified scale technician, and meets monthly comparison checks with certified truck scales as specified in 320-3.2.1.4. Weigh all plant produced hot mix asphalt on the electronic weigh system, regardless of the method of measurement for payment.

Include, as a minimum, the following information on the printed delivery ticket:

1. Sequential load number
2. Project number
3. Date
4. Name and location of plant
5. Mix design number
6. Place for hand-recording mix temperature
7. Truck number
8. Gross, tare, and net tonnage per truck (as applicable)
9. Daily total tonnage of mix for the mix design

Print the delivery ticket with an original and at least one copy. Furnish the original to the Engineer at the plant and one copy to the Engineer at the paving site.

Utilize any one of the following three electronic weigh systems.

320-3.2.1.1 Electronic Weigh System on the Truck Scales: Provide an electronic weigh system on all truck scales, which is equipped with an automatic recordation system that is approved by the Engineer. Use scales of the type that directly indicate the total weight of the loaded truck. Use scales meeting the requirements for accuracy, condition, etc., of the Bureau of Weights and Measures of the Florida Department of Agriculture, and re-certify such fact every six months, either by the Bureau of Weights and Measures or by a registered scale technician.

320-3.2.1.2 Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin: Provide an electronic weigh system on the hopper (hopper scales or load cells) beneath the surge or storage bin, which is equipped with an automatic recordation system approved by the Engineer.

320-3.2.1.3 Automatic Batch Plants with Printout: For batch plants, provide an approved automatic printer system which will print the individual or cumulative weights of aggregate and liquid asphalt delivered to the pugmill and the total net weight of the asphalt mix measured by hopper scales or load cell type scales. Use the automatic printer system only in conjunction with automatic batching and mixing control systems that have been approved by the Engineer.

320-3.2.1.4 Monthly Electronic Weigh System Comparison Checks: Check the accuracy of the electronic weighing system at the commencement of production and thereafter ~~at least every 30 days during production~~ by one of the following two methods and maintain a record of the weights in the Scale Check Worksheet. The time period between scale checks shall not exceed 35 calendar days.

320-3.2.1.4.1 Electronic Weigh System on Truck Scales:

1. The Engineer will randomly select a loaded truck of asphalt mix, a loaded aggregate haul truck, or another vehicle type approved by the Engineer and record the truck number and gross weight from the Contractor's delivery ticket.

2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

3. The gross weight of the loaded truck as shown on the Contractor's delivery ticket will be compared to the gross weight of the loaded truck from the other certified truck scale. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

4. If the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks, a fuel adjustment may be calculated by using the truck odometer readings for the distance measurement, and 6.1 miles per gallon for the fuel consumption rate, and 115 ounces per gallon for fuel weight.

5. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to weigh the truck on his certified scales used during production and then weigh it on another certified truck scale, as soon the other scale is available for the comparison checks.

In addition to the periodic checks as specified above, check the scales at any time the accuracy of the scales becomes questionable. When such inaccuracy does not appear to be sufficient to seriously affect the weighing operations, the Engineer will allow a period of two calendar days for the Contractor to conduct the required scale check. However, in the event the indicated inaccuracy is sufficient to seriously affect the mixture, the Engineer may require immediate shut-down until the accuracy of the scales has been checked and necessary corrections have been made. Include the cost of all scale checks in the bid price for asphalt concrete, at no additional cost to the Department.

320-3.2.1.4.2. Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin and Automatic Batch Plants with Printout:

1. The Engineer will randomly select a loaded truck of asphalt mix and record the truck number, and the net weight of the asphalt mix from the Contractor's delivery ticket.

2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

3. Deliver the asphalt mix to the project, then weigh the selected empty truck on the same certified truck scales. Record the tare weight of the truck.

4. Compare the net weight of the asphalt mix from the delivery ticket to the calculated net weight of the asphalt mix as determined by the certified truck scale weights. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

5. Use the fuel adjustment as specified in 320-3.2.4.1(4), when the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks.

6. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to load a truck with aggregate from the pugmill, surge or storage bin, and follow the above procedures to conduct the comparison checks as soon as certified truck scale is available.

If the check shows a greater difference than the tolerance specified above, then recheck on a second set of certified scales. If the check and recheck indicate that the printed weight is out of tolerance, have a certified scale technician check the electronic weigh system and certify the accuracy of the printer. While the system is out of tolerance and before its adjustment, the Engineer may allow the Contractor to continue production only if provisions are made to use a set of certified truck scales to determine the truck weights.

320-3.2.2 Electronic Weigh Systems for E-Ticketing: Equip the asphalt plant with an electronic weigh system that has an automatic printout, is certified every six months by an approved certified scale technician, and meets monthly comparison checks with certified truck scales as specified in 320-3.2.2.3. Weigh all plant produced hot mix asphalt on the electronic weigh system, regardless of the method of measurement for payment.

Include, as a minimum, the following information in the electronic delivery ticket:

1. Sequential load number
2. Project's Financial Identification Number (FIN)
3. Date
4. Name and location of plant
5. Mix design number
6. Separate, individual, data entry locations for recording mix temperature by:
    a. Plant QC
    b. Plant VT
    c. Roadway QC
    d. Roadway VT
7. Truck number
8. Gross, tare, and net tonnage per truck
9. Daily cumulative tonnage of mix for the mix design

320-3.2.2.1 Electronic Ticketing (E-Ticketing) System: Provide an e-Ticketing System (including any necessary software and hardware) capable of monitoring, collecting, storing, and reporting the information required by the Contract for all loads of asphalt mix delivered to the project. After each truck is loaded, electronically record and use a web service to upload the ticket information to the E-ticketing software database. The E-ticketing system shall provide each truck load's ticket information to users of the e-ticketing software.

E-ticketing software must provide the Engineer the ability to access real-time monitoring of asphalt truck load ticket information as described herein.

The e-Ticketing system shall be integrated with the Load Read-Out scale system at the asphalt plant site.

The e-ticketing system shall have offline capabilities to prevent data loss in the event of power loss or loss of connectivity.

320-3.2.2.1.1 E-Ticketing System Construction Requirements: Install and operate equipment in accordance with the manufacturer's specifications.

320-3.2.2.1.2 Data Deliverables: Provide to the Engineer a means of gathering report summaries by way of iOS or Android apps, web pages, or any other method at the disposal of the Engineer. The Engineer may request data at any time during paving operations. In addition to providing reports referenced in this specification, provide monthly reports, as well as, a final, end of project report in the e-ticketing software and in a comma separated value (.csv) file. Provide all e-ticketing database data required in this Section in the monthly and end of project reports and .csv files.

320-3.2.2.1.3 Real-Time Continuous e-Ticketing Data Items: Provide the Engineer access to the e-Ticketing system data viewer which displays the following information in real-time with a web-based or App-based system compatible with iOS, Windows, or Android environments:

1. Each Truck:
    a. Unique Truck ID
    b. Sequential Truck Load Number
    c. Mix Design Number
    d. Net Weight of material being transported (to the nearest 0.01 ton)
    e. Running Daily Total of Net Weight of material being transported (to the nearest 0.01 ton)
    f. Project's Financial Identification Number
2. Project Location

320-3.2.2.1.4 Daily Summary: Provide the following summary information to the Engineer electronically within 4 hours of beginning operations on the next working day:

1. List of Individual Loads
    a. Contractor Name
    b. Project's Financial Identification Number (FIN)
    c. Unique Truck ID
    d. Sequential Load Number
    e. Net Weight for Payment (nearest 0.01 tons)
    f. Net Weight of Waste (nearest 0.01 tons)
    g. Date Paved
    h. Mix Temperature Measurements (Plant QC, Plant VT, Roadway QC, and Roadway VT)
    i. Time Loaded at Plant site

320-3.2.2.2 Electronic Weigh Systems: Utilize any one of the following three electronic weigh systems.

320-3.2.2.2.1 Electronic Weigh System on the Truck Scales: Provide an electronic weigh system on all truck scales, which is equipped with an automatic recordation system that is approved by the Engineer. Use scales of the type that directly indicate

the total weight of the loaded truck. Use scales meeting the requirements for accuracy, condition, etc., of the Bureau of Weights and Measures of the Florida Department of Agriculture, and re-certify such fact every six months, either by the Bureau of Weights and Measures or by a registered scale technician.

320-3.2.2.2.2 Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin: Provide an electronic weigh system on the hopper (hopper scales or load cells) beneath the surge or storage bin, which is equipped with an automatic recordation system approved by the Engineer.

320-3.2.2.2.3 Automatic Batch Plants: For batch plants, provide an electronic weigh system, which is equipped with an automatic recordation system, that is approved by the Engineer, which will directly indicate the individual or cumulative weights of aggregate and liquid asphalt delivered to the pugmill and the total net weight of the asphalt mix measured by hopper scales or load cell type scales. Use the electronic systems only in conjunction with automatic batching and mixing control systems that have been approved by the Engineer.

320-3.2.2.3 Monthly Electronic Weigh System Comparison Checks: Check the accuracy of the electronic weighing system at the commencement of production and thereafter by one of the following three methods and maintain a record of the weights in the Scale Check Worksheet. The time period between scale checks shall not exceed 35 calendar days.

320-3.2.2.3.1 Electronic Weigh System on Truck Scales:

1. The Engineer will randomly select a loaded truck of asphalt mix, a loaded aggregate haul truck, or another vehicle type approved by the Engineer and record the truck number and gross weight from the Contractor's delivery ticket.

2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

3. The gross weight of the loaded truck as shown on the Contractor's delivery ticket will be compared to the gross weight of the loaded truck from the other certified truck scale. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

4. If the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks, a fuel adjustment may be calculated by using the truck odometer readings for the distance measurement, and 6.1 miles per gallon for the fuel consumption rate, and 115 ounces per gallon for fuel weight.

5. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to weigh the truck on his certified scales used during production and then weigh it on another certified truck scale, as soon as the other scale is available for the comparison checks.

In addition to the periodic checks as specified above, check the scales at any time the accuracy of the scales becomes questionable. When such inaccuracy does not appear to be sufficient to seriously affect the weighing operations, the Engineer will allow a period of two calendar days for the Contractor to conduct the required scale check. However, in the event the indicated inaccuracy is sufficient to seriously affect the mixture, the Engineer may

require immediate shut-down until the accuracy of the scales has been checked and necessary corrections have been made. Include the cost of all scale checks in the bid price for asphalt concrete, at no additional cost to the Department.

320-3.2.2.3.2 Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin:

1. The Engineer will randomly select a loaded truck of asphalt mix and record the truck number, and the net weight of the asphalt mix from the Contractor's delivery ticket.

2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

3. Deliver the asphalt mix to the project, then weigh the selected empty truck on the same certified truck scales. Record the tare weight of the truck.

4. Compare the net weight of the asphalt mix from the delivery ticket to the calculated net weight of the asphalt mix as determined by the certified truck scale weights. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

5. Use the fuel adjustment as specified in 320-3.2.2.3.1(4), when the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks.

6. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to load a truck with aggregate from the pugmill, surge or storage bin, and follow the above procedures to conduct the comparison checks as soon as certified truck scale is available.

If the check shows a greater difference than the tolerance specified above, then recheck on a second set of certified scales. If the check and recheck indicate that the printed weight is out of tolerance, have a certified scale technician check the electronic weigh system and certify the accuracy of the printer. While the system is out of tolerance and before its adjustment, the Engineer may allow the Contractor to continue production only if provisions are made to use a set of certified truck scales to determine the truck weights.

320-3.2.2.3.3 Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin and Automatic Batch Plants with Printout:

1. The Engineer will randomly select a loaded truck of asphalt mix and record the truck number, and the net weight of the asphalt mix from the Contractor's delivery ticket.

2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

3. Deliver the asphalt mix to the project, then weigh the selected empty truck on the same certified truck scales. Record the tare weight of the truck.

4. Compare the net weight of the asphalt mix from the delivery ticket to the calculated net weight of the asphalt mix as determined by the certified truck scale weights. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

5. Use the fuel adjustment as specified in 320-3.2.1.4.1(4), when the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks.

6. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to load a truck with aggregate from the pugmill, surge or storage bin, and follow the above procedures to conduct the comparison checks as soon as certified truck scale is available.

If the check shows a greater difference than the tolerance specified above, then recheck on a second set of certified scales. If the check and recheck indicate that the weight on the E-Ticket is out of tolerance, have a certified scale technician check the electronic weigh system and certify the accuracy of the E-Ticketing system. While the system is out of tolerance and before its adjustment, the Engineer may allow the Contractor to continue production only if provisions are made to use a set of certified truck scales to determine the truck weights.

320-3.3 Asphalt Binder: Meet the following requirements:

320-3.3.1 Transportation: Deliver the asphalt binder to the asphalt plant at a temperature not to exceed 370°F, and equip the transport tanks with sampling and temperature sensing devices meeting the requirements of 300-3.2.

320-3.3.2 Storage: Equip asphalt binder storage tanks to heat the liquid asphalt binder to the temperatures required for the various mixtures. Heat the material in such a manner that no flame comes in contact with the binder. Heat or insulate all pipe lines and fittings. Use a circulating system of adequate size to ensure proper and continuous circulation during the entire operating period. Locate a thermometer, reading from 200 to 400°F, either in the storage tank or in the asphalt binder feed line. Maintain the asphalt binder in storage within a range of 230 to ~~370~~355°F in advance of mixing operations. Locate a sampling device on the discharge piping exiting the storage tank or at a location as approved by the Engineer. Provide a metal can of one quart capacity for binder sampling at the request of the Engineer.

320-3.4 Aggregate: Meet the following requirements:

320-3.4.1 Stockpiles: Place each aggregate component in an individual stockpile, and separate each from the adjacent stockpiles, either by space or by a system of bulkheads. Prevent the intermingling of different materials in stockpiles at all times. Identify each stockpile, including RAP, as shown on the mix design.

Form and maintain stockpiles in a manner that will prevent segregation. If a stockpile is determined to be segregated, discontinue the use of the material on the project until the appropriate actions have been taken to correct the problem.

320-3.4.2 Blending of Aggregates: Stockpile all aggregates prior to blending or placing in the cold feed bins. If mineral filler or hydrated lime is required in the mix, feed or weigh it in separately from the other aggregates.

320-3.4.2.1 Cold Feed Bin: Provide a separate cold feed bin for each component of the fine and coarse aggregate required by the mix design. Equip the cold feed bins with accurate mechanical means for feeding the aggregate uniformly into the dryer in the proportions required for the finished mix to maintain uniform production and temperature. When using RAP as a component material, prevent any oversized RAP from being incorporated into the completed mixture by the use of: a grizzly or grid over the RAP bin; in-line roller or impact crusher; screen; or other suitable means. If oversized RAP material appears in the completed

recycled mix, take the appropriate corrective action immediately. If the appropriate corrective actions are not immediately taken, stop plant operations.

Use separate bin compartments in the cold aggregate feeder that are constructed to prevent any spilling or leakage of aggregate from one cold feed bin to another. Ensure that each cold feed bin compartment has the capacity and design to permit a uniform flow of aggregates. Mount all cold feed bin compartments over a feeder of uniform speed, which will deliver the specified proportions of the separate aggregates to the drier at all times. If necessary, equip the cold feed bins with vibrators to ensure a uniform flow of the aggregates at all times.

320-3.4.2.2 Gates and Feeder Belts: Provide each cold feed bin compartment with a gate and feeder belt, both of which are adjustable to assure the aggregate is proportioned to meet the requirements of the mix design.

320-3.4.3 Screening Unit: Remove any oversized pieces of aggregate by the use of a scalping screen. Do not return this oversized material to the stockpile for reuse unless it has been crushed and reprocessed into sizes that will pass the scalping screen. Ensure that the quantity of aggregates being discharged onto the screens does not exceed the capacity of the screens to actually separate the aggregates into the required sizes.

320-3.5 Dryer: Provide a dryer of satisfactory design for heating and drying the aggregate. Use a dryer capable of heating the aggregate to within the specified temperature range for any mix, and equip the dryer with an electric pyrometer placed at the discharge chute to automatically register the temperature of the heated aggregates.

320-3.6 Asphalt Binder Control Unit: Provide a satisfactory means, either by weighing, metering, or volumetric measuring, to obtain the proper amount of asphalt binder material in the mix, within the tolerance specified for the mix design.

320-3.7 Contractor's Responsibilities: Acceptance of any automatic delivery ticket printout, electronic weight delivery ticket, other evidence of weight of the materials or approval of any particular type of material or production method will not constitute agreement by the Department that such matters are in accordance with the Contract Documents and it shall be the Contractor's responsibility to ensure that the materials delivered to the project are in accordance with the Contract Documents.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 6, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **330**
Proposed Specification: **3300201 Hot Mix Asphalt - General Construction Requirements.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Richard Hewitt to allow the contractor to use electronic ticketing (e-ticketing) for asphalt in lieu of paper tickets in the Standard Specification. This revision is associated with proposed 3200300.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

HOT MIX ASPHALT - GENERAL CONSTRUCTION REQUIREMENTS.
(REV 6-9-22)

SUBARTICLE 330-2.1 is deleted and the following substituted:

330-2 Quality Control (QC) Requirements.

330-2.1 Minimum QC Requirements: Perform as a minimum, the following activities necessary to maintain process control and meet Specification requirements:

1. Pavement Density: Monitor the pavement temperature with an infrared temperature device so compaction is completed before the surface temperature of the pavement drops to the extent that effective compaction may not be achieved or the rollers begin to damage the pavement. Monitor the roadway density with either 6-inch diameter roadway cores, a nuclear density gauge, or other density measuring device, at a minimum frequency of once per 1,500 feet of pavement.

2. Mix Temperature: Determine the mix temperature at the roadway for the first five loads and one out of every five loads thereafter.

3. Mix Spread Rate: Monitor the mix spread rate at the beginning of each day's production, and as needed to control the operations, at a minimum of once per 200 tons placed. When determining the spread rate, use, at a minimum, an average of five truckloads of mix.

4. Pavement Texture: Monitor the pavement texture to minimize pavement segregation. Use density gauges, infrared temperature measurement devices, or roadway cores at the beginning of each day's production, and as necessary, both at truck exchanges and during normal paving operations.

5. Reporting: Ensure the accuracy of the QC Roadway Reports on the Department's approved form to reflect the actual surface area of the finished work and be in compliance with the requirements of the Contract Documents.

6. Electronic Ticketing (E-Ticketing): When E-Ticketing is used, provide a tablet computer on site with the Paving Operation capable of running the E-Ticketing system software outlined in Section 320. Use the E-ticketing software to obtain truck ticket information and record mix temperatures. Use the E-ticketing data for entry into the Asphalt Roadway – Daily Report of Quality Control.

330-2.2 Personnel Qualifications: Provide QC Technicians in accordance with Section 105.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 6, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **330**
Proposed Specification: **3300601 Hot Mix Asphalt - General Construction Requirements.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Richard Hewitt to make the average spreadrate tolerance consistent with maximum pay quantity tolerance in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

HOT MIX ASPHALT - GENERAL CONSTRUCTION REQUIREMENTS.
(REV 6-9-22)

SUBARTICLE 330-6.1 is deleted and the following substituted:

330-6 Placing Mixture.

330-6.1 Requirements Applicable to All Pavement Types:

330-6.1.1 Alignment of Edges: Place all asphalt mixtures by the stringline method to obtain an accurate, uniform alignment of the pavement edge. As an exception, pavement edges adjacent to curb and gutter or other true edges do not require a stringline. Control the unsupported pavement edge to ensure it will not deviate from the stringline more than plus or minus 1.5 inches.

330-6.1.2 Paving Width: If necessary due to the traffic requirements, place the mixture in strips in such a manner as to provide for the passage of traffic. As an option, where the road is closed to traffic, place the mixture to the full width with machines traveling in echelon.

330-6.1.3 Mix Temperature: Maintain the mix temperature at the time of paving within the master range as defined in 320-6.3. Take mix temperatures on the roadway at the minimum frequency indicated in 320-6.3. Any load, or portion of a load, of asphalt mix on the roadway with a temperature outside of the master range shall be rejected for use on the project. Immediately notify the Engineer of the rejection.

Remove any windrow material not meeting the temperature requirements of 320-6.3.2 from the area of deficient temperature and replace with new asphalt meeting the temperature requirements.

330-6.1.4 Speed of Paver: Establish the forward speed of the asphalt paver based on the rate of delivery of the mix to the roadway, but not faster than the optimum speed needed to adequately compact the pavement.

330-6.1.5 Thickness and Spread Rate of Layers: Construct each layer as defined in the following Table 330-2:

Table 330-2	
Thickness and Target Spread Rate Requirements	
Mix Type	Specification Section and Article
Type SP	334-1
Type FC	337-8
Type B	234-8
ATPB	287-8

330-6.1.5.1 Thickness Control: Ensure the spread rate is within plus or minus ~~5~~10% of the target spread rate. When determining the spread rate, use, at a minimum, an average of five truckloads of mix and at a maximum, an average of 10 truckloads of mix, except for windrow paving, use an average of three truckloads of mix. When the average spread rate is beyond plus or minus ~~5~~10% of the target spread rate, monitor the thickness of the pavement layer closely and adjust the construction operations.

When the average spread rate for two consecutive days is beyond plus or minus ~~5~~10% of the target spread rate, stop the construction operation until the issue is resolved.

330-6.1.5.2 Maximum Spread Rate Tolerances: When an individual spread rate, measured in accordance with 330-6.1.5.1, is beyond plus or minus 20% of the target spread rate, stop the construction operation until the issue is resolved. Address the unacceptable pavement in accordance with 330-9.5. The following areas are exempt from a work stoppage based solely on the calculated spread rate: median crossovers, turnouts, variable thickness overbuild courses, leveling courses, miscellaneous asphalt pavement, as well as, turn lanes and ramps less than 1,000 feet.

As an exception, the Engineer may allow the Contractor to leave areas in place if it is determined by the Engineer that the deficiency is not a significant detriment to the pavement quality. For areas of deficient thickness, a reduction to the pay item quantity will be made in accordance with 330-9.5.2.

330-6.1.6 Correcting Defects: Before starting any rolling, check the surface; correct any irregularities; remove all drippings, sand accumulations from the screed, and fat spots from any source; and replace them with satisfactory material. Do not skin patch. When correcting a depression while the mixture is hot, scarify the surface and add fresh mixture.

330-6.1.7 Hand Work: In limited areas where the use of the paver is impossible or impracticable, the Contractor may place and finish the mixture by hand.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 7, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **334**
Proposed Specification: **3340104 Superpave Asphalt Concrete.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Wayne Rilko from the State Materials Office to allow the use of SP-9.5 mm mixtures in Traffic Level E applications and delete language prohibiting the use of more than four mix designs per year in the Standard Specification. This revision is associated with revision 3370303.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

SUPERPAVE ASPHALT CONCRETE.
(REV 8-2-22)

SUBARTICLE 334-1.4 is deleted and the following substituted:

334-1.4 Thickness: The total thickness of the Type SP asphalt layers will be the plan thickness as shown in the Contract Documents. Before paving, propose a thickness for each individual layer meeting the requirements of this specification, which when combined with other layers (as applicable) will equal the plan thickness. For construction purposes, the plan thickness and individual layer thickness will be converted to spread rate based on the maximum specific gravity of the asphalt mix being used, as well as the minimum density level, as shown in the following equation:

$$\text{Spread rate (lb/yd}^2\text{)} = t \times G_{mm} \times 43.3$$

Where: t = Thickness (in.) (plan thickness or individual layer thickness)

G_{mm} = Maximum specific gravity from the verified mix design

The weight of the mixture shall be determined as provided in 320-3.2. For target purposes only, spread rate calculations should be rounded to the nearest whole number.

Note: Plan quantities are based on a G_{mm} of 2.540, corresponding to a spread rate of 110 lb/yd^2-in. Pay quantities will be based on the actual maximum specific gravity of the mix being used.

334-1.4.1 Layer Thicknesses: The allowable layer thicknesses for Type SP Asphalt Concrete mixtures are as follows:

Type SP-9.5.....1 to 1-1/2 inches
Type SP-12.5.....1-1/2 to 3 inches
Type SP-19.0..... 2 to 4 inches

In addition to the minimum and maximum thickness requirements, the following restrictions are placed on mixes when used as a structural course:

Type SP-9.5 - Limited to the top two structural layers, two layers maximum.

Type SP-9.5 - Do not ~~use~~place less than 1-1/2 inches thick for Traffic Level -E applications.

Type SP-19.0 - Do not use for the final (top) structural layer below FC-5 mixtures. Type SP-19.0 mixtures are permissible for the layer directly below FC-9.5 and FC-12.5 mixtures. Do not use for the final (top) layer of shoulders.

334-1.4.2 Additional Requirements: The following requirements also apply to Type SP Asphalt Concrete mixtures:

1. A minimum 1-1/2 inch initial lift is required over an Asphalt Membrane Interlayer (AMI).

2. When construction includes the paving of adjacent shoulders (less than or equal to 5 feet wide), the layer thickness for the upper pavement layer and shoulder must be the same and paved in a single pass, unless called for differently in the Contract Documents.

3. All overbuild layers must be Type SP Asphalt Concrete designed at the traffic level as stated in the Contract Documents. Use the minimum and maximum layer thicknesses as specified above unless called for differently in the Contract Documents. On variable thickness overbuild layers, the minimum and maximum allowable thicknesses will be as specified below, unless called for differently in the Contract Documents.

Type SP-9.5..... 3/8 to 2 inches
Type SP-12.5..... 1/2 to 3 inches
Type SP-19.0.....1-1/2 to 4 inches

4. Variable thickness overbuild layers constructed using a Type SP-9.5 or SP-12.5 mixtures may be tapered to zero thickness provided the contract documents require a minimum of 1-1/2 inches of dense-graded mix placed over the variable thickness overbuild layer.

SUBARTICLE 334-3.2 is deleted and the following substituted:

334-3.2 Mix Design:

334-3.2.1 General: Design the asphalt mixture in accordance with AASHTO R 35, except as noted herein. Prior to the production of any asphalt mixture, submit the proposed mix design with supporting test data indicating compliance with all mix design criteria to the Engineer. For all mix designs, include representative samples of all component materials, including asphalt binder. Allow the Director of the Office of Materials a maximum of four weeks to either conditionally verify or reject the mix as designed.

At no additional cost to the Department, for a Type SP mix the following Traffic Level substitutions are allowed:

Traffic Level E can be substituted for Traffic Level C.
Traffic Level C can be substituted for Traffic Level B.

The same traffic level and binder type that is used for the mainline traffic lanes may be placed in the shoulder at no additional cost to the Department, even if the conditions stated above are not met for the shoulder.

~~Do not use more than four mix designs per nominal maximum aggregate size per traffic level per binder grade per year, where the year starts at the Notice to Proceed. Exceeding this limitation will result in a maximum Composite Pay Factor (CPF) of 1.00 as defined in 334-8.2 for all designs used beyond this limit.~~

Warm mix technologies (additives, foaming techniques, etc.) listed on the Department's website may be used in the production of the mix. The URL for obtaining this information, if available, is:- https://www.fdot.gov/materials/laboratory/asphalt/index.shtm.

When warm mix technologies are used, for mixtures containing a PG 52--28, PG 58--22, or PG 67--22 binder, a mixture will be considered a warm mix asphalt design if the mixing temperature is 285°F or less. For mixtures containing a PG 76--22 or High Polymer binder, a mixture will be considered a warm mix asphalt design if the mixing temperature is 305°F or less.

The Engineer will consider any marked variations from original test data for a mix design or any evidence of inadequate field performance of a mix design as sufficient evidence that the properties of the mix design have changed, and the Engineer will no longer allow the use of the mix design.

334-3.2.2 Mixture Gradation Requirements: Combine the coarse and fine aggregate in proportions that will produce an asphalt mixture meeting all of the requirements

defined in this specification and conform to the gradation requirements at design as defined in AASHTO M 323. Aggregates from various sources may be combined.

334-3.2.2.1 Mixture Gradation Classification: Plot the combined mixture gradation on an FHWA 0.45 Power Gradation Chart. Include the Control Points from AASHTO M 323, as well as the Primary Control Sieve (PCS) Control Point from AASHTO M 323. Fine mixes are defined as having a gradation that passes above the primary control sieve control point and above the maximum density line for all sieve sizes smaller than the primary control sieve and larger than the No. 30 sieve.

334-3.2.3 Aggregate Consensus Properties: For Traffic Level C and E mixtures, meet the following consensus properties at design for the aggregate blend.
Aggregate consensus properties do not apply to Traffic Level B mixtures.

334-3.2.3.1 Coarse Aggregate Angularity: When tested in accordance with ASTM D5821, meet the percentage of fractured faces requirements specified in AASHTO M 323.

334-3.2.3.2 Fine Aggregate Angularity: When tested in accordance with AASHTO T 304, Method A, meet the uncompacted void content of fine aggregate specified in AASHTO M 323.

334-3.2.3.3 Flat and Elongated Particles: When tested in accordance with ASTM D4791, (with the exception that the material passing the 3/8-inch sieve and retained on the No. 4 sieve shall be included), meet the requirements specified in AASHTO M 323. Measure the aggregate using the ratio of 5:1, comparing the length (longest dimension) to the thickness (shortest dimension) of the aggregate particles.

334-3.2.3.4 Sand Equivalent: When tested in accordance with AASHTO T 176, meet the sand equivalent requirements specified in AASHTO M 323.

334-3.2.4 Gyratory Compaction: Compact the design mixture in accordance with AASHTO T 312, with the following exception: use the number of gyrations at N_{design} as defined in Table 334-4. Measure the inside diameter of gyratory molds in accordance with AASHTO T 312.

Table 334-4
Gyratory Compaction Requirements

Traffic Level	N_{design} Number of Gyrations
B	65
C	75
E	100

334-3.2.5 Design Criteria: Meet the requirements for nominal maximum aggregate size as defined in AASHTO M 323, as well as for relative density, VMA, VFA, and dust-to-binder ratio as specified in AASHTO M 323. $N_{initial}$ and $N_{maximum}$ requirements are not applicable.

334-3.2.6 Moisture Susceptibility:

1. For all traffic levels, use a liquid anti-strip agent listed on the APL at the specified dosage rate. Hydrated lime may be used instead of the liquid anti-strip agent.

2. Provide a mixture having a retained tensile strength ratio of at least 0.80 and a minimum tensile strength (unconditioned) of 100 psi in accordance with FM 1-T 283.

334-3.2.7 Additional Information: In addition to the requirements listed above, provide the following information with each proposed mix design submitted for verification:

1. The design traffic level and the design number of gyrations (N_{design}).
2. The source and description of the materials to be used.
3. The Department source number and the Department product code of the aggregate components furnished from a Department approved source.
4. The gradation and proportions of the raw materials as intended to be combined in the paving mixture. The gradation of the component materials shall be representative of the material at the time of use. Compensate for any change in aggregate gradation caused by handling and processing as necessary.
5. A single percentage of the combined mineral aggregate passing each specified sieve. Degradation of the aggregate due to processing (particularly material passing the No. 200 sieve) should be accounted for and identified.
6. The bulk specific gravity (G_{sb}) value for each individual aggregate and RAP component, as identified in the Department's aggregate control program.
7. A single percentage of asphalt binder by weight of total mix intended to be incorporated in the completed mixture, shown to the nearest 0.1%.
8. A target temperature for the mixture at the plant (mixing temperature) and a target temperature for the mixture at the roadway (compaction temperature) in accordance with 320-6.3. Do not exceed a target temperature of 340°F for High Polymer asphalt binders, 330°F for PG 76-22 asphalt binders, and 315°F for unmodified asphalt binders.
9. Provide the physical properties at the optimum asphalt content, which must conform to all specified requirements.
10. The name of the Construction Training Qualification Program (CTQP) Qualified Mix Designer.
11. The ignition oven and maximum specific gravity (G_{mm}) calibration factors.
12. The warm mix technology, if used.

SUBARTICLE 334-5.9 is deleted and the following substituted:

334-5.9 Minimum Acceptable Quality Levels:

334-5.9.1 PFs Below 0.90: In the event that an individual pay factor for any quality characteristic of a LOT falls below 0.90, take steps to correct the situation and report the actions to the Engineer. In the event that the pay factor for the same quality characteristic for two consecutive LOTs is below 0.90, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.2 CPFs Less Than 0.90 and Greater Than or Equal to 0.80: If the composite pay factor for the LOT is less than 0.90 and greater than or equal to 0.80, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.3 CPFs Less Than 0.80 and Greater Than or Equal to 0.75: If the CPF for the LOT is less than 0.80 and greater than or equal to 0.75, address the defective material in accordance with 334-5.9.5.

334-5.9.4 CPFs Less Than 0.75: If the CPF for the LOT is less than 0.75, remove and replace the defective LOT at no cost to the Department, or as approved by the Engineer.

334-5.9.5 Defective Material: Assume responsibility for removing and replacing all defective material placed on the project, at no cost to the Department.

As an exception to the above and upon approval of the Engineer, obtain an engineering analysis in accordance with Section 6 by an independent laboratory (as approved by the Engineer) to determine the disposition of the material. The engineering analysis must be signed and sealed by a Professional Engineer licensed in the State of Florida.

The Engineer may determine that an engineering analysis is not necessary or may perform an engineering analysis to determine the disposition of the material.

Any material that remains in place will be accepted with a CPF as determined by 334-8, or as determined by the Engineer.

If the defective material is due to a high air void failure, gradation, asphalt binder content or density failure, upon the approval of the Engineer the Contractor may perform delineation tests on roadway cores in lieu of an engineering analysis to determine the limits of the defective material that may require removal and replacement. Prior to any delineation testing, all sampling locations shall be approved by the Engineer. All delineation sampling and testing shall be monitored and verified by the Engineer. For materials that are defective due to low air voids, an engineering analysis is required.

When evaluating defective material by engineering analysis or delineation testing, at a minimum, evaluate all material located between passing QC, PC or IV test results. Any additional PC samples obtained in the same work shift after an IV sample has been obtained shall include enough material for three complete sets of tests (PC, IV and IV check samples) in the event the Contractor requests using the PC test results for engineering analysis or delineation. These additional PC samples must compare with verified IV test results as determined by the comparison process of 334-5.7.1 in order to be used for engineering analysis or delineation. Exceptions to this requirement shall be approved by the Engineer.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 7, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **337**
Proposed Specification: **3370303 Asphalt Concrete Friction Courses.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Wayne Rilko from the State Materials Office to change gradation and percentage of binder content tables in the Standard Specification. This revision also allows FC-9.5 substitution for FC-12-5 at no additional cost. This revision is associated with revision 3340104.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

ASPHALT CONCRETE FRICTION COURSES.
(REV 6-23-22)

SUBARTICLE 337-3.3 is deleted and the following substituted:

337-3.3 Grading Requirements:

337-3.3.1 FC-5: Use a mixture having a gradation at design within the ranges shown in Table 337-1.

Table 337-1 FC-5 Gradation Design Range									
3/4 inch	1/2 inch	3/8 inch	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
100	85-100	~~55~~60-75	15-25	5-10	--	--	--	--	2-5

337-3.3.2 FC-9.5: Meet the design gradation requirements for a SP-9.5 Superpave fine mix as defined in 334-3.2.2.

337-3.3.3 FC-12.5: Meet the design gradation requirements for a SP-12.5 Superpave fine mix as defined in 334-3.2.2.

ARTICLE 337-4 is deleted and the following substituted:

337-4 Mix Design.

337-4.1 FC-5: The Department will design the FC-5 mixtures. Furnish the materials and all appropriate information (source, gradation, etc.) as specified in 334-3.2.7. The Department will have three weeks to design the mix.

The Department will establish the design binder content for FC-5 within the following ranges based on aggregate type:

Table 337-2 FC-5 Percent Binder Content	
Aggregate Type	Percent Binder Content
Crushed Granite and/or Granitic Gneiss	~~5.5~~6.0 - 7.5
Crushed Limestone and/or Shell Rock	~~6.0~~6.5 - 8.0

337-4.2 FC-9.5 and FC-12.5: Provide a mix design conforming to the requirements of 334-3.2 unless otherwise designated in the plans. Where the plans call for an FC-12.5, an FC-9.5 may be substituted for the FC-12.5 at no additional cost provided the thickness requirements of 334-1.4.1 are met.

337-4.3 Revision of Mix Design: For FC-5, FC-9.5 and FC-12.5, meet the requirements of 334-3.3. For FC-5, all revisions must fall within the gradation limits defined in Table 337-1.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 12, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **346**
Proposed Specification: **3460202 Structural Portland Cement Concrete.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Thomas Frank to remove the Moderate Heat (MH) designation for consistency with AASHTO M 85 in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

STRUCTURAL PORTLAND CEMENT CONCRETE.
(REV 6-23-22)

SUBARTICLE 346-2.2 is deleted and the following substituted:

346-2.2 Types of Cement: Unless a specific type of cement is designated in the Contract Documents, use Type I, Type IL, Type IP, Type IT, Type IS, Type II, ~~Type II (MH)~~ or Type III cement in all classes of concrete. Use Type IL, Type IT, or Type II ~~(MH)~~ for all mass concrete elements.

Use only the types of cements designated for each environmental classification in structural concrete as shown in Table 346-1. A mix design for a more aggressive environment may be used in a less aggressive environmental condition.

Table 346-1
Cement Use by Environmental Classification

Component	Slightly Aggressive Environment	Moderately Aggressive Environment	Extremely Aggressive Environment (1)
Bridge Superstructures			
Precast Superstructure and Prestressed Elements	Type I or Type III	Type I, Type IL, Type II, Type III, Type IP, or Type IS	Type II ~~(MH)~~, Type IL, Type III (2), Type IT or Ternary Blend
Cast in Place	Type I	Type I, Type IL, Type II, Type IP, or Type IS	Type II ~~(MH)~~, Type IL, Type IT or Ternary Blend
Bridge Substructures, Drainage Structures, and other Structures			
All Elements	Type I or Type III	Type I, Type IL, Type II, Type IP, or Type IS	Type II ~~(MH)~~, Type IL, Type IT or Ternary Blend

Notes:
(1) Cements used in a more aggressive environment may also be used in a less aggressive environment.
(2) Type III cement may be used in an Extremely Aggressive Environment for precast superstructure and prestressed elements when the ambient temperature at the time of concrete placement is 60°F and below.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **346**
Proposed Specification: **3460203 Structural Portland Cement Concrete.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Jose Armenteros from the State Materials Office to revise the language to include changes from the Standard Design Guidelines and Standard Plans.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

STRUCTURAL PORTLAND CEMENT CONCRETE.
(REV 910-23-22)

SUBARTICLE 346-2.3 is deleted and the following substituted:

346-2.3 Supplementary Cementitious Materials: Supplementary cementitious materials (SCMs) are required to produce binary or ternary concrete mixes in all classes of concrete specified in Table 346-3,. Nonreinforced concrete Class I (Seal) and except for Class I (Pavement), are exempted, and Class II the following when used in slightly aggressive environments: Class I (Pavement), and Class II.

The quantity of portland cement that is replaced with SCMs must be on an equal weight replacement percentage basis of the total cementitious materials in accordance with Table 346--2. When using Type IP, IS or IT blended cements, the total quantity of SCMs, including the blended cement added separately at the concrete plant shall meet the requirements of Table 346--2.

346-2.3.1 Highly Reactive Pozzolans: Materials that have a very high degree of pozzolanic reactivity due to their very fine particle sizes, including silica fume, metakaolin and ultrafine fly ash.

346-2.3.2 Binary Concrete Mixes: Concrete mixes containing portland cement and one SCM.

346-2.3.3 Ternary Concrete Mixes: Concrete mixes containing portland cement and any two SCMs.

Table 346-2
Cementitious Materials Concrete Mix Proportions (%)
(Environmental classification is extremely aggressive, unless otherwise noted)

Application	Portland Cement	Fly Ash Type F	Slag	Highly Reactive Pozzolans (4 and 5)		
				Silica Fume	Metakaolin	Ultra-Fine Fly Ash
General Use	7050-82	18-5030				
	66-7851-79	15-2518-40		73-9		
	66-7863-77	15-25			8-12	
	66-7863-77	15-25				8-12
	30-4540	10-20	5045-60			
	30-50		50-70			
	36-43		50-55	7-9		
	33-42		50-55		8-12	
	33-42		50-55			8-12
Precast / Prestressed	70-85 (1)	15-30 (1)				
	7050-82	18-5030				
	66-7851-79	15-2518-40		73-9		
	66-7863-77	15-25			8-12	
	66-7863-77	15-25				8-12
	30-40	10-20	50-60			
	30-50		50-70			
	36-43		50-55	7-9		
	33-42		50-55		8-12	
	33-42		50-55			8-12
Drilled Shaft	63-6750-82	33-3718-50				
	38-42		58-62			
	30-40	10-20	50-60			
Mass Concrete	50-82 (2)	18-50 (2)				
	50-65 (3)	35-50 (3)				
	66-78	15-25		7-9		
	66-7863-77	15-25			8-12	
	66-7863-77	15-25				8-12
	30-40	10-20	50-60			
	30-50		50-70			
	36-43		50-55	7-9		
	33-42		50-55		8-12	
	33-42		50-55			8-12

Notes:
(1) Slightly Aggressive and Moderately Aggressive environments.
(2) For Concrete with Core Temperature T≤165°F.
(3) For Concrete with Core Temperature T≥165°F.
(4) A minimum concrete Surface Resistivity (SR) value of 29 kΩ-cm is required.
(45) Highly reactive pozzolans may be used below the specified ranges to enhance strength and workability when it is not required by the Contract Documents.. A minimum concrete Surface Resistivity (SR) value is not required.

SUBARTICLE 346-2.4 is deleted and the following substituted:

346-2.4 Aggregates: Produce all concrete using Size No. 57, 67 or 78 coarse aggregates. Use Size No. 8, and Size No. 89 alone, only when approved by the Engineer. Use Size No. 4 or larger blended with smaller size coarse aggregate as two components.

346-2.4.1 Optimized Aggregate Gradation: Improve the aggregate packing density at the Contractor's option, by adding an intermediate-size coarse aggregate in accordance with FM 5-621~~. Meet the requirements of Section 9.2, Volume II of the Materials Manual, on the methods used~~ to produce combined aggregate gradation of fine, intermediate, and coarse aggregate sizes for the concrete mixes.

346-2.4.2 Lightweight fine aggregate (LWFA) for internal curing: At the Contractor's option, use LWFA to reduce the early-age concrete cracking by replacing some of normal fine aggregate with saturated LWFA.

346-2.5 Admixtures: Ensure admixtures are used in accordance with the manufacturer's recommendations and meeting the requirements of Section 9.2, Volume II of the Materials Manual.

ARTICLE 346-3 is deleted and the following substituted:

346-3 Classification of Concrete.

346-3.1 General: The classifications of concrete are designated as Class I (Seal), Class I (Pavement), Class II, Class II (Bridge Deck), Class III, ~~Class III (Seal),~~ Class IV, Class IV (Drilled Shaft), Class V, ~~Class V (Special),~~ Class VI, and Class VII. The 28-day specified minimum compressive strength, maximum water to cementitious materials ratio and target slump of each class are detailed in Table 346-3. The required air content for all classes of concrete is less than or equal to 6.0%.

For purposes of this Specification the concrete is further classified as follows:

1. Conventional Concrete: The target slump is described in Table 346-3 with a tolerance of ± 1.5 inches.

2. Increased Slump Concrete: The maximum target slump is 7 inches with a tolerance of ± 1.5 inches when a Type F, G, I or II admixture is used.

3. Slip-form Concrete: The target slump is 1.5 inches with a tolerance of ± 1.5 inches. For Class I (Pavement), meet the requirements of Section 350.

4. Flowing Concrete: ~~Use flowing concrete only in the manufacturing of precast and prestressed products.~~ Request Engineer's authorization to use flowing concrete for cast-in-place applications. The target slump is 9 inches with a tolerance of ± 1.5 inches.~~ Meet the requirements of Section 8.6 Volume II of the Materials Manual.~~

5. Self-Consolidating Concrete (SCC):~~ Use SCC only in the manufacturing of precast and prestressed products.~~ Request Engineer's authorization to use SCC for cast-in-place applications The minimum target slump flow is 22.5 inches with a tolerance of ± 2.5 inches.~~ Meet the requirements of Section 8.4 Volume II of the Materials Manual.~~

346-3.2 Concrete Class Substitutions: The Engineer may allow the substitution of a higher class concrete in lieu of the specified class concrete when the substituted concrete mixes are included as part of the QC Plan, or for precast concrete, the Precast Concrete Producer QC

Plan. The substituted higher class concrete must meet or exceed the requirements of the specified class concrete.

When the average ~~28-day~~ compressive strength is less than the ~~28-day~~ specified minimum compressive strength of the higher class mix design, notify the Engineer. Acceptance is based on the requirements in Table 346-3 for the specified class concrete.

346-3.3 Acceptance Requirements: The specified minimum 28-day strengths, maximum water to cementitious materials ratio (w/cm), and target slumps for each class of concrete are given in Table 346-3. For lightweight concrete, acceptance requirements also include the hardened density specified in the Contract Documents.

~~**Master Proportion Table:** Proportion the materials used to produce the various classes of concrete in accordance with Table 346-3.~~

The calculation of the water to cementitious materials ratio (w/cm) is based on the total mass of cementitious materials including portland cement and any SCMs used in the mix.

Table 346-3
Compressive Strength, w/cm, and Slump of Concrete Classes ~~Master Proportion Table~~

Class of Concrete	28-day Specified Minimum Compressive Strength (f'c) (psi)	Maximum Water to Cementitious Materials Ratio (pounds per pounds)	Target Slump Value (inches)
I (Seal)	3,000	0.53	8
I (Pavement) (1)	3,000	0.50	1.5 or 3
II (3)	3,400	0.53	3 (2)
II (Bridge Deck)	4,500	0.44	3 (2)
III	5,000	0.44	3 (2)
~~III (Seal)~~	~~3,000~~	~~0.53~~	~~8~~
IV	5,500	0.41(4)	3 (2)
IV (Drilled Shaft)	4,000	0.41	8.5
~~V (Special)~~	~~6,000~~	~~0.37(4)~~	~~3 (2)~~
V	6,500	0.37(4)	3 (2)
VI	8,500	0.37(4)	3 (2)
VII	10,000	0.37(4)	3 (2)

Notes:
(1) Meet the requirements of Section 350.
(2) For ~~I~~increased slump concrete, flowing concrete, SCC and slip form concrete ~~as defined in~~ meet the requirements of 346-3.1.
(3) For precast three-sided culverts, box culverts, endwalls, inlets, manholes and junction boxes, the target slump value and air content will not apply. The maximum allowable slump is 6 inches, except as noted in (2). The Contractor is permitted to use concrete meeting the requirements of ASTM C478 (4,000 psi) in lieu of the specified Class II concrete for precast endwalls, inlets, manholes and junction boxes.
(4) When silica fume or metakaolin is required, the maximum water to cementitious material ratio will be 0.35. When ultrafine fly ash is used, the maximum water to cementitious material ratio will be 0.30.

346-3.4 Acceptance of concrete at 56 days: Use concrete mix designs meeting the specified compressive strength at 56 days at the Contractor's option. Submit the request to the Engineer for approval. After the Engineer's approval, notify the concrete producer to initiate the mix design approval process at least 90 days prior to the anticipated concrete placement.

346-3.45 Durability for Concrete Construction:

346-3.45.1 Minimum Cementitious Materials Content: Ensure that the produced concrete meets the minimum amount of cementitious materials content in Table 346-4.

Table 346-4
Minimum Amount of Total Cementitious Materials Content
(pounds per cubic yard of concrete)

Concrete Class	Environmental Classification		
	Extremely Aggressive	Moderately Aggressive	Slightly Aggressive
I (Seal) (1), I (Pavement)(1), and II, ~~and III (Seal)~~	470		
II (Bridge Deck), III (~~1~~2), IV, IV (Drilled Shaft), V~~, V(Special)~~, VI and VII	600	550	510

Notes:
(1) Request the use of concrete mixes with a lower amount of total cementitious materials content at the Contractor's option. The mix design must meet the requirements of Section 9.2 Volume II of the Materials Manual.
(~~1~~2) When precast three-sided culverts, box culverts, endwalls, inlets, manholes or junction boxes require a Class III concrete, the minimum cementitious materials content may be reduced to 470 pounds per cubic yard.

346-3.45.2 Chloride Content Limits: Use the following maximum allowable chloride content limits for the concrete application and/or exposure environment shown:

Table 346-5
Chloride Content Limits for Concrete Construction

Application/Exposure Environment		Maximum Allowable Chloride Content, (pounds per cubic yard of concrete)
Non-Reinforced Concrete		No Test Needed
Reinforced Concrete	Slightly Aggressive Environment	0.70
	Moderately or Extremely Aggressive Environment	0.40
Prestressed Concrete		0.40

Suspend concrete placement immediately for every mix design if chloride test results exceed the limits of Table 346-5 until corrective measures are made. Submit an Engineering Analysis Scope in accordance with 6-4 by a Specialty Engineer knowledgeable in the areas of corrosion and corrosion control, to determine if the material meets the intended service life of the structure on all concrete produced from the mix design failing chloride test results to the previous passing test results.

346-3.45.3 Surface Resistivity Test: Ensure that the ~~Class II (Bridge Deck), Class IV, Class V, Class V (Special), Class VI, or Class VII~~ concrete ~~in extremely aggressive environments~~ meets or exceeds a Sr~~resistivity~~ value of 29 kΩ~~Ohm~~-cm at 28 days~~,~~ or 56 days if specified, when a highly reactive pozzolan is ~~used~~ specified in the Contract Documents.

ARTICLE 346-4 is expanded by the following:

346-4.3 Flowing Concrete and Self-Consolidating Concrete (SCC): Use Flowing concrete or SCC when shown in the Contract Documents or to facilitate concrete placement in structures of complex geometric shape or highly reinforcement.

Perform a field demonstration mockup using an approved mix design. Submit the mockup design to the Engineer for approval including the location of the sawcut.

Cast a partial or full-scale mockup(s) and demonstrate through the successful production the ability to produce and place flowing concrete or SCC.

The design, production, and evaluation product must meet the following requirements:

1. Use the proposed mix design(s).
2. Produce the mockup(s) at the jobsite, using the intended placement and curing methods, such as the use of ready-mix trucks, pumps, chutes, hopper, consolidation equipment, etc. The mockup shall contain reinforcing steel, mass concrete cooling pipes if required during construction, and other embedded items typical of the cast element.
3. Meet the requirements of the plastic properties including the cutoff time.
4. Meet the hardened properties and durability requirement when specified in the Contract Documents.
5. Concrete will be produced in the proposed concrete plant(s).
6. Concrete plant(s) representative(s) must be present during mockup demonstration.
7. Notify the Engineer at least 7 days prior to mockup production.
8. If the production of the structural element that will be represented in the mockup requires concrete from multiple concrete plants, the concrete from each plant must be represented in the mockup.
9. Sawcut the mockup's entire cross-section. Inspect and report for voids, honeycombing, and rock pockets, mix segregation, and other inclusions developed during placement of the concrete.
10. Determine the Coarse Aggregate Index of concrete in accordance with FM 5-617.
11. Complete the demonstration of a successful mockup prior to the beginning of concrete placement operations.

Based on the inspection results of the field demonstration mockup, the acceptance of using flowing concrete or SCC in the structural element or section of the element is at the Engineer's discretion.

The required mockup demonstration may be omitted at the Contractor's request. Submit documentation indicating successful experience of furnishing and placing flowing concrete or SCC on similar Department projects. Such documentation must list projects by date of completion, name or project reference number, structural elements or type of unit placed, quantity of concrete furnished, names and experience of personnel, and contact information for verification.

346-4.4 Lightweight Concrete: Submit the fresh and hardened concrete density for mix design approval. The hardened density is the equilibrium density in ASTM C567. Ensure that the hardened density of the mix design is within ± 2 lb/ft^3 of the hardened density specified in the Contract Documents.

During production, the freshly mixed concrete density must be within ± 3 lb/ft^3 of the approved mix design fresh density.

ARTICLE 346-5 is deleted and the following substituted:

346-5 Sampling and Testing Methods.

Perform concrete sampling and testing in accordance with the following methods:

Table 346-7
Concrete Sampling and Testing Methods

Description	Method
Slump of Hydraulic Cement Concrete	ASTM C143
Air Content of Freshly Mixed Concrete by the Pressure Method (1)	ASTM C231
Air Content of Freshly Mixed Concrete by the Volumetric Method (1)	ASTM C173
Making and Curing Test Specimens in the Field (2)	ASTM C31
Compressive Strength of Cylindrical Concrete Specimens(3)	ASTM C39
Obtaining and Testing Drilled Core and Sawed Beams of Concrete	ASTM C42
Density of Structural Lightweight Concrete	ASTM C567
Initial Sampling of Concrete from Revolving Drum Truck Mixers or Agitators	FM 5-501
Low Levels of Chloride in Concrete and Raw Materials	FM 5-516
Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete	ASTM C138
Temperature of Freshly Mixed Portland Cement Concrete	ASTM C1064
Sampling Freshly Mixed Concrete (34)	ASTM C172
Static Segregation of Self-Consolidating Concrete using Column Techniques	ASTM C1610
Slump Flow of Self-Consolidating Concrete	ASTM C1611
Relative Viscosity of Self-Consolidating Concrete	ASTM C1611
Visual Stability Index of Self-Consolidating Concrete	ASTM C1611
Passing Ability of Self-Consolidating Concrete by J-Ring	ASTM C1621
Rapid Assessment of Static Segregation Resistance of Self-Consolidating Concrete Using Penetration Test	ASTM C1712
Aggregate Distribution of Hardened Self-Consolidating Concrete	FM 5-617
Hardened Visual Stability Index of Self-Consolidating Concrete	AASHTO R 81
Fabricating Test Specimens with Self-Consolidating Concrete	ASTM C1758
Concrete Resistivity as an Electrical Indicator of its Permeability	AASHTO T 358

(1) The Department will use the same type of meter for Verification testing as used for QC testing. When using pressure type meters, use an aggregate correction factor determined by the concrete producer for each mix design to be tested. Record and certify test results for correction factors for each type of aggregate at the concrete production facility.
(2) Provide curing facilities that have the capacity to store all QC, Verification, and Resolution cylinders simultaneously for the initial curing. Cylinders will be delivered to the testing laboratory in their molds. The laboratory will remove the specimens from the molds and begin final curing.
(3) Lightweight concrete also includes hardened specimen density. The ASTM C567 may be used in lieu of ASTM C39 to verify the density.
(34) Take the test sample from the middle portion of the batch in lieu of collecting and compositing samples from two or more portions, as described in ASTM C172.

ARTICLE 346-6 is deleted and the following substituted:

346-6 Quality Control.

346-6.1 General: Perform QC activities to ensure materials, methods, techniques, personnel, procedures and processes utilized during production meet the specified requirements. For precast/prestressed concrete operations, ensure that the QC testing is performed by the producer.

Accept the responsibility for QC inspections on all phases of work. Ensure all materials and workmanship incorporated into the project meet the requirements of the Contract Documents.

346-6.2 Concrete Mix Design: Provide concrete that has been produced in accordance with a Department approved mix design, in a uniform mass free from balls and lumps.

For slump target values in excess of 6 inches, including flowing concrete and SCC, utilize a grate over the conveyance equipment to capture any lumps or balls that may be present in the mix. The grate must cover the entire opening of the conveyance equipment and have an opening that is a maximum of 2-1/2 inches in any one direction. Remove the lumps and balls from the grate and discard them. Discharge the concrete in a manner satisfactory to the Engineer. Perform demonstration batches to ensure complete and thorough placements in complex elements, when requested by the Engineer.

Do not place concretes of different compositions such that the plastic concretes may combine, except where the Plans require concrete with a surface resistivity value of 29 kΩ~~Ohm~~-cm or below and one with higher than 29 kΩ~~Ohm~~-cm values in a continuous placement. Produce these concretes using separate mix designs. For example, designate the mix with calcium nitrite as the original mix and the mix without calcium nitrite as the redesigned mix. Ensure that both mixes contain the same cement, fly ash or slag, coarse and fine aggregates, and admixtures. Submit both mixes for approval as separate mix designs, both meeting all requirements of this Section. Ensure that the redesigned mix exhibits plastic and hardened qualities which are additionally approved by the Engineer as suitable for placement with the original mix. The Engineer will approve the redesigned mix for commingling with the original mix and for a specific project application only. Alternately, place a construction joint at the location of the change in concretes as approved by the Engineer.

346-6.3 Delivery Certification: Ensure that an electronic delivery ticket is furnished with each batch of concrete before unloading at the placement site. The delivery ticket may be proprietary software or in the form of an electronic spreadsheet, but shall be printed. Ensure that the materials and quantities incorporated into the batch of concrete are printed on the delivery ticket. Include the following information on the delivery ticket:

1. Arrival time at jobsite,
2. Time that concrete mix has been completely discharged,
3. Number of revolutions upon arrival at the jobsite,
4. Total gallons of water added at the jobsite,
5. Additional mixing revolutions when water is added,
6. Total number of revolutions.

Items (3) through (6) do not apply to non-agitating concrete transporting vehicles.

Ensure the batcher responsible for production of the batch of concrete signs the delivery ticket, certifying the batch of concrete was produced in accordance with the Contract Documents.

Sign the delivery ticket certifying that the design mix maximum specified water to cementitious materials ratio was not exceeded due to any jobsite adjustments to the batch of concrete, and that the batch of concrete was delivered and placed in accordance with the Contract Documents.

346-6.4 Plastic Property Tolerances: Reject concrete with slump or air content that does not fall within the specified tolerances, except as noted below, and immediately notify the concrete production facility that an adjustment of the concrete mixture is required.

If a load does not fall within the tolerances, test each subsequent load and the first adjusted load. If failing concrete is not rejected or adjustments are not implemented, the Engineer may reject the concrete and terminate further production until the corrections are implemented.

At the Contractor's risk, water may be added at the placement site immediately after completion of the initial slump or slump flow test, either to correct a low slump or slump flow, or to increase the concrete workability, provided the addition of water does not exceed the water to cementitious materials ratio as defined by the mix design.

After adding water~~,~~ at the placement site depending on the type of concrete, perform the following tests:

1. Except for SCC, perform a ~~an additional~~ slump test to confirm the concrete is within the slump tolerance range. If the slump is outside the tolerance range, reject the load.

2. For SCC, perform a slump flow and rapid assessment of static segregation resistance. Do not reject SCC exceeding the high-end slump flow tolerance if it has passed the rapid assessment of static segregation resistance test. Reject the load if the slump flow is below the low-end tolerance. As an exception, the Engineer may accept the concrete if the rejection compromises the structural integrity of the element or produces other detrimental effects. Minimum vibration may be needed in accordance with Section 400.

If an adjustment is made at the concrete production facility, perform a slump test on the next load to ensure the concrete is within the slump tolerance ranges.

Except for SCC, do~~Do~~ not place concrete represented by slump test results outside of the tolerance range. Include water missing from the water storage tanks upon arrival at the project site in the jobsite water added.

Do not allow concrete to remain in a transporting vehicle to reduce slump.

SUBARTICLE 346-2.3 is deleted and the following substituted:

346-7 Mixing and Delivering Concrete.

346-7.1 General Requirements: Operate all concrete mixers at speeds and volumes per the manufacturer's design or recommendation as stipulated on the mixer rating plate.

346-7.2 Transit Truck Mixing: Produce a completely uniform mixed concrete in a truck mixer for a minimum of 70 ~~to 100~~ revolutions at the mixing speed designated by the truck manufacturer.

Prior to starting the discharge of the concrete at the jobsite, when water is added, record the added quantity and mix the concrete 30 additional drum mixing revolutions. Do not make more than two mix adjustments. Seek approval from the Engineer prior to using a central mixer and depositing the batch into a truck mixer.

346-7.2.1 Transit Time: Ensure compliance with Table 346-8 between the initial introduction of water into the mix and completely discharging all the concrete from the truck.

Reject concrete exceeding the maximum transit time. The Engineer may approve an extension of the transit time which will be identified on the approved mix design.

Table 346-8	
Maximum Allowable Transit Time	
Non-Agitator Trucks	Agitator Trucks
45 minutes	60 minutes
75 minutes (1)	90 minutes (1)
Note: (1) When a water-reducing and retarding admixture (Type D, Type G, or Type II) is used.	

346-7.2.2 Placement Time: All the concrete in a load must be in its final placement position a maximum of 15 minutes after the transit time or cutoff time has expired unless a time extension is approved by the Engineer. As an exception, the Engineer may accept concrete that exceeds the transit time or cutoff time if the load passes the slump or slump flow tests. Place concrete in continuous manner in accordance with Section 400.

For Class IV (Drilled Shaft) mixes, placement time may be extended provided the slump loss time of the first concrete placed is not exceeded throughout the elapsed time.

The Engineer may perform Independent Verification (IV) testing to verify the plastic and hardened properties of the concrete when a time extension is granted.

346-7.3 On-site Batching and Mixing: Use a mixer of sufficient capacity to prevent delays that may be detrimental to the quality of the work. Ensure that the accuracy of batching equipment is in accordance with requirements of this Section.

346-7.4 Concreting in Cold Weather: Do not mix or place concrete when the air temperature is below 40ºF. Protect the fresh concrete from freezing in accordance with Section 400. The requirements of concreting in cold weather are not applicable to precast concrete mixing and placement operations occurring in a temperature controlled environment.

346-7.5 Concreting in Hot Weather: Hot weather concreting is defined as the production, placing and curing of concrete when the concrete temperature at placing exceeds 85ºF but is 100ºF or less.

Unless the specified hot weather concreting measures are in effect, reject concrete exceeding 85ºF at the time of placement. Regardless of special measures taken, reject concrete exceeding 100ºF. Predict the concrete temperatures at placement time and implement hot weather measures to avoid production shutdown.

346-7.6 Sample Location: Obtain acceptance samples from the point of final placement.

Where concrete buckets are used to discharge concrete directly to the point of final placement or into the hopper of a tremie pipe, samples will be obtained from the discharge of the bucket. When the concrete is discharged directly from the mixer into the bucket and the bucket is discharged within 20 minutes, samples may be obtained from the discharge of the mixer.

Where conveyor belts, troughs, pumps, or chutes are used to transport concrete directly to the point of final placement or into the hopper of a tremie pipe, samples will be obtained from the discharge end of the entire conveyor belt, trough, pump, or chute system.

Where concrete is placed in a drilled shaft or other element using a tremie pipe and a concrete pump, samples will be obtained from the discharge of the pump line at the location of the tremie hopper.

For all other placement methods, prior to each placement, obtain Department approval for sampling at the discharge of the mixer in lieu of sampling at the point of final placement. Submit the sampling correlation procedure to the Engineer for approval prior to the placement of the concrete. Once the comparative sampling correlation is approved by the Engineer, apply this correlation to the plastic properties tolerances for samples obtained from the discharge of mixer.

Where a concrete pump is used to deposit concrete directly into a drilled shaft which is a wet excavation without the use of a tremie, or other applications as approved by the Engineer, ensure the discharge end of the pump line remains immersed in the concrete at all times after starting concrete placement.

ARTICLE 346-8 is deleted and the following substituted:

346-8 Plastic Concrete Sampling and Testing.

QC tests include air content, temperature, slump, and preparing ~~compressive strength~~ cylinders for testing at later dates~~.~~ with the following exceptions:

with the following exceptions:

For Class I (Pavement), the air content testing is not required.

For Lightweight concrete, tests also include the plastic density (unit weight).

For SCC, QC tests also include slump flow in lieu of slump, visual stability index, and rapid assessment of static segregation.

In addition, calculate the water to cementitious materials ratio in accordance with FM 5-501 for compliance to the approved mix design.

Ensure that each truck has a rating plate and a valid mixer identification card issued by the Department. Ensure that the revolution counter on the mixer is working properly, and calibration of the water dispenser has been performed within the last twelve months. Reject any concrete batches that are delivered in trucks that do not have mixer identification cards. Remove the mixer identification card when a truck mixer is discovered to be in noncompliance and the mixer deficiencies cannot be repaired immediately. When the mixer identification card is removed for noncompliance, make note of the deficiency or deficiencies found, and forward the card to the District Materials and Research Engineer who has Producer QC Plan acceptance authority.

Perform plastic concrete tests on the initial delivery from each plant of each concrete design mix each day. Ensure QC technicians meeting the requirements of Section 105 are present and performing tests throughout the placement operation. Ensure a technician is present and performing tests throughout the placement operation at each placement site. If a project has multiple concrete placements at the same time, identify the technicians in the QC Plan to ensure minimum sampling and testing frequencies are met. Ensure that the equipment used for delivery, placement and finishing meets the requirements of this Specification.

When a truck designated for QC testing arrives at the discharge site, a subsequent truck may also discharge once a representative sample has been collected from the QC truck and while awaiting the results of QC testing. Reject non-complying loads at the jobsite. Ensure that corrections are made on subsequent loads. Immediately cease concrete discharge of all trucks if the QC truck has failing test. Perform plastic properties tests of concrete on all trucks prior to the

first corrected truck and the corrected truck. When more than one truck is discharging into a pump simultaneously, only the truck designated for QC testing may discharge into the pump to obtain a representative sample of concrete from the QC truck only.

Furnish sufficient concrete of each design mix as required by the Engineer for verification (VT) testing. When the Engineer's VT test results do not compare with the QC plastic properties test results, within the limits defined by the Independent Assurance (IA) checklist comparison criteria, located in Materials Manual Chapter 5, disposition of the concrete will be at the option of the Contractor.

On concrete placements consisting of only one load of concrete, perform initial sampling and testing in accordance with this Section. The acceptance sample and plastic properties tests may be taken from the initial portion of the load.

If any of the QC plastic properties tests fail, reject the remainder of that load, and any other loads that have begun discharging, terminate the LOT and notify the Engineer. Make cylinders representing that LOT from the same sample of concrete.

Following termination of a LOT, obtain samples from a new load, and perform plastic properties tests until the water to cementitious materials ratio, air content, temperature and slump comply with the Specification requirements. Initiate a new LOT once the testing indicates compliance with Specification requirements.

Suspend production when any five loads in two days of production of the same design mix are outside the specified tolerances. Increase the frequency of QC testing to one per load to bring the concrete within allowable tolerances. After production resumes, obtain the Engineer's approval before returning to the normal frequency of QC testing.

If concrete placement stops for more than 90 minutes, perform initial plastic properties testing on the next batch and continue the LOT. Cylinders cast for that LOT will represent the entire LOT.

When the Department performs Independent Verification (IV), the Contractor may perform the same tests on the concrete at the same time. The Department will compare results based on the Independent Assurance (IA) Checklist tolerances.

ARTICLE 346-9 is deleted and the following substituted:

346-9 Acceptance Sampling and Testing.

346-9.1 General: Perform plastic properties tests in accordance with 346-8 and cast a set of three QC cylinders, for all structural concrete incorporated into the project. Take these acceptance samples randomly as determined by a random number generator acceptable to the Department. The Department will independently perform VT plastic properties tests and cast a set of VT cylinders. The VT cylinders will be the same size cylinder selected by the Contractor, from a separate sample from the same load of concrete as the Contractor's QC sample.

For each set of QC cylinders verified by the Department, cast two additional cylinders from the same sample, and identify them as the quality control resolution (QR) test cylinders. The Department will also cast two additional verification resolution (VR) test cylinders from each VT sample. All cylinders will be clearly identified as outlined in the Sample/LOT Numbering System instructions located on the State Materials Office website. Deliver the QC samples, including the QR cylinders to the final curing facility in accordance with ASTM C31. Concurrently, the Department will deliver the VT samples, including the VR cylinders, to their final curing facility.

Test the QC laboratory cured samples for compressive strength at the age of 28 days, in a laboratory meeting and maintaining at all times the qualification requirements listed in Section 105.

Ensure the QC testing laboratory input the compressive strength test results into the Department's Materials Acceptance and Certification (MAC) system within 24 hours after testing. Notify the Engineer when results cannot be inputted into MAC.

The Department will compare the VT sample compressive strength test results with the corresponding QC sample test results.

346-9.2 Sampling Frequency: As a minimum, sample and test concrete of each mix design for water to cementitious materials ratio, air content, temperature, slump and compressive strength once per LOT as defined by Table 346-9. The Engineer will randomly verify one of every four consecutive LOTs of each mix design based on a random number generator. The Department may perform Independent Verification (IV) testing to verify compliance with specification requirements. All QC activities, calculations, and inspections will be randomly confirmed by the Department.

Table 346-9
Sampling Frequency

Class Concrete (1)	LOT Size
I (Seal)	Each seal placement
I (Pavement)	According to Section 350
II, II (Bridge Deck), III, IV~~, V (Special)~~, V, VI, VII	50 cubic yards, or one day's production, whichever is less
IV (Drilled Shaft)	50 cubic yards, or one day's production, whichever is less (2)
~~III (Seal)~~	~~Each Seal placement~~

(1) For any class of concrete used for roadway concrete barrier, the lot size is defined as 100 cubic yards, or one day's production, whichever is less.
(2) Start a new LOT when there is a gap of more than two hours between the end of one drilled shaft placement and the beginning of the next drilled shaft placement.

346-9.2.1 Reduced Frequency for Acceptance Tests: Except for Class I (Pavement), the LOT size may represent 100 cubic yards when produced with the same mix design at the same concrete production facility for the same prime Contractor and subcontractor on a given Contract. As an exception, the requirements for the precast/prestressed production facility will only include the same mix design at the same concrete production facility. The reduced testing frequency of Class I (Pavement) is described in the Section 350.

Submit strength test results indicating that the two following criteria are met:

1. The average of the acceptance compressive strengths is equal to or greater than the specified minimum compressive strength (f'c) plus 2.33 standard deviations minus:

a. 500 psi, if f'c is 5,000 psi or less.
b. 0.10 f'c, if f'c is greater than 5,000 psi.

2. Every average of three consecutive strength test equals or exceeds the f'c plus 1.34 standard deviations.

Base calculations on a minimum of ten consecutive strength test results for a Class IV or higher; or a minimum of five consecutive strength results for a Class III or lower.

The average of the consecutive compressive strength test results, based on the class of concrete, can be established using historical data from a previous Department project. The tests from the previous Department project must be within the last calendar year or may also be established by a succession of samples on the current project. Only one sample can be taken from each LOT. Test data must be from a laboratory meeting the requirements of Section 105. Obtain Department approval before beginning reduced frequency LOTs.

If at any time a strength test is not verified or the average strength of the previous ten or five consecutive samples based on the class of concrete from the same mix design and the same production facility does not conform to the above conditions, return to the frequency represented by the LOT as defined in Table 346-9. Notify the Engineer that the initial frequency is reinstated. In order to reinitiate reduced frequency, submit a new set of strength test results.

346-9.3 Strength Test Definition: The strength test of a LOT is defined as the average compressive strength tests of at least two companion cylinders cast from the same sample of concrete and tested at the same age.

346-9.4 Acceptance of Concrete: The Engineer will accept the concrete of a given LOT when the compressive strength test results are verified and meets the minimum specified compressive strength in Table 346-3. Ensure that the hardened concrete strength test results are obtained in accordance with 346-9.3.

The process of concrete compressive strength verification and acceptance consists of the following steps:

1. Verification of QC and VT data.
2. Resolution of QC and VT data if needed.
3. Structural Adequacy determination.

Do not discard a cylinder strength test result based on low strength (strength below the specified minimum strength as per the provisions of this Section).

When one of the three QC cylinders from a LOT is lost, missing, damaged or destroyed, determination of compressive strength will be made by averaging the remaining two cylinders. If more than one QC cylinder from a LOT is lost, missing, damaged or destroyed, the Contractor will core the structure at no additional expense to the Department to determine the compressive strength. Prior to coring, obtain Engineer's approval for coring the structure and its proposed coring location. Acceptance of LOT may be based on VT data at the discretion of the Engineer.

For each QC and each QR cylinder that is lost, missing, damaged or destroyed, payment for that LOT will be reduced by $750.00 per 1,000 psi of the specified design strength [Example: loss of two Class IV (Drill Shaft) QC cylinders that has no VT data will require the element to be cored and a pay reduction will be assessed (4,000 psi / 1,000 psi) x $750 x 2 = $6,000]. This reduction will be in addition to any pay adjustment for low strength.

346-9.4.1 Small Quantities of Concrete: When a project has a total plan quantity of less than 50 cubic yards, that concrete will be accepted based on the satisfactory compressive strength of the QC cylinders. Submit certification to the Engineer that the concrete was batched and placed in accordance with the Contract Documents. Submit a QC Plan for the concrete

placement operation in accordance with Section 105. The Engineer may perform IV testing as identified in 346-9 and evaluate the concrete in accordance with 346-9.7.

346-9.5 Verification: The results of properly conducted test by QC and VT laboratories on specimens prepared from the same sample of concrete are not to differ by more than 14%.

$$\text{Difference (\%)} = \text{ABS}\left(\frac{\text{QC}-\text{VT}}{\text{QC}}\right)100$$

Where:

Difference (%) is the absolute percentage difference between QC and VT average compressive strength.

The procedure consists of verifying if the QC and VT compressive strengths data meet the established comparison criteria:

1. When the difference between the average compressive strength of QC and the average compressive strength of VT is less than or equal to 14%, the QC test results are upheld and verified. The Engineer will accept at full pay only LOTs of concrete represented by plastic property results which meet the requirements of the approved mix design and strength test results which equal or exceed the respective specified minimum strength.
2. When the difference between the average compressive strength of QC and the average compressive strength of VT data exceeds 14%, the compressive strength results are not verified and the Engineer will initiate the resolution procedure.

Maintain the QR and VR cylinders for a minimum of 30 days following the testing date of the specified strength.

346-9.6 Resolution: The Engineer will perform the resolution process to identify the reliability of the compressive strength results when the difference between the average compressive strength of QC and the average compressive strength of VT data exceeds 14% as described in 346-9.5(2).

The Engineer will ~~correlate~~ estimate the 28-day strengths (VR_{28} and QR_{28}) for the VR and QR cylinders using the following equation:

$$\text{Estimated 28-Day Compressive Strength (psi)} = \left(\frac{\text{Average Strength at (t) days}}{\text{-17.8} + 46.3[\ln(t)] - 3.3[\ln(t)]^2}\right)100$$

Where:

(t) is the elapsed number of days from concrete placement to the resolution cylinders testing.

ln (t) is the natural logarithm of (t).

The Engineer ~~and~~ will compare:

1. The VT sample results with the VR_{28} cylinders results.
2. The QC sample results with the QR_{28} cylinders results.

Comparison results must not be greater than 17.5%. Core samples of the hardened concrete may be required.

$$V_D\ (\%) = \text{ABS}\left(\frac{VT - VR_{28}}{VT}\right)100$$

$$Q_D\ (\%) = \text{ABS}\left(\frac{QC - QR_{28}}{QC}\right)100$$

Where:

V_D (%) is the absolute percentage difference between VT and VR_{28}.

Q_D (%) is the absolute percentage difference between QC and QR_{28}.

Perform the resolution with the concrete compressive strength data at 56 days in lieu of the 28 days when the acceptance of concrete is at 56 days.

The resolution procedure will use the above equations. The Engineer will determine through the resolution procedure whether the QC strength test results or the VT strength test are deemed to be the most accurate, LOTs will then be considered to be verified.

The Engineer will inform the QC and VT laboratories within three calendar days of the acceptance compressive strength test to transport their QR and VR cylinders to the resolution laboratory. The QC and VT laboratories will transport their own hold cylinders to the resolution testing laboratory within three calendar days after the Engineer notifies the Contractor that a resolution procedure is required. In addition, the Engineer will ensure that the QR and VR cylinders are tested within 14 calendar days of the acceptance strength tests.

The Engineer will determine the most accurate strength test result to represent the four or fewer consecutive LOTs as follows:

1. When both results meet the established comparison criteria, both are deemed accurate and the QC strength will represent the LOTs. The Department will pay for cost of the resolution testing.

2. When only the QC result is within the established comparison criteria, the QC strength is deemed as most accurate and will represent the LOTs. The Department will pay for the cost of the resolution testing.

3. When only the VT result is within the established comparison criteria, the VT strength is deemed as most accurate and will represent the LOTs. The Department will assess a $1,000 pay reduction for the cost of the Resolution Investigation.

4. When both results are outside the established comparison criteria, the Engineer, with input from the DMO, will determine if any Department IA evaluations are required and which test results are most accurate. The Department will pay for the cost of the resolution testing.

When the Engineer cannot determine which strength test results are the most accurate, the concrete represented by the four consecutive LOTs will be evaluated based on the QC data.

The results of the resolution procedure will be forwarded to the Contractor within five working days after completion of the investigation.

346-9.7 Structural Adequacy: The Engineer will evaluate the structural adequacy for verified concrete that does not meet the minimum specified compressive strength of Table 346-3.

For structural adequacy, with standard molded and cured compressive strength cylinders, the compressive strength of concrete is satisfactory provided that the two following criteria are met:

1. The average compressive strength does not fall below the specified minimum compressive strength by more than:

a. 500 psi if the specified minimum compressive strength is equal to or less than 5,000 psi.

b. 10% of the specified minimum compressive strength if the specified minimum compressive strength is greater than 5,000 psi.

2. The average compressive strength with the previous two LOTs is equal to or exceeds the specified minimum compressive strength. This condition only applies if there are two or more previous LOTs to calculate the average.

The Engineer will consider the concrete for a given LOT as structurally adequate and coring will not be allowed when a concrete compressive strength test result falls below the specified minimum strength but has met the above conditions.

346-9.7.1 Lightweight concrete: The Engineer may require an Engineering Analysis Scope in accordance with 6-4 to establish structural and durability adequacy when the lightweight concrete plastic density (unit weight) is outside of the specified tolerances.

ARTICLE 346-11 is deleted and the following substituted:

346-11 Pay Adjustments for Low Compressive Strength Concrete.

346-11.1 General: For any LOT of concrete failing to meet the f'c as defined in 346-3, 346-9, and satisfactorily meeting all other requirements of the Contract Documents, including structural adequacy, the Engineer will individually reduce the price of each low strength LOT in accordance with this Section.

346-11.2 Basis for Pay Adjustments: The Engineer will determine payment reductions based on the 28--day compressive strength, represented by either acceptance compressive strength or correlated cores strength test results based on the following criteria:

1. When the acceptance compressive strength test result falls below the specified minimum compressive strength, but no more than the limits established in 346-9.7 below the specified minimum strength, do not core hardened concrete for determining pay adjustments. Use the acceptance compressive strength test results.

2. When the acceptance compressive strength test result falls below the specified minimum compressive strength by more than the limits established in 346-9.7, the structure may be cored for determination of structural adequacy as directed by the Engineer. Use the result of the 28--day correlated core compressive strength or the acceptance compressive strength test, whichever is less.

A price adjustment will be applied to the certified invoice price the Contractor paid for the concrete or the precast product.

The Engineer will relate the strength at the actual test age to the 28--day strength for the design mix represented by the cores using appropriate strength time correlation equations.

In precast concrete operations, excluding prestressed concrete, ensure that the producer submits acceptable core sample test results to the Engineer. The producer may elect to use the products in accordance with this Section. Otherwise, replace the concrete in question at no additional cost to the Department. For prestressed concrete, core sample testing is not allowed for pay adjustment. The results of the cylinder strength tests will be used to determine material acceptance and pay adjustment.

346-11.3 Calculating Pay Adjustments: The Engineer will determine payment reductions for low strength concrete accepted by the Department. The 28-day strength is represented by either cylinders or correlated cores strength test results in accordance with 346-11.2.

Reduction in Pay is equal to the reduction in percentage of concrete compressive strength below the specified minimum strength:

$$\text{Reduction in Pay (\%)} = \left(\frac{f'c - \text{28 day Strength}}{f'c}\right) 100$$

For the elements that payments are based on the per foot basis, the Engineer will adjust the price reduction from cubic yards basis to per foot basis, determine the total linear feet of the elements that are affected by low strength concrete samples and apply the adjusted price reduction accordingly.

Use the concrete compressive strength data at 56 days in lieu of the 28 days when the acceptance of concrete is at 56 days.

346-12 Pay Reduction for Plastic Properties.

A rejected load in accordance with 346-6.4 is defined as the entire quantity of concrete contained within a single ready--mix truck or other single delivery vehicle regardless of what percentage of the load was placed. If concrete fails a plastic properties test and is thereby a rejected load but its placement continues after completion of a plastic properties test having a failing result, payment for the concrete will be reduced.

The pay reduction for cast-in-place concrete will be twice the certified invoice price per cubic yard of the quantity of concrete in the rejected load.

The pay reduction for placing a rejected load of concrete into a precast product will be applied to that percentage of the precast product that is composed of the concrete in the rejected load. The percentage will be converted to a reduction factor which is a numerical value greater than zero but not greater than one. The precast product payment reduction will be twice the Contractor's billed price from the producer for the precast product multiplied by the reduction factor.

If the Engineer authorizes placement of the concrete, even though plastic properties require rejection, there will be no pay reduction based on plastic properties failures; however, any other pay reductions will apply.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 11, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **346**
Proposed Specification: **3460402 Structural Portland Cement Concrete.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Jose Armenteros from the State Materials Office to remove language regarding preparation of a Mass Concrete Control Plan (MCCP) that is relevant to the Specialty Engineer and included in a new Materials Manual Section 9.4 in Vol. 2.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

STRUCTURAL PORTLAND CEMENT CONCRETE.
(REV 6-22-22)

SUBARTICLE 346-4.2 is deleted and the following substituted:

346-4.2 Mass Concrete: When the Contract Documents designate any structure as mass concrete, use a Specialty Engineer to develop and administer a Mass Concrete Control Plan (MCCP). Develop the MCCP in accordance with Section 9.4 Volume II of the Materials Manual. Provide the Specialty Engineer a list of all concrete elements identified. Use a sequential identification code for each element indicating the bridge or structure number, location and type of element, least dimension size, and environmental exposure. ~~ACI Publications 207.1R Guide to Mass Concrete, 207.2R Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, and 224R Control of Cracking in Concrete Structures.~~

Record core and differential temperatures for all structures included in the MCCP and monitor only the elements specified therein. Ensure that the concrete core temperatures ~~for any mass concrete element~~ do not exceed the maximum allowable temperature of 180°F and that the differential temperatures between the element core and surface do not exceed the maximum allowable temperature differential of 35°F. Submit the MCCP to the Engineer for approval at least ~~14~~21 calendar days prior to the first anticipated mass concrete placement. ~~Ensure the MCCP includes and fully describes the following:~~

~~1. The Financial Project Identification Number (FPID).~~
~~2. Contact names and numbers.~~
~~3. Names and qualifications of all designees who will inspect the installation of and record the output of temperature measuring devices, and who will implement temperature control measures.~~
~~4. The number, type, and dimensions of each mass concrete element to be constructed.~~
~~5. A sequential ID number assigned to each element indicating bridge number, element type, element size, and element location.~~
~~6. The mix design number of the concrete used to construct each element.~~
~~7. Indicate which mass concrete elements will be monitored.~~
~~8. Casting procedures,~~
~~9. Insulating systems,~~
~~10. Type and placement of temperature measuring and recording devices, as well as any remote monitoring devices and software.~~
~~11. For each concrete mix design and concrete element, provide information included in Table 346-6, listing the maximum allowable concrete placement temperature for each ambient temperature range at time of placement, in 10°F increments from 40°F and 99°F.~~

Table 346-6 Maximum Allowable Concrete Placement Temperature Data Sheet		
Mix Design No.	Maximum Allowable Concrete Placement Temperature (°F)	
Ambient Temperature at Time of Placement	Footer Dimensions(1) W by L by H (ft)	Column Dimensions(1) D by H(ft)
40° - 49°F		
50° - 59°F		
60° - 69°F		
70° - 79°F		
80° - 89°F		
90° - 99°F		
Notes: (1) W = Width, L = Length, H = Height and D = Diameter		

12. Measures to prevent thermal shock.
13. Active cooling measures, if used.

Do not place concrete until the proposed MCCP has beenis approved, and fully complies with its requirements. Any modifications must be submitted as addenda to the original MCCP and must be approved in writing by the Engineer.

Install temperature measuring sensors and recording devices for all mass concrete elements in accordance with the MCCP. Do not add local additional insulation or external sources of heat around the surface sensors that affect the temperature readings.

Ensure that, prior to the first concrete placement of each concrete element the Specialty Engineer or approved designee personally inspects the installation of the temperature measuring devices and verifies that the temperature data acquisition equipment is properly functioning. The Specialty Engineer shall be available for immediate consultation during the monitoring period of any mass concrete element.

Use The temperature data acquisition equipment to must record temperature readings in accordance with the MCCP. at least once per hour, beginning at the completion of concrete placement and continuing until the core temperature is within 50°F of the ambient temperature. The Specialty Engineer shall be available for immediate consultation during the monitoring period of any mass concrete element. Monitor temperature readings at least once every six hours.

Within three workings days of the completion of temperature recording for each concrete element, submit the Mass Concrete Field Report in accordance with Section 9.4, Volume II of the Materials Manual. an electronic spreadsheet file, editable report to the Engineer that includes the element identification, date and time of any changes to the temperature control measures, all original temperature readings and curing notes. Also submit data logger summaries and graphs, and results of the visual inspection of each element.

For a group of elements, the Engineer may approve a monitoring reduction ifIf the first element of a group of elements with the same dimensions is placed does not exceed in accordance with the approved MCCP, without exceeding either the maximum temperature or maximum temperature differential. of the concrete, reduced monitoring of the remaining elements may be allowed with written approval from the Engineer. Request written approval from the Engineer at least 14 calendar days prior to the anticipated date of the intended reduced monitoring. If approved, temperature monitoring of the recorded temperatures is not required

~~only~~ for the remaining~~initial element of a group of concrete~~ elements meeting all of the following requirements:

1. All elements have the same dimensions.
2. All elements have the same concrete mix design.
3. All elements have the same insulation R value and active cooling measures (if used).
4. Ambient temperatures during concrete placement for all elements are within minus 10°F of the ambient temperature during placement of the initial element.
5. Use the same temperature control measures used for the initial monitored element and keep them in place for at least the same length of time as for the initial element~~. The Contractor and Engineer each have the option to have the temperature monitored to ensure the core temperature is within 50°F of ambient temperature prior to termination of temperature control measures~~.

~~Install temperature measuring and recording devices for all mass concrete elements. Position the temperature sensors 2.00± 0.25 inches inside the concrete surface for surface temperature measurements and at the expected location of the maximum temperature for core temperature measurements. Place the ambient temperature sensor in a location that protects it from direct exposure to rain, sun, or sources of radiated heat, such as concrete or asphalt pavement surfaces. Temperatures shall be continuously recorded starting at the end of concrete placement and continuing until the core has cooled to within 50°F of the ambient temperature.~~ Resume monitoring of the temperatures for all elements if directed by the Engineer.

Instrumentation and temperature monitoring are not required for miscellaneous drilled shafts supporting sign, signal, lighting or I~~i~~ntelligent T~~t~~ransportation System (ITS) structures when the as built~~that meet all of the following requirements:~~

~~1. The~~ diameter is six feet or less, and the ~~2. The~~ total cementitious materials content of the concrete mix design is less than or equal to 752 ~~0~~pounds per cubic yard.

M~~Temperature m~~onitoring of the recorded temperatures is not required~~may be omitted at the Contractor's option,~~ for any mass concrete substructure element meeting all of the following requirements:

1. The minimum cross-sectional as-built dimension of the element is six feet or less.
2. Insulation with an R-value of at least 2.5 must be provided for at least 72 hours following the completion of concrete placement.
3. The environmental classification of the concrete element is slightly aggressive or moderately aggressive.
4. The concrete mix design meets the mass concrete proportioning requirements of 346-2.3.
5. The total cementitious material content of the concrete mix design is less than or equal to 752~~0~~ pounds per cubic yard.
6. Temperature of the concrete is 95°F or less at placement.

Implement immediate corrective action as directed by the Specialty Engineer when either the core temperature or the temperature differential of any mass concrete element exceeds its maximum allowable value. The approval of the MCCP shall be revoked. ~~Do not place any mass concrete elements until a revised MCCP has been approved in writing by the Engineer.~~

Submit an Engineering Analysis Scope in accordance with 6-4 for approval, which addresses the structural integrity and durability of any mass concrete element that is not cast in compliance with the approved MCCP, or which exceeds the allowable core temperature or temperature differential.

Submit all analyses and test results requested by the Engineer for any noncompliant mass concrete element ~~to the satisfaction of the Engineer~~. Submit a revised MCCP and do not place any mass concrete elements until a revised MCCP has been approved in writing by the Engineer.

The Department will ~~make~~ not provide compensation for additional costs or loss of time due to additional analyses, tests, or other impacts on production caused by not monitoring the recorded temperatures~~the use of reduced monitoring or the Contractor's option~~.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 8, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **350**
Proposed Specification: **3500902 Cement Concrete Pavement.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Jose Armenteros to move reduced testing frequency language from Section 346 to Section 350 in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CEMENT CONCRETE PAVEMENT.
(REV 6-20-22)

SUBARTICLE 350-9.2 is deleted and the following substituted:

350-9.2 Sampling Frequency for Quality Control Tests: Sample and test concrete of each design mix for temperature and compressive strength tests once per LOT.

A LOT is defined as the concrete placement of 2,000 square yards or one day's production, whichever is less. The LOT must be of the same type of placement method, such as slip form or formwork methods. Partial LOTs of less than 500 square yards will be combined with the previous LOT for testing and acceptance purposes.

350-9.2.1 Reduced Frequency for Quality Control Tests: ~~Reduced frequency for testing may be requested in accordance with Section 346. The LOT may represent a maximum production quantity of 4,000 square yards as approved by the Engineer.~~ The LOT size for reduced testing frequency of Class I (Pavement) may represent a maximum production quantity of 4,000 square yards, provided that the submitted historical compressive strength test results meet the requirements as described below:

1. The average of the acceptance compressive strengths is equal to or greater than 2,500 psi plus 2.33 standard deviations.
2. Every average of three consecutive strength test equals or exceeds the 3,000 plus 1.34 standard deviations.

Base calculations on a minimum of five consecutive compressive strength results. The average of the consecutive compressive strength test results can be established using historical data from a previous Department project. The tests from the previous Department project must be within the last calendar year or may also be established by a succession of samples on the current project. Only one sample can be taken from each LOT. Test data must be from sample(s) tested by a laboratory meeting the requirements of Section 105. Obtain Department approval before beginning reduced frequency LOTs.

If at any time a compressive strength test is not verified or the average compressive strength of the previous five consecutive samples from the same mix design and the same production facility does not conform to the above conditions, return to the frequency represented by the LOT as defined in 350-9.2. Notify the Engineer that the initial frequency is reinstated. To reinitiate reduced frequency, submit a new set of strength test results.

350-9.2.2 Sampling Frequency for Verification: The Engineer will verify one of every four consecutive LOTs, randomly selected, for each mix design in accordance with 346-8.

The Engineer may perform additional independent verifications tests. All QC activities, calculations and inspections may be randomly confirmed by the Engineer. The Engineer may obtain additional samples for informational purposes.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 11, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **350**
Proposed Specification: **3500200 Cement Concrete Pavement.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Richard Hewitt to increase maximum pay thickness tolerance specified thickness plus 1/2 inch (currently 1/4 inch). This will make pay thickness tolerance more in line with asphalt pay quantity tolerance

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CEMENT CONCRETE PAVEMENT.
(REV 8-30-22)

SUBARTICLE 350-20.1 is deleted and the following substituted:

350-20 Method of Measurement.

350-20.1 Concrete Pavement: The quantities to be paid for will be the plan quantity, in square yards, of plain cement concrete pavement and of reinforced cement concrete pavement, omitting any areas not allowed for payment under the provisions of 350-16.3 and adjusted for average thickness as provided herein.

For purposes of payment, the average thickness of pavement will determine the final pay quantities for this pavement as follows:

The area of pavement represented by the difference between the calculated average thickness and the specified thickness will be converted into equivalent square yards of specified thickness pavement, and the quantity thereby obtained will be added to, or deducted from, the quantity of pavement to be paid for, subject to the limitation that the maximum average of over-thickness permitted in the adjustment of the quantity of pavement to be paid for will be 1/42 inch.

Where the Plans call for cement concrete pavement that is to be covered with asphalt concrete surface course, payment will be made for the total thickness of the combination as plain cement concrete pavement. In such cases, price and payment will also include all costs of the asphalt concrete surface course constructed in accordance with Section 334.

Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 11, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **352**
Proposed Specification: **3520800 Grinding Concrete Pavement.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Richrd Hewitt to ensure pavement smoothness incentive is based on unit price for grinding and not the unit price for concrete pavement. Changes are also being made to put pay adjustment into a Pay Factor format.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

GRINDING CONCRETE PAVEMENT.
(REV ~~7-19~~8-30-22)

ARTICLE 352-8 is deleted and the following substituted:

352-8 Basis of Payment.

Price and payment will be full compensation for all work and materials specified in this Section, including furnishing all labor, materials, tools, equipment, testing, and incidentals and for doing all work involved in grinding existing or new concrete pavement, removing residue, and cleaning the pavement, including necessary disposal of residue and furnishing any water or air used in cleaning the pavement.

~~Contract Unit Price~~Pay adjustments based on the surface smoothness will be made in accordance with ~~the following schedules~~Table 352-1.

Table 352-1
Profile Index Pay Factors

Average Profile Index (inches/mile) per 0.1 mile Section		~~Contract Unit Price Adjustments Percent of Pavement Unit Bid Price~~Pay Factor
Curvature Radius ≥2,000 ft	1,000 ft ≤ Curvature Radius < 2,000 ft	
PI ≤ 2	PI ≤ 4	1.0~~3~~5
2 < PI ≤ 5	4 < PI ≤7	1.00
PI > 5	PI > 7	Corrective work required

The Pay Factor~~(Price) Adjustments for Incentives~~ will be based on the initial measured average Profile Index, prior to any corrective work. The Pay Factor will be applied to the bid price for Grinding Concrete Pavement.

The ~~Unit Bid Adjusted Price~~Pay Adjustment will be computed ~~using~~by multiplying the Pay Factor times the unit bid price for grinding concrete pavement times the plan surface area of grinding concrete pavement. The Pay Adjustment~~is Unit Bid Price~~ will apply to the total area of the 0.1 mile section for the lane width represented by the profilograms for the average Profile Index.

Payment will be made under:

Item No. 352- 70- Grinding Concrete Pavement - per square yard.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 8, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **400**
Proposed Specification: **4000711 Concrete Structures.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Jose Armenteros from the State Materials Office to include Self-Consolidating concrete language.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/vc
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONCRETE STRUCTURES.
(REV 7-6-22)

SUBARTICLE 400-7.11.1 is deleted and the following substituted:

400-7.11 Vibration of Concrete:

400-7.11.1 General: Consolidate all concrete except seal, steel pile jackets, and concrete for incidental construction by the use of mechanical vibrators.

Use minimal mechanical vibration of no more than 3 seconds per insertion for Self-Consolidating Concrete (SCC), when necessary to consolidate the concrete or to avoid obtaining a plane of separation or a cold joint between layers.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 8, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **450**
Proposed Specification: **4500704 Precast Prestressed Concrete Construction.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Frank Thomas and Tim Counts from the State Materials Office to update language to be consistent with the proposed changes to Section 105. Changes to Subarticle 450-8.2.1 are updated to provide clarification of requirements for prestressed concrete testing and inspection personnel associated with the changes made to Section 105. Changes to Article 450-7 is based on a request from the Florida Prestressed Concrete Association to use a two-part sheathing in routine production. Changes to Subarticle 450-10.4, addresses consolidation of all precast prestressed products, not just piling and 450-13 includes the Section 930 concrete repair materials as an option for repairs
Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.
If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PRECAST PRESTRESSED CONCRETE CONSTRUCTION
(REV 6-8-22)

SUBARTICLE 450-7.4 is deleted and the following substituted:

450-7.4 Debonded Strands: Install debonding material (sheathing) according to the prestressing strand locations and lengths shown in the Plans, and manufacturer's instructions, except as modified herein. Do not install sheathing over the full length of a product. Extend the ~~tubular debonding material (~~sheathing~~)~~ through the header ~~for debonded prestressing strand~~. Tape~~ie~~ and tie~~ape~~ the sheathing ~~debonding material~~ at the terminus located at the inside of the member. The tape must be strong enough to hold the sheathing closed.

Use ~~slit or~~ non-slit tubular or two-part sheathing that is high-density plastic. The sheathing must have a minimum wall thickness of 0.025 inch, and an inside diameter exceeding the maximum outside diameter of the ~~pretensioning~~ strand by 0.020~~5~~ inch to 0.15~~4~~0 inch. Tape the entire length of seams to ensure mortar tightness when using two-part sheathing. The sheathing and tape must not react with concrete, coating, steel, or FRP components.

Slit tubular sheathing may be used to repair minor defects such as breakages or punctures in non-slit tubular sheathing, rectifying an improperly debonded strand, or incorrect debonded length of a strand. ~~The slit sheathing must maintain its integrity during the placement of fresh concrete without opening the seam.~~ Tape the entire length of the slit tubular sheathing seam and tie the ends to ensure mortar tightness ~~of the sheathing tube~~.

~~Do not use strands debonded over the full length of a product.~~

SUBARTICLE 450-8.2.1 is deleted, and the following is substituted:

450-8.2 Operations:

450-8.2.1 General: The tensioning operations consist of the application of the final force or load required by the Plans and with adjustments for abutment rotation, bed shortening, anchorage header movement, live end seating, dead end seating, splice chuck seating, friction in the jacking system and any other elements as applicable for the type of bed and anchorage used. Also, adjust the force when the temperature differential between the ambient temperature at time of stressing and the expected concrete temperature at time of placement is greater than 25ºF. Increase the force at the rate of 1% for each 10ºF increment that the ambient temperature at time of stressing is below the expected concrete temperature at time of placing. Decrease the force at the rate of 1% for each 10ºF that the ambient temperature at time of stressing is above the expected concrete temperature at the time of placing. Do not allow the stress in the steel prestressing strand to exceed 80% of the specified tensile strength of the strand, after seating. Do not allow the stress in the CFRP prestressing strand to exceed 70% of the specified tensile strength of the strand, after seating. During each tensioning operation, for the verification of the live and dead end seating, check the seating of at least 4 strands or a minimum of 10% of the total number of strands, whichever is greater. Maintain a record of the tensioning operation.

Compensation for temperature differential and abutment rotation are not required for self-stressing beds. However, adjust the final load for the effects of bed shortening due to the load from all the strands.

If the placement of concrete is delayed for more than seven calendar days after the completion of the stressing operation, check and adjust the final strand load as necessary before placement of concrete and maintain a record of the stressing operation.

Accomplish tensioning by either single strand tensioning or multiple strand tensioning, and ensure that it is symmetrical about the vertical axis of the product. Tensioning methods, in general, consist of tensioning to the required loads indicated by the jacking system, or tensioning to the required load while monitoring the elongation of the prestressing strand.

Production personnel will perform tensioning operations under supervision of a QC Inspector/Technician in accordance with Section 105 for prestressed concrete plant quality control personnel,~~personnel possessing a certificate of completion of PCI Quality Control Personnel Certification Level II, and Section 450 Specification examination~~, or certified personnel may perform tensioning operations directly.

SUBARTICLE 450-10.4 is deleted and the following substituted:

450-10.4 Vibration of Concrete: Except for SCC, consolidate concrete in steel reinforced products~~iling~~ by internal or external vibration, or combination of these methods. For SCC, meet the requirements of Section 8.4 of the Materials Manual for production batch verification. For CFRP strand reinforced products~~iling~~, use SCC without the use of vibration. If further consolidation is needed, manual rodding is permitted.

Design external form vibrators for the specific use. Design forms used in conjunction with external vibration and build them to effectively transmit vibration to the concrete mass. Mount and operate form vibrators in compliance with the vibrator manufacturer's recommendations, a copy of which must be on file at the plant. Secure vibrators to the form mounts by positive locking devices so that maximum vibration is transmitted into the form. Modify or replace external form vibrator systems that are demonstrated to be ineffective. Operate vibrators at each mount location for the time necessary for complete concrete consolidation. Do not allow progressive points of vibration to exceed twice the visually effective radius of vibration. Keep forms equipped with external vibrators clean, and free of any buildup of hardened concrete.

Ensure internal vibrators are available before concrete placement is started. Use an internal vibrator with a head of such size that proper vibration of the concrete will be secured without causing movement of the prestressing strand or reinforcing bars. The vibrating frequency range must be 8,000 to 15,000 impulses per minute. Have at least one standby vibrator available on-site. Insert the vibrator in the concrete at points spaced to ensure uniform vibration of the entire mass of the concrete. Do not allow points of insertions to be further apart than the radius over which the vibrator is visibly effective. Allow the vibrator to sink into the concrete by its own weight and penetrate into the underlying layers sufficiently so that the layers are thoroughly consolidated. After the concrete is thoroughly consolidated, slowly withdraw the vibrator to avoid formation of holes.

Revise the existing placement and consolidation procedure to improve the consolidation of the concrete, if the existing placement and consolidation procedure has produced unacceptable surface defects such as honeycombing, aggregate or mortar pockets, or excessive air bubbles.

ARTICLE 450-13 is deleted and the following substituted:

450-13 Repair Methods and Materials.

450-13.1 General: Before beginning the repairs of bug holes, spalls, chips, surface porosity, and honeycomb, remove all laitance, loose material, form oil, curing compound and any other deleterious matter from the repair area. Repair cosmetic or minor deficiencies by methods specified herein. Submit alternative repair methods as needed.

For each project, maintain the record of deficiencies and their repair methods. Ensure the record includes information about product description, unit serial number, date cast, defect description including dimensions, repair method and materials, defect discovery date, and signature of producer's QC Manager indicating concurrence with the information.

Cure repaired surfaces for the full 72 hour curing time or for the curing time as recommended by ~~recommendations from~~ the manufacturer of the repair material. Ensure the repaired surfaces have a surface texture, finish and color which matches the appearance of the unaffected surrounding area of the product.

450-13.1.1 Product Acceptance on the Project: Use only ~~non-shrink grout and/or epoxy that is~~ materials listed on the Approved Product List (APL)~~,~~ in accordance with the following Sections.

Epoxy Compounds (Type F) …….. Section 926
Materials for Concrete Repair……. Section 930
Non-shrink Grout…… Section 934

450-13.2 Cosmetic Surface Filling: Repair areas to be filled with an approved ~~high-strength, non-metallic,~~ non-shrink grout or material for concrete repair ~~meeting the requirements of Section 934~~. Mix, apply, and cure the material~~grout~~ in accordance with the manufacturer's recommendations. Coating of the prepared surface with epoxy compound~~bonding agent~~ before ~~grout~~ placement is not required.

450-13.3 Surface Restoration: Maintain the surface continuously wet for a minimum of three hours before application of repair material. Repair areas to be restored with a mortar mix consisting by volume of one part cement, 2.5 parts sand that will pass a No. 16 sieve, and sufficient water to produce a viscous slurry mix or repair areas to be restored with an approved ~~high-strength, non-metallic,~~ non-shrink grout ~~meeting the requirements of Section 934~~ or material for concrete repair. Mix, apply, and cure the material~~grout~~ in accordance with the manufacturer's recommendations. Cure areas repaired with a mortar mix in accordance with 450-10.6. Coating of the prepared surface with epoxy compound~~bonding agent~~ before ~~grout~~ placement is not required.

450-13.4 Cutting and Filling: Carefully cut all feathered edges of the area to be repaired back perpendicular to (or slightly undercut from) the surface and to the depth of sound concrete or to a minimum depth of 1/2 inch, whichever is deeper. Coat the prepared surface with an approved epoxy bonding compound~~agent~~ applied in accordance with the manufacturer's recommendations. Fill the cutout area with an approved ~~high-strength, non-metallic,~~ non-shrink grout, material for concrete repair, or epoxy mortar. M~~m~~ix~~,ed and~~ apply~~,ied~~ and cure in accordance with the manufacturer's recommendations. Firmly consolidate the material~~grout mix~~ in the cutout area.

450-13.5 Restoration of Surfaces and Edges: When reinforcement is exposed, remove concrete from around the items to provide a 1-inch clearance all around. When less than one-half the reinforcement diameter is exposed, a positive connection utilizing anchor screws may be

proposed in lieu of 1-inch clearance all around. Do not damage the reinforcement. Form surfaces and edges to the original dimensions and shape of the product. Coat the prepared surface with an approved epoxy bonding compound~~agent~~ applied in accordance with the manufacturer's recommendations. Restore surfaces and edges with an approved ~~high-strength, non-metallic,~~ non-shrink grout, material for concrete repair, or epoxy mortar. ~~mixed and applied~~ Mix, apply, and cure in accordance with the manufacturer's recommendations. ~~An epoxy mortar meeting the requirements of Section 926, Type F may be used as an alternative to non-shrink grout.~~ Firmly consolidate the material ~~grout or epoxy mortar~~ in the area to be repaired. Restore surfaces and edges to the original dimensions and shape of the product.

450-13.6 Removal and Restoration of Unsound Concrete: Carefully cut the area of unsound concrete to be repaired back perpendicular to (or slightly undercut from) the surface and to the depth of sound concrete or to a minimum depth of 1 inch, whichever is deeper. When reinforcement is exposed, remove the concrete from around the items to provide a 1-inch clearance all around. When less than one-half the reinforcement diameter is exposed, a positive connection utilizing anchor screws may be proposed in lieu of 1-inch clearance all around. Do not damage the reinforcement. Coat the prepared surface with an approved epoxy bonding compound ~~agent~~ applied in accordance with the manufacturer's recommendations. Fill the area to be repaired ~~and then filled~~ with an approved ~~high-strength, non-metallic,~~ non-shrink grout, concrete repair material, or epoxy mortar. ~~mixed and applied in accordance with the manufacturer's recommendations. An epoxy mortar meeting the requirements of Section 926, Type F may be used as an alternative to non-shrink grout.~~ Mix, apply, and cure in accordance with the manufacture's recommendations. Firmly consolidate the material ~~grout or epoxy mortar~~ in the area to be repaired. Restore surfaces and edges to the original dimensions and shape of the product.

450-13.7 Surface Grinding: Grind off misshaped formed surfaces with an abrasive stone. Apply two coats of penetrant sealer in accordance with the requirements of Section 413, to any surfaces which are not subsequently encased in concrete, immediately after grinding has been accepted. Do not apply a penetrant sealer to any surfaces to be subsequently encased in concrete.

450-13.8 Treatment of Cracks: Treat cracks in accordance with 450-12.3.6.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 24, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **451**
Proposed Specification: **4510405 Prestressed Soil Anchors.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Jose Armenteros from the State Materials Office to provide cylinder testing for compressive strength of cement grout and to be consistent with the requirements listed in Section 455, Article 455-43

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PRESTRESSED SOIL ANCHORS
(REV 7-7-22)

SUBARTICLE 451-4.5 is deleted and the following substituted:

451-4.5 Cement Grout: Use grout for anchorage consisting of a pumpable mixture of portland cement meeting the requirements of Section 921, sand, water, and admixtures. The Contractor may use admixtures which control bleed, improve flowability, reduce water content, and retard set in the grout subject to the approval of the Engineer. The Contractor may only add expansive admixtures to the grout used for filling sealed encapsulations, trumpets, and anchorage covers. Do not use accelerators. Use admixtures compatible with the prestressing steels and mixed in accordance with the manufacturer's recommendations.

Do not perform strength testing as system performance will be measured by proof-testing each anchor. The Department may require cylinder ~~grout cube~~ testing if the Contractor uses admixtures or irregularities occur in anchor testing. Cast a set of three 4 inches x 8 inches grout cylinders for each LOT in accordance with ASTM C31, except fill the cylinder molds in one layer without rodding. Use grout that attains a minimum ~~cube~~compressive strength of 3,400 psi within seven days, when tested in accordance with ASTM C39~~.~~

FDOT
Florida Department of Transportation
RON DESANTIS
GOVERNOR
605 Suwannee Street
Tallahassee, FL 32399-0450
JARED W. PERDUE, P.E.
SECRETARY

October 3, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **455**
Proposed Specification: **4550800 Structures Foundations.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Juan Castellanos from the State Construction Office to ensure H piling are backfilled and do not have lateral stability. Changes to the drilled shaft specifications are necessary to improve the accuracy of the thermal testing results. This will improve safety to our structures by ensuring stability of H piles and integrity of drilled shafts for bridges. These changes are associated with the Design Build Special Provision of Section 455.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

STRUCTURES FOUNDATIONS
(REV 96-2916-22)

SUBARTICLE 455-16.4 is deleted and the following substituted:

455-16.4 Nondestructive Integrity Testing Access Tubes: Install access tubes full length in all drilled shafts from the tip of shaft to a point high enough above top of shaft to allow thermal integrity testing for drilled shafts (TITDS) and cross-hole sonic logging (CSL) testing, but not less than 30 inches above the top of the drilled shaft, ground surface or water surface, whichever is higher. Equally space tubes around circumference of drilled shaft. Securely tie access tubes to the inside of the reinforcing cage and align tubes to be parallel to the vertical axis of the center of the cage. Access tubes from the top of the reinforcing cage to the tip of the shaft shall be NPS 1-1/2 Schedule 40 black iron or black steel (not galvanized) pipe. Access tubes above the top of the reinforcing cage may be the same black iron or black steel pipe or Schedule 40 PVC pipe. Ensure that the access tubes are free from loose rust, scale, dirt, paint, oil and other foreign material. Couple tubes as required with threaded couplers, such that inside of tube remains flush. Seal the bottom and top of the tubes with threaded caps. The tubes, joints and bottom caps shall be watertight. Seal the top of the tubes with lubricated, threaded caps sufficient to prevent the intrusion of foreign materials. Stiffen the cage sufficiently to prevent damage or misalignment of access tubes during the lifting and installation of the cage. Exercise care in removing the caps from the top of the tubes after installation so as not to apply excess torque, hammering or other stress which could break the bond between the tubes and the concrete.

Provide the following number (rounded up to the next whole number of tubes) and configuration of access tubes in each drilled shaft based on the diameter of the shaft.

Table 455-5		
Shaft Diameter	Number of Tubes Required	Configuration around the inside of Circular Reinforcing Cage
36 to 48 inches	4	90 degrees apart
Greater than 48 inches	1 tube per foot of Shaft Diameter	360 degrees divided by the Number of Tubes

Insert simulated or mock probes in each access tube prior to concreting to ensure the serviceability of the tube. Fill access tubes with clean potable water and recap prior to concreting. Repair or replace any leaking, misaligned or unserviceable tubes as in a manner acceptable to the Engineer prior to concreting.

For method shafts for bridge foundations, in addition to the access tubes, provide embedded thermal wires equally spaced around the reinforcing cage.

For drilled shaft foundations requiring anchor bolts, verify access tubes will not interfere with anchor bolt installation before excavating the shaft. When access tube locations conflict with anchor bolt locations, move the access tube location plus or minus 2 inches along the inner circumference of the reinforcing cage. Notify the Engineer before excavating the shaft if the access tube locations cannot be moved out of conflict with anchor bolt locations.

For drilled shafts supporting sign, signal, lighting and ITS structures, if the shaft cleaning operations result in excavating below the required tip elevation, the access tubes do not

need to be extended. If the reinforcing steel cage is suspended in place from the top rather than resting on the bottom of the excavation, clearly mark the top of shaft location on each tube.

When called for in the Contract Documents, provide embedded thermal wires and equipment to allow TITDS in accordance with ASTM D7949 Method B.

SUBSRTICLE 455-17.6 is deleted and the following substituted:

455-17.6 Non-Destructive Testing of Drilled Shaft Integrity:

455-17.6.1 Thermal Integrity Testing for Drilled Shafts (TITDS): Perform all TITDS in accordance with ASTM D7949. Test method shafts, load test shafts and all drilled shafts in bridge bents or piers considered nonredundant in the Plans, using TITDS. For all other drilled shafts, perform TITDS only on drilled shafts selected by the Engineer. The minimum number of shafts tested is the number of shafts indicated in the Plans. The Engineer may increase the number shafts tested as deemed necessary.

Engage a qualified Specialty Engineer to supervise the TITDS. The qualified TITDS Specialty Engineer must have a minimum six months experience of TITDS, have a Florida Licensed Professional Engineer and supervise the collection and interpretation of data. The individual performing the TITDS in the field must work for the Specialty Engineer firm and have a minimum of six months experience of TITDS. The Contractor shall provide all necessary assistance to the TITDS Specialty Engineer to satisfactorily perform the testing.

After acceptance of production shafts by the Engineer, remove all water from the access tubes or core holes and fill the tubes or core holes with a structural non-shrink grout meeting the requirements of Section 934 from the bottom via tremie tube. Place the grout utilizing enough pressure to fill the tubes or core holes completely.

If the Contractor determines at any time during the non-destructive testing and evaluation of the drilled shaft that the drilled shaft should be replaced, no further testing or evaluation of that shaft is required.

455-17.6.1.1 Equipment: Furnish TITDS test equipment in accordance with ASTM D7949 as follows:

1. Provide thermal probes with four orthogonally oriented infrared sensors able to be used in 1-1/2 inch I.D. pipes.
2. Provide a computer based TITDS data acquisition system for display of signals during data acquisition.
3. Provide a depth encoder sensor to determine probe depths.
4. Provide an air compressor and power supply with sufficient pressure to air lift the water from the access tubes.

455-17.6.1.2 Procedure: For non-bridge structures, p~~P~~erform TITDS testing between the minimum and maximum times shown below after the batching time of the first truck load placed in the drilled shaft, unless otherwise directed by the Engineer.

Table 455-6

Shaft Diameter (inches)	Minimum time (hours)	Maximum time (hours)
36-48	24	54
49-60	24	72

61-72	24	72
73-84	24	90
85-120	24	108

The Contractor may propose modifications in the above table for site specific and special concrete mix conditions, as demonstrated from lab and field testing and instrumentation. The Engineer must approve all changes to the testing times prior to the Contractor use them.

For bridges, prior to production drilled shaft and load test drilled shaft installation, perform TITDS in accordance with ASTM D7949 Method B to determine the temperature variability and time to peak temperature for each project specific concrete mix. Obtain temperature measurements at least every 15 minutes during curing on the method shafts piles. Submit the TITDS results within three working days of performing the tests, in accordance with 455-17, including the proposed temperature peak time established from the TITDS. The Engineer will review the results of the test and concur with the proposed peak time or revise it. After the peak time is established for each mix, perform TITDS in accordance with ASTM D7949 Method A on production drilled shafts and load test shafts, within the following times after batching the first truck:

Minimum time (hours)= Peak time (hours) – 8

Maximum time (hours)= Peak time (hours) + 4D

Where:

D= Drilled shaft diameter in ft.

Peak time: Time after batching the first truck load that was placed in the drilled shaft, at which the maximum temperature is observed.

Furnish information regarding the shaft, tube lengths and depths, construction dates, and other pertinent shaft installation observations and details to the Department at the time of testing. Verify access tube lengths and their condition in the presence of the Department, at the end of concrete placement. If the access tubes do not provide access over the full length of the shaft, repair the existing tube(s) or core additional hole(s), as directed by the Engineer, at no additional cost to the Department.

Just prior to inserting the thermal probe, remove water from the access tubes. Store the removed water in an insulated container for later replacement. Allow the thermal probe to acclimate in accordance with the equipment manufacturer recommendations. Continuously record temperatures at depth intervals of 3.0 inches or less from the top to the bottom of each access tube. Repeat the test at each access tube until two sets of data from the same access tube provide similar results. Return the warm water to the access tubes immediately after the testing has been completed.

Immediately report any potential defects indicated by low temperature anomalies to the Engineer.

455-17.6.1.3 Required TITDS Reports: Submit the TITDS data and analysis results to the Engineer in a signed and sealed report, together with all electronic data, within 48 hours of testing. The report shall include as minimum the following items:

1. Graphs displaying all temperature measurements and average temperature versus depth.

2. Indication of unusual temperatures, including cooler local deviations from the average at any depth from the overall average over the entire length.

3. A graph displaying the average temperature and theoretical temperature versus depth.

4. Variations in temperature between access tubes which may indicate variations in cage alignment.

5. When ASTM D7949 method B is used, include a chart indicating the variability of temperature vs. time, for all wires and the average. Submit the peak time in hours for the average temperature of the wires.

6~~5~~. The calculated radius of the shaft throughout the entire depth.

7~~6~~. Calculated concrete cover throughout the entire depth.

8~~7~~. Shaft Details, Probe Details, Environmental Details, Tube Run Selection and Shaft Adjustment Data that show the measurements, inputs and adjustments to the data. Screen captures of these pages from the TIP Reporter software will be acceptable.

9~~8~~. A conclusion stating whether the tested shaft is free from integrity defects, meets the minimum concrete cover and diameter requirements by the specifications and the cage is properly aligned. When anomalies are detected, include in the report a three-dimensional rendering of the shape of the shaft.

455-17.6.1.4 Evaluation of TITDS Test Results: The Engineer will evaluate the observations during drilled shaft construction and TITDS results to determine whether or not the drilled shaft construction is acceptable. Drilled shafts not meeting the minimum cover and diameter requirements, or having integrity defects, are not acceptable without an engineering analysis.

455-17.6.1.5 Coring and/or Repair of Drilled Shafts: If the Engineer determines a drilled shaft is unacceptable based on the TITDS tests and other testing, or observes problems during drilled shaft construction, core the shaft to allow further evaluation and repair, or replace the shaft as directed by the Engineer. If coring to allow further evaluation of the shaft and repair is chosen, one or more core samples shall be taken from each unacceptable shaft for full depth of the shaft or to the depth directed by the Engineer. The Engineer will determine the number, location, and diameter of the cores based on the results of the TITDS. Keep an accurate log of cores. Properly mark and place the cores in a crate showing the shaft depth at each interval of core recovery. Submit the coring log and transport the cores to the location designated by the Engineer. Perform strength testing by an AASHTO certified lab on portions of the cores as required by the Engineer. If the TITDS and coring indicate the shaft is defective, propose remedial measures for approval by the Engineer. Such improvement may consist of, but is not limited to correcting defective portions of the shaft, providing straddle shafts to compensate for capacity loss, or providing a replacement shaft. Repair all detected defects and conduct post repair integrity testing using horizontal and offset CSL testing and 3-D tomographic imaging as described in 455-17.6.2. Engage a Specialty Engineer to perform gamma-gamma density logging calibrated to 1-1/2 inch black iron access tubes, prior to and after the repair is performed, to verify the integrity of the shaft outside the reinforcing cage in the same locations where the repair was required. When straddle shafts or replacement shafts are used to correct a deficient foundation perform TITDS in accordance with 455-17.6.1 through 455-17.6.3 to verify integrity of these shafts. Submit all results to the Engineer within five days of test completion for

approval. Perform all work described in this subarticle at no additional cost to the Department, and with no increase in Contract Time.

455-17.6.2 Cross Sonic Logging (CSL) and Tomography: When required by the Engineer, perform CSL testing in accordance with ASTM D6760. Engage a qualified Specialty Engineer to perform the CSL testing. The qualified CSL Specialty Engineer must be a Professional Engineer in the State of Florida and have a minimum six months experience of CSL testing, supervising the collection of CSL data and interpretation of CSL results. The individual performing the CLS testing in the field must work for the Specialty Engineer firm and have a minimum of six months experience of CSL testing. The Contractor shall provide all necessary access and assistance to the CSL Specialty Engineer to satisfactorily perform the testing.

When a shaft contains four tubes, test every possible tube combination. For shafts with five or more tubes, test all pairs of adjacent tubes around the perimeter, and one-half of the remaining number of tube combinations, as chosen by the Engineer. Pull the probes simultaneously, starting from the bottoms of the tubes, over an electronic depth measuring device. Perform the CSL tests with the source and receiver probes in the same horizontal plane. Continuously record CSL signals at depth intervals of 2-1/2 inches or less from the bottom of the tubes to the top of each shaft. Remove all slack from the cables prior to pulling to provide accurate depth measurements in the CSL records. When the measurements indicate a 30% or greater reduction in velocity between one or more pairs, take one or two concrete cores to allow further evaluation and repair, or replace the shaft as directed by the Engineer. Determine the location of the concrete cores by performing 3D tomographic analysis using the CSL measurements. The core depths shall be at least 5 feet deeper than the bottom of the anomaly determined by the 3D tomography analysis or full depth if the anomaly is within 5 feet of the bottom of the shaft. The Engineer may accept a drilled shaft without rock cores if an EAR demonstrates that the anomaly does not affect the structural and the geotechnical axial capacity, the structural and geotechnical lateral stability, the settlement behavior of the shaft, and that the anomaly will not impact the durability of the foundation.

When repairs are done, perform CSL measurements in all tube pair combinations with the source and receiver running at the same horizonal plane and at the vertical offsets of 45 degrees above and below. Perform all measurements including the offset measurements from the point where the higher probe is at least 5 feet below the lower limit of the repaired zone to the point where the lower probe is at least 5 feet above the upper limit of the repaired zone. Offset measurements must be as follows: plus 45 degrees (source below receiver) and minus 45 degrees (source above receiver). Use the measurements of these two offsets in combination with the horizontal measurements to perform the 3D tomography. Provide the CSL measurements, CSL logs and 3D tomographic analysis at no additional cost to the Department.

After acceptance of production shafts by the Engineer, fill the tubes or core holes with a structural non-shrink grout in accordance with 455-17.6.1.

If the Contractor determines at any time during the non-destructive testing and evaluation of the drilled shaft that the drilled shaft should be replaced, no further testing or evaluation of that shaft is required.

455-17.6.2.1 Required CSL Reports: Present the CSL data and analysis results to the Engineer in a signed and sealed report. Include CSL logs with analyses of first pulse arrival time (FAT) versus depth and pulse energy/amplitude versus depth. Present a CSL log for each tube pair tested with any defect zones identified on the logs and discussed in the test

report as appropriate. When offset measurements are required, perform 3D tomographic analysis using all offset data, and include color coded 3D tomographic images in the report.

455-17.6.2.2 Evaluation of Cross Hole Sonic logging Testing: The Engineer will evaluate the observations during drilled shaft construction and the CSL test results to determine whether or not the drilled shaft construction is acceptable. Drilled shafts with velocity reduction exceeding 30% are not acceptable without an engineering analysis.

455-17.6.2.3 Coring and/or Repair of Drilled Shafts: If the Engineer determines a drilled shaft is unacceptable based on the CSL test and other testing, core the shaft to allow further evaluation and repair, or replace the shaft in accordance with 455-17.6.1.5.

If repairs are performed or additional shafts installed to correct a deficient foundation, conduct integrity testing and submit the results to the Engineer in accordance with 455-17.6.1.5.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 21, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **460**
Proposed Specification: **4600102 Structural Steel and Miscellaneous Metals.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Ben Goldsberry from the Structures Design Office to provide consistency with policy updated made to FDM 266 for prefabricated steel truss pedestrian bridge. The changes are associated with Section 5.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

STRUCTURAL STEEL AND MISCELLANEOUS METALS
(REV 97-145-22)

SUBARTICLE 460-1.2 is deleted and the following substituted:

460-1.2 Fabrication Categories: As a prerequisite for being on the Department's Production Facility Listing, fabricators must currently be accredited in accordance with one of the programs in Table 460-1, by fabrication category/categories of the products that they are producing.

Fabricators are required to submit their proposed fabrication Quality Control (QC) Plan for review by the Department.

Table 460-1
Fabrication Categories

Structure Type	Accepted Accreditation Program
Simple Steel Bridge: Pedestrian bridge (prefabricated steel truss pedestrian bridges meeting the Category 1 conditions of FDOT Design Manual 266.4), bridge grid decking	AISC Simple Bridge
Steel Bridge: Vehicular bridge, Pedestrian bridge (all others)	AISC Advanced Bridge Fracture Critical Endorsement
Structural Highway Metal Components, Group I: bridge machinery, bridge bearings, modular joints, load plates, laminated bearing pads, cantilever, truss/span, monotube, gantry, mast arms, steel light poles, aluminum light poles, aluminum j-arms, drainage (welded gratings, frames, inlets)	AISC Components Manufacturer or AWS Welding Fabricator
Structural Highway Metal Components, Group II: bridge forgings, bridge castings, steel railing, aluminum railing, castings (manhole, grating, inlet, frame), guardrail, coated steel fence, elastomeric bearing pads, stay in-place forms	ISO 9001

Notes:
An AISC fracture critical (FC) endorsement is required for all FC work.
Other accreditations programs may be submitted to the FDOT State Materials Office for review and consideration in addition to the programs listed in the table above.

SUBARTICLE 460-6.4.2 is deleted and the following substituted:

460-6.4.2 Tubular Bridge ~~or Overhead Sign Structures~~: Comply with the requirements of the AWS D1.1 Structural Welding Code as amended by the following:

Unless otherwise shown in the Plans, perform ultrasonic testing (UT) or radiographic testing (RT) on full penetration groove welds at the following frequency (use the AWS D1.1 Tubular Connections Class R Criteria for UT and Cyclically Loaded Criteria for RT).

One hundred percent of each joint subject to tension or reversal of stress.

Twenty-five percent of each joint subject to only compression or shear. If unacceptable discontinuities are found in the joint, the remainder of the joint shall be tested.

Perform Magnetic Particle Testing at the following frequencies:

A minimum of 25% of all fillet or partial penetration groove welds in main members (Use the AWS D1.1 Tubular Connections Criteria). If unacceptable discontinuities are found, the remainder of the welds on the members shall be tested.

SUBARTICLE 460-6.4.3 is expanded by the following:

460-6.4.3 Overhead Sign Structures and Toll Gantries: Comply with the requirements of the AWS D1.1 Structural Welding Code as amended by the following:

Unless otherwise shown in the Plans, perform 100 percent ultrasonic testing (UT) or radiographic testing (RT) on all full penetration groove welds.

Prior to galvanizing, perform Magnetic Particle Testing (MT) at the following frequencies:

One hundred percent of all fillet or partial penetration groove welds in the upright columns. A minimum of 25% of all other fillet or partial penetration groove welds in main members other than upright columns. If unacceptable discontinuities are found, the remainder of the welds on the member shall be tested.

After members are galvanized, perform one hundred percent MT of all fillet welds in the upright columns.

For acceptance, use AWS D1.1 Tubular Connection Criteria for MT, Tubular Connection Class R Criteria for UT, and Cyclically Loaded Criteria for RT.

FDOT
Florida Department of Transportation
RON DESANTIS
GOVERNOR
605 Suwannee Street
Tallahassee, FL 32399-0450
JARED W. PERDUE, P.E.
SECRETARY

October 13, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **462**
Proposed Specification: **REVISED 4620000 Post-Tensioning.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Teddy Theryo from the Structures Design Office to address the presence of water and moisture within ducts for tendons with flexible filler

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

POST-TENSIONING
(REV 97-2211-22)

462-1 Description.

1. Furnish, test, transport, store, handle, and install all components of Post-Tensioning (PT) systems, in accordance with the requirements of this Section and the component manufacturer's recommendations. Constituent components of PT systems include, but are not limited to, anchorage assemblies, filler containment assemblies, filler material, and related steel reinforcement. Use the most stringent requirements, as determined by the Engineer, of those specified in this Section or the component manufacturer's recommendations for protecting components from damage due to environmental exposure, improper handling, or improper installation.

2. With the exception of mild reinforcing and prestressing steel, furnish all PT system components from a single supplier (vendor).

3. Submit PT system shop drawings in accordance with Section 5. Perform PT system testing in accordance with Section 960. Include in the PT system testing all possible combinations of components to be incorporated into the structure.

4. Use only PT systems meeting the requirements of Section 960 and approved by the Engineer in accordance with Section 5.

a. Use only PT systems of appropriate type and size required to construct tendons shown in the Contract Documents.

b. Use only the exact manufacturer and/or model of major components, as defined in 960-2, that were used in system testing and as listed on the approved PT system shop drawings.

c. With the exception of local zone reinforcement, do not substitute, modify, or delete any major components, as defined in 960-2, of a PT system approved by the Engineer for use on the project.

5. Provide a mockup test in accordance with this Section. PT system acceptance testing may be performed concurrent with mockup testing if performed prior to installation of any PT system hardware.

6. Just prior to PT tendon installation, blow oil-free dry compressed air meeting ASTM D4285 through the duct. Provide visual confirmation that the duct is free of water and moisture.

7. Install the PT tendon (e.g., strands, wires, or bars) in ducts. Stress the PT tendon to a predetermined load, and anchor ends directly against hardened concrete. After anchoring the PT tendon, and install permanent anchorage caps.

8. Just prior to wax filler injection, blow oil-free dry compressed air meeting ASTM D4285 through the duct. Provide visual confirmation that the duct and tendon are free of water and moisture.

9. Inject ducts with filler to completely fill voids, and install protection at anchorages.

10. Submit all required documents in accordance with this Section and Section 5 to the Engineer for review and written approval.

11. Arches, cable supported and extradosed bridges are not covered by this Specification.

12. Install duct filler. Provide fully filled duct and anchorage assemblies free from leaks, blockages, and voids. Submit test data to the Engineer to verify that the work meets the requirements of this Section. Perform filler injection operations in accordance with 462-7.4.

462-2 Materials.

462-2.1 General:

Approval of any material by the Engineer will not preclude subsequent rejection if material is damaged or otherwise found to not meet the requirements of this Section or Section 960.

462-2.2 Steel Reinforcing:

462-2.2.1 Mild Steel:

1. Provide reinforcing steel per Section 931.
2. Final design and details of local zone reinforcement are ~~project~~system specific and are the responsibility of PT system supplier (vendor). Design ~~project~~system specific local zone reinforcement for the number of strands or wires a particular PT system can accommodate at maximum allowable strand or wire force; do not design project specific local zone reinforcement for a reduced system capacity.
3. Submit signed and sealed project specific local zone reinforcement details to the Engineer for review and written approval.

462-2.2.2 Prestressing:

462-2.2.2.1 Strand:

1. Provide prestressing strands per Section 960.
2. Strand couplers are not permitted.

462-2.2.2.2 Bar:

1. Provide prestressing bars per Section 960.
2. For permanent applications, use and location of bar couplers is subject to written approval by the Engineer.

462-2.2.2.3 Parallel Wire:

1. Provide prestressing parallel wire assemblies per Section 960.
2. Wire couplers are not permitted.

462-2.3 Duct Filler: Use only grout and flexible filler meeting the requirements of Section 938 and are listed on the Department's Approved Product List (APL).

462-2.3.1 Grout:

1. Select grout for use in PT system by application: repair, horizontal, or vertical.
2. Mix grout per manufacturer's instructions with potable water meeting requirements of Section 923.
3. Do not combine different grout products.

462-2.3.2 Flexible Filler: Prepare flexible filler for installation in accordance with the manufacturer's instructions. Do not combine different flexible filler products.

462-2.4 Other Material References:

Meet the requirements of this Section, as well as the following:

Class 5 Applied Coating* .....Section 975
Elastomeric Coating System* .....Section 975
Epoxy Compound* .....Section 926
Magnesium Ammonium Phosphate Concrete* .....Section 930
Methacrylate* .....Section 413
Water.....Section 923
*Use products listed on the Department's Approved Product List (APL).

462-2.5 Component Samples:

462-2.5.1 Prestressing Steel:

1. Furnish samples per Section 933 from each manufacturer of prestressing strand, wire, and bar to be used on project.

2. The Engineer will collect sample materials from prestressing steel used for PT operations on the Project.

3. Samples, properly identified and tagged per 462-6, will be stored by the Engineer.

462-2.5.2 Grout:

1. The Engineer may sample grout packages at random, not to exceed a total quantity of one bag per LOT or shipment. A LOT is defined as a quantity of material from a single production batch or shipment

2. Grout sample may be virgin package mix, liquefied state, or solid state; Engineer will determine at what frequency, interval, sample phase (powder, liquid or solid) and location those samples will be recovered from the project.

3. Sample, properly identified and tagged per 462-6, will be stored by the Engineer.

4. Submit the following samples from each manufacturer per each production LOT of grout to be used on the project. These samples will be used by the State Materials Office for product testing.

a) Submit three 2” x2” x2” hardened grout cube samples from a trial batch using the same water source and grout to be used for production grouting.

b) One bag of grout.

Submit samples a minimum of four weeks prior to initial production grouting. Do not commence grouting operations until grout test results are available and approved by the Engineer. Mock-up testing per section 462-7.4.1.1 (5) may proceed prior to grout approval.

462-2.5.3 Flexible Filler:

1. The Engineer may sample flexible filler at random, not to exceed a total quantity of one gallon per LOT. A LOT is defined as a quantity of material from a single production batch or shipment not to exceed 1,000 gallons.

2. Sample may be virgin product in liquefied state or solid state. The Engineer will determine at what frequency, interval, sample phase (liquid or solid) and location those samples will be recovered from the project.

3. Sample, properly identified and tagged per 462-6, will be stored by the Engineer.

462-3 Alternate PT System Designs.

Designs using a PT scheme different from that shown in the Contract Documents may be submitted for the Engineer’s approval provided proposed scheme fulfills the design requirements, and the Contractor demonstrates compliance with these requirements:

1. PT system type and size meets all requirements of this Section.

2. Net compressive stress in the concrete after all prestress losses is equivalent to or greater than that provided by the PT scheme shown in original Contract Documents.

3. Distribution of individual tendons at each cross section generally conform to the distribution shown in original Contract Documents.

4. Proposed PT scheme meets the ultimate strength requirements of the American Association of State Highway and Transportation Officials Load and Resistance Factor Design,

AASHTO LRFD Bridge Design Specifications Section 5, and is equivalent to or greater than service and strength limit states provided in original Contract Documents.

5. Stresses in concrete and PT steel at all sections and at all stages of construction meet requirements of the Design Criteria shown in original Contract Documents.

6. All Design Criteria provisions noted in original Contract Documents are satisfied.

7. Show complete design and detail of all elements for proposed locations of alternate PT scheme.

8. Submit the following for the Engineer's approval:

a. design calculations including short and long term prestress losses

b. complete shop drawings including PT scheme and system, reinforcing steel, and concrete cover

9. Any alternate PT system approved by the Engineer resulting in a change in quantity from that shown in the Contract Documents is paid based on comparison of the following:

a. quantity actually used and accepted or original plan quantity, whichever is less, and

b. unit bid price.

If approved alternate PT scheme or system is under a Cost Savings Initiative Proposal (CSIP), method of payment will be in compliance with CSIP agreement.

10. Submit alternate PT scheme signed and sealed by the Contractor's Engineer of Record.

462-4 Qualifications.

Provide all project personnel and crew foreman in accordance with Section 105.

462-5 Submittals.

1. Submit to the Engineer all necessary information, Plans, shop and working drawings, and manuals in accordance with this Section and Section 5. Submit to the Engineer signed and sealed PT related shop drawings designed by the Contractor's Engineer of Record.

2. Prepare shop drawings addressing all requirements stated in the Contract Documents and requirements of this Section. Show details of PT hardware components, tendon geometry and locations complying with the Contract Documents and limitations of selected PT system. Include all inlets, outlets, high point inspection port details, anchorage inspection details, permanent anchorage caps, protection system materials, and application limits. If applicable, include details of the duct dehumidification system.

462-6 Transport, Handling and Storage.

462-6.1 General:

Store all materials in a weatherproof building, shed, covering, or container until time of use.

462-6.2 LOT Identification:

1. Assign an individual LOT number and tag items shipped to project in a manner that allows each LOT to be clearly identified at project site for all PT system components, filler, bars of each size from each mill heat of steel, and all strands from each manufactured reel.

2. Submit records to the Engineer identifying assigned LOT numbers with heat or reel of material represented if applicable.

3. All unidentified prestressing components, strands, wires, bars, or filler received at the site will be rejected.

4. Loss of positive identification of these items at any time will be cause for rejection.

5. Submit filler Quality Control Data Sheets from the manufacturer, to the Engineer for each LOT of filler on the project.

462-6.3 Prestressing Steel:

1. Protect all prestressing steel against physical damage and corrosion at all times.

a. Package prestressing steel in containers for protection against physical damage and corrosion during shipping and storage.

b. Place a corrosion inhibitor, which prevents rust, in package or incorporate it into a corrosion inhibitor carrier type packaging material.

c. Corrosion inhibitor must have no deleterious effect on steel, filler, concrete, or bond strength of steel to concrete.

d. Inhibitor carrier type packaging material must conform to provisions of Federal Specification MIL-P-3420.

e. Immediately replace or restore damaged packaging to original condition.

f. Clearly mark shipping package with a statement that package contains high-strength prestressing steel, care to be used in handling, include type, kind, and amount of corrosion inhibitor used, date when placed, safety orders, and instructions for use.

2. The Engineer will reject prestressing steel that has sustained physical damage.

3. Remove and discard lengths of strand found to contain broken wires.

4. Wire must be bright and uniformly colored, with no foreign matter or pitting on its surface.

462-6.4 Filler:

1. Maintain filler in environmental exposure conditions (e.g., temperature, humidity) in strict conformance with manufacturer's recommendations at all times from manufacture to installation.

2. Storage in the open must be on a raised platform with adequate waterproof covering to protect the filler.

3. On site storage of grout filler on a raised and covered platform is limited to a maximum period of one week. The allowable on site storage time may be extended by the Engineer if the grout filler is in a climate-controlled structure. Grout filler material with a total time from manufacturer in excess of six months must be removed from the jobsite and replaced with new material.

4. Flexible filler may be stored on site on a raised and covered platform up to the manufacturer's expiration date. Do not use flexible filler that has exceeded the manufacturer's recommended usage date. Remove all such filler from the jobsite and replace with new material.

462-6.5 Duct and Pipe:

1. Protect ducts against ultraviolet degradation, crushing, excessive bending, dirt contamination, corrosive elements, or any other damage or contamination during transport, storage, and handling.

2. Furnish ducts with end caps to prevent contamination inside duct. Do not remove duct end caps until duct is incorporated into the bridge component.

3. Ship capped duct in bundles that are covered during transport and storage.

4. Store on a raised platform and completely covered to prevent contamination.

5. If contamination is discovered, immediately flush duct with potable water per 462-7.2.4 before use.

462-7 Construction.

462-7.1 General:

1. Prior to installing any PT system hardware:

a. Submit to the Engineer a list of all PT systems chosen for the project.

b. For each PT system, submit a package to the Engineer meeting the requirements of Section 960-3.6.

c. For each PT system, submit to the Engineer written certification that all major components, as defined in 960-2, furnished to the project and shown on the approved PT system shop drawings exactly match the major components used in PT system testing.

2. Use methods to place and consolidate concrete that will not displace or damage any PT ducts, anchorage assemblies, splices and connections, reinforcement, or other embedded items.

3. Conduct all stressing and filler injection operations in the presence of the Engineer.

462-7.2 System Installation:

Accurately and securely fasten all PT anchorages, ducts, inlet and outlet pipes, miscellaneous hardware, reinforcing bars, and other embedded items at locations shown in the Contract Documents or on approved shop or working drawings or as otherwise approved by the Engineer in writing.

462-7.2.1 Ducts:

1. Construct tendon ducts using the minimum number of splices as practical.

2. Accurately position and align ducts at locations shown in the Contract Documents, or according to approved shop or working drawings, or as approved in writing by the Engineer.

3. Securely fasten all internal ducts at regular intervals not exceeding 30 inches for steel pipes, 24 inches for round plastic ducts, and 12 inches for flat ducts to prevent movement, displacement, or damage from concrete placement and consolidation operations.

4. Show method and spacing of duct supports on appropriate shop drawings.

5. Ensure external tendon ducts are straight between connections to internal ducts at anchorages, diaphragms, and deviation saddles and are supported at intermediate locations according to the Contract Documents including approved shop drawings.

6. Ensure all alignments, including curves and straight portions, are smooth and continuous with no lips, kinks, or dents. This also applies to curves in pre-bent steel pipe.

7. Check and repair all ducts in accordance with 462-7.5 as necessary before placing any concrete.

8. Ensure ducts at end connections to anchorages, splices, inlets, outlets, drains, and all other duct openings are sealed at all times after installing ducts and until tendon installation is complete. ~~Briefly open low point drains just prior to tendon installation and again just prior to filler injection to allow for drainage of any water that may be present within the duct.~~

9. Provide an absolute seal of anchorage and duct termination locations per the ~~pre-~~approved system drawings.

10. Use of tape, caulking, epoxy or other sealants is not permitted to make connections or sealing for any reason.

11. Use heat welding techniques, in accordance with duct manufacturer's instructions, to make splices between sections of smooth plastic duct or make connection with electrofusion duct coupler as shown on the approved PT system shop drawings.

12. When connecting steel pipe to plastic pipe with a boot, use a 3/8 inches wide power seated band and clamps in accordance with 960-2.2 on each end of a duct boot to seal against filler leakage. Install band per manufacturer's instructions.

13. Ducts for prestressing used exclusively for temporary erection where PT will be removed from structure are not required to be coupled across segment joints.

14. Briefly open low point drains to allow for drainage of any water that may be present within the duct.

462-7.2.1.1 Installation Tolerances:

1. Ensure final position of PT ducts is within the tolerances in the following table:

Table 462-1
Duct Installation Tolerances

Type	Vertical Position (inches)	Horizontal Position (inches)
Horizontal tendons in slabs or in slab regions of larger members	±1/4	±1/2
Longitudinal draped superstructure tendons in webs: Tendon over supports or in middle third of span	±1/4	±1/4
Tendon in middle half of web depth	±1/2	±1/4
Longitudinal, generally horizontal, superstructure tendons usually in top or bottom of member	±1/4	±1/4
Horizontal tendons in substructures and foundations	±1/2	±1/2
Vertical tendons in web	Longitudinal Position ±1	Transverse Position ±1/4
Vertical tendons in pier shafts	±1/2	±1/4
All other cases	±1/4	±1/4

2. Ensure entrance and exit angles of tendon paths at anchorages, duct joints, and/or at faces of concrete are within plus or minus 3 degrees of desired angle measured in any direction.

3. Accomplish any deviations in alignment with smooth unkinked transitions.

4. Locate anchorages within plus or minus 1/4 inches of desired position laterally and plus or minus 1 inch along tendon except that minimum cover requirements must be maintained.

5. Position local zone anchorage confinement reinforcement in the form of spirals, multiple U-shaped bars, or links centered around duct and anchorage (±1/4 inch tolerance) and starting within 1/2 inch~~es~~ of the back of the main anchorage plate.

6. If conflicts exist between reinforcement and a PT duct/anchorage and other non-local zone reinforcement, the position of duct prevails. Adjust the non-local zone reinforcement with the Engineer's written approval.

462-7.2.2 Splices and Joints:

1. All splices, joints, couplings, connections (inlet and outlet), and valves are part of approved PT system.

2. Fabricate all duct splices to prevent duct kinks during concrete placement.

3. Use mandrels as needed to maintain duct alignment and shape.

462-7.2.3 Inlets, Outlets, Drains and Ports:

1. Place filler inlets, outlets, drains and ports at locations shown in the Contract Documents including approved shop drawings.

2. Equip all filler inlets, outlets, drains and ports with approved positive shut-off devices (e.g., valves).

3. At a minimum, place filler inlets, outlets or ports in the following positions and those shown in Standard Plans, Index 462-001:

a. Top of tendon anchorage;

b. Top and bottom of anchorage cap;

c. At high points of duct profile when vertical distance between highest and lowest point is more than 2 feet;

d. At major change in duct cross section; and,

e. At other locations required by the Engineer.

4. For all tendons other than grouted top slab transverse tendons in box girders, place drains at the geometric low points of all duct profiles, or as close as is practical to the geometric low points of all duct profiles, except where an inlet, outlet or anchorage that can serve as a drain is located at a low point. Locate drains, and inlets and outlets serving as drains, at the bottom of the duct cross section. Do not locate drains within the limits of diabolos.

5. Extend filler and drain tubes a sufficient distance out of concrete member to allow for proper closing of valves.

6. Direct inlets, outlets, drains and ports exiting on vertical or predominantly vertical surfaces of box and I-girders toward the inside face of exterior I-girders or toward the interior of box girders.

462-7.2.4 Tendons:

1. Store the PT tendon in such a way that it remains completely dry and free of moisture prior to installation within the duct.

2. Do not exceed 14 calendar days between first installation of PT strand~~prestressing steel~~ within duct and completion of the stressing and filler injection operation ~~for PT bars located in superstructure and all strands and wires regardless of location~~.

3~~2~~. Do not exceed 21 calendar days between the first installation of PT bars~~prestressing steel~~ within duct and completion of the stressing and filler injection operations ~~for PT bars located in substructure~~.

4. With written approval of the Engineer, the maximum number of calendars days allowed between the first installation of the PT tendon within the duct and

completion of the stressing and filler injection operations is 30 for PT strand and 45 for PT bars by monitoring and continuously maintaining the relative humidity of air within the duct below 40%. Use a closed dehumidification system or other means approved by the Engineer. The dehumidification system must be installed and operational within 24 hours of first installation of the PT tendon within the duct and remain operational until just prior to filler injection.

5. The use of temporary corrosion inhibitor powder is not permitted as a method to increase the allowed number of calendar days between the first installation of the PT tendon within the duct and completion of the stressing and filler injection operations.

63. Any light surface corrosion forming during the period of time described in (1), ~~or~~ (2), (3) or (4) of this Article will not be cause for rejection of ~~prestressing steel~~the PT tendon.

74. Failure to inject filler into duct within the number of calendar days specified, will result in stoppage of work, except when waived by the Engineer in writing.

85. Just prior to PT tendon installation, briefly open low point drains to allow for drainage of any water that may be present within the duct. Close all low point drains and ports except the inlet and outlet ports at the anchorage caps. Blow oil-free dry compressed air meeting ASTM D4285 through one of the anchorage cap ports until the relative humidity measured at the inlet and outlet ends are less than 40% and continuing blowing for an additional 30 minutes. Stop blowing, wait a minimum of 15 minutes, and take humidity measurements at the inlet and outlet ends of blowing. Further blowing is not required if both humidity readings are less than 40%. If the humidity readings are 40% or greater, then repeat the process of blowing and waiting for 15 minutes until the humidity measurements at the inlet and outlet end of blowing are less than 40%. Take humidity measurements of air within the duct at the inlet end and outlet end of blowing using separate humidity meters. Use humidity meters approved by the Engineer.

9. Provide visual confirmation that the duct is free of water, moisture, and debris at the anchorages and low points of the tendon profile before installing the PT tendon within the duct.

10. Flushing of filler is not permitted without written approval of the Engineer and is only permitted as defined in this Article.

116. For grouted operations, vacuum injection is required to repair all voids and blockages as subject to provisions of 462-8.3.2. For flexible filler operations, use the repair procedure described in the approved Wax Injection Operations Plan.

127. For tendon ducts subjected to contamination with chlorides (e.g., uncapped ducts that have been subjected to salt spray), flush duct with potable water containing slack lime (i.e., calcium hydroxide) or quicklime (i.e., calcium oxide) in the amount of 0.17 pounds per gallon.

a. Test for presence of chlorides and oils in discharged water before placing tendon.

b. If chloride levels in flush water outflow exceed 300 ppm, continue to flush duct until chloride level in flush water outflow is below 250 ppm.

c. After the chloride level of flush water is below 250 ppm, open low point drains to allow for drainage of flush water within the duct. Perform the blowing process described in (8) of this Article. Provide visual confirmation that the duct is free of water and moisture for its entire length before installing the PT tendon within the duct ~~Dry duct interior by blowing oil-free compressed air, by vacuuming, or by other means deemed acceptable to the~~

~~Engineer. Remove excess water trapped in duct corrugations. The Engineer may require use of a borescope or other visual inspection means, at no additional cost to the Department, to ensure duct interior is water free.~~

138. Push or pull strands and wires through ducts to make up a tendon using methods that will not snag on any lips or joints in ducts.

149. Round off end of strands and wires that are pushed or fit advancing end with smooth protective cap.

150. Do not intentionally rotate strands or wires by any mechanical means during installation of PT strand into duct.

161. For superstructure tendons, provide sufficient strand and wire length beyond dead end anchorages to allow for second end stressing as needed for reconciliation of jacking force versus measured elongation.

172. Alternatively, tendons may be pulled through duct using a special steel wire sock or other device attached to advancing end. Strands may be brazed together for pulling as long as one foot of strand from the brazed end is removed by cutting after installation. Do not electric arc weld strand ends together for this purpose.

183. Cut tendons in accordance with 462-7.3.2.7.

194. Strand installation aids (i.e. wire/nylon ties around strand bundle, strand spacers, etc.) must be removed prior to stressing

2015. Do not install permanent tendons before completion of testing as required by this Section or the Contract Documents. The only two exceptions are:

a. Tendon to be tested by "Theoretical Elongation Verification" may be installed for test; and,

b. Transverse tendons may be pre-installed in precast segmental boxes prior to concrete casting such that they meet 462-8.3.1.

462-7.3 Post-Tensioning Operations:

1. Do not apply PT forces until concrete has attained compressive strength specified in the Contract Documents.

2. Conduct all stressing operations in presence of the Engineer.

3. With the written approval of the Engineer, revise PT operations so final tendon force is in agreement with the Contract Documents.

462-7.3.1 Stressing Equipment:

Only use equipment furnished by supplier of PT system.

462-7.3.1.1 Jacks and Gauges:

Equip each jack with pressure gauge for determining jacking pressure that has a minimum dial diameter of six inches.

462-7.3.1.2 Calibration:

1. Calibrate each jack and its gauges as a unit.

2. Calibration must consist of three test cycles with cylinder extension of jack in various positions (e.g., two-inch, four-inch, eight-inch stroke).

3. At each pressure increment, average forces from each test cycle to obtain an average force.

4. Perform calibration with equipment (e.g., jack, pump, hoses, etc.) setup in same configuration intended for use on Project.

5. Jack and gauge calibration is to be initially performed by PT supplier or an independent laboratory.

6. Use load cells calibrated within the past 12 months to calibrate stressing equipment.

7. Supply documentation denoting the load cells calibration date and tractability to National Institute of Standards and Technology (NIST) along with jack/gauge calibration.

8. Submit to the Engineer certified calibration charts and curves for each jack and gauge unit used on the project prior to start of work and every six months thereafter or as requested by the Engineer.

9. Calibrations subsequent to initial calibration with a load cell may be accomplished with use of a master gauge. Supply master gauge to the Engineer in a protective waterproof container capable of protecting calibration of gauge during shipment to a laboratory. Provide a quick-attach hydraulic manifold to enable quick and easy installation of master gauge to verify permanent readings. Master gauge will remain in the possession of the Engineer for duration of project and will be returned to the Contractor after final acceptance of project by the Engineer.

10. Any jack repair, such as replacing seals or changing length of hydraulic lines, requires recalibration using a load cell.

11. No extra compensation will be allowed for initial or any subsequent calibrations or use of master gauge required by the Engineer.

462-7.3.2 Stressing Tendons:

1. Tension all PT steel so PT force is not less than that required by the Contract Documents or as otherwise approved by the Engineer in writing.

2. Do not use monostrand jacks to stress straight tendons with five or more strands or wires, or for curved tendons with two or more strands or wires.

3. 4-strand curved top slab transverse tendons in box girders are permitted to use a monostrand jack.

4. Use of curved stressing noses or chairs is not permitted.

462-7.3.2.1 Jacking Maximum Stress:

Maximum temporary stress (i.e., jacking stress) in PT steel must not exceed 80% and 75% of Guaranteed Ultimate Tensile Strength (GUTS) for PT strands and bars, respectively. The maximum temporary jacking stress must not exceed 50% of GUTS for PT bars that will be reused.

462-7.3.2.2 Initial and Permanent Stresses:

1. PT steel must be anchored at initial stresses resulting in long term retention of permanent stresses or forces of no less than those shown in the Contract Documents.

2. Unless otherwise approved by the Engineer in writing, initial stress after anchor set must not exceed 70% of GUTS at anchorages and 74% of GUTS at all other locations between anchorages.

3. Permanent stress and permanent force are stress and force remaining in PT steel after all losses, including long term creep and shrinkage of concrete, elastic shortening of concrete, relaxation of steel, losses in PT steel from sequence of stressing, friction, and unintended wobble of ducts, anchor set, friction in anchorages, and all other losses particular to the specific PT system.

462-7.3.2.3 Stressing Sequence:

1. Permanent PT tendons must be stressed from both ends, except as noted in the Contract Documents.

2. Required force may be applied at one end and subsequently at other end or simultaneously at both ends.

462-7.3.2.4 Elongation:

1. Ensure forces being applied to tendon and resulting elongation of tendon can be measured at all times.

2. Measure elongations to nearest 1/16 inch.

3. For required tendon force, observed elongation must agree within 7% of theoretical elongation or entire operation must be halted, checked, and source of error determined and remedied to satisfaction of the Engineer before proceeding.

4. Do not overstress tendon to achieve theoretical elongation.

5. If~~n event that~~ agreement between observed and theoretical elongations at the required force falls outside acceptable tolerances, additional tests may be required, at the Engineer's ~~may, at his~~ discretion and without additional compensation to the Contractor, ~~require additional tests~~ for Tendon Modulus of Elasticity and/or In Place Wobble and Friction Test, or Lift-Off Test.

462-7.3.2.5 Friction:

1. Provide actual expected friction and wobble coefficients and anchor set in the shop drawings; submit calculations and show a typical tendon force diagram on shop drawings based upon expected actual coefficients and values for the PT system to be used.

2. Graphite may be used as a lubricant when friction must be reduced, subject to written approval of the Engineer.

462-7.3.2.6 Tendon Wire Failure:

1. Multi-strand PT tendons with wires which fail by breaking or slipping during stressing may be accepted provided these conditions are met:

a. Completed structure has a final PT force of at least 98% of original total design PT force;

b. PT force across a mating joint is at least 98% of PT force required by the Contract Documents for that mating joint for that stage of construction for precast or cast-in-place segmental construction. This 98% minimum PT force requirement applies to segmental construction, or any similar construction, that has members post-tensioned together across a common joint face at any stage of construction; and,

c. Any single tendon must have no more than a 5% reduction in cross-sectional area of PT steel due to wire failure.

2. When conditions permit the Contractor to propose acceptable alternative means of restoring PT force lost due to wire failure, any of the above conditions may be waived at discretion of and with approval of the Engineer in writing.

462-7.3.2.7 Cutting of PT Steel:

1. Cut PT steel using an abrasive saw or plasma torch within 3/4 inches to 1-1/2 inches away from the anchorage.

2. Flame cutting of PT steel is not permitted.

3. Do not cut tendon to final length prior to acceptance.

462-7.3.2.8 Post-Tensioning Operations Record:

1. Keep a record of these PT operations for each tendon installed:

a. Project name, Financial Project ID (FPID);

b. Contractor and/or subcontractor;
c. Tendon location, size, and type;
d. Date tendon was first installed in duct;
e. Reel number for strands and wires and heat number for bars;
f. Tendon cross-sectional area;
g. Modulus of elasticity;
h. Date stressed;
i. Jack and Gauge numbers per tendon end;
j. Required jacking force;
k. Gauge pressures at the pump and at the inlet;
l. Elongations (theoretical and actual);
m. Anchor sets (anticipated and actual);
n. Stressing sequence (i.e., sequential order of tendon stressing by number);
o. Stressing mode (single-end, dual-end, simultaneous);
p. Witnesses to stressing operations (Contractor and Inspector);
q. Any other relevant information.

2. Submit to the Engineer a complete set of stressing operation records within five days of completed tendon installation.

462-7.3.3 System Protection:

462-7.3.3.1 Tendon:

1. Seal all other duct openings other than installing anchorage caps within four hours after tendon stressing.

2. Install anchorage caps after tendon has been accepted. If acceptance of tendon will be delayed more than four hours after stressing, immediately provide temporary weatherproofing of tendons at open ends of anchorages. If tendons and anchorages are temporarily weatherproofed, install anchorage caps within 1 day of tendon being accepted.

3. If tendon contamination occurs and if directed by the Engineer, remove tendon, flush duct with potable water per 462-7.2.4, and replace with new tendon.

462-7.3.3.2 Anchorage:

1. Provide the following at anchorages as shown on Standard Plans, Index 462-002:

a. Temporary drain holes at the bottom of open top blockouts.

b. Temporary weatherproof plugs for upwardly oriented access or vent holes.

2. Cap all filler inlets/outlets with plugs meeting the requirements of Section 960.

3. Construct anchorage pour-backs and place elastomeric coatings at anchorages as indicated in the Contract Documents and as shown on Standard Plans, Index 462-002 within seven days of completing filler injection operations (see 462-7.4 for filler injection operations). For anchorages which require acrylic aliphatic polyurethane top coating, apply the acrylic aliphatic polyurethane top coating after the elastomeric coating has fully cured. See Standard Plans Index 462-002 and the Contract Documents for details on anchorages which

require acrylic aliphatic polyurethane top coating. Construct anchorage pour-backs using reinforced concrete, magnesium ammonium phosphate concrete, or a Type Q epoxy grout meeting the requirements of Section 926.

a. Remove all laitance, grease, curing compounds, surface treatments, coatings, and oils by grit blasting or water blasting. Flush surface with water and blow dry. Surfaces must be clean, sound, and without any standing water. Test substrate at all pour-back locations using ACI 503 and develop a minimum of 175 psi tension (e.g., pull-off value). Testing frequency may be reduced, as determined by the Engineer, after the Contractor has demonstrated an ability to prepare substrate surfaces for bonding as indicated by the result of the ACI 503 test.

b. Mix and apply epoxy grout and magnesium ammonium phosphate concrete in accordance with the manufacturer's current standard technical guidelines. Construct all pour-backs in leak proof forms creating neat lines. Epoxy grout may require pumping for proper installation. Construct forms to maintain a liquid head to ensure intimate contact with concrete surface. Use vents as needed to provide for escape of air to ensure complete filling of forms.

4. Coat exposed surfaces of pour-backs and anchorage caps as shown on Standard Plans, Index 462-002 with an elastomeric coating system meeting the requirements of Section 975 and having a thickness of 30 mils to 45 mils. Apply the acrylic aliphatic polyurethane top coating to a dry film thickness of 5 to 6 mils. Ensure concrete, anchorage caps, or other substrates are structurally sound, clean, and dry. Concrete must be a minimum of 28 days old. Remove all laitance, grease, curing compounds, surface treatments, coatings, and oils by grit blasting or water blasting using a minimum 3,000 psi nozzle pressure. Blow surface with compressed air to remove dust or water. Apply the elastomeric coating within 90 days of filler injection. Apply the acrylic aliphatic polyurethane top coat and the manufacturer's approved primer over the elastomeric coating before applying Class 5 coating, if required.

5. Prior to application of elastomeric coating, construct a 2 foot x 4 foot concrete test block with a similar surface texture to surfaces to be coated. Coat a vertical face with chosen elastomeric coating system. Determine number of coats required to achieve the specified thickness without runs and drips. Mix and apply elastomeric coating as per manufacturer's current standard technical specifications. Spray application is preferred; roller application is permitted. Have coating manufacturer representative on site to supervise and comment on application of elastomeric coating onto test block. Apply coating using approved and experienced personnel with a minimum of three years experience applying similar polyurethane systems. Submit credentials of these persons to the Engineer for review and consideration for approval.

462-7.4 Filler Injection Operations:

462-7.4.1 Grouting Operations: Conduct all grouting operations in the presence of the Engineer.

462-7.4.1.1 Grout Injection Operations Plan:

1. Submit a Grouting Operations Plan to the Engineer for approval at least six weeks in advance of any scheduled grouting operation.

2. Written approval of Grouting Operations Plan by the Engineer is required before any grouting of permanent structure takes place.

3. At minimum, Grouting Operations Plan will address and provide:

a. Names and proof of training for grouting crew and crew supervisor in conformance with this Specification;

b. Type, quantity, and brand of materials to be used in grouting, including all required certifications;

c. Type of equipment to be used, including capacity in relation to demand and working conditions, as well as, standby equipment and spare parts;

d. General grouting procedure;

f. If applicable, procedures for monitoring and continuously maintaining less than 40% relative humidity of air within the duct;

~~f~~g. Method to be used to control rate of flow within ducts;

~~g~~h. Theoretical grout volume calculations;

~~h~~i. Mixing and pumping procedures in accordance with the manufacturer's recommendations;

~~i~~j. Direction of grouting accounting for grade and/or slope of tendon;

~~j~~k. Sequence of inlet and outlet pipes use;

~~k~~l. Procedures for handling blockages;

~~l~~m. Procedures for possible post grouting repair.

4. Conduct a joint meeting of the Contractor, grouting crew, and the Engineer before grouting operations begin. Discuss Grouting Operations Plan, required testing, corrective procedures, and any other relevant issues at the meeting.

5. Prior to production grouting, demonstrate to the Engineer's satisfaction successful grout injection by injecting full-scale mockups that are constructed with all associated PT system components using the mockup tendon profiles shown in the Plans and the proposed Grouting Operations Plan. Utilize smooth duct and associated couplers and fittings meeting the requirements of Section 960 for all mockups. Utilize smooth duct for the mockups which has an inside diameter required for a given mockup tendon size. If the mockup is also being used to perform PT system acceptance testing, use the duct type appropriate for the PT system location. Place the mockup tendons specified in the Plans inside the ducts to simulate the in-place PT tendons. Stress mockup tendons to the minimum values shown in the Plans by using jacks or other methods approved by the Engineer. Perform pressure tests on the mockups in accordance with 462-8.2.1 prior to grout injection. For the grout injection operations, utilize the same grout material and types and sizes of grout injection equipment that will be used on the project including but not limited to mixers, pumps, hoses, valves and pressure gauges. Inject grout into the mockups using the proposed Grouting Operations Plan. Allow the grout to harden a minimum of 24 hours after injection before inspecting the mockup. Inspect the mockup in accordance with the requirements of 462-8.3.2.1 and then carefully cut open the duct at all high points and other locations as directed by the Engineer to check for voids. Prepare a report documenting the findings and submit it to the Engineer. If voids are found, determine the cause and revise the proposed Grouting Operations Plan accordingly. If directed by the Engineer, construct additional mockups and repeat the grout injection operation using the revised Grouting Operations Plan as many times as are required until the results are acceptable.

462-7.4.1.2 Inlets and Outlets:

1. Ensure connections from grout pump hose to inlets are free of dirt and are air-tight.

2. Inspect valves to ensure they can open and close properly.

462-7.4.1.3 Supplies:

Provide an adequate supply of water and compressed air for clearing and testing ducts, as well as, mixing and pumping grout before grouting operations start.

462-7.4.1.4 Equipment:

1. Provide grouting equipment consisting of measuring devices for water, a high-speed shear colloidal mixer, a storage hopper (e.g., holding reservoir) and pump with all necessary connecting hoses, valves, and pressure gauge.

2. Provide pumping equipment with sufficient capacity to ensure PT ducts can be filled and vented in not more than 30 minutes without interruption.

3. Provide an air compressor and hoses with sufficient output to perform required functions.

4. Have vacuum grouting equipment (i.e., volumetric measuring type) and experienced operators available to meet the timeframe requirements of 462-8.3.2.1-6.

462-7.4.1.4.1 Mixer and Storage Hopper:

1. Provide colloidal grout machinery with a charging tank for blending and a holding tank. Blending tank must be equipped with a high speed shear colloidal mixer capable of continuous mechanical mixing producing a homogeneous and stable grout free of lumps and un-dispersed cement. Holding tank must be kept agitated and at least 10% full at all times during pumping operations to prevent air from being drawn into duct.

2. Add water during primary mixing phase in the colloidal mixer by use of a flow meter or calibrated water reservoir with measuring accuracy equal to 1% of total water volume.

462-7.4.1.4.2 Pumps:

1. Provide pumping equipment capable of:

a. continuous operation which includes a system for circulating and agitating grout when actual grouting is not in progress,

b. maintaining pressure on grouted ducts,

c. fitted with a valve that can be closed off without loss of pressure in duct.

2. Grout pumps will:

a. be positive displacement type,

b. provide a continuous grout flow

c. be able to maintain a discharge pressure of at least 145 psi.

3. Use pumps constructed with seals to prevent oil, air, or other foreign substances from contaminating grout and prevent loss of grout or water.

4. Specify pump capacity adequate to maintain the specified grouting rate.

5. Place pressure gauges with full scale reading of no more than 300 psi at the pump and at the duct inlet.

6. Grout hoses to be compatible with pump output (diameter and pressure rating).

462-7.4.1.4.3 Vacuum Grouting: Provide vacuum grouting equipment meeting these minimum requirements:

1. Volumeter for measurement of void volume;

2. Vacuum pump with a minimum capacity of ten cubic feet per minute and equipped with a flow-meter, graduated hopper, or other acceptable means approved by the Engineer capable of measuring the amount of grout being injected.

3. Manual colloidal mixers, manual high speed shear mixers, or other mixing methods recommended and approved by the grout manufacturer, in writing, for the specific project covered by this Section for voids less than 5.5 gallons in volume. However, mix a minimum of one full bag of grout regardless of the size void to be grouted.

4. Standard colloidal mixers for voids 5.5 gallons and greater in volume.

462-7.4.1.4.4 Standby Equipment: Provide a standby colloidal grout mixer and pump during grouting operations.

462-7.4.1.5 Grouting:

1. Maintain grout fluidity in strict compliance with grout manufacturer's recommendations.

2. In the presence of the Engineer, perform a test to confirm accuracy of grouting equipment volume-measuring components each day of use before performing any grouting operations. Testing in a warehouse or similar condition is acceptable. Use either water or grout for testing using standard testing devices with volumes of 0.5 gallon and 6.5 gallon and an accuracy of equal to or less than four ounces. Perform one test with each device. Results must verify accuracy of grouting equipment void volume-measuring component within 5% of test device volume and must verify accuracy of grouting equipment grout volume component within 10% of test device volume for the 0.5 gallon test device. When testing the 6.5 gallon device, ensure an accuracy of 3% (test device volume) and 6% (grout volume).

3. Do not use grout that tests outside allowable flow rates.

4. Perform grouting in accordance with procedures set forth in approved Grouting Operations Plan.

5. Grout all ducts.

462-7.4.1.5.1 Temperature:

1. At inlet end of grout hose, the maximum limit for grout temperature is 90°F for normal grouting procedures and 85°F when performing repair operations with vacuum grouting.

2. Condition grout material to maintain mixed grout temperature below maximum limit.

3. Grouting operations are not permitted when ambient temperature is below 40°F or is expected to fall below 40°F within one day subsequent to grouting.

4. Postpone grouting operations if freezing temperatures are forecasted within two days subsequent to grouting.

462-7.4.1.5.2 Mixing and Pumping:

1. Mix grout with a metered amount of water.

2. Mix materials to produce a homogeneous grout.

3. Continuously agitate grout until grouting operations are complete.

4. Reject bags of grout containing clumps.

462-7.4.1.5.3 Production Test:

1. Test grout fluidity to verify it is within limits established by grout manufacturer during grouting operations. Target fluidity rate is established by manufacturer's representative based on ambient weather conditions.

2. Determine grout fluidity in accordance with Section 938.

a. Perform a fluidity test using flow cone on grout discharged from anchorage cap outlet immediately after uncontaminated uniform consistency discharge begins for each tendon greater than 50 feet in length. For tendons 50 feet or less, perform a fluidity test on a per batch basis. For fluidity tests done on a per batch basis, perform test after new batch has been transferred from mixing tank to holding tank and thoroughly mixed with remains of the previous batch to produce a new homogenous mixture. During mixing process, continually re-circulate grout from hose into holding tank. Ensure measured grout efflux time is not less than efflux time measured at injection end of grout hose.

b. Additionally, check grout fluidity using Wet Density method contained in Section 938. Density at discharge outlet must not be less than grout density at inlet. Continuously discharge grout until density requirements are met. Discard grout used for testing fluidity.

3. Perform fluidity test for each tendon to be grouted without modifying water-cement ratio.

4. Check temperature of grout at inlet end of grout hose hourly to verify conformance to this Section.

5. Obtain a sample from first production batch of grout and perform a wick induced bleed test on this sample in accordance with Section 938 at beginning of each day's grouting operation. Begin grouting operations after sample is obtained.

6. Once grouting has begun, if zero bleed requirement is found to not have been achieved in the wick induced bleed test at any time during required test time period, complete grouting of any partially grouted tendons currently being grouted but do not begin grouting any new or additional tendons. Immediately inform the Engineer when grouting operations have ceased due to non-compliance of the wick induced bleed test.

7. Do not re-start grouting operations until such time that testing shows grout meets specified requirements.

462-7.4.1.5.4 Grout Injection Operations:

1. Briefly open low point drains to allow for drainage of any water that may be present within the duct. If water is present:

a. Capture and measure the water removed from the duct and retain for further testing as directed by the Engineer; blow the duct with oil free dry compressed air meeting the ASTM D4285 with the end vent port open.

b. Obtain written authorization from the Engineer to proceed with grouting injection operations.

2. Open all grout outlets before starting grouting operation.

32. Inject grout into duct in accordance with approved Grouting Operations Plan.

43. Pump grout at the lowest possible pressure practical.

54. Conduct normal grouting operations at a pressure range of 10 psi to 50 psi measured at grout inlet.

65. Do not exceed a pumping pressure of 145 psi anywhere within the system. Do not exceed a pumping pressure of 75 psi at the grout inlet for flat ducts.

7~~6~~. Use grout pumping methods that ensure complete filling of ducts and complete encasement of steel.

8~~7~~. Grout must flow from first and subsequent outlets until any residual water or entrapped air has been removed prior to closing outlet.

9~~8~~. Pump grout through duct and continuously discharge it at anchorage and anchorage cap outlets until all free water and air are discharged and consistency of grout is equivalent to that of grout being pumped into inlet. Close anchorage outlet and discharge a minimum of two gallons of grout from anchorage cap into a clean receptacle. Close anchorage cap outlet.

10~~9~~. Elevate grout pressure to the equivalent realized pumping pressure while grouting the duct, seal inlet valve, and wait two minutes to determine if any leaks exist after all outlets have been bled and sealed. If leaks are present repair all identified leaks using methods pre-approved by the Engineer and repeat steps until no leaks are present. Bleed pressure to 5 psi and wait a minimum of ten minutes for any entrapped air to flow to high points if no leaks are present. Increase pumping pressure not to exceed actual realized pumping pressure of duct and discharge grout at each high point outlet to eliminate any entrapped air or water after specified ten minute period has expired. Complete process by locking a pressure of 30 psi into tendon duct.

11~~0~~. If actual grouting pressure exceeds maximum allowed, close inlet and pump grout at next outlet which has just been closed or is ready to be closed as long as a one-way flow is maintained. Do not pump grout into a succeeding outlet from which grout has not yet flowed. Fit outlet/inlet to be used for pumping with a positive shut-off valve as shown in the approved system drawings and pressure gauge if this procedure is used.

12~~1~~. Stop grouting operation if complete grouting of tendon cannot be achieved by the steps stated and in compliance with the approved Grouting Operations Plan. After waiting 48 hours, vacuum grout duct in accordance with this Section.

462-7.4.1.5.5 Vertical Grouting:

1. Provide a reservoir, equivalent to a minimum of 2% of the total anticipated grout volume used on a particular tendon, at upper end of tendon to store bleed water and grout; maintain grout level above level of prestressing plate and anchorage for all vertical tendons. Design and size this device to maintain level grout at an elevation that ensures potential bleed will not drop below the highest point of upper anchorage device. Design reservoir to allow all bleed water, if any, to rise into reservoir.

2. Discharge grout and check grout fluidity as described in this Section. Immediately add grout if level of grout begins to drop, potentially allowing bleed water into the upper anchorage device and tendon duct. Remove reservoir after grout has hardened. Visually inspect for voids using a borescope or probe in presence of the Engineer. Fill all voids found in duct using volumetric measuring vacuum grouting process in accordance with this Section.

3. Allow grout to flow from each outlet until all air and water have been purged prior to using a higher elevation outlet for pumping. Pump grout at increasingly higher outlets which have been or are ready to be closed, as long as one-way grout flow is maintained for vertical tendons within allowable grouting pressures.

462-7.4.1.5.6 Grouting Operations Report:

1. Submit grouting report signed by the grouting Contractor within five days of each grouting operation for review by the Engineer.

2. Record theoretical quantity of grout anticipated as compared to actual quantity of grout used to fill duct. Notify the Engineer immediately of shortages or overages.

3. Information to be noted in this report must include at a minimum, but not necessarily be limited to:

a. identification of tendon;
b. date grouted;
c. number of days from tendon installation to grouting;
d. type of grout;
e. injection end;
f. verification that water or moisture is not present within the duct;
g. daily duct humidity readings if applicable;
~~f~~h. Pressure gauge readings at the pump and at the inlet;
~~g~~i. Ratio of actual to theoretical grout quantity;
~~h~~j. Number of grout bags mixed;
~~i~~k. Total quantity of water used to mix grout;
~~j~~l. Summary of any problems encountered; and,
~~k~~m. corrective action taken,
~~l~~n. description and results of the post grouting operations and inspection.

462-7.4.2 Flexible Filler Operations:

1. Inject flexible filler with or without using vacuum assistance for tendons with vertical or predominately vertical profiles as shown on Standard Plans, Index 462-001.

2. Inject flexible filler using vacuum assistance for all other tendon profiles shown on Standard Plans, Index 462-001.

462-7.4.2.1 Microcrystalline Wax: Conduct all wax injection operations, repairs, and inspections in the presence of the Filler Injection Foreman, Filler Injection QC Inspector and the Engineer.

462-7.4.2.1.1 Wax Injection Operations Plan:

1. Prepare a Wax Injection Operations Plan in cooperation with the PT system vendor and the PT wax manufacturer.

2. Submit the Wax Injection Operations Plan to the Engineer for approval at least six weeks in advance of any scheduled injection operation.

3. Written approval of the Wax Injection Operations Plan by the Engineer is required before any injection of permanent structure can begin.

4. At a minimum, the Wax Injection Operations Plan will address and provide the following:

a. ~~-~~Names and qualifications for wax injection crew and crew supervisor in conformance with this Specification;
b. Type, quantity, and brand of materials to be used in wax injection including all required certifications;

c. Type of equipment to be used, including capacity in relation to demand and working conditions, as well as, standby equipment and spare parts;

d. Personal Protective Equipment (PPE);

e. Communication equipment to be used during injection;

~~d~~f. Location and sequence of ducts to be injected;

~~e~~g. Calculation of temporary elongation of tendons due to wax injection temperature;

h. Procedures for checking the presence of water or moisture in the duct, blowing oil-free dry compressed air, and measuring humidity of air within the duct;

i. If applicable, procedures for monitoring and continuously maintaining less than 40% humidity of air within the duct;

~~f~~j. General wax injection procedure for all duct geometries and types;

~~g~~k. Duct pressure test and repair procedures;

~~h~~l. Method to be used to control rate of flow within ducts and anchorage assembly;

~~i~~m. Theoretical wax volume calculations;

~~j~~n. Injection rate;

~~k~~o. Maximum injection pressure during injection and locking pressure;

~~l~~p. Vacuum (gauge) pressure requirements, vacuum tests and repair procedures;

~~m~~q. Heating, mixing and pumping procedures in accordance with the manufacturer's recommendations;

~~n~~r. Direction of wax injection accounting for grade and/or slope of tendon;

~~o~~s. Location of all high points and all low points accounting for grade and/or slope of tendon;

~~p~~t. Sequence of valve operations at PT system inlets and outlets, including minimum wax discharge quantities;

~~q~~u. Procedures for handling blockages;

~~r~~v. Procedure for sealing duct after wax injection;

~~s~~w. Procedure for inspecting the PT system after wax injection, filling voids created by inspection procedures, and sealing duct after PT system inspection;

~~t~~x. Procedures for possible post injection repair;

~~u~~y. Method(s) and material(s) that will be used to protect concrete surfaces from wax spills, leaks, etc. during wax injection, post injection inspection and post injection repair;

~~v~~z. Safety and clean-up procedures;

5. Conduct a joint meeting of the Contractor, wax injection crew, and the Engineer before wax injection operations begin. Discuss Wax Injection Operations Plan, required testing, corrective procedures, and any other relevant issues at the meeting.

6. Prior to production wax injection, demonstrate to the Engineer's satisfaction successful wax injection by injecting full-scale mockups that are constructed with all associated PT system components using the mockup tendon profiles shown in the Plans and the proposed Wax Injection Operations Plan. Utilize smooth duct and associated couplers and fittings meeting the requirements of Section 960 for all mockups. Utilize smooth duct for the mockups which has an inside diameter required for a given mockup tendon size. If the mockup is also being used to perform PT system acceptance testing, use the duct type appropriate for the PT system location. Place the mockup tendons specified in the Plans inside the ducts to simulate the in-place PT tendons. Stress mockup tendons to the minimum values shown in the Plans by using jacks or other methods approved by the Engineer. Perform pressure tests on the mockups in accordance with 462-8.2.1 prior to wax injection. If vacuum assisted wax injection is required to be used, perform vacuum tests on the mockups in accordance with 462-8.2.1 prior to wax injection. For the wax injection operations, utilize the same wax material and types and sizes of wax injection equipment that will be used on the project including but not limited to heaters, pumps, hoses, valves and pressure gauges. Inject wax into the mockups using the proposed Wax Injection Operations Plan. Allow the wax to cool a minimum of 24 hours after injection before inspecting the mockup. Inspect the mockup in accordance with the requirements of 462-8.3.2.2.1 and then carefully cut open the duct at all high points and other locations as directed by the Engineer to check for voids. Prepare a report documenting the findings and submit it to the Engineer. If voids are found, determine the cause and revise the proposed Wax Injection Operations Plan accordingly. If directed by the Engineer, construct additional mockups and repeat the wax injection operation using the revised Wax Injection Operations Plan as many times as are required until the results are acceptable.

462-7.4.2.1.2 Inlets and Outlets:

1. Ensure connections from wax pump hose to inlets are free of dirt and are air-tight.

2. Inspect valves to ensure they can open and close properly.

3. Provide clear hose and connections to outlet valves compatible with heated wax injection for discharging excess wax. Kinks and clogs in the vent hoses are not permitted during pumping operations.

462-7.4.2.1.3 Supplies:

1. Provide an adequate supply of compressed air for clearing and testing ducts before wax injection operations start.

2. Provide clean receptacles for collecting excess wax at outlet locations.

3. Provide supplies for stopping wax leaks including rags and buckets of cold water.

462-7.4.2.1.4 Equipment:

1. Provide equipment consisting of measuring devices for wax, wax melting unit(s), wax mixer for maintaining uniform temperature, a storage holding reservoir, pump, and volumetric flow rate and displacement volumetric meters with all necessary connecting hoses, valves, pressure gauges, timer, and temperature gauge.

2. Provide pumping equipment with sufficient capacity to ensure PT ducts can be filled and vented in not more than time specified by the wax manufacturer and this Specification.

3. Provide an air compressor and hoses with sufficient output to perform required functions.

4. For filling of air voids in an incomplete wax injection, have the required equipment and personnel as stated in the approved Wax Injection Operations plan available to meet the timeframe requirements of 462-8.3.2.2.1-6.

5. For vacuum assisted injection, provide vacuum pump equipment able to measure and have sufficient capacity to ensure a minimum of 90% vacuum in the PT system prior to filler injection. Provide a continuously running vacuum pump or vacuum reservoir capable of maintaining vacuum during the wax injection process.

6. Ensure that all injection and inspection equipment is maintained in accordance with equipment manufacturer's instructions and is calibrated and in good working condition.

7. Provide equipment for dislodging congealed wax blockages.

8. Provide standby pumping and vacuum equipment on the project site during injection operations.

462-7.4.2.1.4.1 Storage Reservoir and Mixing:

1. Provide heated holding tanks for wax injection.

a. Holding tanks must be equipped with a heating system capable of producing a melted wax free of lumps within the temperature limits specified by the manufacturer.

b. Holding tanks must be kept at least 10% full at all times during pumping operations to prevent clogs and air from being drawn into duct

c. Holding tanks must have at time of injection a quantity of heated wax required to inject the PT system. The quantity of heated wax required to inject the PT system is calculated as 25% more than the total quantity to fill the duct and anchorages, to discharge wax at outlets, to fill pumping equipment and hoses, and to maintain the minimum amount of wax in the holding tanks during pumping operations.

2. Provide equipment to ensure uniform temperature of heated wax, either by mixing or other methods.

462-7.4.2.1.4.2 Pumps:

1. Provide pumping equipment capable of the following:

a. continuous operation which includes a system for heating pump components when wax injection is not in progress;

b. maintaining pressure on wax injected ducts;

c. fitted with a valve that can be closed off without loss of pressure in duct.

2. Wax pumps will:

a. be positive displacement type;

b. provide a continuous wax flow;

c. be able to maintain a discharge pressure of at least 75 psi;

d. provide an injection of filler into duct in a velocity range of 40-70 ft/min.

3. Use pumps constructed with seals to prevent oil, air, or other foreign substances from contaminating wax and prevent loss of wax.

4. Pumps with hoppers are not permitted.

5. Specify pump capacity adequate to maintain the wax injection rate.

6. Place pressure gauge with full scale reading of no more than 300 psi at pump and duct inlets.

7. Wax injection hoses to be compatible with pump output (diameter, pressure rating and temperature).

462-7.4.2.1.4.3 Vacuum Wax Injection:

1. If vacuum wax injection is to be used for filling voids in incomplete wax filling operations, provide vacuum wax injection equipment meeting these minimum requirements:

a. Volumeter for measurement of void volume;

b. Vacuum pump with a minimum capacity of ten cubic feet of air per minute and equipped with a flow-meter, graduated reservoir, or other acceptable means approved by the Engineer capable of measuring the amount of wax being injected.

c. Mixers and heaters, or other mixing and heating methods recommended and approved by the wax manufacturer, in writing, for the specific project covered by this Section.

2. For vacuum assisted injection, provide vacuum wax injection equipment meeting these minimum requirements:

a. Vacuum pump with a minimum capacity of ten cubic feet of air per minute (free air) with the capability of removing 90% of standard atmospheric pressure within the PT system and equipped with a vacuum pressure gauge;

b. Hoses, vacuum reservoirs, and connections required for attachment to the PT system.

462-7.4.2.1.4.4 Heaters: Use a heater and temperature monitoring system capable of liquefying the entire mass of PT wax to be used for a given injection operation within the temperature limits specified by the PT wax manufacturer. The heater systems must apply a uniform heat to the PT wax and avoid locally high temperatures that may damage the PT wax or container. Use a heater and temperature monitoring system which complies with the recommendations of the PT wax manufacturer.

462-7.4.2.1.5 Wax Injection:

1. Maintain wax temperature in strict compliance with the wax manufacturer's published product data sheet and within the limits of this Section.

2. Perform wax injection in accordance with procedures set forth in approved Wax Injection Operations Plan.

3. Inject hot wax into specified duct inlet.

462-7.4.2.1.5.1 Temperature:

1. Condition wax to maintain its temperature during injection between 212°F and 240°F.

2. Wax injection operations are not permitted when ambient temperature is below minimum temperatures specified by the wax manufacturer.

462-7.4.2.1.5.2 Production Test:

1. Check wax temperature to verify it is within established limits during operations.

2. Do not start operations until such time that testing shows wax meets specified requirements.

462-7.4.2.1.5.3 Wax Injection Operations:

1. Briefly open low point drains to allow for drainage of any water that may be present within the duct. If water is present:

a. Capture and measure the water removed from the duct and retain for further testing as directed by the Engineer;

b. Obtain written authorization from the Engineer to proceed with blowing of compressed air.

2. Just prior to wax injection, close all low point drains and ports except the inlet and outlet ports at the anchorage caps. Blow oil-free dry compressed air meeting ASTM D4285 through one of the anchorage cap ports until the humidity measured at the inlet and outlet ends are less than 40% and continuing blowing for an additional 30 minutes. Stop blowing, wait a minimum of 15 minutes, and take humidity measurements at the inlet and outlet ends of blowing. Further blowing is not required if both humidity readings are less than 40%. If the humidity readings are 40% or greater, then repeat the process of blowing and waiting for 15 minutes until the humidity measurements at the inlet and outlet end of blowing are less than 40%. Take humidity measurements of air within the duct at the inlet end and outlet end of blowing using separate humidity meters. Use humidity meters approved by the Engineer.

4. Provide visual confirmation that the duct and tendon are free of water, moisture and debris at the anchorages and low points of the tendon profile. ~~Open all inlets, outlets, drains and ports before beginning the wax injection operation to remove standing water from duct. Capture and measure the water removed from the duct. If the volume of water is significant, as determined by the Engineer, then utilize compressed air, vacuuming, or other means deemed acceptable by the Engineer to dry the duct interior.~~

5~~2~~. Protect concrete surfaces from wax spills, leaks, etc.

6~~3~~. Inject wax in accordance with approved Wax Injection Operations Plan.

7~~4~~. Use pumping methods that ensure complete filling of ducts and anchorage assembly with wax.

8~~5~~. Ensure the entire mass of wax is fully liquefied prior to and throughout injection operations. Establish a non-turbulent, laminar system circulation by continuously recirculating the wax between the pump and the storage container prior to injecting the wax into the duct. Pump components must be at wax injection temperature prior to wax injection into duct. Do not allow wax to free fall during recirculation or injection operations. Maintain a positive head of liquid wax above all withdrawal and recirculation ports and do not allow air intrusion into the pumping system. Do not pour liquid wax into an open pump or hopper.

9~~6~~. Inject PT wax at a continuous and steady rate in accordance with the approved Wax Injection Operations Plan at a flow rate through duct at a

velocity between 40 and 70 feet per minute and pressure limited to 75 psi at the duct inlet and 145 psi at the pump.

107. For tendons in which vacuum assisted injection is used, provide a minimum of 90% vacuum in the duct prior to injection. Connect both the anchorage outlet and the cap outlet to the vacuum system. After the vacuum is established, lock off the air supply to the duct and monitor the vacuum for 1 minute. If the loss of vacuum after 1 minute exceeds 10%, repair leaks as directed by the Engineer and retest the duct. If the results are acceptable, reestablish and maintain a minimum 90% vacuum using the outlets at the higher end anchorage shown on Standard Plans, Index 462-001 while injecting wax using the inlet at the lower end anchorage shown on the same Standard. Close all outlets, inlets, and ports other than at injection and vacuum locations during injection procedure. Pump wax into inlet and continuously vacuum air at the outlet. After the duct is fully injected with wax and the wax reaches the vacuum end, close the outlet valve, turn off the vacuum pump and continue the injection pump. Bleed all outlets starting at the anchorage cap at the injection end and proceed to bleed every valve thereafter from injection end to vacuum end, ending with the anchorage cap at the vacuum end. When bleeding each valve, collect a minimum of two gallons of continuously flowing wax free from air before closing the valve. After all outlet valves are closed, close inlet valve with locking pressure between 30 psi and 45 psi. Do not reuse discharged wax.

118. For tendons in which vacuum assisted injection is not used, inject wax under pressure at locations shown on Standard Plans, Index 462-001. Allow wax to flow from duct and anchorage discharge points until a steady flow of wax free from air is continuously discharged. Collect a minimum of two gallons of continuously flowing wax free from air at discharge point before closing outlet valve. Do not reuse discharged wax. After all outlets are closed, close the inlet valve at locking pressure between 30 and 45 psi.

129. Record the total volume of wax injected into the system.

130. Upon completion of wax injection, seal the duct in accordance with the approved PT system drawings. Remove all excess wax from exposed surfaces.

462-7.4.2.1.5.4 Wax Injection Operations Report:

1. Submit the wax injection report signed by the wax injection Contractor within five days of each wax injection operation for review by the Engineer.

2. Record theoretical quantity of wax anticipated as compared to actual quantity of wax used to fill duct. Notify the Engineer immediately of shortages or overages.

3. Information to be noted in this report must include at a minimum, but not necessarily be limited to:

a. Identification of duct;
b. Date of duct pressure test;
c. Date wax injected;
d. Number of days from tendon installation to wax injection;
e. Wax product identification;
f. Daily duct humidity readings if applicable;

g. Humidity readings from blowing compressed air through duct;

h. Verification that water or moisture is not present within the duct prior to wax injection;

~~f~~i. Pressure gauge readings at the pump and at the inlet;

~~g~~j. Final locking pressure of wax in PT system;

~~h~~k. Reservoir temperature at time of initiation of wax injection;

~~i~~l. Theoretical volume of wax required to completely fill the duct;

~~j~~m. Volume of wax injected into duct;

~~k~~n. Volume of wax collected at discharge points;

~~l~~o. Injection rate including timing of duct inlet opening and closing;

~~m~~p. Ambient temperature;

~~n~~q. Summary of any problems encountered and any deviations from the Wax Injection Operations Plan;

~~o~~r. Corrective action taken;

~~p~~s. Description and results of the post wax injection operations and inspection;

~~q~~t. Vacuum gauge pressure and percent vacuum in duct prior to injection;

4. Maintain daily wax injection operations reports at the job site for review by the Engineer. Submit all daily reports to the Engineer on a weekly basis or as directed by the Engineer.

462-7.4.2.1.6 Manufacturer's Installation Technician:

Provide for a PT system vendor installation technician, certified by the vendor as having sufficient knowledge and expertise to oversee the wax injection personnel. The vendor's technician shall be under the direct employ of the vendor and shall be present for all wax injection activities for a minimum of the first two days of wax injection for each of the Contractor's wax injection crews. The vendor's technician shall submit written certification to the Engineer that the Contractor's installation process is in conformance with the approved Wax Injection Operations Plan.

462-7.5 Repair: Perform no remedial or repair work without the Engineer's approval in writing.

462-7.5.1 Lifting and Access Holes:

1. Repair all holes with magnesium ammonium phosphate concrete meeting requirements of Section 930 or Type Q epoxy grout meeting requirements of Section 926. Immediately before casting concrete (i.e., within 24 hours), mechanically clean and roughen the mating concrete surfaces to remove any laitance and expose small aggregate. Use grit blasting or water blasting using a minimum 10,000 psi nozzle pressure. Flush surface with water and blow dry. Form, mix, place, and cure material in strict compliance with manufacturer's recommendations.

2. Upon completion of deck grooving, coat repaired holes, block-outs, and an area extending six inches outside perimeter of repair with a high molecular weight methacrylate (HMWM) meeting the requirements of Section 413. Prepare surface to be coated and apply HMWM in accordance with Section 413. Friction (skid) tests per Section 413 are not required.

462-7.5.2 Inlets, Outlets, Drains and Ports:

1. Place threaded plastic plugs in all inlet, outlet, drain and port locations required in the Contract Documents.

2. Fill inlet, outlet, drain and port recesses as shown in the Contract Documents using a Type Q epoxy compound, Type E epoxy compound, or Type F-1 epoxy compound meeting requirements of Section 926.

3. Prepare surface to receive epoxy compounds in compliance with manufacturer's recommendations.

462-7.5.3 Duct:

1. Repair the following ducts using heat-shrink wrap material designed for duct repair:

a. Smooth plastic ducts that will be encased in concrete;

b. Corrugated plastic ducts;

c. External smooth plastic ducts after the flexible filler injection procedure has been completed.

Install heat-shrink wrap in accordance with manufacturer's instructions.

2. Repair external smooth plastic ducts before the flexible filler injection procedure has been completed using elastomer sleeves and stainless steel band clamps.

462-8 Acceptance and Testing.

462-8.1 Contractor Material Testing:

1. The following tests are not required on post-tensioned, precast flat slab bridges, and double-tee bridges, but are required on all other PT applications.

2. Include cost for Contractor Tendon Modulus of Elasticity Test and In-Place Wobble and Friction Test in price of PT system.

462-8.1.1 Tendon Modulus of Elasticity Test:

Perform a tendon modulus of elasticity test in accordance with the following procedure if required in the Contract Documents or ordered by the Engineer.

1. Bench test two samples of each size tendon prior to stressing tendons to determine modulus of elasticity for purpose of accurately determining tendon elongations while stressing.

2. Bench length between anchorages must be at least 40 feet and tendon duct at least two inches clear of tendon all around for purpose of this test.

3. Test procedure must consist of stressing tendon at an anchorage assembly with a load cell at dead end.

4. Tension test specimen 80% of GUTS in ten increments and then detention from 80% of GUTS to zero in ten decrements.

5. Record gauge pressure, elongations, and load cell forces for each increment and decrement.

6. Note elongations of tendon for both ends and the central 30 feet, measured to an accuracy of plus or minus 1/32 inches.

7. Correct elongations for actual anchor set of dead end.

8. Calculate modulus of elasticity as follows:

$E = PL/Adl$

where,

P = force in tendon

L = distance between pulling wedges and dead end wedges or exact length in the center 30 feet of tendon

A = cross sectional area of tendon

dl = tendon elongation within length, L, for load, P

9. Submit revisions to theoretical elongations to the Engineer for approval if bench test varies from modulus of elasticity used for shop or working drawings by more than 1%.

10. Additional Tendon Modulus of Elasticity Tests may be required when observed tendon elongations in erected structure fall outside acceptable tolerances or to otherwise settle disputes to the satisfaction of the Engineer.

11. Additional test series of substantiation from previous projects, not to exceed two per source, will be required if source of prestressing steel changes during project.

12. Apparatus and methods used to perform the test must be submitted to the Engineer for approval in writing.

13. Tests must be conducted in the Engineer's presence.

462-8.1.2 In-Place Wobble and Friction Test:

1. Test in-place a minimum of one tendon per tendon group performing the same function for tendons in excess of 100 feet long.

2. Functional tendon groups are cantilever tendons, continuity tendons, draped external tendons, or continuous profiled tendons passing through one or more spans.

3. Selected tendon will represent the size and length of tendon group being tested.

4. In-place test is not required on projects with straight tendons used in flat slabs or precast voided slabs.

5. Test procedure consists of stressing tendon at an anchorage assembly with a load cell or a second certified jack at dead end.

6. Stress test specimen to 80% of GUTS in eight equal increments.

7. For each increment, record gauge pressure, elongations, and load cell force (if a load cell is used).

8. Take into account any wedge seating in both live end (i.e., back of jack) and dead end (i.e., back of load cell) and any friction within anchorages, wedge plates, and jack as a result of slight deviations of strands or wires through these assemblies.

9. Keep an accurate account of elongation at jacking end allowing for intermediate wedge seating and slip of the jack's wedges for long tendons requiring multiple jack pulls with intermediate temporary anchoring.

10. If elongations fall outside the plus or minus 7% range compared to anticipated elongations, investigate reason and make detailed calculations confirming final tendon forces are in agreement with requirements of the approved Contract Documents.

11. Do not vary value of expected friction and wobble coefficients by more than plus or minus 10% in reconciling theoretical and actual elongations.

12. Submit for written approval by the Engineer a plan to correct or compensate for elongation discrepancies if necessary.

13. The Engineer will require one successful test for each tendon group for the project.

14. The Engineer may require additional in-place tests if there are irreconcilable differences between forces and elongations or other difficulties during the course of routine stressing operations.

15. Submit apparatus and methods used to perform test to the Engineer for approval in writing.

16. Conduct all in-place tests in the Engineer's presence.

462-8.1.3 Required Reports:

1. Submit the test report for "Tendon Modulus of Elasticity Test" to the Engineer at least 30 days before installing tendon.

2. Submit the test report for "In-Place Wobble and Friction Test" to the Engineer within two weeks after successful installation of tested tendon.

462-8.1.4 Test Results Application:

1. Reevaluate theoretical elongations shown on PT shop or working drawings using results of "Tendon Modulus of Elasticity Test" and "In-Place Wobble and Friction Test," as appropriate, and correct calculations as necessary.

2. Submit revisions to theoretical elongations to the Engineer for approval in writing.

462-8.2 Contractor Field Tests:

462-8.2.1 Prior to Concrete Placement:

462-8.2.1.1 All Tendons Except as Noted:

1. Test all PT system components utilized on the project, except those used for internal longitudinal tendons in precast box-girder segments in the casting cell (e.g., cantilever tendons).

2. In the formwork, pressure test each duct with all assemblies used in a single structural component (e.g. segment, beam, etc.).

3. Test assemblies in their final position just prior to concrete placement by sealing them at their anchorages or construction joint termini and then applying compressed air in accordance with this Section to determine if assembly connections are pressure tight.

4. In presence of the Engineer, pressurize duct to 7.5 psi and lock-off outside air source. Record pressure loss for one minute. If pressure loss exceeds 0.75 psi, or 10%, find and repair leaks in duct assembly using repair methods approved by the Engineer and retest.

462-8.2.1.2 Tendons for Which Vacuum Assisted Filler Injection Will Be Used:

1. Test all PT system components utilized on the project except those used for internal longitudinal tendons in box-girder segments.

2. In the formwork, perform a vacuum test for each duct with all assemblies used in a single structural component (e.g. segment, beam, etc.).

3. Test assemblies in their final position just prior to concrete placement by sealing them at their anchorages or construction joint termini and then applying a vacuum in accordance with this Section to determine if assembly connections are pressure tight.

4. In presence of the Engineer, apply a 90% vacuum and lock-off outside air source. Record vacuum loss for five minutes. If vacuum loss exceeds 10%, find and repair leaks in duct assembly using repair methods approved by the Engineer and retest.

462-8.2.2 Post Concrete Placement:

1. After stressing and before injecting filler into duct, install all anchorage caps, inlets and outlets and test the duct with compressed air in accordance with this Section to determine if duct connections require repair.

2. In the presence of the Engineer, pressurize duct to 50 psi and lock-off outside air source. Record pressure loss for one minute. A pressure loss less than 25 psi, or 50%, is acceptable for ducts with a length of equal to or less than 150 feet and a pressure loss less than 15 psi is acceptable for ducts longer than 150 feet.

3. If the pressure loss exceeds allowable, repair leaking connections using methods approved by the Engineer and retest.

462-8.3 Contractor Inspections:

462-8.3.1 Post Concrete Placement/Prior to Filler Injection Operations:

1. Upon completion of concrete placement and except as otherwise described, prove PT ducts are free and clear of any obstructions or damage and are able to accept intended PT tendons by passing a torpedo through ducts.

2. Use a torpedo having same cross-sectional shape as duct that is 1/4 inches smaller all around than clear, nominal inside dimensions of duct. Make no deductions to torpedo section dimensions for tolerances allowed in manufacture or fixing of ducts. For straight ducts, use a torpedo at least two feet long. For curved ducts, determine length so that when both ends touch outermost wall of duct, torpedo is 1/4 inches clear of innermost wall. The Engineer will reject member if torpedo will not travel completely through duct and workable repair cannot be made to clear duct. Torpedo must pass through duct easily when pushed through by hand, without resorting to excessive effort or mechanical assistance.

3. Alternatively, four strand tendons in flat ducts used for transverse PT of segmental box-girders may be preplaced prior to concrete casting. Prove PT ducts are free and clear of any obstructions or damage by moving the group of strands back and forth in duct for a minimum distance of one foot in each direction. Move strands easily, by hand, without resorting to excessive effort or mechanical assistance.

462-8.3.2 Post Filler Injection Operations:

462-8.3.2.1 Post Grouting Operations:

1. Inspect all tendons. Complete the inspection of a given tendon within 96 hours after grouting of that tendon.

2. Do not open or remove inlets, outlets, drains or ports until grout has cured for a minimum of 24 hours.

3. Perform inspections within one hour after removal of all inlets and outlets and drains located at anchorages and points along the tendon.

4. Drill into grout ports at all high points along tendon as well as inlets or outlets located at anchorages for inspection. Drill through hardened grout to penetrate full-length of grout port access piping to top of trumpet or duct. If drilling of inlets or outlets is not feasible with conventional equipment, propose an alternative method of tendon inspection for approval by the Engineer in writing. Use drilling equipment that will automatically shut-off when steel is encountered. Do not drill into anchorage cap unless anchorage caps are determined to have voids by sounding.

5. Perform all inspections using borescopes or probes and in presence of the Engineer.

6. Fill voids using volumetric measuring vacuum grouting process within 4 days from grouting.

7. Seal and repair all anchorage and inlet/outlet voids that are produced by drilling for inspection purposes as specified within four hours of completion of inspections if no additional voids are detected in tendon ducts or anchorages.

8. Remove inlet/outlet to a minimum depth of two inches below face of concrete and seal the surface as specified within 4 hours of inlet/outlet removal. Use an injection tube to extend to bottom of holes for backfilling with epoxy grout.

9. Drill into duct and explore voided areas with a borescope if grouting operations were prematurely terminated prior to completely filling duct. Probing is not allowed. Determine location and extent of all voided areas. Fill voids using volumetric measuring vacuum grouting equipment in accordance with this Section.

462-8.3.2.2 Post Flexible Filler Injection Operations:

462-8.3.2.2.1 Microcrystalline Wax:

1. Inspect all tendons. Complete the inspection of a given tendon within 96 hours after injecting that tendon with wax.

2. Do not open or remove inlets, outlets, drains or ports until wax has cooled for a minimum of 24 hours.

3. Perform inspections within one hour after removal of all inlets/outlets located at anchorages and high points along the tendon.

4. Visually inspect existing ports at all high and low points along tendon as well as all ports located at anchorages. Repair wax leaks according to the Wax Injection Operations Plan.

5. Between 24 and 48 hours following wax injection, perform the following inspection operations for each tendon:

a. Sound external ducts with a rubber mallet to ensure the system is free from voids,

b. Remove all inspection port caps and visually inspect to ensure the system is free from voids,

c. If a void is detected and the void is deeper than 1/2 inch or if the strands are exposed and uncoated, address the void using this section and methods described in the approved Wax Injection Operations Plan;

d. Fill voids created by inspection procedures and replace all inspection port caps and seal in accordance with the approved Wax Injection Operations Plan.

6. Fill voids using the methods described in the approved Wax Injection Operations Plan within 4 days from filler injection.

7. Seal and repair all anchorage and inlet, outlet and port voids that are produced for inspection purposes as described in the approved Wax Injection Operations Plan within four hours of completion of inspections if no additional voids are detected in tendon ducts or anchorages.

8. Inspect duct and explore voided areas with a borescope if wax injection operation was prematurely terminated prior to completely filling duct. Determine

location and extent of all voided areas. Fill voids using gravity feed or injection, do not use vacuum repair injection unless proven by a mockup and approved by the Engineer.

462-9 Method of Measurement.

1. Quantity of PT tendons to be paid for under this Section will be computed weight, in pounds, of permanent PT steel tendons installed in the completed structure and accepted.

2. Quantity is determined by theoretical plan length measured from anchorage to anchorage (measured from front face of bearing plate) with no allowance made for waste or extension past bearing faces.

3. No measurement will be made for temporary PT which is considered incidental to Pay Item 462-2, Post Tensioning Tendons.

4. Use these unit weights for quantity determination:

Table 462-2 PT
Strand and Bar Weight per Unit Length

Prestressing System	Weight per Unit Length, Lb/Ft
1/2 inch diameter 7-wire strand	0.52
0.6 inch diameter 7-wire strand	0.74
5/8 inch high strength deformed bar	0.98
3/4 inch high strength deformed bar	1.49
1 inch high strength deformed bar	3.01
1-1/4 inch high strength deformed bar	4.39
1-3/8 inch high strength deformed bar	5.56
1-3/4 inch high strength deformed bar	9.10
2-1/2 inch high strength deformed bar	18.20
3 inch high strength deformed bar	24.09

Note: Weight per unit length of high strength deformed bars is based on values given in ASTM A722.

462-10 Basis of Payment.

462-10.1 General:

1. PT tendons will be paid for at the Contract unit price per pound of steel tendon, completed and accepted.

2. Payment will be full compensation for furnishing, installing, stressing, and filler injection of all temporary and permanent, internal and external ducts. Payment also includes anchorage assemblies and associated supplemental reinforcing steel required by supplier, PT system hardware not embedded in concrete, ducts, grout and grouting operations, flexible filler and filler injection operations, all testing, including construction of and filler injection into mockups, Tendon Modulus of Elasticity Test and In-Place Wobble and Friction Test, protection of PT anchorages, inlets, outlets, drains, and all labor, materials, tools, equipment, and incidentals necessary for completing the work in accordance with the Contract Documents. This payment also includes lubricants in tendon ducts for friction control and flushing lubricants or contaminants from ducts.

3. Anchorage components, ducts, and similar items of PT system hardware embedded within precast components or cast-in-place concrete will be deemed to be included in cost of precast component or cast-in-place concrete in which it is embedded.

4. Payment is based on unit price bid extended by either quantities shown in the Contract Documents or actual quantities used and accepted, whichever is less, if the Contractor constructs structure with an accepted alternate not detailed in the Contract Documents.

5. Permanent PT strand, wire, or bar tendons which are an integral part of individual precast concrete segments or units will be measured and paid for under this item and will not be considered incidental to cost of those precast concrete segments or units.

6. Payment for PT will be made following successful placement, stressing, filler injection, inspection, repair, protection, and written approval by the Engineer.

7. Full payment for PT tendons within precast segmental concrete structure units may occur prior to erection of segments into final position when ducts have been injected and anchorage protection system applied and the segmental unit otherwise approved in writing for placement by the Engineer.

462-10.2 Pay Items:

Payment will be made under:

Item No. 462- 2- Post-Tensioning Tendons - per pound.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 6, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **524**
Proposed Specification: **5240500 Concrete Ditch and Slope Pavement.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Tim Holley to remove specification language from Standard Plans Index 524-001 and insert into the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONCRETE DITCH AND SLOPE PAVEMENT.
(REV 7-25-22)

ARTICLE 524-5 is deleted and substituted with the following:

524-5 Joints and Weep Holes.

524-5.1 Joints:

524-5.1.1 Joints in Ditch Pavement: Construct formed (construction joint) or tooled contraction joints, spaced at 25 feet maximum intervals. Open joints are prohibited. Construct expansion joints with ½1/2 -inch preformed joint filler at all inlets, endwalls, and at intervals of not more than 200 feet.

524-5.1.2 Joints in Slope Pavement: Form open or tooled (dummy) type joints as shown in the Plans. Form open joints by staking a metal bulkhead in place and placing the concrete on both sides of it. When the concrete has set sufficiently to preserve the width and shape of the joints, remove the bulkhead. Upon finishing the pavement over the joint, open and edge the slot with a tool having a 1/4 -inch radius.

524-5.2 Method of Placing Slope Pavement: Place slope pavement in vertical strips, 4 feet, plus or minus 1 inch, wide, except taper radii strips from the 4-foot width at the bottom to a minimum width of 1 foot at the top. Score the strips horizontally at intervals of 2 feet, plus or minus 1 inch, with a tool having a double 1/4-inch radius. Edge construction joints between strips with a tool having a 1/4-inch radius. The Engineer will allow construction joints at horizontal scorings.

524-5.3 Weep Holes: Locate and construct weep holes as shown in the Plans. Construct weep holes at the toe of slope for all slope pavements.

524-5.4 Filter Fabric: Place filter fabric directly beneath ~~under~~all concrete ditch pavement for the entire length and width of the pavement, regardless of the pavement thickness. Place filter fabric below weep hole aggregate to form a mat continuous with the pavement filter fabric or underlapping the pavement filter fabric, if present.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 29, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **546**
Proposed Specification: **5460100 Rumble Strips.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by David Amato from the Roadway Design Office to add the Standard Plans Indexes associated and include depth measurement on arterials and collectors in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

RUMBLE STRIPS.
(REV 7-25-22)

ARTICLE 546-1 is deleted and the following substituted:

546-1 Description.

Construct rumble strips in accordance with the details shown in the Plans and Standard Plans, Indexes 546-001, 546-010, and 546-020.

SUBARTICLE 546-3.3 is deleted and the following substituted:

546-3.3 Ground-In Rumble Strip:

546-3.3.1 General: Grind rumble strips that have well-defined edges and smooth interiors without tearing the finished pavement.

On a daily basis, before opening the adjacent lane to traffic, ensure that all debris generated by the grinding process is removed and disposed of by vacuum or a method approved by the Engineer. Do not dispose of the debris within the right of way. Do not use the debris generated by the grinding process in recycled asphalt (RAP).

Restore any pavement to the satisfaction of the Engineer, at no additional cost to the Department, when ground-in rumble strips do not meet the requirements of the Contract Documents.

546-3.3.2 Inspection: For limited access roadways, measure depth every one mile during the grinding operation to monitor tolerances specified in Standard Plans, Index 546-010. For arterial and collector roadways, measure depth every 500 feet during the grinding operation to monitor tolerances specified in Standard Plans Index 546-020.

If measurements are outside tolerances, immediately stop grinding operations and adjust grinding machine to meet tolerances before continuing the grinding. Measure depth along the rumble strip centerline at the high and low point of the grinding pattern. Measure depth ~~as distance~~ from top of pavement grade to top of ground-in surface. ~~ground-in grooves at the transverse and longitudinal centerline of the grinding prior to the placement of longitudinal thermoplastic pavement markings.~~ Measure, record and certify on a Department approved form and submit to the Engineer.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 29, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **560**
Proposed Specification: **56060603 Coating New Structural Steel.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Tim McCullough from the State Materials Office to clarify Quality Control Inspectors' qualifications in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

COATING NEW STRUCTURAL STEEL.
(REV ~~7-21~~8-10-22)

SUBARTICLE 560-6.3 is deleted and the following substituted:

560-6.3 Quality Control (QC) ~~Personnel~~ Supervisor in the Shop and Field:

~~**560-6.3.1 Quality Control Inspectors:**~~ Personnel performing inspection of coating ~~QC~~ activities in the supervisory position must visit the shop at suitable intervals throughout the coating process. Personnel performing inspection of coating activities in the supervisory position must visit the field location at suitable intervals throughout the coating process, as defined in the site specific coating plan~~be employed by the coating contractor~~. Submit documentation to the Engineer that all acting as supervisors ~~personnel performing QC inspections~~ are certified, at a minimum, to one of the following certifications~~as a~~:

~~National Association of Corrosion Engineers (NACE) International Coating Inspector Level I or a SSPC Bridge or Protective Coatings Inspector Level 1. QC inspectors must report directly to a QC Supervisor.~~

1. AMPP Bridge Coatings Inspector Level 2
2. AMPP Senior Certified Coatings Inspector
3. NACE Coatings Inspector Level 3
4. SSPC Bridge Coatings Inspector Level 2
5. SSPC Protective Coatings Inspector Level 3

~~**560-6.3.2 Quality Control Supervisor:** Personnel performing coating activities in the supervisory position must be certified either as a NACE International Coating Inspector Level 3 or a SSPC Bridge or Protective Coatings Inspector Level 2.~~

560-6.~~4~~3.1 Certifications: Maintain certifications for the duration of the Contract. If the certifications expire, do not perform any work until certifications are reissued. The requirement for a Coating Application Specialist may be waived on a project when there is no media blasting involved in the operations.

Notify the Engineer of any change in certification status.

SUBARTICLE 560-6.4 is deleted.

~~**560-6.4 Certifications:** Maintain certifications for the duration of the Contract. If the certifications expire, do not perform any work until certifications are reissued.~~

~~Notify the Engineer of any change in certification status.~~

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 20, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **611**
Proposed Specification: **6110402 Acceptance Procedures for Traffic Control Signals, Devices, and Intelligent Transportation System Devices.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to provide information on recently published standalone test forms for dynamic message signs and remote power management units.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

ACCEPTANCE PROCEDURES FOR TRAFFIC CONTROL SIGNALS, DEVICES, AND INTELLIGENT TRANSPORTATION SYSTEM DEVICES

(REV 97-2015-22)

SUBARTICLE 611-4.2 is deleted and the following substituted:

611-4.2 Intelligent Transportation System Device Installation: Test all stand-alone functions of the ITS devices as detailed in the Contract Documents and as approved by the Engineer.

For the managed field Ethernet switch (MFES), complete FDOT Form Number 750-040-07 for all installed field switches ~~or other procedure approved by the Engineer~~.

For the closed--circuit television (CCTV) camera, complete FDOT Form Number 750-040-08 for all installed CCTV cameras ~~or other procedure approved by the Engineer~~.

For microwave vehicle detection system (MVDS), complete FDOT Form Number 750-040-09 for all installed MVDS sensors ~~or other procedure approved by the Engineer~~.

For the camera lowering device (CLD), complete FDOT Form Number 750-040-10 for all installed CLDs ~~or other procedure approved by the Engineer~~.

For the dynamic message sign (DMS), complete FDOT Form Number 750-040-11 for all installed DMS.

For the remote power management unit (RPMU), complete FDOT Form Number 750-040-12 for all installed RPMU.

For ITS devices without official FDOT forms, evaluate ITS devices as per Contract Documents and as approved by the Engineer.

Complete approved data forms and turn them over to the Engineer for approval. Provide a minimum notice of 10 calendar days prior to all tests to permit the Engineer or their representative to observe each test.

If any unit fails to pass its stand-alone test, correct the unit, or substitute another unit in its place, then repeat the test.

If a unit has been modified as a result of a stand-alone test failure, prepare a report describing the nature of the failure and the corrective action taken and submit it to the Engineer prior to re-testing the unit. If a failure pattern develops, the Engineer may direct that modification be made to all units without additional cost to the Department or an extension of the Contract Time.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 15, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **630**
Proposed Specification: **6300204 Conduit.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to modify message texts required on warning tape to reflect standardized markings and David Wagner from the State Construction Office to address embedded conduit that extends from the bridge to the proposed pull box and a new pay item option has been added to address under pavement, open trench.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

CONDUIT
(REV 97-148-22)

SUBARTICLE 630-2.4 is deleted and the following substituted:

630-2.4 Warning Tape: Ensure that the buried cable warning tape is flexible, elastic material 3 inches wide, 6 mil thick, intended for burial and use as an underground utility warning notice, and that the surface of the warning tape is coated and sealed to prevent deterioration caused by harsh soil elements. Ensure that the warning tape color follows the American Public Works Association color code for underground utilities and has the repeating message "CAUTION: FDOT CABLE~~,~~ BURIED BELOW~~,~~" or other wording approved by the Engineer, permanently printed on its surface. Ensure that the tape material and ink colors do not change when exposed to acids, alkalis, and other destructive chemical variances commonly found in Florida soils.

SUBARTICLE 630-3.1 is deleted and the following substituted:

630-3 Installation Requirements.

630-3.1 General: Install the conduit in accordance with NEC or National Electrical Safety Code (NESC) requirements and the Standard Plans. Consider the locations of conduit as shown in the Plans as approximate. Construct conduit runs as straight as ~~possible, and~~possible and obtain the Engineer's approval for all major deviations in conduit locations from those shown in the Plans. Include buried cable warning tape with all trenched conduit. Mark the location of the conduit system with route markers as shown in the Plans and approved by the Engineer. Ensure that all route markers used are new and consistent in appearance.

For conduit installed by directional bore, install in accordance with Section 555. For conduit installed by jack and bore, install in accordance with Section 556.

Use only intermediate galvanized metal conduit, rigid galvanized metal conduit, rigid aluminum conduit or PVC coated intermediate metal conduit for above-ground electrical power service installations and rigid galvanized metal conduit or rigid aluminum conduit for underground electrical power service installations. Meet the requirements of Section 562 for coating all field cut and threaded galvanized pipe.

Use Schedule 80 PVC or fiberglass reinforced epoxy conduit in or on structural elements.

For non-structural, above ground ITS communication and electrical conduit, use intermediate galvanized metal conduit, rigid galvanized metal conduit, or Schedule 80 PVC conduit.

Use HDPE with an SDR number less than or equal to 13.5, Schedule 80 HDPE, Schedule 40 HDPE, Schedule 80 PVC, or Schedule 40 PVC for underground installations of electrical conduit in earth for ITS electrical applications.

Use HDPE with an SDR number less than or equal to 11, Schedule 80 PVC, or Schedule 40 PVC for underground installations in earth or concrete for ITS and traffic control signal applications, except, use only HDPE with an SDR number less than or equal to 11 for blown fiber optic cable installations on limited access facilities.

Use HDPE with an SDR number less than or equal to 13.5, Schedule 80 PVC, or Schedule 40 PVC for underground installations of electrical conduit in earth for lighting applications and landscape irrigation applications.

Use HDPE with an SDR number less than or equal to 13.5, Schedule 80 PVC, Schedule 40 PVC, or rigid galvanized metal for underground installations of electrical conduit in concrete for lighting applications.

Use HDPE with an SDR number less than or equal to 11 for directional bores or Schedule 80 PVC for open trenching and conduits serving toll site vehicle detection loop pull boxes. Use the following for all underground toll site applications except for conduits serving vehicle detection loop pull boxes:

1. Rigid steel conduit coated with PVC or a bituminous coating extending 6 inches above finished grade for conduits entering or leaving the ground. Use threaded end and paint all exposed exterior conduit.

2. Rigid galvanized steel elbows and bends for HDPE and PVC conduit raceways longer than 200 feet in length or 2 inches trade size and larger.

Do not place more than the equivalent of three quarter bends or 270 degrees of bends, including the termination bends, between the two points of termination in the conduit, without a pull box. Obtain the Engineer's approval to use corrugated flexible conduits for short runs of 6 feet or less.

When a conduit installation changes from underground to above-ground, make the change a minimum of 6 inches below finished grade.

Install a No. 12 AWG pull wire or polypropylene cord inside the full length of all conduits. Ensure that a minimum of 24 inches of pull wire/cord is accessible at each conduit termination.

Ensure the conduit includes all required fittings and incidentals necessary to construct a complete installation.

When earth backfill and tamping is required, place backfill material as per Section 120 in layers approximately 12 inches ~~thick, and~~thick and tamp each layer to a density equal to or greater than the adjacent soil.

When backfilling trenches in existing pavement, use a flowable fill meeting the requirements of Section 121.

Provide a standard clearance between underground control cable and electrical service cable or another parallel underground electrical service cable that meets NESC requirements.

Prevent the ingress of water, dirt, sand, and other foreign materials into the conduit prior to, during, and after construction. Seal the ends of conduit after wiring is complete with a moisture resistant sealant that is designed for this specific application.

SUBSRTICLE 630-3.3 is deleted and the following substituted:

630-3.3 Conduit Joints: Make conduit joints using materials as specified by the manufacturer. When conduit crosses an expansion joint of a structure and where shown in the Plans, install an expansion or expansion/deflection fitting as specified by the manufacturer. Certify that expansion/deflection fittings are rated to accommodate a minimum rotation of 30 degrees and that both the expansion and expansion/deflection fittings are rated to accommodate the anticipated longitudinal movement (minimum of 2 inches for expansion

fittings and 0.7 inches for expansion/deflection fittings). Ensure that all installed joints are waterproof. As an exception to the threaded coupling for intermediate metal conduit, at locations where it is not possible to screw the threaded coupling properly, the Contractor may use a waterproof slip-joint coupling approved by the Engineer. Secure the joint~~,~~ and tighten threaded connections.

Prior to insertion into the coupling, clean, prime and coat the ends of PVC conduit with solvent-type cement as specified by the manufacturer.

For toll site conduit applications: Join lengths of smooth wall HDPE conduit using the Butt Fusion process or universal aluminum couplings. Use PVC to HDPE threaded transition couplings to join PVC conduit to HDPE conduit.

SUBSRTICLE 630-3.10 is deleted and the following substituted:

630-3.10 Route Markers: Install route markers for new fiber optic cable installations, replace route markers as shown in the Plans, and ensure the following:

1. Markers are ~~plumb~~plumb, ~~and~~ level, and the notification information is clearly visible when viewed from the side facing the roadway.
2. Markers are set within the right of way.
3. Markers are placed at a 1 foot offset from the conduit system.
4. The top of the marker post is a minimum of 5 feet and maximum of 6 feet above the finish grade
5. Markers are spaced a maximum of 500 feet apart.
6. A clear line of sight is maintained from one marker to the next.
7. Markers are installed on both sides of the roadway at any crossing point where the conduit system changes to the opposite side of the roadway.
8. Markers are installed at the center point of any conduit run between two pull or splice boxes.
9. Markers are installed at gate locations when the conduit system is adjacent to a fence line.
10. Markers are installed on both sides of a stream, river, or other water crossing, and on both sides of aboveground attachments such as bridges and walls.

Remove and replace all marker posts damaged during installation at no additional cost. Ensure that route marker signs are labeled with a unique identification number, as detailed in the Plans or as approved by the Engineer. Provide as-built documentation at the completion of installation that includes identification number and location of all installed route markers and correlates the marker to the fiber optic infrastructure that it signifies.

Ensure that installation of ERMs includes connection of the route marker to the locate wire associated with the conduit run that the markers identify. Install locate wire through the base of the marker and terminate the locate wires to connectors mounted on the terminal board inside the marker. Install an underground magnesium anode a minimum of 10 feet away from the marker and perpendicular to the conduit system. Terminate the anode lead on the connector mounted on the terminal board inside the marker. Install the bond straps between the anode connector and all locate wire connectors to provide cathodic protection for the locate wire conductor.

ARTICLE 630-4 is deleted and the following substituted:

630-4 Method of Measurement.

The Contract unit price per foot of conduit, furnished and installed, will include furnishing all hardware and materials and all testing as specified in this Section and the Contract Documents, and all labor, casings, removal of excavated materials and spoils, removal and disposal of drilling fluids, locate wire, trenching, boring, backfilling, flowable fill and restoration materials necessary for a complete and accepted installation.

Payment for conduit placed underground will be based on the horizontal length of the trench or bore measured in a straight line between the centers of pull boxes, cabinets, poles, etc., in linear feet, regardless of the length or number of conduits installed. No allowance will be made for sweeps or vertical distances below the ground.

Payment for conduit placed aboveground or bridge mounted will be based on the actual length of conduit installed.

~~Payment for conduit embedded in concrete will be based on the length of each conduit run measured in a straight line between centers of junction boxes, regardless of the length of conduit installed, and will include all expansion and expansion/deflection fittings. Conduit that does not both begin and end at a junction box will be considered incidental to their related items of work.~~ Payment for each individual conduit run embedded in concrete barriers or traffic railings, as shown in Standard Plans, Index 630-010, will be based on the length of the concrete barrier or traffic railing section that includes the conduit, regardless of the actual length of conduit installed. This length is limited by the begin and end of the concrete barrier or traffic railing run and includes the portions of the conduit exiting the structure towards the ends of the concrete barrier or traffic railing as shown in the Standard Plans. This includes all expansion and expansion/deflection fittings, but no allowance will be made for sweeps or vertical distances below the ground.

Payment for conduit embedded in miscellaneous concrete structures will be based on the length of each individual conduit run, measured in a straight line between centers of junction boxes, regardless of the length of conduit installed, and will include all expansion and expansion/deflection fittings. Conduit that does not both begin and end at a junction box will be considered incidental to their related items of work.

Payment for replacement of route markers, per each, will be made only for those markers identified in the Plans.

ARTICLE 630-5 is deleted and the following substituted:

630-5 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment for conduit placed under existing turf will be made as open trench.

Payment for conduit placed under existing pavement (roadway, driveways, or sidewalk) will be made as directional bore, unless specifically identified as open trench. If conduit is being placed under both existing turf and existing pavement between two pull boxes, payment for the total pull box-to-pull box length will be made as directional bore. Payment for conduit placed by jack & bore will be made as jack & bore, for the total pull box to pull box length.

Payment for conduit embedded in concrete structures or traffic railings will be made as embedded conduit.

No additional payment will be made for multiple conduits in the same trench.

No payment adjustment will be made if the Contractor chooses to use an alternative method approved by the Engineer.

No payment will be made for failed bore paths, injection of excavatable flowable fill, products taken out of service, or incomplete installations.

Payment for replacement of route markers will include all the work, labor, equipment, and materials specified in this Section. No separate payment for route markers will be made for new conduit installation.

Payment will be made under:

Item No. 630- 2- Conduit - per foot.

Item No. 630- 3- Replace Route Marker for Existing Conduit - per each.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 15, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **633**
Proposed Specification: **6330201 Communication Cable.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to provide updated labeling requirements for splice enclosures, cables and fiber cable termination. The changes also clarify that all fiber strands installed per the Plans be terminated (i.e., connectorized) in a patch panel.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

COMMUNICATION CABLE
(REV 97-1227-22)

SUBARTICLE 633-2.1.2.1 is deleted and the following substituted:

633-2.1.2.1 Splice Enclosures: Contain all optical fiber splices within a splice enclosure. Ensure that the enclosures provide storage for splices, fiber, and buffer tubes. Ensure that the splice enclosure restores the mechanical and environmental integrity of the fiber optic cable, encases the sheath opening in the cable, and organizes and stores optical fiber. Ensure all hinges and latching devices are stainless steel. Ensure that the enclosure is airtight and prevents water intrusion. Ensure that the splice enclosure can accommodate pressurization and has the ability to be reentered without requiring specialized tools or equipment. Ensure that the enclosure provides fiber and splice organizers including splice trays and strain relief.

Ensure that splice enclosures are hermetically sealed to protect internal components from environmental hazards such as moisture, insects, and UV light. Fiber optic splice enclosures shall also:

Comply with the Telcordia Technologies' GR-771-CORE standard and all applicable NEC requirements.

Provide space for future expansion equal to 100% of the initial utilization.

Provide fiber optic cable penetration end caps to accommodate a minimum installation of two trunk fiber optic cables and two fiber optic drop cables. Ensure that the enclosure end caps are factory-drilled to the proper diameter to accept and seal the fiber optic cable entries. Ensure that the cable entry locations can accommodate an assortment of cables with outside diameters ranging from 0.45 inches to 0.55 inches, plus 10%, without jeopardizing the waterproof characteristics of the enclosure.

Ensure that splice enclosures are permanently labeled using machine printed, waterproof labels suitable for outside plant applications.

Provide fiber optic splice enclosures meeting the following requirements:

Mechanical
Resist compression deformation to a maximum of 300 pounds.
Withstand an impact energy to a maximum of 40 foot-pounds at 0°F.
Axial Tension: 100 pounds for 30 minutes.
Cable Torsion: ten 90-degree rotations.
Cable Flexing: ten 90-degree bends.
Environmental
Hydrostatic Pressure Head: Up to 20 foot-pounds (-9 pounds per square inch).
Withstand 40 freeze/thaw temperature cycles.
Ultraviolet resistant during a maximum 30-day exposure in compliance with the requirements detailed in the ASTM B117 standard.
Chemical

Withstand a 90-day exposure to solutions of 3% sulfuric acid, 0.2 normal of sodium hydroxide, 10% Igepal®, kerosene, and be fungus resistant as required in the ASTM G21 standard.

SUBARTICLE 633-2.1.3 is deleted and the following substituted:

633-2.1.3 Cable Terminations: Use Type LC connectors for all new network installations. Use Type ST, SC, or FC connectors only for connections to existing equipment or as specified in the Plans or by the Engineer. Use ultra physical contact (UPC) pre-terminated cable assemblies with factory-installed connectors for all new network installations. Use UPC field-installed connectors only for connections or temporary repairs to existing equipment as specified in the Plans or by the Engineer. Ensure that all connectors include a ceramic ferrule and provide a strain relief mechanism when installed on a single fiber cable that contains strength elements. Ensure that ST and FC connectors include a metallic body. Ensure that all connectors provide a minimum 11 pound pullout strength. Ensure that the optical fiber within the body of all connectors is mechanically isolated from cable tension, bending, and twisting.

Ensure that all connectors are compliant with the TIA/EIA-604 standards, as applicable, and are tested according to the Telcordia/Bellcore GR-326-CORE standard. When tested according to the TIA and EIA's Fiber Optic Test Procedure (FOTP)-171 (TIA/EIA-455-171B) at the manufacturer, ensure that the connectors have an ~~average~~ insertion loss, as reflected on the manufacturer data sheet, ~~of less than or equal to 0.15 decibel and a maximum loss of~~ less than or equal to 0.30 ~~0.20~~ decibel for pre-terminated cable assemblies with factory-installed connectors and a maximum loss of less than or equal to 0.50 decibel for field-installed temporary connectors. Test the connectors as detailed in FOTP-107 (TIA -455-107A) to reflectance values of less than or equal to minus ~~50~~ 45 decibels.

SUBARTICLE 633-3.1 is deleted and the following substituted:

633-3 Installation Requirements.

633-3.1 Fiber Optic Cable Installation: Install all materials and equipment according to the latest version of the manufacturer's installation procedures. Ensure that all materials and installation practices are in accordance with the applicable OSHA requirements as found in 29 CFR Part 1926, Safety and Health Standards for Construction. In addition, perform the following:

1. Ensure conduit and inner-duct is clean and free from damage prior to installing fiber optic cable.
2. Document the sequential cable length markings at each splice box and pull box wall that the cable passes through~~,~~ and include the information with the as-built documentation.

Provide all incidental parts needed to complete the installation, but not specified in the Plans, as necessary for a complete and properly operating system.

SUBARTICLE 633-3.1.1 is deleted and the following substituted:

633-3.1.1 Cable Identification: Develop a nomenclature plan for identification of fiber optic cable. Submit the nomenclature plan to the Engineer for approval. Use approved

cable nomenclature to create cable tags for the identification of fiber optic cable. Provide cable tag identification on all test results or fiber related documents submitted to the Engineer.

Install cable tags within 1 foot of each splice and/or termination point indicating the cable type, fiber count, and each fiber optic cable origination and termination points. Ensure that the cable tags are machine printed, waterproof, and ~~are~~ permanent labels suitable for outside plant applications and are affixed to all fiber optic cables. Ensure that lettering is in permanent ink and displays the phrase "FDOT FIBER OPTIC CABLE".

SUBARTICLE 633-3.1.6 is deleted and the following substituted:

633-3.1.6 Cable Termination Installation: Ensure that fiber optic cables, buffer tubes, ~~or~~ and strands are neatly routed, secured, and terminated in a patch panel. Ensure every fiber strand within all fiber drops terminating in field cabinets are terminated in a connector panel using LC connectors unless otherwise shown in the Plans. Ensure all cable termination points include documentation regarding the identification, route, and function of each fiber installed at that location. Ensure that a copy of this information is placed alongside the installed equipment (for instance, in a document pouch or drawer within a field cabinet).

SUBARTICLE 633-3.1.7 is deleted and the following substituted:

633-3.1.7 Patch Panel Installation: Ensure that patch panels are neatly installed and secured in a weather-proof enclosure. Ensure all patch panel connectors are clearly and permanently labeled using machine printed, waterproof labels suitable for outside plant applications. Ensure all installed patch panels include documentation regarding the identification, route, and function of each patch panel connector at that location. Ensure that a copy of this information is placed alongside the installed equipment in a document pouch or drawer within the cabinet.

FDOT
Florida Department of Transportation
RON DESANTIS
GOVERNOR
605 Suwannee Street
Tallahassee, FL 32399-0450
JARED W. PERDUE, P.E.
SECRETARY

September 20, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **635**
Proposed Specification: **6350302 Pull, Splice, and Junction Boxes.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to incorporate language requested by FTE regarding placement of boxes, a minimum of two feet above ditch bottoms or drainage features.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PULL, SPLICE, AND JUNCTION BOXES.
(REV 9~~7~~-20~~19~~-22)

SUBARTICLE 635-3.2 is deleted and the following substituted:

635-3.2 Pull and Splice Boxes: Install pull and splice boxes in accordance with Standard Plans, Index 635-001. Ensure pull and splice boxes are sized for the amount of cable to be placed inside. Ensure that the pull or splice box cover is flush with the concrete apron or sidewalk. Do not install pull or splice boxes in roadways, driveways, parking areas, ~~ditches~~ or public sidewalk curb ramps. Avoid placing pull and splice boxes in low-lying locations with poor drainage. Ensure that pull and splice boxes house fiber optic cable without subjecting the cable to a bend radius less than 14 times the diameter of the cable. Install identification plates according to the box manufacturer's instructions.

635-3.2.1 Placement and Spacing: Place pull and splice boxes as shown in the Plans and at the following locations, unless directed otherwise by the Engineer:

1. At all major fiber optic cable and conduit junctions.
2. Approximately every 2,500 feet for fiber optic cable applications in rural areas with any continuous section of straight conduit if no fiber optic cable splice is required.
3. At a maximum of 1,760 feet for fiber optic cable applications in metropolitan areas.
4. At a maximum of 500 feet for electrical applications.
5~~4~~. At each end of a tunnel, and on each side of a river or lake crossing.
6~~5~~. On each side of an aboveground conduit installation, such as an attachment to a bridge or wall.
7~~6~~. At all turns in the conduit system.
8~~7~~. Near the base of a service pole or communication cabinet to provide:
    a. A transition point between the fiber optic conduits extending from the fiber backbone and the conduit feeding the communication cabinet.
    b. An assist point for the installation of fiber optic drop cable.
    c. Storage of slack fiber optic drop cable.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 15, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **639**
Proposed Specification: **6390301 Electrical Power Service Assemblies.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to provide requirements for electrical power transformers and provide clarification of requirements for electrical splices in pull boxes.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

ELECTRICAL POWER SERVICE ASSEMBLIES
(REV 9~~7~~-14~~20~~-22)

ARTICLE 639-3 is expanded by the following new Subarticle:

639-3 Materials.

639-3.1 Weatherhead: Use a weatherhead made of a copper free aluminum alloy with three electrical service wire entrance holes, meeting National Electric Code (NEC) requirements.

639-3.2 Conduit: Use conduit meeting the requirements of Section 630. Meet the requirements of Section 562 for coating all field cut and threaded galvanized pipe.

639-3.3 Electrical Service Wire: For signal and ITS service points, use stranded copper wire with XHHW (cross-linked polyethylene (XLPE) high heat-resistant, water-resistant) insulation, rated at 600 V in dry and wet conditions, no smaller than No. 6 AWG for connections between service disconnect and traffic and ITS cabinets, unless otherwise shown in the Plans.

For lighting service points, use single-conductor cable Type THWN-2 no smaller than No. 6 AWG for connections between service disconnect and load center.

639-3.4 Meter Base: Use meter bases approved by the local electric power company.

639-3.5 Service Disconnect:

639-3.5.1 Enclosure (Cabinet): Use an enclosure conforming to National Electrical Manufacturers Association (NEMA) Standards for Type 3R, Type 3S or Type 4, made of galvanized steel, aluminum, stainless steel or other materials approved by the Engineer. Ensure that the enclosure has a hinged door which can be locked with a padlock. Provide padlock and two keys. Do not use external handles or switches. Ensure that the inside dimensions meet NEC requirements.

639-3.5.2 Circuit Breaker: Use a manually resettable circuit breaker which has a current rating above the current rating of the circuit breaker to which electrical power is provided. Do not use less than a 40A circuit breaker.

639-3.6 Surge Protective Device: Use a lightning arrester rated for a maximum permissible line to ground voltage of 175 V_{AC}.

639-3.7 Electrical Power Transformer: Provide a dry type, air-cooled, factory assembled transformer. All units must be UL listed under the requirements of UL 5085 and UL 1561, IEEE Standard 259, and meet the requirements of NEMA ST-20. Provide transformers for the primary and secondary voltages indicated on the Plans. Provide two 2.5% full capacity below normal taps and two 2.5% above normal taps on the primary side. All taps are full capacity taps.

639-3.7.1 Enclosure: Use an enclosure conforming to NEMA Standards for Type 3R, made of hot-dip galvanized steel, aluminum, stainless steel or other materials approved by the
Engineer.

639-3.7.2 Electrical Rating: Transformer electrical ratings may range from 3 KVA to 300 KVA, 120V to 600 V, single phase or three phase, primary or secondary, as shown in the plans.

639-3.7.3 Temperature classifications: Transformers rated less than 15 KVA shall utilize Class 180 or 185 insulation systems, with a 115°C or lower winding temperature rise. Transformers rated 15 KVA and greater shall utilize Class 220 insulation systems, with a 150°C or lower winding temperature rise. The transformer shall utilize an insulation system that has been properly temperature classified in accordance with NEMA ST-20.

Encapsulated transformers rated 15KVA to 25KVA using a Class 180 or 185 insulation system with a 115°C or lower winding temperature rise may be utilized if approved by the Engineer. Transformer windings shall be all aluminum or all copper.

639-3.7.4 Load rating: Furnish and install transformers with load ratings as described in the Plans. Transformers shall be capable of operating continuously at 100 percent of nameplate rating in an ambient temperature not exceeding 40°C. Transformers 5 KVA and above shall be capable of meeting overload requirements per ANSI C57.96 with normal life maintained.

639-3.7.5 Sound rating: Sound levels shall not exceed the following:

Table 639-1

Transformer Rating (KVA)	Average Sound Level Decibels per NEMA ST-20
0-9	40
10-50	45
51-150	50
150-300	55

639-3.~~7~~ 8 Attachment Hardware: Use attachment hardware that meets the requirements of Section 603.

ARTICLE 639-4 is expanded by the following new Subarticle:

639-4 Installation Requirements.

639-4.1 General: Meet the following requirements for the installation of individual components of the electrical power service assembly:

Use extreme care and caution in the installation of all components of the electrical power service assembly.

Follow installation procedures recommended by NEC and National Electrical Safety Code (NESC).

Consider the location of electrical power service assemblies as shown in the Plans to be approximate, and coordinate with the appropriate electrical power company authority to determine the exact locations of each assembly.

Do not use transformers or spliced electrical wire on a traffic signal power service.

639-4.2 Weatherhead: Securely attach the weatherhead to the upper end of the conduit which extends upward from the meter base (or service disconnect if a meter base is not required) to a minimum height of 22 feet above grade.

639-4.3 Conduit: Securely attach all conduit to the pole or cabinet with a maximum distance of 5 feet between conduit attachment hardware.

639-4.4 Electrical Service Wire: Install the electrical service wire in a manner which will ensure that damage to the installation will not occur.

Ensure that the service wire is of sufficient length after installation in the conduit to provide for attachment to the power company service and for termination within the cabinet for which power is required.

Use waterproof gel-filled splices to splice electrical wires in pull boxes only when the length of the cable run prohibits use of continuous wire. Wire nuts and electrical tape splicing are not acceptable.

639-4.5 Meter Base: When a meter base is required, securely fasten the meter base to the pole or cabinet. Install pole mounted meter bases at a minimum height of 5-1/2 feet above grade when measured from the center of the meter base or meet the local electric power company requirement, whichever is greater.

639-4.6 Service Disconnect: Securely fasten the service disconnect to the pole (or cabinet with the Engineers approval), and electrically position the service disconnect between the service meter and the traffic control device cabinet to which electrical service is being supplied. Install pole mounted service disconnects a minimum of 4 feet above grade when measured from the bottom of the disconnect. For cabinet installations, mount the service disconnect at a height approved by the Engineer or as shown in the Plans.

639-4.7 Electrical Power Transformer: Follow installation procedures recommended by NEMA ST-20, National Electric Code (NEC), and National Electrical Safety Code (NESC). Set the ground mount transformer unit level on the pad and secured to the pad with bolts. Pole mount transformers are required to be fastened securely to the pole using bolts, stainless steel straps, or galvanized strut channel.

Conduct field acceptance testing in accordance with Section 611. Perform local field inspection at each site to verify and confirm the following:

1. Check wiring connections for damage and torque, as applicable, prior to energizing the transformer.
2. Check grounding and bonding of transformer enclosure. Ensure that separately derived systems, which are required to be grounded by the NEC 250.30 or the Plans, are fitted with an appropriately installed and sized system bonding jumper in accordance with the NEC 250.30.
3. Measure primary and secondary voltages under normal load conditions.

ARTICLE 639-5 is expanded by the following new Subarticle:

639-5 Method of Measurement.

639-5.1 General: Measurement for payment will be in accordance with the following work tasks.

Payment for electrical service wire between service disconnect and traffic cabinet is based upon the distance of the cable run and includes payment for all conductors used in the run. For lighting applications, payment for service conductors will be made in accordance with Section 715.

Payment for conduit and electrical service wire which is vertically attached to the electrical power assembly is considered incidental and paid under item 639-1.

639-5.2 Furnish and Install: The Contract unit price per foot of electrical service wire, or the Contract unit price each for electrical service disconnect, furnished and installed, will include furnishing all materials and hardware as specified in the Contract Documents, and all labor, equipment, and miscellaneous materials necessary for a complete and accepted installation.

639-5.3 Furnish: The Contract unit price per foot of electrical service wire, or the Contract unit price each, for electrical service disconnect, furnished, will include the cost of the

required materials and hardware as specified in the Contract Documents, plus all shipping and handling costs involved in delivery as specified in the Contract Documents.

639-5.4 Install: The Contract unit price per foot of electrical service wire, or the Contract unit price each, for electrical service disconnect, installed, will include all labor, equipment, and miscellaneous materials necessary for a complete and accepted installation. The Engineer will supply electrical service wire or electrical service disconnect.

639-5.5 Electrical Power Service: The Contract unit price per assembly for electrical power service will include furnishing and installing all material and hardware as specified in the Contract Documents, and all labor and equipment necessary to make a complete and accepted installation.

639-5.6 Electrical Power Transformer: The Contract unit price for each Electrical Power Transformer will include furnishing, installing, and testing all materials and hardware as specified in the Contract Documents, and all labor, equipment, and miscellaneous materials necessary for a complete and accepted installation.

ARTICLE 639-6 is deleted and the following substituted:

639-6 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 639-	1-	Electrical Power Service - per assembly.
Item No. 639-	2-	Electrical Service Wire - per foot.
Item No. 639-	3-	Electrical Service Disconnect - each.
Item No. 639-	6-	Electrical Power Transformer - each.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 15, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **654**
Proposed Specification: **6540000 Midblock Crosswalk Enhancement Assemblies.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to align with content in the Standard Plans and clarify requirements for electrical requirements in pull boxes and restrictions on specific controller types.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

MIDBLOCK CROSSWALK ENHANCEMENT ASSEMBLIES
(REV 97-1420-22)

SECTION 654 is deleted and the following substituted:

654-1 Description.

Furnish and install midblock crosswalk enhancement assemblies.

654-2 Materials.

Use In-roadway light assemblies and rectangular rapid flashing beacon (RRFB) assemblies that meet the requirements of Section 995 and are listed on the Department's Approved Product List (APL). Use hardware that meets the requirements of Section 603.

Pedestrian hybrid beacon assemblies must meet the physical and operational requirements of the latest edition of the MUTCD, Chapter 4F. The cabinet, signals, controller, pedestrian detectors, and other traffic control devices used to create a pedestrian hybrid beacon assembly must be listed on the APL.

654-3 Installation Requirements.

Restore any areas impacted by the installation of the crosswalk enhancement assembly to original condition unless otherwise shown in the Plans. Install crosswalk enhancement assembly in accordance with the Americans with Disabilities Act Standards for Transportation Facilities.

Install post mounted RRFB assemblies in accordance with Standard Plans, Index 654-001. Use sign panel attachment hardware in accordance with Standard Plans, Index 700-010.

~~Optional mast arm and pole installation may be used if shown in the Plans.~~ Follow ~~the~~ manufacturer~~'s specifications~~ recommendations on the number of RRFB units that are connected to the timer's output driver. ~~Use attachment hardware in accordance with Section 995.~~ The outside edges of ~~the~~ RRFB indications, including any housings, shall not project beyond the outside edges of the associated warning sign.

If installed with highlighted signs or flashing yellow beacons, in-roadway light assemblies shall operate in unison and with an identical flash rate as the signs or beacons.

654-4 Warranty.

Ensure the midblock crosswalk enhancement assembly has a manufacturer's warranty covering defects for two years from the date of final acceptance in accordance with 5-11 and Section 608. Ensure the warranty includes providing replacements within 10 calendar days of notification for defective parts and equipment during the warranty period at no cost to the Department or the maintaining agency.

654-5 Method of Measurement.

654-5.1 General: All midblock crosswalk assemblies will include all materials, equipment, and labor necessary for a complete and accepted installation.

654-5.2 In-Roadway Light Assembly: The in-roadway light assembly includes in-roadway lights, signs, sign support structures, cabinet, electronics, wiring, and pedestrian detectors for a complete crossing. Include ~~S~~solar panels ~~are included~~ in the cost of the assembly~~,~~ when shown in the Plans.

654-5.3 Rectangular Rapid Flashing Beacon (RRFB) Assembly: Assemblies mounted in accordance with Standard Plan 654-001~~Post mounted assemblies~~ include ~~the~~ rectangular beacons and signs for each approach, sign support structure, mounting brackets, attachment hardware, cabinet, electronics, wiring, and pedestrian detector~~s~~. Include ~~S~~solar panels ~~are included~~ in the cost of the assembly~~,~~ when shown in the Plans.

~~Pole mounted assemblies include the rectangular beacon and signs, pole mount bracket, cabinet, electronics, wiring, and pedestrian detector. Solar panels are included in the cost of the assembly when shown in the Plans. Poles will be paid for separately.~~

~~Mast arm mounted assemblies include the rectangular beacon and signs, attachment hardware, and wiring for a single direction unit for non-standard installations. Mast arms will be paid for separately.~~

654-5.4 Pedestrian Hybrid Beacon Assembly: The Contract unit price for each pedestrian hybrid beacon assembly will consist of all labor and materials necessary for a complete and accepted installation. The assembly includes the 3-section signal, hardware, and backplate. Pedestrian signals, cabinet, signs, mast arms, strain poles or other support structures, and signal cable will be paid under the applicable sections for each item.

654-6 Basis of Payment.

Price and Payment will be full compensation for all work specified in this Section. Payment will be made under:

Item No. 654- 1	Midblock Crosswalk - In-Roadway Light Assembly - per assembly.
Item No. 654- 2	Midblock Crosswalk - Rectangular Rapid Flashing Beacon Assembly - per assembly.
Item No. 654- 3	Midblock Crosswalk - Pedestrian Hybrid Beacon Assembly - per assembly.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 21, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **660**
Proposed Specification: **6600100 Vehicle Detection System.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to provide references to Section 995 material requirements. Deleted unnecessary references, updated field acceptance test requirements for wrong way vehicle detection systems, method of measurement to clarify payment of highlighted signs per Sections 700. The changes to Section 660 are associated with the proposed changes to Section 995.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

VEHICLE DETECTION SYSTEM
(REV 97-1520-22)

ARTICLE 660-1 is deleted and the following substituted:

660-1 Description.

Furnish and install a vehicle detection system in accordance with the Contract Documents and this Section. ~~Use vehicle detection systems and loop sealant that meet the requirements of Section 995 and are listed on the Department's Approved Product List (APL).~~ Meet the requirements of Section 603.

SUBARTICLE 660-2.1 is deleted and the following substituted:

660-2 Materials.

660-2.1 General: ~~All equipment shall be permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number. Meet the requirements of Section 603.~~ Meet the following requirements:

Traffic Data Detection System- Microwave* .....Section 995
Vehicle Detector- Microwave*.....Section 995
Vehicle Detector- Video* .....Section 995
Vehicle Loop Detector* .....Section 995
Wireless Magnetometer Assembly* .....Section 995
Automatic Vehicle Identification*.....Section 995
Wrong Way Vehicle Detection Systems*.....Section 995
Loop Sealant* .....Section 995
Highlighted Signs*..... Section 995
*Use products listed on the Department's APL.

SUBARTICLE 660-3.1 is deleted and the following substituted:

660-3.1 Installation Requirements for all Detectors: Install, configure, and demonstrate a fully functional vehicle detection system as shown in the Plans. Connect all field equipment to the existing communication network, and provide all materials specified in the Contract Documents. Install all equipment in accordance with this Section and the manufacturer's recommendations.

~~Ensure that~~Install above-ground detectors ~~can be mounted~~ on ~~existing~~ poles or sign structures, ~~or on new poles,~~ as shown in the Plans. Furnish and install the power cable and the communication cables in accordance with the manufacturer's recommendation. Ensure that the cables comply with NEC sizing requirements and meet all other applicable standards, specifications, and local code requirements.

Do not install communication cables in the same conduit or pull boxes as power cables carrying voltage greater than 24 V_{DC}/V_{AC} or current in excess of 1.5 amps.

Cut all wires to their proper length before assembly. Do not double back any wire to take up slack. Neatly lace wires into cables with nylon lacing or plastic straps. Secure cables

with clamps and provide service loops at all connections. Label all field wiring cables in the cabinet.

In the event that power to the vehicle detection system or a subcomponent thereof is interrupted, ensure that the equipment automatically recovers after power is restored. Ensure that all programmable system settings return to their previous configurations and the system resumes proper operation.

SUBARTICLE 660-3.2.10.3 is deleted and the following substituted:

660-3.2.10.3 Loop Detector Turn-on: Connect the loop assemblies to the appropriate inductive loop vehicle detectors and tune the detectors in accordance with the manufacturer's instructions. Separate the operating frequencies of vehicle detectors, in adjacent lanes, by at least 2 kHz. ~~Verify operation in accordance with 660-2.2.1.~~

SUBARTICLE 660-4.4 is deleted and the following substituted:

660-4.4 Wrong Way Vehicle (WWVDS) Detection System: Submit a test plan for the field acceptance test (FAT) to the Engineer a minimum of 30 calendar days before commencement of testing for review and approval; tests cannot commence or be scheduled until test plans are approved by the Engineer~~for approval~~. For each testing phase, test plans must include descriptions of test procedures; test form with areas for test result recording, test conductor, and witness signatures; pass/fail criteria; and test schedule.

Conduct a field acceptance test for each ramp being monitored by a WWVDS. Test all local system functions using the installed WWVDS equipment as detailed in the Plans and as approved by the Engineer. Testing must demonstrate that:

1. All wiring and local configurations are correct.

2. The WWVDS is detecting vehicles driving the wrong way, in all ramp travel lanes and any paved shoulders 8 feet or wider, while ignoring vehicles traveling in the correct direction. A true positive rate of 95% or greater must be achieved using the methodology described in Section 660-4. A false positive rate of 1% or less must be achieved using the methodology described in Section 660-4.

3. The WWVDS is activating all wrong way highlighted signs on the ramp upon detection of a vehicle traveling in the wrong direction and sign activation occurs before the vehicle reaches the sign.

If any WWVDS fails to pass its field acceptance test, correct the unit, or substitute another unit in its place, then repeat the test.

If a unit has been modified due to a field acceptance test failure, prepare a report describing the nature of the failure and the corrective action taken and submit it to the Engineer prior to re-testing. If a failure pattern develops, the Engineer may direct that design and construction modification be made to all units without additional cost to the Department or extension of the Contract Time.

660-4.4.1 True Positive Testing: Conduct this test on a closed ramp using Contractor-provided test vehicles. Test each lane and paved shoulder 8 feet or wider by driving two types of test vehicles traveling at two travel speed ranges the wrong direction. For this testing,

the small vehicle shall be a FHWA Class Group 2 (passenger car) vehicle, and the large vehicle shall be a FHWA Class Group 3 (pick-ups and vans) or Class Group 5 (two-axle truck) vehicle.

Each ramp lane shall be subjected to the following test vehicle runs; each ramp paved shoulder 8 feet or wider must only undergo test runs described in #1 and #2.

1. Five runs of a small vehicle traveling between 10 and 15 miles per hour.
2. Five runs of a large vehicle traveling between 10 and 15 miles per hour.
3. Five runs of a small vehicle traveling 35 miles per hour or greater.
4. Five runs of a large vehicle traveling 35 miles per hour or greater.

Calculate the true positive rate using the following formula:

$$TPR = {}^{TP}/_{N} * 100$$

Where *TPR* = True positive rate %.

TP = Cumulatively for all test runs, the total number of times the WWVDS correctly detected the wrong way vehicle and activated the highlighted signs.

N = Total number of test vehicle runs.

660-4.4.2 False Positive Testing: Conduct this test on a ramp open to the traveling public. Test the WWVDS by monitoring a minimum of 300 total vehicles traveling in the correct direction of travel passing through the WWVDS detection zones. At least 150 vehicles shall be monitored during daylight hours and at least 150 vehicles shall be monitored at night. The Engineer may reduce minimum volume requirements under low volume conditions if necessary.

Calculate the false positive rate using the following formula:

$$FPR = {}^{FP}/_{N} * 100$$

Where:

FPR = False positive rate %.

FP = Total number of times the WWVDS activated for a vehicle traveling in the correct direction.

N = Total number of vehicles traveling in the correct direction.

ARTICLE 660-6 is deleted and the following substituted:

660-6 Method of Measurement.

The quantity to be paid will be the plan quantity~~Contract unit price~~ for each inductive loop detector and per assembly for loop assembly completed and accepted. ~~will include all equipment, materials as specified in the Contract Documents, and all labor, equipment, and miscellaneous materials necessary for a complete and accepted installation.~~

~~The~~ The quantity to be paid will be the plan quantity~~Contract unit price~~ for each ~~component of an~~ MVDS, VVDS, WMDS, AVI or WWVDS ~~will~~ completed and accepted.~~include furnishing, placement, and testing of all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages and firmware, supplies, support, personnel training, shop drawings, warranty documentation, and incidentals necessary to complete the work.~~

~~Activation of highlighted signs installed as a component of an WWVDS will be included in the cost of the detection system.~~ The highlighted signs ~~and incidentals related~~

~~to~~for a WWVDS~~the sign~~ will be paid for ~~separately~~in accordance with Section 700. Only one WWVDS will be paid per exit ramp, regardless of the number of signs~~ or components used~~.

ARTICLE 660-7 is deleted and the following substituted:

660-7 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section including furnishing, placement, and testing of all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages and firmware, supplies, support, personnel training, shop drawings, warranty documentation, and incidentals necessary for a complete and accepted installation.

Payment will be made under:

Item No. 660-1	Inductive Loop Detector - each.
Item No. 660-2	Loop Assembly – per assembly.
Item No. 660-3	Vehicle Detection System - Microwave - each.
Item No. 660-4	Vehicle Detection System - Video - each.
Item No. 660-5	Vehicle Detection System - Wireless Magnetometer - each.
Item No. 660-6	Vehicle Detection System - AVI - each.
Item No. 660-7	Vehicle Detection System - WWVDS - each.
Item No. 660-8	Traffic Data Detection System - Microwave - each.
Item No. 660-9	Traffic Data Detection System - Video - each.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 7, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **665**
Proposed Specification: **6650000 Pedestrian Detection System.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to provide material references for sign to the Materials Section. Removed unnecessary language that is covered in the Standard Plans.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PEDESTRIAN DETECTION SYSTEM
(REV 7-20-22)

SECTION 665 is deleted and the following substituted:

665-1 Description.

Install a pedestrian detection system as shown in the Plans. Pedestrian detection systems are classified into three categories: Standard Pedestrian Pushbutton Detectors, Accessible (Audible/Tactile) Pedestrian Pushbutton Detectors, and Passive Detectors. The components of the pedestrian detection system include pushbuttons, pedestrian actuation signs, electronics, wiring, and mounting hardware.

665-2 Materials.

Use pedestrian detection systems ~~and components~~ that meet the requirements of Section 995 and are listed on the Department's Approved Product List (APL). For the pedestrian actuation sign, use Type XI retroreflective sign sheeting meeting the requirements of Section 994 and the Standard Plans, Index 700-102.

665-3 Warranty.

Ensure that pedestrian detection systems have a manufacturer's warranty covering defects for a minimum of 5 years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608. Ensure the warranty includes providing replacements, within 10 calendar days of notification, for defective parts and equipment during the warranty period at no cost to the Department or the maintaining agency.

665-4 Installation.

Install pedestrian detectors at the locations and in a manner as shown in the Plans and Standard Plans, Index 665-001. Ensure all detectors are the same manufacturer and model.

Pushbuttons mounted on wood poles must be serviced by a conduit riser. Pushbuttons mounted on steel or aluminum (poles, pedestals, or posts) must be serviced by wiring inside the pole. Pushbuttons mounted on existing concrete poles may be serviced by a conduit riser. ~~———~~Pushbuttons mounted on new concrete poles or pedestals must be serviced by wiring on the inside.

A pedestrian actuation sign must be included with each pushbutton assembly. ~~Provide the sign type, size and legend as specified on the plans or as directed.~~ Tactile arrows of accessible pedestrian pushbuttons must align parallel with the direction of the crossing.

~~The Engineer will direct any variation from the locations shown.~~ When mounting, place the detector housing or saddle in complete contact with the pole or controller cabinet. When a post is required in the installation of the pedestrian detector, restore the area around the post to its original condition or as required by the Plans.

665-5 Method of Measurement.

The Contract unit price for pedestrian detectors, will be paid per each, and will include the pedestrian actuation sign, all mounting hardware, wiring, materials and equipment, and all labor and miscellaneous materials necessary for a complete and accepted installation.

Payment for poles, pedestals, and posts will be made under their respective pay item numbers.

665-6 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 665- 1- Pedestrian Detector - each.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 24, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **671**
Proposed Specification: **REVISED 6710000 Traffic Control.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to modify the content as it is being moved as part of the ongoing Department effort to move all materials requirements from Division II and Division III. This change is associated with the proposed changes to Section 995.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

TRAFFIC CONTROLLERS
(REV 10~~7~~-24~~0~~-22)

SECTION 671 is deleted and the following substituted:

671-1 Description.

Furnish and install a traffic controller unit as shown in the Plans. Meet the requirements of Section 603.

671-2 Materials.

Use traffic controllers that meet the requirements of Section 995 and are listed on the Department's Approved Product List (APL).

~~Ensure equipment is permanently marked with the manufacturer's name or trademark, part number, and serial number.~~

~~Controllers must meet the following applicable industry standards:~~

~~NEMA TS2 Controller NEMA TS-2-2016~~

~~Model 2070 Controller~~

~~CALTRANS TEES, 2009 ERRATA No. 2~~

~~Note: All controllers must meet AASHTO/ITE/NEMA ATC 5201, v06.25.~~

~~All controllers must provide functionality that meets or exceeds operational characteristics, including NTCIP support, as described in NEMA TS-2-2016.~~

~~All controllers must:~~

~~1.Capture all mandatory event-based data elements listed in supplemental requirement SR-671-2, Supplemental Traffic Controller High Resolution Data Logging Requirements, as published on the Department's State Traffic Engineering and Operations Office website at the following URL: https://www.fdot.gov/traffic/Traf-Sys/Product-Specifications.shtm.~~

~~2. Provide and make Management Information Bases (MIBs) available for Traffic Signal Controller Broadcast Messages (TSCBM) to local agencies and FDOT that are compatible with Society of Automotive Engineer (SAE) J2735 201603.~~

~~3. Support programming of destination Internet Protocol (IP) addresses via controller front panel for interface with Dedicated Short-Range Communication (DSRC) Roadside Units (RSU), also called Vehicle to Infrastructure (V2I) Hubs.~~

If shown in the Plans, new installations must include controllers that will deactivate the dimming circuit of LED street lighting during pedestrian activations. Pedestrian detector diagnostics must be activated when this feature is used.

671-3 Installation Requirements.

Install and configure traffic controllers in accordance with the Plans and the manufacturer's recommendations.

671-~~3~~4 Method of Measurement.

The Contract unit price each for traffic controller, furnished and installed, will include all materials specified in the Contract Documents, and all labor, equipment, and miscellaneous materials necessary for a complete and acceptable installation.

No separate payment will be made for a traffic controller when included with the Traffic Controller Assembly per section 670. ~~No separate payment will be made for the controller; payment is included with the Traffic Controller Assembly.~~

671-5 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item 671- 2- Traffic Controller - each

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 24, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **676**
Proposed Specification: **REVISED 6760000 Traffic Cabinets.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to move all material requirements from Division II to Division III. This change is associated with the proposed changes to Section 995.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

TRAFFIC CABINETS
(REV 107-2421-22)

SECTION 676 is deleted and the following substituted:

676-1 Description.

Furnish and install traffic cabinets as shown in the Plans. Meet the requirements of Section 603.

676-2 Materials.

676-2.1 General: Use traffic signal controller cabinets, ITS cabinets, and small equipment enclosures and accessories that meet the requirements of Section 995-11 and are listed on the Department's Approved Product List (APL). Cabinets must be permanently marked with a label including the manufacturer's name or trademark, model/part number, and the year and month of manufacture. Place the label on the inside of the main door using a water resistant method. The label must be visible after installation. Provide the cabinet with an automatic transfer switch if shown in the Plans. If shown in the Plans, nNew signal installations must include controller cabinets that will interface with the dimming circuit of LED street lighting with an auxiliary relay if shown in the Plans. Provide cabinets with No. 2 locks unless otherwise shown in the Plans.

Painted and unpainted cabinets must meet the applicable requirements in Aluminum Cabinets, NEMA TS-2-2016, 7.7.2.

676-2.2 NEMA Traffic Signal Controller Cabinets: Provide NEMA traffic signal controller cabinets with all terminals and facilities necessary for traffic signal control meeting the following requirements:

NEMA TS1 Controller Cabinet NEMA TS-1-1989
NEMA TS2 Controller Cabinet NEMA TS-2-2016

676-2.2.1 Documentation: Provide four paper copies of the cabinet wiring diagram with each cabinet. The nomenclature of signal heads, vehicular movements and pedestrian movements on the wiring diagram must be in accordance with the signal operating plan.

Documentation must include a list identifying the termination points of cables used for vehicular and pedestrian signal heads, detector loop lead-ins, and pedestrian pushbutton wires.

A heavy duty, resealable plastic opaque bag must be mounted on the backside of main cabinet door for storing cabinet documentation.

676-2.2.2 Police Switches: Provide the following police switches with Type 3and larger controller cabinets. The switches must be mounted on the police panel and identified as to their function.

1. AUTO-FLASH: When this switch is in the FLASH position, all signal indications must immediately transfer to the flashing mode. AC power shall be removed from the load switches and stop timing applied to the controller unit. When this switch is placed in the AUTO position the controller unit must operate in accordance with the appropriate specification.

2. MANUAL ON-OFF: When this switch is in the on position, a logic ground must be applied to the manual control enable input of the controller unit.

3. MANUAL JACK: Install a manual jack on the police panel. The jack must mate with a three circuit, 1/4 inch diameter phone plug. Connect the tip and ring (middle) circuits of the jack to the logic ground and the interval advance inputs of controller unit. When the manual hand cord is plugged into the jack and the pushbutton is pressed, logic ground must be connected to the interval advance input of the controller unit.

Provide a manual pushbutton with Type 3 and larger cabinets. The pushbutton cord must have a minimum length of six feet with a 1/4 inch diameter three circuit plug connected to one end and a hand held manual pushbutton at the other end. With the exception of the vehicular yellow and all red clearance intervals, a complete cycle (push-release) of the manual pushbutton shall terminate the controller unit interval that is active. Cycling the push-button during the vehicular yellow or all red clearance intervals must not terminate the timing of those intervals.

676-2.2.3 Service Switches: Service switches must be mounted on the service panel or other locations approved by the Department and identified as to their functions. Provide the following service switches with Type 3 and larger cabinets.

1. SIGNALS ON-OFF: When this switch is in the off position, AC power shall be removed from all signal heads. The SIGNALS ON-OFF switch must be connected to the control input of a contactor (displacement relay). Current supplied to the switch must not exceed five amperes (amps) total. Do not directly route the main signal head power buss and cabinet power through the service or police switches.

2. AUTO-FLASH: When this switch is in the FLASH position, all signal indications must transfer to the flashing mode in accordance with the Uniform Code Flash (UCF) requirements. AC power shall be removed from the load switches when the signal indications transfer to the flashing mode. The controller unit must operate in accordance with appropriate specifications during the flashing mode. When the switch is placed in the AUTO position, transfer from the flash mode to normal operation shall be made in accordance with UCF requirements.

3. CONTROLLER ON-OFF: When this switch is in the off position, AC power shall be removed from the controller.

4. AUX POWER ON-OFF: When this switch is in the off position, AC power shall be removed from all circuits of the cabinet except for the duplex receptacle, cabinet light and ventilation fan.

5. VEHICLE DETECTORS: A detector test switch must be provided for each phase of the controller unit. Detector test switches must include a position for normal operation (phase receives calls from detectors), a position that provides a constant call, and a position that provides a momentary call.

676-2.2.4 Doors and Locks: Provide Type 3 and larger cabinets with a hinged, rain tight and dust tight police door which allows access to the police switches and manual jack.

Locate the police door in the bottom half of the main door for Type 3 and 4 pole mount cabinets. Locate the police door in the upper half of the main door for Type 4 and larger base mount cabinets.

Hinges and hinge pins must be constructed of stainless steel and prevent the door (main or police) from sagging. Hinges for the main and police doors must be 14 gauge and be located on the right side (viewed from the front).

Type 3 and larger cabinets must be furnished with a three point draw roller latching system consisting of the following latching points:

1. Center of the cabinet (lock)
2. Top of the cabinet--controlled by the door handle
3. Bottom of the cabinet--controlled by the door handle

The latching points on the top and bottom of the cabinet must remain in the locked position until the main cabinet door lock is unlocked. The locking mechanism must be equipped with nylon rollers to secure the top and bottom of the door.

Type 3 and larger cabinets must be furnished with a door stop which retains the main door open in a 90 degree and 120 degree position.

676-2.2.5 Police and Service Panels: Provide a police service panel with Type 3 and larger cabinets. The panels may be constructed of either sheet aluminum or cast aluminum. Locate the police panel behind the police door attached to the main door. The service panel must be mounted on the back side of the police panel. The police panel must have the following minimum dimensions:

1. Height – 4 inches
2. Width – 8 inches
3. Depth – 2-1/2 inches

676-2.2.6 Ventilation: Type 1 and 2 cabinets must be vented to allow dissipation of the heat generated by the equipment housed inside the cabinet.

Type 3 and larger cabinets must have dual, UL listed, thermostatically controlled fans, rated for continuous duty with a service life of at least three years. Mount thermostats on the inside top of the cabinet. Thermostats must be user adjustable to allow temperature settings ranging from a minimum of 70°F to a maximum of 140°F and capable of activating the fans within plus or minus 5 degrees of the set temperature. The intake vent must be rain tight, located on the bottom half of the cabinet, and covered with a removable filter.

676-2.2.7 Shelves: Type 2 cabinets must be furnished with one shelf. Type 3 and larger cabinets must be furnished with two adjustable shelves. Shelves must be adjustable in a maximum of 2 inch increments from the top of the load panel to 12 inches from the top of the controller cabinet.

676-2.2.8 Mounting Hardware: Type 1, 2, and 3 cabinets must be supplied with hardware for attaching the top and bottom half of the cabinet onto a flat or round surface. Optional wall or pole mount hardware must be provided for mounting Type 4 cabinets in specific installations.

Type 4 cabinets must have rigid tabs attached to the bottom of the cabinet. Type 5 cabinets must have rigid brackets attached to the bottom of the cabinet. Rigid brackets and tabs must be constructed of the same material used for the cabinet.

Type 4 and larger cabinets must be provided with one of the following alternatives for fastening to a concrete base:

1. Galvanized anchor bolts, nuts, lock washers, and flat washers in accordance with ASTM A153. The anchor bolts must be at least 1/2 inch in diameter, seven inches in vertical length with at least three inch horizontal, or
2. Heavy duty machine bolt anchors, flat washers, lock washers and machine screws with at least 1/2 inch thread diameter.

676-2.2.9 Electrical: Fabricate ground bussbars of copper or aluminum alloy material compatible with copper wire and provide at least two positions where No. 2 AWG stranded copper wire can be attached.

Mount a ground bussbar on the side of the cabinet wall adjacent to the power panel for the connection of AC neutral wires and chassis ground wires.

If more than one ground bussbar is used in a cabinet, a minimum of a No. 10 AWG copper wire must be used to interconnect them.

676-2.2.9.1 Wiring: All wiring must be laced. All conductors in the cabinet must be stranded copper.

All inputs and outputs must be terminated on terminal strips. A connector harnesses for the controller, conflict monitor, vehicle detectors, and other controller accessory equipment must be furnished and wired into the cabinet circuitry.

A vehicle detector harness or rack must be furnished with the cabinet. Terminal strip circuits must be provided for connection of the loop lead-in cable.

676-2.2.9.2 Terminal Strips: The voltage and current rating of terminal strips must be greater than the voltage and current rating of the wire which is terminated on the terminal strip.

Conductors must be terminated on terminal strips with insulated terminal lugs. A calibrated ratchet crimping tool must be used to terminate the conductor in the terminal lug.

When two or more conductors are terminated on field wiring terminal strip screws, a terminal ring lug shall be used for termination of those conductors. All terminal strip circuits must be numbered.

676-2.2.9.3 Cabinet Light and Receptacle: For Type 3 and larger cabinets, provide one or more light fixtures that illuminate the entire interior of the cabinet. All lighting fixtures must automatically turn on when the cabinet doors are opened and off when the doors are closed.

Mount and wire a three-wire 115 V_{AC} duplex receptacle in all cabinets. The receptacle must be protected by a 15A circuit breaker. Do not mount the receptacle on the main cabinet door or police and service switch panels.

676-2.2.9.4 Main Circuit Breaker: Provide a 15A circuit breaker with Type 1 and 2 cabinets, and a 30A circuit breaker with Type 3 and larger cabinets.

The main circuit breaker must turn off all power to the cabinet and shall not be used for the power switch located in the service panel.

676-2.2.9.5 Radio Interference Suppression: A radio interference suppressor must be provided in series with the AC power before it is distributed to any equipment inside the cabinet. The suppressor must provide a minimum attenuation of 50 decibels over a frequency range of 200 kHz to 75 MHz when used with normal installations and shall be hermetically sealed in a metal case.

The radio interference suppressor must have the same minimum current rating as the main circuit breaker.

The ground connection of the radio interference suppressor must be connected only to AC neutral and shall not be connected to earth ground directly.

676-2.2.9.6 Opto Isolation: The Opto Common input is the common reference pin for four optically isolated inputs.

The Opto inputs are intended to provide optical isolation for pedestrian detector and remote interconnect inputs. The Opto inputs are intended to connect through external 27 kS, 1 W resistors for 120 V_{AC} operation and are intended for direct connection to 12 V_{AC} from the cabinet power supply for pedestrian detector applications. These

~~inputs may alternatively be used for low-true DC applications when the Opto Common pin is connected to the 24 V supply.~~

~~The Opto inputs shall provide electrical isolation of 10 MS minimum resistance and 1000 V_{AC} RMS minimum breakdown to all connector pins except the Opto Common pin. These inputs shall exhibit nominal impedance to the Opto Common pin of 5 kS', plus or minus 10 percent, and shall require 2.4 mA, plus or minus 10 percent, from a nominal 12 V_{AC} supply. The Opto inputs shall not recognize 3 V_{AC} RMS or less relative to the common input and recognize 6 V_{AC} RMS or more relative to the common input. Any steady state voltage applied between an Opto input and the Opto Common shall not exceed 35 V_{AC} RMS. Opto inputs shall not be acknowledged when active for 25 ms or less, and shall be acknowledged when active for 50 ms or more.~~

~~**676-2.2.9.7 Load Resistors:** A load resistor or capacitor must be installed between the AC (common) and each signal field wiring terminal for the yellow, green and walk indication. All load resistors and capacitors must be on the front side of any panel used in the cabinet.~~

~~**676-2.2.9.8 Surge Protection:** Furnish surge protective devices (SPDs) for the main AC power input, all signal head field wiring terminals, interconnect cable terminals and loop lead-in cable terminals which are located in the cabinet. SPDs must be unobstructed and accessible from the front side of any panel used in the cabinet. Cabinets utilizing Din rail mounted SPDs must be grounded with a conductor to the cabinet bussbar.~~

~~The SPD for the main AC power input of the cabinet must be connected on the load side of the cabinet circuit breaker.~~

~~SPDs for signal and interconnect cable field wiring terminals must meet the following:~~

~~1. Clamp the surge voltage to a level no greater than twice the peak operating voltage of the circuit being protected.~~

~~2. Withstand a surge current of 1000A with an 8 by 20 µs waveform six times (at 1 second intervals between surges) without damage to the suppressor.~~

~~SPDs for loop lead-in cables must be designed in accordance with the following requirements:~~

~~1. Protect the detector unit loop inputs against differential (between the loop lead) surges, and against common mode (between loop leads and ground) surges.~~

~~2. Clamp the surge voltage to 25 V or less when subjected to repetitive 300A surges.~~

~~3. Withstand repetitive 400A surges with an 8 by 20 µs waveform without damage.~~

~~SPDs must be installed according to the SPD manufacturer's instructions and not affect the operation of detectors. SPD leads must be kept as short as possible.~~

~~**676-2.3 Type 170 Traffic Signal Controller Cabinets:** Provide Type 170 traffic signal controller cabinets with all terminals and facilities necessary for traffic signal control and meeting the following requirements:~~

~~Model 332, 334 and 336S Cabinets~~

~~CALTRANS TEES 2009~~

~~Model 336S cabinet must incorporate input surge protection mounted on a fold-down termination panel at the input file.~~

~~Model 332 cabinets must incorporate a lower input termination panel. Model 332 and 334 cabinets must be base mounted. The Model 332 cabinet must have an auxiliary MODEL 420 output file, and be configured for 8 vehicle, 4 pedestrian, and 4 overlaps.~~

~~Model 552A designation is given to Model 332 cabinet assemblies that include a swing-out EIA 19 inch rack cage.~~

~~Model 662 designation is given to Model 552A cabinets with a 66 inch height.~~

~~Cabinets must comply with figures for traffic control signals and devices available on the Department's State Traffic Engineering and Operations Office website at the following URL:~~

Error! Hyperlink reference not valid.~~-~~

~~All terminals and facilities on panels must be clearly identified using permanent silk-screened text.~~

~~**676-2.3.1 Base Plate and Mounting Brackets:** Provide cabinets with a standard base mounting bolt pattern and a minimum of two aluminum plates welded inside for anchoring to a concrete or composite base.~~

~~**676-2.3.2 Output File:** Fabricate the output file using a "hard wired" harness. Printed board circuit boards are not acceptable.~~

~~**676-2.3.3 Shelf:** Provide an aluminum shelf with storage compartment in the rack below the controller (for remote secondary monitor/lap top computer use). The storage compartment must have telescoping drawer guides for full extension. The compartment top must have a non-slip plastic laminate attached. Provide an RS-232 connector for communications to the C2S port.~~

~~**676-2.3.4 Loads:** Provide dummy loads consisting of 4.7k resistors rated at five watts minimum for Greens, Peds, and Yellows. The dummy loads must be mounted on a terminal block in the rear of the output file or other approved location. Wire one side of each dummy load to AC return in a manner that allows a technician to easily attach the load to outputs from selected load switches.~~

~~**676-2.3.5 Cabinet Light:** Provide one or more light fixtures that illuminate the entire interior of the cabinet. All lighting fixtures must automatically turn on when the cabinet doors are opened and off when the doors are closed.~~

~~**676-2.3.6 Surge Protection:** Provide each cabinet with devices to protect equipment from surges. Surge protector termination panels must be attached to the cabinet rack assembly and allow sufficient space for connections, access, and surge protector replacement. AC isolation terminals must be on the same side of the cabinet as the AC service inputs. DC terminals and loop detector terminals must be installed on the opposite side of the cabinet from the AC power lines.~~

~~Surge protection for 332A cabinets must be mounted on the lower input termination panel.~~

~~Surge protection for 336S cabinets must be mounted on a custom fold down termination panel at the input file.~~

~~Under no circumstance (normal operation or short-circuit condition) shall the amperage capacity of the internal wiring and printed circuit board traces be less than the protecting threshold of circuit breakers and surge protectors provided.~~

676-2.3.6.1 Power Distribution Assembly Protection: The power distribution assembly (PDA) SPD must be a two stage series/parallel device that meets or exceeds the following:

1. Maximum AC line voltage: 140 V_{AC}
2. 20 pulses of peak current, each of which will rise in 8 microseconds and fall in 20 microseconds to one-half the peak: 20kA.
3. The protector must include the following terminals:
   a. Main line (AC Line first stage terminal)
   b. Main Neutral (AC Neutral input terminals)
   c. Equipment Line Out (AC Line second stage output terminal, 10A)
   d. Equipment Neutral Out (Neutral terminal to protected equipment)
   e. Ground (Earth connection)
4. The main AC line in and the equipment line outer terminals must be separated by a 200 microhenry (minimum) inductor rated to handle 10A AC service
5. The first stage clamp shall be between Main Line and ground terminals
6. The second stage clamp shall be between Equipment Line Out and Equipment Neutral
7. The protector for the first and second stage clamp must have a metal oxide varistor (MOV) or similar solid state device, rated 20 kA.

The main neutral and equipment neutral output shall be connected together internally, and shall have an MOV (or similar solid state device, or gas discharge tubes) rated at 20 kA between main neutral and ground terminals.

The PDA SPD must have a peak clamp voltage of 250V at 20 kA (voltage measured between equipment line out and equipment neutral out terminals, current applied between main line and ground terminals with ground and main neutral terminals externally tied together).

The PDA SPD must have a maximum let through voltage not exceeding 500 Vpk using an 8 by 20 µs/1.2 by 50 µs; 6 kV, 3 kA surge. The SPD must either be epoxy-encapsulated in a flame retardant material or utilize thermally protected varistors and be designed for continuous service current of 10A at 120 V_{AC} RMS. Power to the Type 170E controller and to the 24V power supply must be provided from the equipment line out terminal of the PDA SPD.

676-2.3.6.2 Inductive Loop Detector Protection: Protect each inductive loop detector input channel with an external SPD that meets or exceeds the following:

1. The SPD must be a three-terminal device, two of which shall be connected across the signal inputs of the detector. The third terminal shall be connected to chassis ground to protect against common mode damage.
2. The SPD must instantly clamp differential mode surges (induced voltage across the loop detector input terminals) via a semiconductor array. The array shall be designed to appear as a very low capacitance to the detector.
3. The SPD must clamp common mode surges (induced voltage between the loop leads and ground) via solid state clamping devices.

4. Peak Surge Current
a. Differential Mode: 400A (8 by 20 µs)
b. Common Mode: 1000A (8 by 20 µs)
c. Estimated Occurrences: 500 @ 200A
5. Response Time: 40 ns
6. Input Capacitance 35 pF typical
7. Clamp Voltage
a. 30V max @ 400A (Differential Mode)
b. 30V max @1000A (Common Mode)

676-2.3.6.3 Signal Load Switch Protection: The outputs of each load switch in the output file shall be provided with a MOV connected from the AC positive field terminal to the chassis ground. The MOV must be rated 150 V_{AC} and shall be a V150LA20A (or approved equal).

676-2.3.6.4 Communication Input Protection: Each low voltage communication input must be protected as it enters the cabinet with a hybrid two-stage SPD that meets or exceeds the following:

1. The SPD must be a dual pair (four-wire) module with a double-sided, gold-plated printed circuit board connector.
2. The SPD must be installed in a ten-circuit card edge terminal block (PCB1B10A).
3. The SPD must be utilized as two independent signal pairs. The data circuits must pass through the SPD in a serial fashion.
4. Peak Surge Current
a. 10kA (8 by 20 µs)
b. Occurrences at 2000A: greater than 100
5. Response Time: less than 1 ns
6. Clamp Voltage: 30V maximum
7. Series Resistance: greater than 15 ohms per line
8. Primary Protector: 3 element gas tube
9. Secondary Protector: Solid state clamp (1.5 kW minimum)

The line side of the SPD must be connected to the communication field wires, the load side connected to the communication connector of the controller, and the ground terminal connected to chassis ground.

676-2.3.6.5 Low Voltage DC input protection: Each DC input must be protected by an SPD that meets or exceeds the following:

(a) The SPD must be a 5 terminal device. Two terminals must be connected to the line side of the low voltage pair, two terminals must be connected to the input file side, and the fifth terminal connected to chassis ground.
(b)Peak Surge Current
2 kA (8 by 20 µs)
Occurrences at peak current: 100 (typical)
(c) Response Time: 5-30 ns
(d) Shock: Must withstand 10 foot drop on concrete
(e) Clamp Voltage: 30V
(f) Series Resistance: greater than 15 ohms each conductor

676-2.3.6.6 Preemption and 115V AC signal input protection: Each preemption or AC signaling input channel must be protected by an external SPD that meets or exceeds the following requirements:

(a) The SPD must be a 3 terminal device

(b) Peak Surge Current

2000A (8 b 20 µs)

Occurrences at peak current: 25 (minimum)

(c) Response Time: less than 200 ns

(d) Peak Surge Trip Point: less than 890V nominal

676-2.3.7 Model 210 Conflict Monitor with Absence of Red Monitoring: The conflict monitor must be a Model 210 "PLUS" conflict monitor capable of detecting fault sequencing of signals on a per channel basis (i.e. short or absence of yellow interval and/or simultaneous dual indications). All integrated circuits having 14 pins or more must be socket-mounted.

676-2.3.7.1 Absence of Red Monitoring: The conflict monitor must be capable of monitoring for the absence of voltage on all of the inputs of a channel (defined here as red, yellow, and green). If an output is not present on at least one input of a channel at all times, the unit shall begin timing the duration of this condition. If this condition exists for less than 700 milliseconds, the unit shall not trigger. If this condition exists for more than 1000 milliseconds, the unit shall trigger as if a conflict had occurred, causing the intersection to transfer immediately into a flashing mode, and "stop-time" to be applied to the controller. A red signal shall require the presence of a minimum of 60 $V_{AC,}$ plus or minus 10 $V_{AC,}$ to satisfy the requirements of a red indication. The red input signals shall be brought into the conflict monitor through an auxiliary connector on the monitor's front panel. Provide a similar connector on the output file, with a removable harness connecting the two. Provide an indicator on the front panel of the monitor to identify the triggering of the monitor in response to the absence of red condition.

676-2.3.7.2 Red Monitor Harness: A connector and terminal assembly designated as P20 for monitoring the absence of red, shall be an integral part of the output file. The connector must terminate, and be compatible with, the cable and connector of a Type 170 conflict monitor unit (CMU), capable of monitoring the absence of red. Provide the pin assignments of the P20 connector and terminal assembly with the cabinet plans. The P20 connector shall be physically like the cable and connector of a Type 170 CMU to prevent the absence of red cable connector from being inserted into the P20 connector 180 degrees out of alignment.

676-2.3.7.3 Programming of Unused Red Channels: Provide all cabinet assemblies with a means of programming unused red channels by installing jumpers from red monitor inputs to 115 V_{AC}. The connecting terminals for the jumpers must be accessible and located in the same terminal block for all 16 channels to assure full compatibility of all cabinet assemblies with "210 Plus" conflict monitor units.

676-2.3.8 Police Door and Panel: Provide cabinets with police doors and panels. The police panel must include text informing officers that yellow and all-red clearance intervals are timed internally.

676-2.3.8.1 Manual Control: Police switch panels must include a manual jack. The jack must mate with a three circuit, 1/4 inch diameter phone plug. Connect the tip and ring (middle) circuits of the jack to the logic ground and the interval advance inputs of controller

unit. When the manual hand cord is plugged into the jack and the pushbutton is pressed, logic ground must be connected to the interval advance input of the controller unit.

The pushbutton cord must have a minimum length of six feet with a 1/4 inch diameter three circuit plug connected to one end and a hand held manual pushbutton at the other end. With the exception of the vehicular yellow and all red clearance intervals, a complete cycle (push-release) of the manual pushbutton shall terminate the controller unit interval that is active. Cycling the push-button during the vehicular yellow or all red clearance intervals must not terminate the timing of those intervals.

676-2.3.9 Technician Service Panel: Provide cabinets with a technician service panel which is mounted on the back side of the police panel (inside the main cabinet front door).

676-2.3.9.1 Service Panel Switches: There must be two switches located on the technician service panel, clearly labeled according to the following functions:

(a) UCF – This toggle switch shall:

Place the intersection into Flashing Operation.

After meeting requirements for Flashing Operations, all power shall be removed immediately from signal load switches.

(b) Signal On/Off – This toggle switch shall disconnect all power to the signal lights through the use of a 60A contact switch placed in series with the load switch packs.

Labels must be silk screened directly on the panel.

676-2.3.10 Swing-out Rack Assembly: Provide 552-A cabinets with a pullout and rotatable rack assembly as well as an interface panel mounted on the top of the rack assembly and attached to the top shelf. The rack assembly must be constructed to house components designed to be installed in a standard EIA 19 inch rack and shall house the Controller, Input File, Output File No. 1, PDA No. 2, and a storage compartment.

Construct the rack and slide/hinged mounting brackets so that when the rack assembly (fully loaded) can be pulled out with one hand with complete ease of operation including rotation of the assembly.

The rack assembly must have a spring-loaded latch mechanism to secure the rack assembly inside the cabinet while in the "rest" position. When pulled out of the cabinet at any point from its resting position (inside cabinet) to its full extension and rotation, the fully loaded rack assembly shall not cause any member of the assembly to bend, warp or bind. The rack must be made of one inch square aluminum tubing with welded joints and extend and retract smoothly without noticeable friction or stress on roller guides, extension brackets, or other mechanical components. Maximum deflection of the entire rack assembly (with all equipment installed) shall not exceed 1/8 inch.

The rack assembly must have 12 technician test switches mounted to the interface frame assembly. Technician test switches must be of the momentary type and shall have eight vehicle and four pedestrian inputs.

The front of the rack assembly must be tapped with 10-30 threads with EIA universal spacing for 19 inch electrical equipment racks.

The rack assembly must be attached to the left cabinet wall through combination slide/hinged mounting brackets.

The slide/hinged mounting brackets must be fabricated from aluminum and/or stainless steel only.

Mounting bracket guides must utilize 7/8 inch stainless steel ball bearing rollers and allow extension and retraction of a loaded rack with minimal effort.

The rack assembly must be capable of rotating 210 degrees from its rest position after full extension from the cabinet.

The rack assembly must have an minimum 7/16 inch diameter aluminum rack stop rod attached to the inside left cabinet wall from the left side of the rack assembly to lock the rack into final position.

All cabinet harnesses must be long enough to maintain cabinet connections and functionality when the rack assembly is fully extended and rotated to its maximum limit. Harnesses must not bind or crimp when the rack is fully retracted, extended, or in motion.

676-2.3.11 Service Panels for 552A: The 552A cabinet must include a field service panel, auxiliary field service panel, and interface panel, all constructed of aluminum with a 1/8 inch minimum thickness. All components must be accessible from the front of the panels. Do not mount components or attach wires behind panels.

676-2.3.11.1 Field Service Panel: The field service panel must consist of terminal strips, circuit breakers, transient protection devices, load resistors, capacitors, cable tie mounts and associated wiring for making all field wiring connections. Mount the field service panel in the cabinet on the lower right exterior cabinet wall.

The field service panel must provide the necessary interconnecting junction points between the rack assembly and cabinet for the field service wires. The panel must be grouped for internal connections (jumpers) between terminals boards, wiring from the panel to the rack assembly, and wiring from the panel to the cabinet.

The field service panel wiring harness must have flexible wire covered by a flexible non-metallic conduit from the field service panel to the PDA, output file, and interface panel. The harness must have a metal clamp with a rubber grommet center attached to the field service panel to secure the harness to the panel for proper orientation of the harness with the rack assembly. Terminal strips for the panel shall be as listed below:

a) TBS1 - Terminal Block, Deadfront type, 3 position, No. 4 to No. 14 AWG wire range, 70A, 600V.

b) TBS2 - Terminal Block, Barrier, 16 position, .375 Density, 5-40 x 3/16 BH Screw, Open Bottom, Double Row, No. 16 AWG (max), 15A, 250V.

c) TBS3 - Terminal Block, Barrier, 20 position, .375 Density, 5-40 x 3/16 BH Screw, Open Bottom, Double Row, No 16 AWG (max), 15A, 250V.

d) TBS4 &TBS5 - Terminal Block, Barrier, 12 position, .438 Density, 6-32 x 1/4 BH Screw, Open Bottom, Double Row, No. 14 AWG (max), 20A, 250V.

The panel must have a main cabinet circuit breaker rated at 30A and a cabinet accessory circuit breaker rated at 15A for cabinet fans and light. Mount the circuit breakers near the back cabinet door on the panel.

The panel must include load resistors for all Walk, Green, Green Arrow, Yellow and Yellow Arrow Switch Pack outputs to prevent the conflict voltage monitor from going into "Flash" due to a failed signal lamp. Load resistors must be 2K, 10 watt.

MOVs must be physically tied to one side of each terminal on TBS4 and TBS5 and be physically secured to the field service panel with a 6-32 screw.

676-2.3.11.2 Auxiliary Field Service Panel: The auxiliary field service panel must be mounted on the lower left interior cabinet wall and consist of a minimum of four terminal strips, 18 detector surge protectors and one pedestrian button isolation board assembly. The 18 surge protectors must be a three-terminal device, two of which are connected across the signal inputs of the detector for differential mode protection and the third terminal is grounded to protect against common mode damage. Mount the pedestrian button isolation board on the auxiliary field service panel. Terminal strips for the panel shall be Terminal Block, Barrier, 12 position, .438 Density, 6-32 x 1/4 BH Screw, Open Bottom, Double Row, No. 14 AWG (max), 20A, 250V.

Install a four-button pedestrian isolation board on the auxiliary field service panel to provide for the connection of the pedestrian buttons on phases 2, 4, 6 and 8. The board must provide electrical isolation of the field wiring to the internal cabinet wiring. The inputs to this isolation board shall be wired to terminal block TBA5 for connection to field wiring. The outputs of this board shall be carried through the harness to the input file to the proper wires that go to the interface extension panel of the controller.

The pedestrian button isolation board must include a PC board mounted on an aluminum panel with the following minimum dimensions:

Height: 2 inches

Width: 8 inches

Thickness: 1/8 to 3/16 inches

676-2.3.11.3 Interface Panel: The interface panel must consist of eight terminal strips, one telephone line suppressor and mounting fixture, two 24 V_{DC} relays and mounting fixtures, and all associated wiring for connecting the required interface equipment modules.

The front of the panel must be covered by a 1/4 inch clear plexiglass sheet, supported from the panel by four 1-1/2 inch standoffs. Secure the panels and cover using wing nuts that are removable without the use of tools. The plexiglass cover shall have 1/2 inch slot, centered over each of the terminal strips. All covers and panels must be interchangeable.

The panel wiring must provide the necessary interconnecting junction points between interface equipment cable harnesses and controller cabinet input and output signal. The panel wiring provides the functional wiring information for connecting the interface equipment in the cabinet.

The panel wiring must be grouped for internal connections (jumpers between terminal boards) as well as wiring from the controller and related cabinet functions to the terminal boards on the interface panel.

Ground wires must be No. 14 AWG wire, minimum. The internal harnesses must be located between TB1, TB2 and TB3. The external and internal wiring must be located outside of TB1 and TB4, between TB2 and TB3.

Terminal strips shall be Barrier type, .375 Density, 5-40 x 3/16 BH Screw, Open Bottom, Double Row, No. 16 AWG (max), 15A, 250V. Terminals must use nickel/cadmium plated brass screws. All terminals and facilities on panels must be clearly identified using permanent silk-screened

The K1P and K2F relays shall be 15A miniature relays with polycarbonate cover, 2 form C (CO) contact arrangement, DC coil input, socket mount, .187 inch quick connect/solder terminals, AgCdO (15A) contacts, and 24 V_{AC} coil voltage with matching

socket and hold down spring. All screws on the relay socket must be brass with nickel/cadmium plating.

676-2.3.12 Storage Compartment: Mount an aluminum storage compartment in the rack assembly. The storage compartment must have telescoping drawer guides for full extension of drawer from rack assembly and have a continuous front lip for opening the compartment top for storage. The top of the compartment must be non-slip plastic laminate.

Install a communication port on the right hand side of the drawer at the front for connecting to the communications port of the controller unit via the cabinet harness.

676-2.3.13 Cabinet Rails: Provide the cabinet with four cabinet rails for mounting wiring panels and various brackets. Rails must be keyhole design with slots 2 inches on center with a top opening diameter of 5/8 inches to allow the insertion of a 5/8 inch by 1 inch carriage bolt. The rails must be approximately 1-1/2 inch to 2 inches wide by 1/2 inches deep. Do not use unistruts or other rails.

676-2.3.14 Electrical: Do not use printed circuit boards in any controller cabinet subsystem file or panel, including but not limited to the output file (except for the red monitor program board), service panel, interface panel, and input file.

676-2.3.14.1 Wiring: Cut all wires to the proper length and neatly laced into cables with nylon lacing. No wire shall be doubled back to take up slack. Cables in the cabinet must not interfere with the routing and connection of field wiring. Cables must be secured with nylon cable clamps, unless specified otherwise. The position of cables between the components must be such that when the door is closed, it does not press against the cables or force the cables against the various components inside the controller cabinet.

Fabricate ground buss bars of a copper or aluminum alloy material compatible with copper wire and provide at least two positions where a No. 2 AWG stranded copper wire can be attached. Mount a 6 inch ground buss bar with screw terminals on the bottom flange on each side of the cabinet for connection of AC neutral wires and chassis ground. Attach a flexible ground strap between the left side ground buss bar and the left side bottom rear of the rack assembly. Wiring harnesses must be covered by a flexible non-metallic conduit. Panel wire size must be a minimum of No. 18 AWG unless otherwise specified.

676-2.3.14.2 Terminals: Terminal connections must be soldered or constructed using a calibrated ratchet type crimping tool. Wiring must be traceable and without entanglement.

676-2.4 Controller Cabinet Flashing Operation: When a non-emergency flashing operation is required, the selected operation shall be performed by the UCF format. The following shall utilize UCF format:

a) Flash Switch located on the cabinet service panel
b) Time Base Coordination Flash
c) Time Switch

When flashing operation is initiated, the controller assembly shall transfer from normal operation to flashing operation only at the end of the common major street red interval, the common minor street yellow interval, or the all red interval.

UCF shall be an internal function of the controller unit and must not be inhibited by the hold command. External logic will not be allowed to provide this function.

In the event of an emergency when flashing operation is required, the controller assembly shall immediately place the intersection on flash. Emergency flash may be initiated by the following:

a) Auto/Flash Switch - A switch located on the cabinet police panel
b) Conflict-Voltage Monitor senses a conflicting indication or system error

The transfer of the controller assembly from flashing operation to normal operation shall cause the controller unit to revert to its start-up sequence unless the conflict-voltage monitor has transferred the controller assembly to flashing operation. If transferred to flashing operation by the conflict-voltage monitor, the controller assembly shall remain in flashing operation until the monitor unit is reset and automatic operation can be implemented through the normal start-up sequence.

676-2.5 Intelligent Transportation System Cabinets: The cabinet shell must conform to NEMA 3R requirements, be constructed of unpainted sheet aluminum alloy 5052-H32 with a minimum thickness of 0.125 inches and have a smooth, uniform natural aluminum finish without rivet holes, visible scratches or gouges on the outer surface. Other finishes are acceptable if approved.

The dimensions for cabinets are listed below.

Table 676-1

Cabinet Dimensions in Inches

Cabinet Type	Height	Width	Depth
340	66" - 68"	44" - 46"	26" - 28"
336	36" - 39"	24" - 26"	20' - 22"
336S	46" - 48"	24" - 26"	22" - 24"
334	66" - 68"	24" - 26"	30" - 32"
332D	66" - 68"	48" - 50"	30" - 32"
P44	55" - 59"	44" - 46"	26" - 29"

The cabinet must be weather resistant and constructed with a crowned top to prevent standing water. All exterior cabinet welds must be gas tungsten arc (TIG) welds and all interior cabinet welds must be gas metal arc (MIG) or TIG welds. All exterior cabinet and door seams must be continuously welded and smooth and all inside and outside edges of the cabinet must be free of burrs, rounded and smoothed for safety. All welds must be neatly formed and free of cracks, blow holes and other irregularities. Use ER5356 aluminum alloy bare welding electrodes conforming to AWS A5.10 requirements for welding on aluminum. Procedures, welders and welding operators must conform to AWS requirements as contained in AWS B3.0 and C5.6 for aluminum.

The cabinet must have a lifting eye plate on both sides of the top of the cabinet for lifting and positioning it. Each lifting eye must be secured with a minimum of two bolts to the cabinet body and have a lift point opening diameter of 0.75 inches and capable of supporting a weight load of 1,000 pounds. All external bolt heads must be tamperproof.

Ground-mount cabinets must include a removable base plate and two aluminum plates, welded inside, for anchoring the cabinet to a concrete or composite type base as shown in the Plans. Fabricate the plates from aluminum alloy 5052-H32 a minimum of 4 inches wide by 0.125 inches thick. Provide the cabinet with four 1 inch diameter holes for anchoring.

676-2.5.1 Doors: Provide cabinets with front and rear doors, each equipped with a lock and handle. Doors must be full size, matching the height and width dimensions of the

cabinet enclosure, with no fewer than three Type 4 or larger stainless steel hinges or; alternately, one full-length "piano" hinge. Hinges must be constructed of 14 gauge stainless steel with stainless steel hinge pins that are spot-welded at the top. Mount the hinges so that they cannot be removed from the door or cabinet without first opening the door. Brace the door and hinges to withstand 100 pounds per vertical foot of door height load applied to the outer edge of the door when standing open. Ensure there is no permanent deformation or impairment of any part of the door or cabinet body when the load is removed.

Door opening must provide a flange that allows the door gasket to mate with a flat surface. Include a gasket made of closed-cell material resistant to UV, weathering, elevated temperatures, and permanent deformation that is permanently bonded to the inside of each door forming a weather-tight seal when the door is closed.

676-2.5.2 Latches: Provide all cabinets with a three-point draw roller latching system for the doors. The latching system must have the following latching points.

1. Center of the cabinet (lock).
2. Top of the cabinet – controlled by the door handle.
3. Bottom of the cabinet – controlled by the door handle.

The latching points on the top and bottom of the cabinet must remain in the locked position until the main cabinet door lock is unlocked. The locking mechanism must be equipped with nylon rollers to secure the top and bottom of the door.

Provide the cabinet with a door stop that retains the main door open in a 90-degree and 120-degree position.

Outfit the doors with an industrial standard pin tumbler lock with No. 2 key, or an approved alternate, and hardware that allows the door to be secured using a padlock. Provide two keys for each cabinet lock.

676-2.5.3 Rails: Provide the cabinet with four cabinet rails that form a cage for mounting miscellaneous wiring panels and various mounting brackets. Use rails constructed of either 0.1345 inch thick plated steel or 0.105 inch thick stainless steel that extend the length of the cabinet's sides, starting from the bottom of the enclosure. Rails must be keyhole designed with slots 2 inches on center with a top opening of 5/8 inch in diameter to allow the insertion of a 5/8inch by 1 inch carriage bolt. Rails must be 1-1/2 to 2 inches wide by 1/2 inches deep, drilled and tapped for 10-32 screws or rack screws with EIA universal spacing. Do not use unistruts or other rail types.

676-2.5.4 Racks: The cabinet must include a standard 19 inch EIA/TIA equipment rack centered in the cabinet for mounting devices to be installed inside. Clearance in the rack between the rails must be 17-3/4 inches.

676-2.5.5 Shelf: Provide a level, rollout internal shelf with a minimum work area measuring 10 inches by 10 inches. The shelf must be capable of sustaining a constant 20 pound load and the shelf position must be adjustable.

676-2.5.6 Sunshield: Sunshields must be mounted with tamper resistant hardware to standoffs that provide an air gap of at least of one inch between the exterior cabinet walls and the sunshields. Sunshield standoffs located on the roof of the cabinet must be welded to the cabinet body. Construct sunshields of 0.125 inch thick 5052-H32 aluminum sheet with corners that are rounded and smoothed for safety.

676-2.5.7 Ventilation: Provide ventilation through the use of a louvered vent at the bottom of the door. Vent depth must not exceed 0.25 inch. Provide an air filter a minimum of

192 square inches and 1 inch thick behind the vent. The filter must be removable and held firmly in place so that all intake air is filtered.

Provide a bottom trough and a spring-loaded upper clamp to hold the filter in place. The bottom trough must drain any accumulated moisture to the outside of the field cabinet.

ITS field cabinets must have dual thermostatically controlled fans, with one thermostat per fan, rated for continuous duty with a service life of at least three years. Mount thermostats on the inside top of the cabinet. Thermostats must be user adjustable to allow temperature settings ranging from a minimum of 70°F to a maximum of 140°F and capable of activating the fans within plus or minus 5 degrees of the set temperature. Use UL listed exhaust fans having a minimum air flow rating of 100 cubic feet per minute. Electric fan motors must have ball or roller bearings. Vent the exhaust air from openings in the roof of the field cabinet.

676-2.5.8 Electrical Requirements: All equipment must conform to applicable UL, NEC, EIA, ASTM, ANSI, and IEEE requirements. SPD's must be accessible from the front of any panel used in the cabinet. Connect the SPD for the cabinet's main AC power input on the load side of the cabinet circuit breaker. All wiring must be laced. All conductors must be stranded copper.

676-2.5.8.1 Service Panel Assembly: Provide a service panel assembly to function as the entry point for AC power to the cabinet and the location for power filtering, transient suppression and equipment grounding. Provide branch circuits, SPDs, and grounding as required for the load served by the cabinet, including ventilation fans, internal lights, electrical receptacles, etc.

676-2.5.8.2 Terminal Blocks: Terminate electrical inputs and outputs on terminal blocks. The voltage and current rating of the terminal block must be greater than the voltage and current rating of the wire fastened to it.

Terminate conductors on terminal blocks using insulated terminal lugs large enough to accommodate the conductor to be terminated. When two or more conductors are terminated on field wiring terminal block screws, use a terminal ring lug for termination of those conductors. Number all terminal block circuits and cover the blocks with a clear insulating material to prevent inadvertent contact.

676-2.5.8.3 Ground Buss Bar: Fabricate ground buss bars of copper or aluminum alloy material compatible with copper wire and provide at least two positions where a No. 2 AWG stranded copper wire can be attached.

Mount the ground buss bar on the side of the cabinet wall adjacent to the service panel assembly for the connection of AC neutral wires and chassis ground wires. If more than one ground buss bar is used in a cabinet, use a minimum of a No. 10 AWG copper wire to interconnect them. Connect the equipment rack to the ground buss bar in the cabinet to maintain electrical continuity throughout the cabinet.

Follow the PANI recommendations of USDA-RUS-1751 for connections to the ground buss bar. Producer (P) or electrical power and sources of stroke current connections shall be on the left end of the buss bar. Absorbing (A) or grounding wires shall be connected immediately right of the P connections. Non-isolated (N) connections such as doors and vents shall be connected to the right of the A connections. Isolated (I) equipment grounds from equipment in the cabinet shall be connected on the right end of the buss bar.

676-2.5.8.4 Power Distribution Assembly: Furnish a power distribution assembly that fits in the EIA 19 inch rack and provides for protection and distribution of 120 V_{AC} power unless otherwise shown in the Plans.

676-2.5.8.5 Interior Lighting: Provide one or more light fixtures that illuminate the entire interior of the cabinet. All light fixtures must automatically turn on when the main cabinet door is opened and turn off when the door is closed.

676-2.5.9 Adapter Bracket: If shown in the plans, provide an adapter bracket for pole mounted cabinets that is slotted or otherwise designed to allow banding straps to be installed to avoid pole handholes.

676-2.6 Generator and Auxiliary Power Connection: Traffic signal controller cabinets must include a generator and auxiliary power connection. ITS cabinets must include a generator and auxiliary power connection unless otherwise shown in the Plans.

Cabinets with generator and auxiliary power connection must include provisions for the connection of an external power source, such as a portable generator, through a weatherproof, secure interface. This feature must allow authorized personnel to access, connect, and secure an external power source to the cabinet in order to restore power within five minutes of arrival time at the cabinet. A 10 gauge, 600V UL rated cable, fabricated with an L5-30R on one end and standard 120 V duplex plug on the other, a minimum of 12 feet in length or as shown in the Plans, must be supplied with cabinet assemblies for field connection between generator and cabinet. The generator access door and cable entrance must include means to prevent access to insects when cable is not present.

Provide the cabinet with an automatic transfer switch as shown in the Plans.

676-2.6.1 Automatic Transfer Switch: The transfer switch must meet UL 1008 and be rated equal to or higher than the design load of the cabinet's main breaker and the generator input twist-lock connector rating. The transfer switch must provide a means of switching between normal utility power and auxiliary backup generator power. Switching time cannot exceed 250 milliseconds. Ensure that the transfer switch does not allow simultaneous active power from more than one source and does not allow generator backflow into normal utility AC circuits.

676-2.6.2 Generator Access Panel: Include a generator connection panel consisting of, at a minimum, the automatic transfer switch with a three-prong, 30 amp L5-30P twist-lock connector with recessed male contacts for generator hookup, unless otherwise shown in the Plans. Locate the access panel as close as possible to the main AC circuit breaker with the bottom of the access panel no less than 24 inches above the bottom of the cabinet. Do not place the generator access panel on the main cabinet door or back door. Locate and label the transfer switch and twist lock connector on a panel easily accessible behind a weatherproof lockable exterior access door equipped with a tamper-resistant hinge. Label this access door "Generator Access Door". Provide the access door with a No. 2 lock unless otherwise specified in the Plans.

The access door and cable entrance must include means to prevent access to insects when cable is not present. The generator hookup compartment must be recessed no more than six inches into the cabinet but be deep enough to allow closing and locking of the access door when the generator cable is connected. Avoid blocking access to any other equipment in the cabinet.

676-2.7 Small Equipment Enclosures:

Small equipment enclosures must be a minimum NEMA 3R rated and smaller than 16 inches wide by 24 inches tall by 12 inches deep. The enclosure must be constructed of aluminum or

~~non-metallic materials. Enclosures must include a safe means of removing power from the installed equipment for servicing and replacement, such as a switch, fuse, or breaker. Discrete markings, such as manufacturer name and model, are permitted on the outside of small enclosures.~~

~~All fasteners less than 5/8 inch exposed to the elements must be Type 304 or 316 stainless steel.~~

~~Construct aluminum enclosures of 5052 sheet aluminum alloy with a minimum thickness of 0.090 inches. Aluminum enclosures must have a uniform natural finish or be powder coat painted in accordance with AAMA 2603-02 specifications. All welds, bends, and seams must be neatly formed and free of cracks, blow holes and other irregularities. All inside and outside edges of the enclosure must be free of burrs, rivet holes, visible scratches, and gouges and have a smooth, uniform finish.~~

~~Non-metallic enclosures must be UL 508A listed, be rated for outdoor use, and resist chemicals, corrosion, and ultraviolet rays.~~

~~Enclosure doors must include a vandal resistant hinge and be secured with a locking latch or a minimum of two quick-release Type 304 or 316 stainless steel latches with padlock hasps. Removal of the hinge or hinge pin must not be possible while the enclosure is closed. Provide two sets of keys with each lock.~~

~~Enclosures may be vented. Holes larger than 1/8 inches must be covered by heavy duty screen.~~

~~Post mounted enclosures must be supplied with mounting hardware for attaching the enclosure to a 4-1/2 inch (OD) aluminum post.~~

676-3 Installation Requirements.

676-3.1 General: Ground all cabinets in accordance with the requirements of Section 620. Keep the ground wire from the cabinet ground ~~bussbar~~busbar to the ground rod assembly or array as short as possible. Ensure the ground wire is not in contact with any other part of the cabinet. Controller cabinets shall be wired in accordance with the signal operating plan specified in the Contract Documents. If phases are omitted for future use, the cabinet must be wired for these future phases. However, the load switches for the future phases do not have to be furnished. All field drilled conduit entrance holes or other holes must be reamed and free of burrs. All conduit connections to ~~the~~ cabinets and small equipment enclosures must be weatherproof.

676-3.2 Traffic Signal Controller Cabinet Installation: Install traffic signal controller cabinets in accordance with Standard Plans, Index 676-010.

676-3.2.1 Pole Mounted Cabinets:

(a) Fasten the pole mounted hardware furnished with the cabinet to the cabinet using bolts no less than 1/2 inch threaded diameter. Ensure all connections are watertight.

(b) Use stainless steel bands for mounting cabinets onto steel strain poles.

(c) Use stainless steel bands or lead anchors (or equivalent) for mounting cabinets onto concrete strain poles.

(d) Use stainless steel bands or lag bolts for mounting cabinets onto wood poles.

676-3.2.2 Base Mounted Cabinets:

(a) Use anchor bolts to fasten base mounted cabinets to the concrete base.

(b) Seal the joint between the bottom of the cabinet and the concrete base (inside and outside of cabinet) with a clear silicone rubber sealant.

(c) Construct the base for the cabinets with concrete in accordance with Section 347. Make the concrete base for the cabinet level, free of honeycombs and as smooth as possible. Temporarily seal the end of conduit risers located in the base before placing the concrete. Position the end of the conduit risers a minimum of 2 inches above the finished surface of the concrete base.

676-3.2.3 Field Wiring:

(a) Terminate signal cable, interconnect cable, and loop lead-in wires on the appropriate terminal strips in the controller cabinet with insulated terminal lugs. Use a calibrated ratchet type crimping tool to install the insulated terminal lugs onto the field wires.

(b) Label spare circuits of the signal and interconnect cables and connect them to the cabinet ground bussbar.

(c) Neatly bundle and identify all field wiring cables in the controller cabinet.

676-3.3 Intelligent Transportation System Cabinet Installation: Mount the cabinet as shown in the Plans~~,~~ and provide the cabinet with the necessary base or pole mount hardware. Ensure that pole and structure-mounted field cabinets have mounting brackets on the side so that both cabinet doors are fully functional. Provide an adapter bracket for pole mounted cabinets that is designed to allow banding straps to be installed without ~~Mounting straps must not~~ obstructing pole handholes.

Make provisions for all ~~telephone,~~ data, control, and confirmation connections between the ITS device and field cabinet and for any required wiring harnesses and connectors.

Place a heavy-duty resealable plastic bag on the backside of the main cabinet door for storing a list of terminal block connections and other cabinet documentation.

Place all equipment in the cabinet according to the recommendations of the manufacturer. Maintain a minimum clearance of 6 inches between the top of the cabinet and the top of any equipment placed on the top shelf of the cabinet and a minimum clearance of 2 inches between each side of the cabinet and any equipment placed on the cabinet shelves.

Construct a maintenance service slab as shown in Standard Plan 676-010 or as shown in the Plans. Construct the maintenance service slab with concrete in accordance with Section 347.

676-3.4 Small Enclosure Installation: Mount the enclosure on a pole or support structure as shown in the Plans~~,~~ and provide any hardware necessary for a complete and accepted installation.

676-4 Warranty.

Ensure ~~traffic~~ cabinets and enclosures have a manufacturer's warranty covering defects for a minimum of two years from the date of final acceptance in accordance with 5-11 and Section 608. The warranty must include providing replacements, within 10 calendar days of notification, for defective parts and equipment during the warranty period at no cost to the Department or maintaining agency.

676-5 Method of Measurement.

The Contract unit price each for ~~traffic~~ cabinet or enclosure, furnished and installed, will include all materials specified in the Contract Documents, and all labor, equipment, and miscellaneous materials necessary for a complete and acceptable installation.

No separate payment will be made for a traffic signal controller cabinet when included with the controller assembly as per Section 670.

676-6 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 676- 1- Traffic Signal Controller Cabinet - each.

Item No. 676- 2- ITS Cabinet - each.

Item No. 676- 3- Small Equipment Enclosure - each.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 21, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **678**
Proposed Specification: **6780000 Traffic Controller Accessories.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to move all material requirements from Division II to Division III. The changes are associated with the proposed changes to Section 995.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

TRAFFIC CONTROLLER ACCESSORIES
(REV 7-20-22)

SECTION 678 is deleted and the following substituted:

678-1 Description.

Furnish and install traffic controller accessories as shown in the Plans. Meet the requirements of Section 603.

678-2 Materials.

~~Use traffic controller accessories listed on the Department's Approved Product List (APL). Ensure that all traffic controller accessories are permanently marked with the manufacturer's name or trademark, model or part number, and serial~~

~~Traffic controllers must meet the following applicable industry standards~~Meet the following requirements:

Conflict Monitor*	Section 995
Malfunction Management Unit*	Section 995
Power Supply*	Section 995
Load Switch*	Section 995
Flasher*	Section 995
Flash Transfer Relay	NEMA TS2-2021, Section 6.4
Model 206L Power Supply Unit*	Section 995
Model 208 Monitor Unit*	Section 995
Model 210 Monitor Unit*	Section 995
Power Distribution Assembly*	Section 995
Input File*	Section 995
Model 430 Flash Transfer Relay	CALTRANS TEES 2020, 6.4.5.1.5
Time Switch*	Section 995

*Use products listed on the Department's APL.

NEMA TS1 Conflict Voltage Monitor ..... NEMA TS-1-1989, Section 6
NEMA TS2 Malfunction Management Unit ..... NEMA TS-2-2016, Section 4
Power Switch ..... NEMA TS-2-2016, Section 5.3.5
Load Switch ..... NEMA TS-2-2016, Section 6.2
Flasher ..... NEMA TS-2-2016, Section 6.3
Flash Transfer Relay ..... NEMA TS-2-2016, Section 6.4
210 Conflict Monitor (Model 210) ..... CALTRANS TEES, 2009
Power Supply Module (Model 206) ..... CALTRANS TEES, 2009
Power Distribution Assembly ..... CALTRANS TEES, 2009 6.4.3
Flash Transfer Relay (Model 430) ..... CALTRANS TEES, 2009 6.4.5.1.5
Input File ..... CALTRANS TEES, 2009 6.4.4
Current Monitor (Model 208) ..... CALTRANS TEES, 2009 3.7.2

Ensure all traffic controllers perform all specified functions during and after being subjected to the environmental testing procedures described in NEMA TS-2, Sections 2.2.7, 2.2.8, and 2.2.9.

678-2.1 Time Switch: Ensure the time switch is a 24-hour timer which controls the daily switching operation of circuit contacts at preselected times.

Type 1 time switches must contain a single circuit contact and a solid state timer with at least 48 programmable on and off times.

Type 2 time switches must contain two circuit contacts and a solid state timer with at least three independently programmable on and off times per circuit.

Type 3 time switches must contain three circuit contacts and a solid state timer with at least three independently programmable on and off times per circuit.

678-2.1.1 Timing: Solid state timing must be accomplished by digital circuits utilizing the power line 60 Hz frequency as the normal timing reference or GPS Time Sync. Time-of-day must be settable and displayed in maximum increments of one minute.

678-2.1.2 Programming: Programming for selection of contact openings or closures must be provided in maximum increments of one minute for Types 1 through 3 time switches.

A day omit device or circuit must be provided with Types 1 through 3 time switches to omit the programmed switching operation for any combination of up to three days of the week. A positive means of indicating the day of the week must be provided with Types 1 through 3 time switches.

678-2.1.3 Reserve Power: Type 1, Type 2, and Type 3 solid state time switches must be provided with a battery backup circuit which maintains time during a power failure of up to 10 hours. The timing accuracy of battery backup circuits during a power failure must be plus or minus 0.5 seconds.

~~**678-2.1.4 Output Circuit Contacts:** Each output circuit contact must be rated for a 3A, 115 V_{AC} load. The output circuit contact must have 115 V_{AC} present when the timer turns the circuit on.~~

~~**678-2.1.5 Construction Requirements:** Time switches must be enclosed in durable sheet aluminum or approved alternate housing. A terminal strip or screws must be provided with the time switch for AC power and all output circuit contacts.~~

678-3 Installation Requirements.

678.3.1 General: Install all ~~system control equipment~~traffic controller accessories in accordance with the manufacturer's recommendations. Terminate wires on the appropriate terminal strips in the controller cabinet with insulated terminal lugs. Neatly bundle, secure, and identify all wiring and cables.

678-3.2 Time Switch: Mount time switches on the inside wall of the controller cabinet ~~in such a manner as~~ to allow easy access for programming the switch. Ensure that the load current on the output circuits of the time switch does not exceed 3 A at 115 $V_{AC.}$ Whenever time switches are used for transferring a controller assembly to and from flashing operation, wire the controller cabinet for uniform code flashing as specified in Section 676.

678-4 Basis of Payment.

No separate payment will be made for traffic controller accessories. Include the cost in the Contract unit price for the traffic controller assembly.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 21, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **680**
Proposed Specification: **6800000 System Control Equipment.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to move all materials requirements from Division II to Division III. This change is associated with the proposed changes to Section 995.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

SYSTEM CONTROL EQUIPMENT
(REV 7-21-22)

SECTION 680 is deleted and the following substituted:

680-1 Description.

Furnish and install system control equipment as shown in the Plans. Meet the requirements of Section 603.

680-2 Materials.

680-2.1 General: Use system control equipment and components ~~that meet the requirements of these Specifications and are~~ listed on the Department's Approved Product List (APL).

~~**680-2.2 Adaptive Signal Control System:** Adaptive signal control systems external to the traffic controller place detector calls to the traffic signal controller to adjust signalization timing based on measured traffic conditions independently of the traffic signal controller's preconfigured timings.~~

~~The system must interface with the traffic controller using either the Synchronous Data Link Control (SDLC) Port 1 interface and protocol or 24 V_{DC} inputs/outputs available in the traffic controller cabinet. Dynamically modifying controller configuration settings through serial communications is not allowed.~~

~~The system must include a user interface that allows the configuration of subcomponents, such as detectors and cameras, and includes remote monitoring and reporting.~~

~~The system must include the option of incorporating existing vehicle detection in addition to the primary detection used by the adaptive signal control system.~~

~~The system must not affect the normal operation of the traffic signal controller upon any failure of communication, detection, or system component.~~

~~Ensure adaptive signal control system hardware is permanently marked with manufacturer name or trademark as well as part number and serial number. Ensure that the markings are visible after installation.~~

~~**680-2.3 Environmental Requirements:** Ensure system control equipment performs all required functions during and after being subjected to the transients, temperature, voltage, humidity, vibration, and shock tests described in NEMA TS2, 2.2.7, 2.2.8, and 2.2.9.~~

680-3 Installation Requirements.

Install all system control equipment in accordance with the manufacturer's recommendations. Terminate wires on the appropriate terminal strips in the controller cabinet with insulated terminal lugs. Neatly bundle, secure, and identify all wiring and cables.

680-4 Warranty.

Ensure system control equipment has a manufacturer's warranty covering defects for a minimum of three years. The warranty must include provisions for providing replacements within 10 calendar days of notification for defective parts and equipment during the warranty period at no cost to the Department or the maintaining agency.

680-5 Method of Measurement.

The Contract unit price for system control equipment, furnished and installed, will include all materials, equipment, hardware labor and miscellaneous materials necessary for a complete and accepted installation.

680-6 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 680- 1 System Control Equipment - each.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 24, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **685**
Proposed Specification: **REVISED 6850000 Traffic Control System Auxiliaries.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to move all material requirements from Division II to Division III. This change is associated with the proposed changes to Section 996.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

TRAFFIC CONTROL SYSTEM AUXILIARIES
(REV 10~~7~~-24~~21~~-22)

SECTION 685 is deleted and the following substituted:

685-1 Description.

Furnish and install traffic control system auxiliaries as shown in the Plans.

685-2 Materials.

685-2.1: General: Use traffic control system auxiliaries listed on the Department's Approved Product List (APL). ~~Equipment must be permanently marked with the manufacturer's name or trademark, model/part number and serial number or date of manufacture.~~

685-2.2 Uninterruptible Power Supply (UPS): Use a line interactive or online/double-conversion UPS as shown in the Plans. UPS assemblies must be designed for installation in a roadside NEMA 3R enclosure to provide battery backup functionality for traffic control systems, including traffic signal and intelligent transportation system (ITS) devices. UPS assemblies must include batteries provided by the UPS manufacturer or in accordance with manufacturer's requirements. Batteries must be sealed and require no maintenance, cause no corrosion, and be capable of maintaining 80% of original capacity and performance for a minimum of five years.

Loss of utility power, transfer from utility power to battery power, and transfer back to utility power must not interfere with normal operation of connected equipment. In the event of UPS failure or battery depletion, connected equipment must be energized automatically upon restoration of utility power.

~~The UPS must operate in hot standby mode with power transfer being accomplished in 40 milliseconds or less.~~

Removal and replacement of the UPS must not disrupt the operation of the equipment being protected.

All harnesses necessary to connect and operate the system must be included. ~~All connectors must be keyed to prevent improper connection.~~

~~**685-2.2.1 Configuration and Management:** Provide a UPS that supports local and remote configuration and management, including access to all user-programmable features as well as alarm monitoring, event logging, and diagnostic utilities.~~

~~Configuration and management functions must be password protected.~~

~~Alarm function monitoring must include the following: loss of utility power, inverter failure, low battery, and temperature out of range. The UPS must include an event log that indicates the date and time of the following events: AC high, AC low, AC frequency error, AC fail/blackout, and over temperature. The UPS event log must be able to store a minimum of 60 events.~~

~~The UPS must include a front panel display and controls that allows programming of configurable parameters, features, and functions without the need for another input device. The UPS must have visual indications for Power On, Mode of Operation (utility power or inverter), Battery Status, Alarm Status, Load Levels, and AC Output Voltage.~~

~~**685-2.2.2 Communication Interfaces:** Provide an Ethernet port (RJ45) for local control using a laptop PC and remote control via a network connection.~~

~~**685-2.2.3 Batteries:** Use only batteries or other technologies recommended by the manufacturer. Batteries must be sealed and require no maintenance, cause no corrosion, and~~

~~be capable of maintaining 80% of original capacity and performance for a minimum of five years.~~

~~The UPS must be supplied with a wiring harness for battery connections. The battery wiring harness must allow 6 feet of separation between the UPS and its battery bank. Battery terminals must include a protective covering to prevent accidental spark or shorting.~~

~~The UPS must include battery management functions that includes active or equalized balancing; monitoring of temperature, voltage, and amperage of charge and discharge; and temperature compensated automatic charging to maximize the life of the batteries.~~

685-2.2.14 Electrical: UPS assemblies used to provide backup power in an ITS cabinet must provide a minimum of 350 watts (at 120 V_{AC}) of continuous backup power for a minimum of two hours unless otherwise shown in the Plans.

UPS assemblies used to provide backup power in a traffic signal controller cabinet must provide a minimum 400 watts (at 120 V_{AC}) of continuous power for a minimum of 6.5 hours unless otherwise shown in the Plans.

~~Frequency must be regulated to 60 Hz, plus or minus 0.5 Hz, while the UPS is supplying power. The UPS must operate on 85 to 140 V_{AC} without requiring assistance from the batteries.~~

~~The UPS must be listed to the requirements of UL 1778. Upstream back feed voltage from the UPS must be less than 1 V_{AC}.~~

~~Double-conversion UPS must be capable of simultaneously producing fully regenerated and regulated, conditioned, True Sine Wave power and hot standby AC output, and have a minimum operating efficiency of 90%.~~

685-2.2.25 Traffic Signal UPS Cabinet: Cabinets used to house traffic signal UPS assemblies must be designed to be mounted to the side of a traffic cabinet or base mounted. Cabinets must meet the requirements of Section 676 and must include shelves and rack rails to house all UPS system components including the UPS, batteries, harnesses, switches, surge protective device, power terminal block and a generator hookup with transfer switch. The UPS cabinet must allow a maintenance technician to safely insert power for traffic signal operation while the UPS or associated equipment is serviced or replaced.

A surge protective device must be installed where the supply circuit enters the cabinet in accordance with 620-2.7.1.

~~The cabinet must include a 20 A, 120 volt, 60 Hz GFCI receptacle. The receptacle must be wired to utility power and not regulated by the UPS module. The cabinet must include a main breaker and a breaker for the technician GFCI outlet.~~

685-2.2.25.1 Transfer Switch and Generator Access Panel: The cabinet must include an automatic transfer switch and generator access panel in accordance with Section 676. The generator access door must not protrude more than 1 inch when closed.

~~**685-2.2.6 Mechanical:** All parts must be made of corrosion-resistant materials such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements must be Type 304 or 316 passivated stainless steel.~~

~~**685-2.2.7 Environmental:** UPS assemblies, including batteries, must provide continuous power with specified wattage and operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8, and 2.2.9.~~

685-2.3 Remote Power Management Unit (RPMU): Use a RPMU as shown in the Plans. The RPMU must be designed for installation in a roadside Traffic Cabinet to provide remote control of electrical receptacles.

~~**685-2.3.1 Configuration and Management:** Provide a RPMU that supports local and remote configuration and management, including access to all user-programmable features as well as alarm monitoring, event logging, and diagnostic utilities.~~

~~Configuration and management functions must be password protected.~~

~~The RPMU must include an event scheduler that can store a minimum of 60 events.~~

~~The RPMU must include LED indicators for relay inputs and outlet status.~~

~~Upon loss of communications the RPMU must maintain each receptacle and relay in its currently stored state of operation.~~

~~Upon restoration of electrical power after an outage the RPMU automatically restores each receptacle and relay to its previously stored state of operation and all configurable parameters are retained.~~

~~The unit must support SNMP v2c, including trap notifications of receptacle state changes.~~

~~**685-2.3.2 Communication Interfaces:** Provide an Ethernet port (RJ45) for local control using a laptop PC and remote control via a network connection.~~

~~**685-2.3.3 Electrical:** Provide a minimum of 4 NEMA 5-15R receptacles, nominal 120 V_{AC}. Provide a minimum current capacity of 12 amperes (amps).~~

~~**685-2.3.4 Mechanical:** All parts must be made of corrosion-resistant materials such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements must be Type 304 or 316 passivated stainless steel.~~

~~**685-2.3.5 Environmental:** Operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 2 2016, Sections 2.2.7, 2.2.8, and 2.2.9.~~

685-3 Installation.

Install UPS assemblies in accordance with the manufacturer's recommendations. All equipment used to keep the intersection signalized must be backed up and protected by the UPS. Include a UPS operation and maintenance manual in the cabinet where the UPS is installed that includes cabinet wiring schematics, electrical interconnection drawings, parts layout and parts lists.

Install the RPMU in accordance with the manufacturer's recommendations. Include a RPMU operation and maintenance manual in the cabinet where the RPMU is installed that includes cabinet wiring schematics, electrical interconnection drawings, parts layout and parts lists.

685-4 Testing.

Provide a field acceptance test plan to the Engineer for approval at least 14 days prior to commencement of testing. After approval of the acceptance test plan, perform testing of the installed UPS and RPMU equipment. Furnish all equipment, software, and supplies necessary for conducting the test.

685-5 Warranty.

Ensure the UPS includes a manufacturer's warranty covering defects for a minimum of three years (5 years for the ~~external~~ batteries in accordance with 685-2.2.~~3~~) from the date of final acceptance in accordance with 5-11 and Section 608. The warranty must include provisions for providing a replacement UPS within 10 calendar days of notification for any UPS found to be defective during the warranty period at no cost to the FDOT or the maintaining agency.

Ensure the RPMU includes a manufacturer's warranty covering defects for a minimum of three years from the date of final acceptance in accordance with 5-11 and Section 608.

685-6 Method of Measurement.

The Contract unit price for each UPS or RPMU, will include furnishing, placement, and testing of all equipment and materials as specified in the Contract Documents, and all tools, labor, operational software packages and firmware, supplies, support, documentation (including the field acceptance test plan), and incidentals necessary for a complete and accepted installation.

685-7 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 685- 1-	Uninterruptible Power Supply - each
Item No. 685- 2-	Remote Power Management Unit - each

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **700**
Proposed Specification: **7000000 Highway Signing.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Derek Vollmer and Rick Jenkins, including a team from the State Traffic Operations Office, State Roadway Design Office, and State Program Management Office to move materials/manufacturer requirements from Section 700. Separating the manufacturer's requirements from the Contractor's requirement will help with the review of APL product submittals, field installations, inspections, and acceptance criteria.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

HIGHWAY SIGNING.
(REV ~~6-20~~ ~~8-17~~-22)

SECTION 700 is deleted and the following substituted:

700-1 ~~General Requirements~~Description.

~~700-1.1 Description:~~ Furnish and ~~erect~~install roadway signs ~~at the locations, and~~ in accordance with the details in the Standard Plans ~~,~~ and as shown in the Plans.

~~The Department designates~~Erect ground traffic signs as signs ~~erected~~ on the shoulders, slopes, or medians~~., but not extending over the traveled roadway, and may further classify these~~ ~~s~~Signs are classified as single column(post)~~, or~~ multi-column, or In-Street signs.

~~The Department designates~~Erect overhead traffic signs ~~erected~~ partially or completely over the traveled roadway or mounted on bridges. ~~as o~~Overhead traffic signs~~, and may further~~ are classi~~fy~~fied ~~these signs~~ as span wire mounted, mast arm mounted, overhead cantilever structure, or overhead span structure traffic signs.

The sign face(s) may be a single or combination of static sign panels, illuminated sign panels, dynamic message signs, or electronic display signs.

Fabricate standard sign panel messages in accordance with details included in the Standard Highway Signs (SHS) manual published by the U.S. Department of Transportation, the Plans, or Standard Plans. Submit shop drawings to the Department for approval, as specified in Section 5.

All Traffic Control Signals and Devices must ~~M~~meet the requirements of Section 603.

700-~~1.~~2 Materials.~~:~~

700-2.1 General Requirements: Meet the following requirements:

Flowable Fill for precast foundation	Section 121
Structural Concrete	Section 346
Non-Structural Concrete	Section 347
Reinforcing Steel	Section 415
Structural Steel Welding	Section 460
Repair of Galvanized Surfaces	Section 562
Transformer Base	Section 965
Structural Steel and Miscellaneous Metal Items (other than aluminum)	Section 962
Aluminum Items	Section 965
Retroreflective Sign Sheeting*	Section 994
Sign Panel Fabrication	Section 994
Internally Illuminated Signs*	Section 995-14
Highlighted Signs*	Section 995-15
Dynamic Message Signs*	Section 995-16
Electronic Display Signs (ERS, ESFS, BOS)*	Section 995-17
Sign Beacon*	Section 995-18
In-street Sign*	Section 995-19

*Use products listed on the Department's Approved Products List (APL).

~~**700-1.2.1 General:** Meet the materials requirements shown in the Specifications, Standard Plans, and any additional requirements identified in the Plans.~~

~~**700-1.2.2 Concrete:** Use concrete meeting the requirements of Section 346. Obtain concrete from a plant that is listed on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105.~~

700-~~1~~2.2~~2.3~~ Static Sign Assembly Requirements: ~~See 700-7 for In-Street sign requirements. Sheets and plates for sign panels shall meet the requirements of ASTM B209, Aluminum Association Alloy 6061-T6, 5154-H38 or 5052-H38. Sign panels for single column ground mounted signs shall utilize aluminum plate with a minimum thickness of 0.08 inch. All other sign panels shall utilize aluminum plate with a minimum thickness of 0.125 inch. All panels shall have rounded corners. For flip up signs, the continuous hinge shall be stainless steel ANSI grade 316.~~

700-2.2.1 Static Sign Panels: Provide aluminum sheets for sign panels meeting the requirements of Section 965 and Section 994. Meet the minimum thickness requirements of Table 700-1.

For flip signs, use continuous hinges constructed of ANSI grade 316 stainless steel.

For In-Street signs, see 700-7.

Table 700-1 Static Sign Panel Requirements	
Type	Minimum Thickness
Single column ground sign	0.08 inch
All other sign panels	0.125 inch

700-2.2.2 Sign Panel Mounting Hardware: Provide aluminum materials (plates, bars, shapes, bolts, nuts, and washers) in accordance with Section 965. Stainless steel mounting hardware meeting Table 962-6 (ASTM F593 for bolts and ASTM F594 for nuts) may be substituted. Steel plates, shapes and hardware must meet Section 962.

700-~~1.~~2.~~4~~2.3 Retroreflective Sign Sheeting: Sign sheeting must meet the~~Use signs that meet the material and process~~ requirements of Section 994 and Table 700-2.

Table 700-2 Retroreflective Sign Sheeting		
Application	Sheeting System Type	Notes
All signs and retroreflective strips, except as otherwise noted below	Type XI	
R1-1, R1-2, R5-1, and R5-1a signs	Type XI with a colorless film overlay	
School: S1-1, S3-1, S3-2, S4-5, S4-5a, S5-1 (SCHOOL portion) Bicycle: W11-1 Pedestrian: R1 6, R1 6a, R1 6b, R1 6c, R1 9, R1 9a, R10 15, W11 2 Shared Use Path (trail): W11 15, W11 15a	Type XI fluorescent yellow green sheeting*	Includes supplemental panels

*Do not mix signs having fluorescent yellow green sheeting with signs having yellow retroreflective sheeting.

~~Use Type XI sheeting for all signs and retroreflective strips on signs unless otherwise specified. The R1-1, R1-2, R5-1 and R5-1a signs must use a sheeting system that includes a colorless film overlay.~~

~~Use fluorescent yellow-green sheeting for the following signs:~~
~~1. school: S1-1, S3-1, S3-2, S4-5, S4-5a, S5-1 (SCHOOL portion),~~
~~2. bicycle: W11-1,~~
~~3. pedestrian: R1-6, R1-6a, R1-6b, R1-6c, R1-9, R1-9a, R10-15, W11-2,~~
~~4. shared use path (trail): W11-15, W11-15a,~~
~~5. supplemental panels used with signs in (1) through (4), above.~~
~~Do not mix signs having fluorescent yellow-green sheeting with signs having yellow retroreflective sheeting.~~
~~Use Type VI sheeting for Roll-up signs.~~

700-2.3 Galvanized Bolt Assemblies (Bolts, Nuts, Washers): Provide galvanized bolt assemblies meeting Section 962 for high-strength steel fastener assemblies. Provide galvanized anchor rods, plate washers, U-bolts, and shims meeting the requirements of Section 962 for hardware not designated as high strength.

700-2.4 Sign Support Structure:

700-2.4.1 Single Column Ground Signs and Single Post Barrier Mounted Signs: Use aluminum tubing meeting the requirements of Section 965. For top-mounted single post barrier mounted signs use galvanized steel pipe meeting the requirements of Section 962. Steel shapes and welding must meet 962-10.

700-2.4.2 Multi-Column Ground Signs: Multi-column signs must be galvanized steel W or S beams steel columns meeting Section 962.

700-~~1~~2.4.3 ~~Sign Fabrication Requirement~~Overhead Signs: Obtain overhead sign structures from a facility that is listed on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section~~-~~ 105.

Meet the requirements for overhead signs in accordance with Section 962.

Repair galvanized surfaces in accordance with Section 562. Galvanizing materials used for repair must meet the requirements of Section 975.

700-2.4.4 Enhanced Highway Sign Assemblies: Use aluminum pedestal posts, transformer bases, anchors, caps, and shims meeting the requirements of Section 646.

700-~~1~~2.~~4~~5 Storage, Handling and Labeling: If signs are stored prior to installation, store them in accordance with the manufacturer's recommendations. Properly package signs to protect them during storage, shipment and handling to prevent damage to the sign face and panel.

~~In addition to the information required in Section 994,~~Install a label on all permanent roadway signs ~~must be labeled~~ on the back bottom edge with the date of installation~~.~~, APL number of the base sheeting, and Name of Fabricator. Make the labels unobtrusive, but legible enough to be easily read by an observer on the ground when the sign is in its final position. Apply the label in a manner that is at least as durable as the sign face.

700-~~1~~2.~~5~~6 Acceptance of Signs:

700-~~1~~2.~~5~~6.1 Sign Inspection: Submit certification that the sign assembly meets the material and installation requirements of the Contract Documents. The Engineer will inspect the signs upon delivery to the storage or project site and again at the final construction

inspection. Repair and replace damaged signs ~~deemed unacceptable by the Engineer~~ at no expense to the Department.

700-~~1~~2.~~5~~6.2 Imperfections and Repairs: Repair or replace signs containing imperfections or damage regardless of the kind, type, or cause of the imperfections or damage. For sign panels exceeding 30 square feet, the Contractor may make one patch, if necessary, to each sign panel not to exceed two square inches. Make repairs according to the manufacturer's recommendations ~~and to the satisfaction of the Engineer~~. Ensure that completed repairs provide a level of quality necessary to maintain the service life of the sign and are satisfactory in appearance to the Engineer.

700-~~2~~3 Static Signs.

700-~~2~~3.1 Single Column and Multi-Column Ground Sign Assemblies~~Ground Mounted Signs~~: ~~Ground mounted signs consist of both single column and multi-column static signs~~ Furnish and install single column and multi-column ground signs in accordance with the Plans and Standard Plans, Indexes 700-010, 700-011, and 700-020.

~~**700-2.1.1 Materials:** Use aluminum tubing materials meeting the general provisions of Section 965 for all single column ground signs. Multi-column signs must be galvanized steel W or S beams steel columns meeting the general provisions of Section 962. All materials must meet the requirements of the appropriate Standard Plans.~~

~~**700-2.1.2 Fabrication of Panel Messages:** Fabricate standard sign panel messages in accordance with details included in the Standard Highway Signs (SHS) manual published by the U.S. Department of Transportation. Submit shop drawings to the Department for approval as specified in Section 5.~~

700-~~2~~3.1.~~3~~1 Foundation: Construct foundations in accordance with the applicable Standard Plans. The Contractor may use precast foundations in augured or excavated holes a minimum of 12 inches larger than each axis dimension of the precast foundation. Obtain precast foundations from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105.The holes must be clean and without loose material. Temporary casing will be required if the soil is unstable. Fill the void around the precast foundation with flowable fill meeting the requirements of Section 121 or use clean sand placed using hydraulic methods.

700-~~2~~3.1.~~4~~2 Breakaway Support Mechanisms for Ground Traffic Signs:

700-~~2~~3.1.~~4~~2.1 Frangible Supports: Provide support posts for all frangible sign assemblies consisting of aluminum tubes up to 3-1/2 inches outside diameter with 3/16-inch wall thickness in accordance with the requirements in the Standard Plans.

700-~~2~~3.1.~~4~~2.2 Slip Bases: Slip base assemblies for single column signs will use aluminum sleeves and base plates. The slip base stub (the lower base plate assembly) may be galvanized steel in accordance with the Standard Plans.

Slip base assemblies for multi-column signs will use galvanized steel bases. All slip bases must be fabricated in accordance with the requirements of the Standard Plans.

700-3.1.3 Fabrication: Fabricate the supports and wind beams in accordance with the Standard Plans. Weld joints in accordance with Section 460.

Drill or sub-punch and ream holes in multi-column fuse plates and hinge plates.

Hot dip galvanize after fabrication. Remove all drips, runs or beads on base plate within washer contact areas (including saw cuts).

700-~~2~~3.1.~~5~~4 Installation: Verify the length of the column supports in the field prior to fabrication to permit the appropriate sign mounting height. ~~Fabricate the supports and wind beams in accordance with the Standard Plans.~~ Columns must be plumb and panels must be level with the proper orientation.

700-~~2~~3.1.~~6~~5 Retroreflective Strips for Signs: Use only on signs where the retroreflective strip is called for in the Plans. The retroreflective strip must be 2 inches in width and 5 feet in height for all signs, except for signs mounted at a height of 4 feet, then use a retroreflective strip 2 feet in height. For the back of Railroad Crossbuck signs, the retroreflective strip will be 2 inches wide for the full length of the blade. Match the color of the retroreflective strip to the background color of the sign (per the SHS), except for YIELD signs and DO NOT ENTER signs, where the color must be red. Install retroreflective strips directly to a panel attached to the column in accordance with the manufacturer's instructions. ~~If a panel is required to install the retroreflective sheeting, u~~Use a 0.040-inch minimum aluminum plate or other material approved by the sheeting manufacturer. Use stainless steel attachment hardware for the installation. Install retroreflective strips in a manner that does not require drilling holes through the column (post). A set screw no larger than 1/4 inch may be used with band attachments. ~~The retroreflective strip panel and sheeting must be 2 inches in width and 5 feet in height for all signs, except for signs mounted at a height of 4 feet, then use a retroreflective strip 2 feet in height. For the back of Railroad Crossbuck signs, the retroreflective strip will be 2 inches wide for the full length of the blade. Match the color of the retroreflective sheeting to the background color of the sign except for YIELD signs and DO NOT ENTER signs, where the color must be red.~~

700-~~2~~3.1.~~7~~6 Flip ~~up~~ Signs: Install in accordance with the Plans and Standard Plans Index 700-010.

700-3.2 Single Post Barrier Mounted Signs: Meet the requirements of the Standard Plans, Indexes 700-012 and 700-013. Snap-in post cap is UV and weather-resistant glass-filled polyester cap.

700-~~2~~3.~~2~~3 Overhead Signs: Meet the requirements of the Plans and Standard Plans for overhead sign structures, including those for walk-in dynamic message signs (DMS).

700-3.3.1 Fabrication: Weld joints in accordance with Section 460.

Structural bolt hole diameters: Bolt diameter plus 1/16 inch.

Anchor bolt hole diameters: Bolt diameter plus 1/2 inch.

Upright splices are not allowed. Sign trusses may be fabricated in sections that fit into available galvanizing vats. Provide magnetic particle testing on 100% of upright fillet welds after galvanizing.

Shop assemble the entire structure after galvanizing to validate proper fit for all bolted connections. Complete necessary repairs prior to shipping. Assemblies may be separated for shipment.

~~**700-2.2.1 Materials:**~~

~~**700-2.2.1.1 General:** Obtain reinforcing steel, overhead sign structures from a fabrication facility that is listed on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105.~~

~~Hot-Dip galvanize structural steel, including bolts, nuts, and washers in accordance with Section 962.~~

~~Repair galvanized surfaces in accordance with Section 562. Galvanizing materials used for repair must meet the requirements of Section 975.~~

~~700-2.2.1.2 Reinforcing Steel: Use reinforcing steel in footings meeting the requirements of Section 415.~~

~~700-2.2.1.3 Specific Uses of Aluminum and Galvanized Steel: Use aluminum bolts, nuts, and hardware to connect parts of the cast base.~~

~~Use galvanized steel anchor bolts for anchoring base plates to concrete bases and for the nuts and washers.~~

~~For all other metal parts of the cast base, the Engineer will allow galvanized steel as an alternative to aluminum.~~

700-~~2~~3.~~2~~3.2 Foundations: Meet the requirements of Section 455. Use Class IV concrete for spread footings and IV (Drilled Shaft) for drilled shaft foundations.

700-~~2~~3.~~2~~3.3 Installation: Install nuts on anchor bolts in accordance with Section 649 with the following exception. For cantilever overhead sign structures, after placement of the upright and prior to installation of the truss, adjust the leveling nuts beneath the base plate to achieve the back rake shown on the Camber Diagram. If the top surface of the base plate has a slope that exceeds 1:40, use beveled washers under the top nuts. Split-lock washers are not permitted.~~For span overhead sign structures, install a screen around the base plate in accordance with 649-6. For cantilever overhead sign structures, install a structural grout pad in accordance with 649-7~~

Install screens or grout pads in accordance with the Standard Plans, and as required by Section 649.

Install ASTM F3125, Grade A325 bolt, nut and washer assemblies in accordance with 460-5, except that 460-5.4.2 Preparation of Faying Surfaces is not required.

700-~~2~~3.~~2~~3.4 Erection of Signs and Sign Supports: Do not erect overhead sign supports until the concrete strength in the support footing is at least 2,500 psi. Determine concrete strength from tests on a minimum of two test cylinders sampled and tested in accordance with ASTM C31 and ASTM C39 and verifying test results have been submitted to the Engineer.

Erect the signs and sign structures in accordance with the details shown in the Plans. ~~The Contractor may fabricate the structural steel sign trusses in sections that will fit into available galvanizing vats. Prior to galvanizing, weld the joints as specified in Section 460 and in accordance with the details shown in the Plans.~~ Re-galvanize damaged parts as specified in Section 562. Record the as-built anchor locations and submit to the Engineer prior to erecting the sign supports. Place backfill above spread footings prior to installation of the sign panels. Do not remove or reduce backfill without prior approval of the Engineer.

~~Weld aluminum structures in accordance with Section 965.~~

~~Attach electronic display signs to the supporting structure in accordance with the manufacturer's recommendations using the mounting hardware provided by the manufacturer.~~ ~~700-2.2.5 Shop Drawings: Submit shop drawings to the Department for approval as specified in Section 5. Prior to the submittal of the shop drawings, determine the actual in-place dimensions for all sign structures on the basis of existing field conditions and include these on the shop drawings.~~

~~700-2.3 Method of Measurement: For single post and multi post sign assemblies, an assembly consists of all the signs mounted on a single structure. The Contract unit price per assembly for ground mounted signs (single post and multi-post), furnished and installed, will include furnishing the sign panels, support structure, foundation, hardware, and labor necessary for a complete and accepted installation.~~

~~The retroreflective sign strip will be paid for separately, and the Contract unit price per each will include furnishing the retroreflective sign strip, hardware and labor necessary for a complete and accepted installation.~~

~~For overhead signs, sign panels will be paid separately from support structures. The Contract unit price per each for sign panel, furnished and installed, will include furnishing the sign panels, hardware, and labor necessary for a complete and accepted installation. The Contract unit price for each overhead static sign structure, furnished and installed, will include furnishing the support structure, foundation, hardware, and labor necessary for a complete and accepted installation.~~

~~For the removal of overhead static sign structures, the quantity to be paid for will be the number of overhead static sign structures, including the foundation, to be removed.~~

~~When partial foundation removal is called for, remove the support structure, and foundation to a minimum depth of four feet below existing grade.~~

~~When complete foundation removal is called for, completely remove the support structure including the foundation.~~

~~Relocation of signs will consist of removing the existing sign assembly and installing the sign on a new foundation at the location shown in the Plans.~~

~~When the Plans call for existing ground-mounted signs to be relocated or removed, after removing the sign panel from the assembly, remove supports and footings. Restore the area of the sign removal or relocation to the condition of the adjacent area.~~

~~**700-2.4 Basis of Payment:** Price and payment will be full compensation for all work specified in this Section.~~

~~Payment will be made under:~~

~~Item No. 700- 1- Single Post Sign, per Assembly.~~
~~Item No. 700- 2- Multi Post Sign, per Assembly.~~
~~Item No. 700- 3- Sign Panel, per Each.~~
~~Item No. 700- 4- Overhead Static Sign Structure , per each.~~
~~Item No. 700- 13- Retroreflective Sign Strip, per each.~~

700-4 Enhanced Highway Sign Assemblies.

700-4.1 Description: Furnish and install enhanced highway sign assemblies in accordance with the Plans and Standard Plans, Index 700-120.

700-4.2 Materials: Use flashing beacons, highlighted signs, electronic display signs (EDS), and associated mounting hardware that meet the requirements of Section 995 and are listed on the APL. EDS are specialized electronic signs that include dynamic display components. The term EDS refers to a general category of electronically enhanced road signs (ERS) with warning regulatory, or guide legends; electronic speed feedback signs (ESFS); and blank-out signs (BOS).

For new roadside sign assemblies, provide support structure in accordance with Section 646. Meet all static sign requirements for the static portion of the highlighted sign (i.e., sign panel, reflective sheeting, etc.).

700-4.2.1 Warranty: Ensure that beacons, highlighted signs, and EDS have a manufacturer's warranty covering defects for three years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

700-4.3 Foundations: Construct foundations in accordance with the Standard Plans and Specification 646.

700-4.4 Installation: Install sign assembles based on Alpha-Numeric Type designation shown in the Plans. Assembly Type is based on Power Configuration "Alpha" Identification and Numerical Identification shown in Standard Plans, Index 700-120. Install sign panel and wind beam meeting the requirements of this Section and Standard Plans, Index 700-110. For roadside sign assemblies, construct foundation and install support structure in accordance with 646-3 and the Standard Plans, Index 700-120. Install enhanced highway sign assembly components in accordance with the manufacturer's recommendations.

700-~~3~~5 Internally Illuminated Signs.

700-~~3~~5.1 Description: Furnish and install internally illuminated signs in accordance with the details specified in the Contract Documents.

700-~~3~~5.2 Materials: Use internally illuminated signs and associated mounting hardware listed on the Department's Approved Product List (APL).

~~Signs must be marked with the name or trademark of the manufacturer, the part number, and the date of manufacturer. Marking must be accomplished by permanently affixing an indelible label, identification plate, dot peen type stamp, casting, metal-marking, or other approved method. Markings must remain visible after installation.~~

~~**700-3.2.1 Internally Illuminated Signs:**~~

~~**700-3.2.1.1 General:** Signs must not exceed 9 feet in length or be larger than 18.0 square feet in area, and must not weigh more than 144 pounds. Provide an internally illuminated sign assembly listed to the requirements of UL48. Light emitting diode (LED) retrofit kits must be listed on the APL.~~

~~**700-3.2.1.2 Housing:** Ensure that the sign housing is constructed of continuous 5052 or 6063-T5 aluminum. All housing, corners, and door seams must be continuously welded. All exterior surfaces of the assembly must be powder-coat painted in accordance with Military Standard MIL-PRF-24712A or AAMA-2603-02. Finish must meet the requirements of ASTM D3359, ASTM D3363, and ASTM D522. Sign housings with any interior airspace must consist of a box type enclosure and separate hinged door assembly. The sign housing must include provisions to prevent water from entering the sign housing. Drain holes in the sign larger than 0.125 inch must be covered by a screen.~~

~~Signs must have removable sign faces. The sign assembly must have one face unless specified otherwise in the Plans. The sign face must be secured by a method that holds the sign face securely in place. Slide-in grooves are allowed to secure the sign face if the sign is edge lit.~~

~~The sign face must be a translucent lens constructed of 0.125 inch thick high impact strength polycarbonate or acrylic meeting UL48. Letters must be as detailed in the Contract Documents. Background must be translucent retroreflective sheeting coated with a transparent, pressure-sensitive adhesive film. Color must meet the criteria as detailed in Sections 994. Retroreflective sheeting must meet the requirements of Section 994, and be listed on the APL.~~

~~If a door opens upward, it shall have a bracket on each side to secure the door in the open position during maintenance. Doors shall be permanently and continuously sealed with a foam gasket listed to UL157 to prevent the entry of water into the sign housing. Each door must be secured from opening by stainless steel rotary action draw latches as follows:~~

~~Signs of 5 feet up to 7 feet in length must have a minimum of three latches for each sign door.~~

~~Signs over 7 feet up to 9 feet in length must have a minimum of four latches for each door.~~

~~Ensure the rotary action draw latch is captive and does not become detached or allow the door to open when the sign housing is torqued or twisted~~

~~The sign assembly must be designed and constructed to withstand 150 mph wind loads meeting the requirements of the Department's Structures Manual.~~

~~**700-3.2.1.3 Luminance:** The sign face must be illuminated evenly across the entire surface. Contrast ratio between the background and legend shall be established by the lowest and the highest color retroreflective measurement and shall be at least 4:1. Measure the retroreflectivity in accordance with ASTM D4956.~~

~~**700-3.2.1.3.1 Background Luminance:** Minimum luminance for the legend portion of the street sign face shall be no less than 87.5 lux. The luminance shall be determined by averaging a minimum of seven readings. Four of the readings shall be taken near the midpoint of a line that would span between the outside corners of the background and the outside corners of the legend. One reading shall be taken near the midpoint of a line that would connect the top corner readings. One reading shall be taken near the midpoint of a line that would connect the bottom corner readings. One reading shall be taken near the vertical and horizontal midpoint of the sign.~~

~~**700-3.2.1.3.2 Border and Lettering Luminance:** Minimum luminance of the legend and border shall be 350 lux. The luminance shall be determined by averaging a minimum of 17 readings. There shall be a minimum of one reading from each letter in the legend. Readings within the legend shall alternate between the top, middle and bottom portion of each letter. Readings within top and bottom of the border shall be perpendicular to the top and bottom readings in the background. Readings within the sides of the border shall be taken parallel to the readings taken within each letter.~~

~~**700-3.2.1.4 Clamp-On Cantilever Arm:**~~ Use ~~only~~ clamp-on cantilever arms for internally illuminated signs which meet all design and wind loading requirements as specified in the Contract Documents. Ensure the clamp is adjustable to accommodate various size poles.

~~**700-3.2.2 Highlighted Signs:**~~

~~**700-3.2.2.1 General:** Ensure highlighted signs meet the design and functional requirements specified in this Section and Section 2A of the MUTCD. Use LEDs to highlight the sign's shape, color, or message.~~

~~Stop, Do Not Enter, Yield, and Wrong Way signs that are highlighted with LEDs must use red LEDs. All other signs must use LEDs which resemble the color of the sign background color.~~

~~For roadside sign assemblies, provide support structure in accordance with 646-2.~~

~~**700-3.2.2.2 Performance Requirements:** Ensure highlighted signs are capable of automatically dimming to reduce brightness of the LEDs at nighttime.~~

~~Ensure highlighted signs that rely upon solar power or batteries are capable of at least 10 days of continuous operation without the need for charging.~~

~~**700-3.2.3 Cabinets:** If the illuminated sign assembly includes a cabinet, the cabinet must be currently listed on the APL or meet the applicable cabinet material requirements listed in Section 676.~~

~~700-3.2.4 Mechanical Requirements:~~ ~~Ensure all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter are Type 304 or 316 passivated stainless steel. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.~~

~~700-3.2.5 Electrical Requirements:~~ ~~Electrical wiring must meet NEC requirements for the light source provided. All wiring must be copper wire. All internal electrical wiring must be tight and secure. Ensure the sign includes an accessible electrical power service entrance compartment (internal or external) for connection of field wiring. External compartments must be weather-tight. All power supplies and ballasts must be Federal Communications Commission (FCC) approved.~~

~~Ensure electrical connections are protected against corrosion. All signs must have provisions for an integrated photocell.~~

~~700-3.2.6 Environmental Requirements:~~ ~~Ensure that the illuminated sign assembly operates properly during and after being subjected to the environmental testing procedures described in NEMA TS 4-2016, Section 2.~~

700-~~3~~5.2.~~7~~1 Acceptance of Internally Illuminated Signs: Certify that signs and clamp-on cantilever arms provided meet the criteria in this Section and Section 995.

700-~~3~~5.2.~~8~~2 Warranty:

~~700-3.2.8.1 Internally Illuminated Signs:~~ Ensure that internally illuminated signs have a manufacturer's warranty covering defects for five years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

~~700-3.2.8.2 Highlighted Signs:~~ ~~Ensure that highlighted signs have a manufacturer's warranty covering defects for three years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.~~

700-~~3~~5.3 Installation of Internally Illuminated Signs:

~~700-3.3.1 General:~~ Secure the brackets to the sign housing in accordance with the manufacturer's instructions.

~~700-3.3.2 Single Sided Sign Assembly:~~ ~~Install as specified in the Contract Documents.~~

700-~~3~~5.3.~~3~~1 Double Sided Sign Assembly: Use a free swinging mounting method.

700-~~3~~5.3.~~3~~2.~~1~~ Two Point Support Assembly: Use a two point support assembly when the sign assembly is attached to a mast arm that is perpendicular to the street on which the sign is viewed.

Use a two point mast arm mounting assembly consisting of the following:

1. Stainless steel band or cable type clamp,
2. Clevis,
3. Span wire adapter,
4. Tri-stud hanger body.

Ensure one of the hangers has a mechanism for the horizontal adjustment of the sign.

700-~~3~~5.3.3.~~2~~ One Point Support Assembly: Use a one point support assembly consisting of an articulated horizontal stainless steel band or cable type mast arm clamp, sign bracket and mounting hardware, when the sign assembly is attached to a mast arm

that is diagonal to the street on which the sign is viewed. Do not use a one point support assembly for internally illuminated sign assemblies exceeding four feet in width.

Ensure the band or cable clamp is capable of horizontal rotation of 360 degrees.

700-~~3~~5.3.~~3~~4.~~3~~ Clamp-On Cantilever Arm: Attach the arm perpendicular to the street on which the sign assembly is viewed. Use a clamp and arm that are galvanized in accordance with ASTM A123 unless otherwise shown in the Plans. Ensure the arm has a cap secured in place.

700-~~3~~5.3.~~4~~5 Electrical Wiring: Unless otherwise shown in the Plans, install dedicated 14 AWG conductors to supply power to the sign and connect the conductors to a dedicated 15 amp circuit breaker located either inside the controller cabinet or inside the electrical service disconnect. Using the same conduit system for both signal cables and internally illuminated sign conductors is permitted, unless otherwise shown in the Plans.

Install conductors in such a manner as to prevent damage to conductors or conductor insulation. Remove and replace all damaged conductors /insulation at no additional cost to the Department.

Ensure drilled holes through which conductors pass through are fitted with a weather tight rubber grommet fitting.

Install continuous lengths of conductors between the dedicated circuit breaker and internally illuminated signs.

Do not splice conductors unless otherwise shown in the Plans.

Provide one photoelectric cell for all internally illuminated signs at each intersection. Use an L bracket to mount the photoelectric cell as specified in the Contract Documents. Connect the photoelectric cell to a contactor assembly inside the controller cabinet to provide switching of the internally illuminated signs. ~~**700-3.4 Installation of Highlighted Signs:** For roadside sign assemblies, construct foundation and install support structure in accordance with 646-3 and the Standard Plans, Index 700-120. Install highlighted sign equipment in accordance with the manufacturer's instructions.~~

~~**700-3.5 Method of Measurement:** The Contract unit price per each for internally illuminated signs, furnished and installed, will include furnishing the sign panels, housing, hardware, electrical connection, and labor necessary for a complete and accepted installation. When the internally illuminated sign is ground mounted, the Contract price will include the support structure and foundation. All other mounting will include the hardware necessary to complete the attachment to the support structure; the span wire, monotube, or mast arm structure will be paid separately.~~

~~The Contract unit price per each for highlighted signs, furnished and installed, will include furnishing the sign panels, cabinet, support structure, foundation, hardware, solar panel, and labor necessary for a complete and accepted installation.~~

~~**700-3.6 Basis of Payment:** Price and payment will be full compensation for all work specified in this Section.~~

~~Payment will be made under:~~

~~Item No. 700- 5- Internally Illuminated Signs, per each.~~
~~Item No. 700- 6- Highlighted Signs, per assembly.~~

700-~~4~~6 Dynamic Message Signs.

700-~~4~~6.1 General: ~~Dynamic message signs (DMS) must meet the requirements of NEMA TS4-2016. DMS are classified by the type of sign display and the type of mechanical~~

~~construction.~~ Provide monochrome, tri-color, or full-color signs as shown in the ~~Contract Documents~~Plans. ~~Use only equipment and components that meet the requirements of these minimum specifications and are listed on the APL. DMS LED retrofit kits must be listed on the APL.~~

~~**700-4.1.1 Front Access DMS:** Ensure that front access signs meet the requirements of NEMA TS 4-2016, Section 3.2.6.~~

~~**700-4.1.2 Walk-In DMS:** Ensure that walk-in signs meet the requirements of NEMA TS 4-2016, Section 3.2.8.~~

~~**700-4.1.3 Embedded DMS:** Embedded DMSs are typically mounted to ground traffic signs, overhead traffic signs, or overhead cantilever traffic signs.~~

700-46.2 Sign Housing Requirements for all DMS: ~~Ensure that the external skin of the sign housing is constructed of aluminum alloy 5052 H32. Ensure the interior structure is constructed of aluminum.~~ Ensure that the sign housing design and appearance is approved by the Engineer. ~~Ensure that no internal frame connections or external skin attachments rely upon adhesive bonding or rivets.~~

~~Ensure the sign enclosure meets the requirements of NEMA TS 4-2016, Section 3.1.1. Ensure that all drain holes and other openings in the sign housing are screened to prevent the entrance of insects and small animals.~~

~~Ensure that the sign housing complies with the fatigue resistance requirements of the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Design and construct the DMS unit for continuous usage of at least 20 years. The sign assembly must be designed in accordance with the Department's Structures Manual, including a wind load of 150 miles per hour.~~

~~Ensure that the top of the housing includes multiple steel lifting eyebolts or equivalent hoisting points. Ensure hoist points are positioned such that the sign remains level when lifted. Ensure that the hoist points and sign frame allow the sign to be shipped, handled, and installed without damage.~~

~~Ensure all assembly hardware, including nuts, bolts, screws, and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel and meet the requirements of ASTM F593 and ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized and meet the requirements of ASTM A307.~~

~~Ensure all exterior, excluding the sign face, and all interior housing surfaces are a natural aluminum mill finish. Ensure signs are fabricated, welded, and inspected in accordance with the requirements of the current ANSI/AWS Structural Welding Code-Aluminum.~~

~~Ensure the sign housing meets the requirements of NEMA TS 4-2016, Section 3.2.9 for convenience outlets.~~

~~**700-4.2.1 Sign Housing for Walk-In DMS:** Ensure that exterior seams and joints, except the finish coated face pieces, are continuously welded using an inert gas welding method. Limit the number of seams on the top of the housing to a maximum of three. Stitch weld the exterior housing panel material to the internal structural members to form a unitized structure.~~

~~Ensure that exterior mounting assemblies are fabricated from aluminum alloy 6061-T6 extrusions a minimum of 0.1875 inch thick. Include a minimum of three 6061-T6 structural aluminum Z members on the rear of the sign housing in accordance with the Standard Plans. Ensure structural aluminum Z members run parallel to the top and bottom of the sign~~

housing and are each a single piece of material that spans the full length of the sign. Ensure structural aluminum Z members are attached to the internal framework of the sign.

Ensure hoist points are attached directly to structural frame members by the sign manufacturer.

Ensure housing access is provided through an access door that meets the requirements of NEMA TS 4-2016, Section 3.2.8.1. Ensure the access door includes a keyed tumbler lock and a door handle with a hasp for a padlock. Ensure the door includes a closed-cell neoprene gasket and stainless steel hinges.

Ensure the sign housing meets the requirements of NEMA TS 4-2016, Section 3.2.8.3 for service lighting. If incandescent lamps are provided, ensure they are fully enclosed in heavy-duty shatterproof, protective fixtures. Ensure that incandescent fixtures include aluminum housing and base, a porcelain socket, and clear glass inner cover. Ensure that all removable components are secured with set screws. If fluorescent lamps are provided, ensure they are fitted with shatter proof protective guards.

Ensure that the sign housing includes emergency lighting that automatically illuminates the interior in the event of a power outage. Emergency lighting must be capable of operation without power for at least 90 minutes.

700-4.2.1.1 Walk-In DMS Work Area: Ensure the walk-in DMS has a work area that meets the requirements of NEMA TS 4-2016, Section 3.2.8.2. Finish all edges of the walkway to eliminate sharp edges or protrusions.

700-4.2.2 Sign Housing for Front Access and Embedded DMS: Ensure front access and embedded signs meet the requirements of NEMA TS 4-2016, Section 3.2.5 and Section 3.2.6. Ensure access does not require specialized tools or excessive force to operate.

700-4.2.3 Housing Face Requirements for all DMS: Ensure the sign face meets the requirements of NEMA TS 4-2016, Section 3.1.3. Ensure that all sign face surfaces are finished with a matte black coating system that meets or exceeds American Architectural Manufacturers Association (AAMA) Specification No. 2605. Submit certification that the sign face parts are coated with the prescribed thickness. Except for embedded DMS, ensure the sign face includes a contrast border that meets the requirements of NEMA TS 4-2016, Section 3.1.6.

700-4.2.3.1 Housing Face for Walk-In DMS: No exposed fasteners are allowed on the housing face. Ensure that display modules can be easily and rapidly removed from within the sign without disturbing adjacent display modules.

700-4.2.3.2 Housing Face for Front Access and Embedded DMS: Any exposed fasteners on the housing face must be the same color and finish as the housing face. Only captive fasteners may be used on the housing face.

700-4.2.3.3 External Fascia Panels: If the sign includes external fascia panels, ensure that they are constructed using aluminum. Finish each fascia panel with a matte black coating system that meets or exceeds AAMA Specification No. 2605.

700-4.2.3.4 Lens Panel Assembly: If the sign includes lens panel assemblies, ensure they are modular in design, removable, and interchangeable without misalignment of the lens panel and the LED pixels. The lens panel assembly must consist of an environmental shielding layer coating to protect and seal the LED and internal electronics. The coating must be a minimum 90% UV opaque. Lens panels must have a matte black coating that meets or exceeds AAMA Specification No. 2605. Lens panels must include a mask constructed of 0.080 inch minimum thickness aluminum. Ensure that the mask is perforated to provide an

aperture for each pixel on the display module. Ensure that the apertures do not block the LED output at the required viewing angle.

700-4.2.4 Sign Housing Ventilation System: The ventilation systems for walk-in, front-access, and embedded DMS must meet the requirements of NEMA TS 4-2016, Section 3.1.2.

Ensure that air drawn into the sign is filtered upon entry. Ensure the ventilation system is automatically tested once each day and that it may be tested on command from remote and local control access locations. Ensure the sign includes a sensor or a sensor assembly to monitor airflow volume to predict the need for a filter change. Ensure the ventilation system fans possess a 100,000 hour, L10 life rating.

700-4.2.4.1 Ventilation System for Walk-In DMS: Ensure the sign includes a fail-safe ventilation subsystem that includes a snap disk thermostat that is independent of the sign controller. Preset the thermostat at 130°F. If the sign housing's interior reaches 130°F, the thermostat must override the normal ventilation system, bypassing the sign controller and turning on all fans. The fans must remain on until the internal sign housing temperature falls to 115°F.

700-4.2.5 Sign Housing Temperature Sensor: Ensure that the sign controller continuously measures and monitors the temperature sensors. Ensure that the sign blanks when a critical temperature is exceeded and that the sign reports this event when polled. Ensure that remote and local computers can read all temperature measurements from the sign controller.

700-4.2.6 Sign Housing Humidity Sensor: Humidity sensors must detect from 0 to 100% relative humidity in 1% or smaller increments. Sensors must operate and survive in 0 to 100% relative humidity, and have an accuracy that is better than plus or minus 5% relative humidity. Use of a humidistat is not acceptable.

700-4.2.7 Sign Housing Photosensors: Ensure the sign meets the requirements of NEMA TS 4-2016, Section 9.1.3. Ensure that the sensors provide accurate ambient light condition information to the sign controller for automatic light intensity adjustment. Ensure that the automatic adjustment of the LED driving waveform duty cycle occurs in small enough increments that the sign's brightness changes smoothly, with no perceivable brightness change between adjacent levels. Ensure that stray headlights shining on the photoelectric sensor at night do not cause LED brightness changes.

Ensure that the brightness and color of each pixel is uniform over the sign's entire face within a 30 degree viewing angle in all lighting conditions.

700-4.3 Display Modules: Provide display modules manufactured by one source and fully interchangeable throughout the manufacturer's sign system. Ensure that removal or replacement of a complete display module or LED board can be accomplished without the use of special tools.

Ensure display modules contain solid-state electronics needed to control pixel data and read pixel status.

Ensure that the sign has a full matrix display area as defined in NEMA TS 4-2016, Section 1.6.

700-4.3.1 LED and Pixel Specifications: Ensure that LED lamps have a minimum viewing angle of 30 degrees.

Ensure that all pixels in all signs in a project, including operational support supplies, have equal color and on-axis intensity. Ensure that the sign display meets the luminance requirements of NEMA TS 4-2016, Section 5.4, for light emitting signs connected at

full power. Ensure that amber displays produce an overall luminous intensity of at least 9200 candelas per square meter when operating at 100% intensity. Provide the LED brightness and color bins that are used in each pixel to the Engineer for approval. Ensure that the LED manufacturer demonstrates testing and binning according to the International Commission on Illumination (CIE) 127-1997 Standard.

Ensure that all LEDs operate within the LED manufacturer's recommendations for typical forward voltage, peak pulsed forward current, and other ratings. Component ratings must not be exceeded under any operating condition.

Ensure that the operational status of each pixel in the sign can be automatically tested once a day. Ensure that the pixel status test determines the functional status of the pixel as defined by the pixel Failure Status object in National Transportation Communications for ITS Protocol (NTCIP) 1203 v02.39 and does not affect the displayed message for more than half a second.

Ensure that LEDs are individually mounted directly on a printed circuit board (PCB).

700-4.3.2 Optical, Electrical, and Mechanical Specifications for Display Modules: Ensure the display modules are rectangular and have an identical vertical and horizontal pitch between adjacent pixels. Ensure that the separation between the last column of one display module and the first column of the next module is equal to the horizontal distance between the columns of a single display module. Full-color signs must have a pitch equal to or less than 35 mm.

Ensure that the LED circuit board is a NEMA FR4-rated, single 0.062 inch, black PCB. Ensure that no PCB has more than two PCB jumper wires present. Finish all PCBs with a solder mask and a component-identifying silk screen.

Provide PCBs with conformal coating meeting the material requirements of MIL-I-46058C Military Standard, United States Department of Defense (USDOD).

Ensure that any devices used to secure LEDs do not block air flow to the LED leads or block the LED light output at the required viewing angle. Ensure that all components on the LED side of a PCB are black.

Ensure that there are a minimum of two power supplies that are wired in a parallel configuration for redundancy. Ensure that if one, or 25% of the supplies in a group, whichever is greater, completely fails, the sign shall still be supplied with enough power to run 40% of all pixels at a 100% duty cycle with an ambient operating temperature of 165°F.

Ensure that the sign controller continuously measures and monitors all LED module power supply voltages and provides the voltage readings to the TMC or a laptop computer on command.

Ensure that LEDs are protected from external environmental conditions, including moisture, snow, ice, wind, dust, dirt, and UV rays. Do not use epoxy to encapsulate the LEDs.

700-4.3.3 Display Area for Walk-In DMS: Ensure that the display area is capable of displaying three lines with a minimum of 15 characters per line, using an 18 inch font that meets the height to width ratio and character spacing in the MUTCD, Section 2L.04, paragraphs 05, 06, and 08.

700-46.43 Characters, Fonts, and Color: Ensure that the signs are capable of displaying American Standard Code for Information Interchange (ASCII) characters 32 through 126,

~~including all uppercase and lowercase letters, and digits 0 through 9, at any location in the message line.~~ Submit a list of the character fonts to the Engineer for approval.

~~All signs must be loaded (as a factory default) with a font in accordance with or that resembles the standard font set described in NEMA TS 4-2016, Section 5.6. For signs with a pixel pitch of 35 mm or less, ensure the sign is loaded (as a factory default) with a font set that resembles the FHWA Series E2000 standard font.~~

~~Ensure DMS fonts have character dimensions that meet the MUTCD, Section 2L.04, paragraph 08.~~

~~Ensure that full-color signs can display the colors prescribed in the MUTCD, Section 1A.12.~~

700-6.4.~~5~~ Main Power Supply and Energy Distribution Specifications: ~~Provide a nominal single-phase power line voltage of 120/240 V_{AC}. Ensure the DMS meets the requirements of NEMA TS 4-2016, Section 10.2.~~

~~Ensure all 120 V_{AC} wiring has an overall nonmetallic jacket or is placed in metal conduit, pull boxes, raceways, or control cabinets and installed as required by the NEC. Do not use the sign housing as a wiring raceway or control cabinet.~~

Provide Type XHHW power cables sized as required by the NEC for acceptable voltage drops while supplying alternating current to the sign.

~~Ensure surge protective devices (SPD) are installed or incorporated in the sign system by the manufacturer to guard against lightning, transient voltage surges, and induced current. Ensure that SPDs meet or exceed the requirements of Section 620. Ensure SPDs protect all electric power and data communication connections.~~

700-~~4~~6.~~6~~5 Uninterruptible Power Supply (UPS): ~~If a UPS is required in the Contract Documents for walk-in DMS, ensure the UPS is installed within the sign housing or as shown in the Plans. If a UPS is required in the Contract Documents for front access and embedded signs, ensure the UPS is installed within the control cabinet or as shown in the Plans.~~ The UPS system must be capable of displaying the current messages on a sign when a power outage occurs. Signs with an UPS must be able to operate on battery power and display text messages for a minimum of two hours. ~~Ensure the system uses sealed absorbed glass mat (AGM) batteries.~~

700-~~4~~6.~~7~~6 Operational Support Supplies: Furnish the operational support supplies listed in Table 700-~~1~~3. Promptly replace any of the supplies used to perform a warranty repair prior to final acceptance.

For every group of 10 or fewer DMSs provided or required, provide one set of supplies as follows:

Table 700-~~1~~3
DMS Operational Support Supplies

1 each	Sign controller and I/O board(s)
1 per DMS	LED display modules
1 each	Display power supply
1 each	Uninterruptible power supply
2 each	Surge suppression sets
1 each	Fan assembly

~~**700-4.8 Components:** All components must meet the requirements of NEMA TS 4-2016, Section 8.~~

700-4.8.1 Mechanical Components: Ensure that all fasteners, including bolts, nuts, and washers less than 5/8 inch in diameter, are passivated stainless steel, Type 316 or 304 and meet the requirements of ASTM F593 and ASTM F594 for corrosion resistance. Ensure that all bolts and nuts 5/8 inch and over in diameter are galvanized and meet the requirements of ASTM A307. Do not use self-tapping screws. Ensure that all parts are fabricated from corrosion resistant materials, such as plastic, stainless steel, aluminum, or brass. Ensure that construction materials are resistant to fungus growth and moisture deterioration. Ensure that all dissimilar metals are separated with an inert, dielectric material.

700-4.8.2 Sign Controller: Ensure that the sign controller monitors the sign in accordance with NEMA TS 4-2016, Section 9. Ensure the sign monitors the status of any photocells, LED power supplies, humidity, and airflow sensors. Ensure sign controllers use fiber optic cables for data connections between the sign housing and ground-level cabinet.

Ensure that the sign controller meets the requirements of NEMA TS 4-2016, Sections 8.3 and 8.4. Ensure that the sign controller is capable of displaying a self-updating time and date message on the sign. Ensure that sign controllers within ground cabinets are rack-mountable, designed for a standard Electronic Industries Alliance (EIA) EIA-310 19 inch rack, and includes a keypad and display.

700-4.8.3 Display System Hardware: Ensure the sign utilizes a system data interface circuit for communications between the sign controller and display modules. Except for embedded DMS, ensure that the following components reside inside the sign housing: sign controller (master or slave), display system interface circuits, display modules, power supplies, local and remote control switches, LED indicators, EIA-232 null modem cables (minimum of four feet long for connecting laptop computer to sign controller), and surge protective devices.

700-4.8.4 Control Cabinet: Provide a control cabinet that meets the requirements of Section 676. Ensure that the minimum height of the cabinet is 46 inches.

Provide a ground control cabinet that includes the following assemblies and components: power indicator, surge suppression on both sides of all electronics, communication interface devices, connection for a laptop computer for local control and programming, a four foot long cable to connect laptop computers, a workspace for a laptop computer, and duplex outlets.

Provide for all telephone, data, control, power, and confirmation connections between the sign and ground control box, and for any required wiring harnesses and connectors.

700-4.8.5 Sign Controller Communication Interfaces: Ensure the sign controller has communication interfaces in accordance with NEMA TS 4-2016, Section 8.3.2. Ensure that EIA-232 serial interfaces support the following:

Table 700-2
Communication Interface Requirements

Data Bits	7 or 8 bits
Parity	Even, Odd, or None
Number Stop Bits	1 or 2 bit

Ensure the sign controller has a 10/100 Base TX 8P8C port or a 100 Base FX port Ethernet interface.

~~For dial-up operations, acquire and bear the charges of installing and connecting the dial-up telephone line. Provide modems to be retained by the Department at each location. Provide a user-selectable data transmission rate of up to 19.2 kbps for dial-up operations. Ensure that switching between dial-up, Ethernet, and multidrop operation does not require sign controller software or hardware modifications.~~

~~Ensure that the TMC or a laptop computer can be used to remotely reset the sign controller.~~

700-46.~~9~~7 Message and Status Monitoring: ~~Ensure the DMS provides two modes of operation: (1) remote operation, where the TMC commands and controls the sign and determines the appropriate message or test pattern; and (2) local operation, where the sign controller or a laptop computer commands and controls the sign and determines the appropriate message or test pattern.~~

Ensure that the sign can perform the following functions:

1. Control Selection – Ensure that local or remote sign control can be selected~~. Ensure that there is a visual indicator on the controller that identifies whether the sign is under local or remote control~~.

2. Message Selection – Ensure that the sign controller can select a blank message or any one of the messages stored in the sign controller's nonvolatile memory when the control mode is set to local.

3. Message Implementation – Ensure that the sign controller can activate the selected message.

~~Ensure that the sign can be programmed to display a user-defined message, including a blank page, in the event of power loss.~~

~~Ensure that message additions, deletions, and sign controller changes may be made from either the remote TMC or a local laptop computer.~~ Ensure that each font may be customized, and modifications to a font may be downloaded to the sign controller from the TMC or a laptop computer at any time without any software or hardware modifications.

Ensure that there is no perceivable flicker or ghosting of the pixels during sign erasure and writing periods.

700-46.~~10~~8 TMC Communication Specification for all DMS: ~~Ensure that the sign controller is addressable by the TMC through the Ethernet communications network using software that complies with the NTCIP 1101 base standard (formerly the NEMA TS 3.2-1996 Standard), including all amendments as published at the time of Contract letting, the NTCIP Simple Transportation Management Framework, and conforms to Compliance Level 1. Ensure that the software implements all mandatory objects in the supplemental requirement SR-700-4.1.1, Dynamic Message Sign NTCIP Requirements, as published on the Department's State Traffic Engineering and Operations Office web site at the following URL: https://www.fdot.gov/traffic/Traf-Sys/Product-Specifications.shtm.~~

~~Ensure that the sign complies with the NTCIP 1102v01.15, 2101v01.19, 2103v02.07, 2201v01.15, 2202v01.05, and 2301v02.19 Standards. Ensure that the sign complies with NTCIP 1103v02.17, Section 3.~~

~~Ensure that the controller's internal time clock can be configured to synchronize to a time server using the network time protocol (NTP). NTP synchronization frequency must be user-configurable and permit polling intervals from once per minute to once per week in one-minute increments. The controller must allow the user to define the NTP server by internet protocol (IP) address.~~

Provide communications line circuits that are point-to-point or multipoint, and that provide full duplex asynchronous data transmissions at the rate shown in the Contract Documents or directed by the Engineer.

Assign each sign controller a unique address.

700-46.119 Sign Control Software: ~~Ensure that the sign is provided with computer software from its manufacturer that allows an operator to program, operate, exercise, diagnose, and read current status of all sign features and functions using a laptop computer. Ensure that sign control software provides a graphical representation that visibly depicts the sign face and the current ON/OFF state of all pixels as well as allows messages to be created and displayed on the sign.~~ Ensure that the laptop computer and sign can communicate when connected directly by an EIA-232 cable and via Ethernet. Ensure that the software allows communication between multiple users and multiple signs across the same communication network.

700-46.120 Sign Support Structure: Meet the requirements of 700-2.~~2~~3.

700-46.131 Installation Requirements: Provide a walk-in DMS for locations over interstate travel lanes. Verify that any ventilation system incorporated within the sign is operational per the manufacturer's recommendations.

Install the DMS in accordance with the manufacturer's recommendations and Standard Plans, Index 700-090.

Ensure that the location of the lifting eyebolts, left in place or removed, is sealed to prevent water entry after installation.

Load the initial message libraries on both the sign control software and the sign controller. The Engineer will furnish the messages to be placed in these libraries.

700-46.142 Documentation: Submit documentation for electronic equipment in accordance with 603-6.

700-46.153 Licensing: Ensure that the manufacturer grants the Department a license that allows the Department to use and internally distribute any and all sign communications protocols, operating systems, drivers, and documentation.

700-46.164 Technical Assistance: Ensure that a manufacturer's representative is available to assist the Contractor's technical personnel during pre-installation testing and installation.

Do not provide initial power to the signs without the permission of the manufacturer's representative.

~~**700-4.17 Environmental Requirements:** The DMS must meet the requirements of NEMA TS 4-2016, Section 2.~~

700-46.185 Pre-installation Field Testing: Conduct pre-installation tests on all units at a Contractor-provided facility within the appropriate District. Perform the tests on each unit supplied to verify that no damage was done to any sign during the shipment and delivery process. Notify the Engineer a minimum of 10 calendar days before the start of any tests. Conduct all tests according to the approved test procedures detailed in this Section. Each DMS must pass the individual tests detailed below prior to installation.

700-46.185.1 Material Inspection: Examine each DMS carefully to verify that the materials, design, construction, markings, and workmanship comply with all applicable standards, specifications, and requirements.

700-46.185.2 Operational Test: Operate each DMS long enough to permit equipment temperature stabilization, and to check and record an adequate number of

performance characteristics to ensure compliance with applicable standards, specifications, and requirements.

700-46.185.3 Pre-Installation Test Failure Consequence: If any unit fails, the unit shall be corrected or another unit substituted in its place and the test repeated.

If a unit has been modified as a result of a failure, a report shall be prepared and submitted to the Engineer. The report shall describe the nature of the failure and the corrective action taken.

If a failure pattern develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the Department or an extension of the Contract Time.

700-46.196 Installed Site Tests: Conduct Intelligent Transportation System Device Installation testing in accordance with Section 611.

700-46.2017 System Testing: Conduct Intelligent Transportation System Device Installation testing in accordance with Section 611.

~~**700-4.21 Warranty:** Ensure that the DMS system and equipment has a manufacturer's warranty covering defects for a minimum of five years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.~~

~~**700-4.22 Method of Measurement:** For each DMS, the quantity to be paid will be each sign furnished, installed, completed in accordance with the details shown in the Plans, warrantied, made fully operational, and tested in accordance with Section 611.~~

~~For each DMS Support Structure, the quantity to be paid will be each structure furnished, installed, completed in accordance with the details shown in the Plans; including posts and supports, catwalks, handrails, footings, excavation, site grounding, painting, and incidentals necessary to complete the work.~~

~~**700-4.23 Basis of Payment:** Price and payment will be full compensation for furnishing all materials and completing all work as specified in this Section or as shown in the Plans.~~

~~Payment will be made under:~~

~~Item No. 700- 7- Embedded Dynamic Message Sign - each.~~
~~Item No. 700- 8- Front Access Dynamic Message Sign - each.~~
~~Item No. 700- 9- Walk-in Dynamic Message Sign - each.~~
~~Item No. 700- 10- Dynamic Message Sign Support Structure - each.~~

~~**700-5 Electronic Display Sign.**~~

~~**700-5.1 Description:** All electronic display signs (EDS) must meet the physical display and operational requirements for warning, guide or regulatory signs described in the MUTCD and the SHS.~~

~~EDS are specialized electronic signs that include dynamic display components. The term EDS refers to a general category of electronically enhanced signs that includes electronic warning signs (EWS), electronic guide signs (EGS), electronic regulatory signs (ERS), electronic speed feedback signs (ESFS), and blank-out signs (BOS).~~

~~**700-5.2 Material:** EWS, EGS, ERS, ESFS, and ground mounted BOS must allow attachment to vertical and horizontal support structures as part of a single or double sign post configuration. Bolts must be used for load bearing attachments.~~

~~For roadside sign assemblies, provide support structure in accordance with 646-2.~~

~~**700-5.2.1 Requirements Common to all EDS:** All EDS must be designed to withstand the loads defined in the Department's Structures Manual without deformation or damage. EDS, other than BOS, must provide an option to include flashing beacons. Printed~~

circuit boards shall be protected with conformal coating. Housings that contain electronics shall be constructed of aluminum alloy sheet a minimum of .090 inch thick. Welding used during the construction of EDS must be accordance with Section 965.

700-5.2.1.1 General: Signs included on the APL will be designated with a size and type category and may be listed with restrictions, such as "requires District Traffic Operations Engineer approval", "school zones only", or "low speed only".

700-5.2.1.2 Electronic Display Sign with Static Sign Panel: EDS that include both a static sign panel and dynamic display may be a modular system comprised of a static sign panel with an attached electronic display. Static sign panels shall meet the Department's requirements for highway signing found in this Section.

700-5.2.2 Electronic Display: Electronic displays shall appear completely blank (dark) when not energized. No phantom characters or graphics will be allowed under any ambient light conditions.

700-5.2.2.1 Housing: The housing must protect and seal the dynamic display and other internal electronics. Any polycarbonate material used on the sign face must be a minimum 90% UV-opaque and resistant to fading and yellowing. The housing shall be NEMA 3R rated and prevent unauthorized access. The housing shall include weather tight cable entry or connection points for any required power or data connections.

700-5.2.2.2 Cabinet: Any equipment cabinets provided with the EDS must be listed on the APL.

700-5.2.2.3 Optical, Electrical, and Mechanical Specifications for Display Modules: Ensure that all LEDs operate within the LED manufacturer's recommendations for typical forward voltage, peak pulsed forward current, and other ratings. Component ratings shall not be exceeded under any operating conditions.

700-5.2.2.4 LED and Pixel Specifications: Ensure that all LEDs used in the display have a wavelength output that varies no more than plus or minus two nanometers from the specified peak wavelength. Ensure that the display and LED pixel cone of vision is a minimum of 15 degrees (centered around the optical axis, or zero point, of the pixel). The cone perimeter is defined by the point where light output intensity is 50% of the intensity measured at the zero point of the pixel. For all colors other than white, ensure that the sign display produces an overall luminous intensity of at least 9200 candelas per square meter when operating at 100% intensity. For white or full color matrix displays ensure that the sign display produces white with an overall luminous intensity of at least 12,400 candelas per square meter when operating at 100% intensity. Submit documentation that indicates the LED brightness and color bins that are used in each pixel. Ensure that LEDs are individually mounted on a PCB, and are able to be removed and replaced using conventional electronic repair methods. Encapsulated LEDs within a pixel are not allowed. ERS LEDs must be arranged and powered in a manner that maintains a discernible message in the event of a single LED or pixel failure.

700-5.2.2.5 Character Size, Fonts, and Graphics: The minimum numeral and letter size of the electronic display must meet or exceed the numeral and letter sizes prescribed in the MUTCD and the SHS. Fonts and graphics must mimic the characteristics of fonts and graphics defined in the MUTCD and SHS.

700-5.2.3 Electronic Display Controller: Any electronic display controller required for the operation of the EDS shall be housed within the sign and be equipped with a security lockout feature to prevent unauthorized use. The controller shall have the capability to

provide a stipulated default message upon loss of controller function. A blank message is acceptable.

700-5.2.3.1 Communication: The electronic display controller shall possess a minimum of one serial, Ethernet, USB, or Bluetooth interface with the ability to connect to a laptop computer. The serial data interface shall support multiple data rates from 9,600 bps to 115,200 bps.

700-5.2.3.2 Configuration and Management: Ensure that the sign is provided with computer software from its manufacturer that allows a user to program, operate, exercise, diagnose, and read current status of all sign features and functions using a laptop. Configuration and management functions must be password protected.

700-5.2.4 Operation and Performance: Ensure that the EDS is visible from a distance of at least 1/4 mile and legible from a distance of 400 feet for applications on roads with a speed limit less than 45 mph and visible from a distance of at least 1/2 mile and legible from a distance of at least 650 feet for roads with speed limits 45 mph or higher. In both cases, the requirements must be met under both day and night conditions.

The electronic display shall automatically adjust brightness for day and night operation. The EDS must be equipped with a light sensor that accurately measures ambient light level conditions at the sign location. The EDS must automatically adjust LED intensity based on the ambient light conditions in small enough increments that the sign's brightness changes smoothly, with no perceivable brightness change between adjacent levels. Stray headlights shining on the photoelectric sensor at night must not cause LED brightness changes.

Flashing messages must not exceed 150 flashes per minute.

700-5.2.5 Mechanical Specifications: EDS mounting provisions and mounting hardware must accommodate sign weight and wind loading requirements of the Department's Structures Manual. BOS must be designed to accommodate overhead attachment using a tri-stud signal hanger. Multiple tri-stud attachment points may be used to meet weight and wind loading requirements. Tri-stud attachment points must be weather-tight and structurally reinforced.

700-5.2.5.1 Fasteners and Attachment Hardware: Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws and studs must meet ASTM F593. Nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

700-5.2.6 Electrical Specifications: All power inputs must be fuse and reverse polarity protected. All EDS must be able to recover from power loss and return to their operational state without user intervention.

700-5.2.6.1 Solar Power: Solar powered signs must be capable of fully autonomous operation 24 hours per day, 365 days per year. Batteries must be a standard 12 volt deep cycle battery suitable for the application and operating environment. Flooded lead-acid batteries are prohibited.

Batteries must be capable of providing 10 days of continuous operation without sunlight. Charging system must use a solar charge controller with temperature compensation. The system must provide for automatic battery charging, overcharge protection, and have indications that display current status and faults.

700-5.2.6.2 AC Power: Fluctuations in line voltage must have no visible effect on the appearance of the display.

700-5.2.7 Electronic Warning Signs (EWS): The EWS must be designed to alert road users to conditions that might call for a reduction of speed or an action, in the interest of safety and efficient traffic operations. EWS must include a secure wireless connection to communicate with a nearby laptop.

700-5.2.7.1 EWS Foreground/Background Colors: If a black background is used on the changeable electronic display, the color used for the legend must match the background color that would be used on a standard sign for that type of legend, in accordance with the MUTCD. Black EWS display backgrounds must be flat black (FED-STD-595-37038) with a reflectance value not exceeding 25%. EWS must utilize yellow LEDs with a peak wavelength of either 585 or 590 nanometers. EWS must have a minimum one-inch contrasting margin around illuminated characters or graphics.

700-5.2.7.2 Speed Detector: EWS that detect or display the speed of approaching vehicles must be programmable for the posted speed limit and the maximum speed to display. When the detected speed exceeds the maximum programmed speed (high speed cut-off) threshold, the display must automatically blank. Alternately, the display may show an alert message such as "SLOW DOWN" when speeds above the maximum programmed speed threshold are detected.

The EWS must detect when the posted speed is exceeded by one mph and then activate the alert. When the alert is activated, the display shall be able to flash. When no advancing traffic is detected, the display must be blank. The speed detector must not activate alerts for vehicles outside the display cone of vision.

The speed detector must meet the requirements of FCC Title 47, Part 90 and not require an FCC operating license. The speed detector must operate on 10.8 to 16.6 V_{DC} and draw less than three amperes. The EWS must monitor and display the speed of approaching traffic only. The EWS detector must be able to accurately detect and determine the speed of approaching vehicles. The EWS must be capable of measuring and displaying speeds of approaching traffic only between 10 and 99 mph with an accuracy of plus or minus one mph, 1,000 feet in advance of the sign.

700-5.2.8 Electronic Guide Signs (EGS): Meet the requirements of electronic warning sign (EWS) with the following exceptions: Use a white legend and green background in accordance with the MUTCD. EGSs must utilize white LEDs.

700-5.2.9 Electronic Regulatory Signs (ERS): The ERS must be designed to give notice of traffic laws or regulations, such as the posted speed limit. ERS used for variable speed limit (VSL) applications must be able to display speed limits from 5-70 mph in five mph increments and mimic the physical appearance of a static regulatory speed limit sign as shown in the MUTCD and SHS. ERS for VSL applications shall use black characters on a white background. ERS for VSL applications must log the time and date of any speed limit change to internal non-volatile memory. The log must be able to record a minimum of 1,000 events in a first-in, first-out fashion.

700-5.2.9.1 Foreground/Background Colors and Display Types: Display modules for all ERS must have a minimum two-inch contrasting margin around digits, text, or graphics. ERS must utilize LED technology for the dynamic display.

700-5.2.9.2 Variable Speed Limit (VSL) ERS Controller Communications: ERS for variable speed applications must be equipped with a sign controller that includes a minimum of one Ethernet 10/100 Base TX 8P8C port.

~~**700-5.2.9.3 Configuration and Management Requirements for VSL ERS:** Ensure that ERS for VSL applications can be managed remotely from a TMC or managed locally using a laptop computer. Ensure that the TMC or a laptop computer can be used to remotely reset VSL sign controllers. Ensure that ERS for VSL applications log and report status, errors, and failures, including data transmission errors, receipt of invalid data, communication failure recoveries, alternating current power failures, power recoveries, display errors, fan and airflow status, temperature status, power supply status, and information on the operational status of the temperature, photocell, airflow, humidity, and LED power supply sensors.~~

700-7 In-Street Sign~~s~~ Assemblies.

700-7.1 Description: In-Street signs consist of the R1-6a or R1-6c In-Street Pedestrian Crossing Sign assemblies including the sign base.

~~**700-7.2 Materials:** The sign assembly includes the vertical panel, retroreflective sign sheeting, a rebounding boot support, and a base. The vertical sign panel is bolted to a flexible boot which is fastened to a plastic, recycled PVC, or rubber base and secured to the pavement surface. The sign assembly shall contain no upright metal parts.~~

~~The vertical panel shall yield (bend) fully upon vehicle impact, then return to vertical position plus or minus 10 degrees with no delaminating. The face of the vertical panel shall resist twisting and remain oriented to the installed direction after vehicle impact. The sign shall not split, crack, break, or separate from base.~~

~~**700-7.2.1 Vertical Panel:** Use only UV stabilized, ozone and hydrocarbon resistant outdoor-grade thermoplastic polymer, polycarbonate, recycled PVC, or HDPE materials. UV stabilization testing shall be in accordance with ASTM (D1435).~~

~~Place retroreflective sign sheeting on both sides of the vertical panel.~~

~~The surface of the panel shall be smooth and free of defects, suitable for adherence of appropriate retroreflective sheeting.~~

~~**700-7.2.2 Sign Sheeting Legend:** The legend of the sign (white) shall be of the same grade of retroreflective sheeting as the body of the sign.~~

~~**700-7.2.3 Base:**~~

~~**700-7.2.3.1 Sign Base (Fixed):** The base shall be constructed with high-impact materials using ozone and hydrocarbon resistant outdoor-grade thermoplastic polymer, polycarbonate, or HDPE materials meeting the general provisions for all In-Street sign bases.~~

~~**700-7.2.3.2 Sign Base (Portable):** Portable base assemblies shall consist of a lightweight plastic, recycled PVC, or rubber material that may be easily moved or relocated by a single person.~~

~~**700-7.2.3.3 Color:** Sign bases shall be either black, or the same color as the adjacent pavement marking.~~

~~**700-7.2.4 Approved Product List (APL):** Use In-Street Signs listed on the APL. Manufacturers seeking inclusion on the APL must submit the following in accordance with Section 6:~~

~~1. Product Photo~~
~~2. Product Drawings, which at a minimum includes:~~
~~a. Model Number~~
~~b. Allowable sign panel size and substrate~~
~~c. Dimensions of sign base and mounting heights~~
~~3. Installation Instructions~~
~~4. Crash Test Reports demonstrating MASH compliance~~

~~5. All FHWA Eligibility Letters~~
~~6. When requested, submit product sample~~

700-7.~~3~~2 Fabrication of Panel Messages: Fabricate standard sign panel messages in accordance with the Standard Plans. Sign panels of 8~~"~~ inches wide x 28~~"~~ inches tall or 12~~"~~ inches x 36~~"~~ inches are acceptable. See Standard Plans Section 700-102.

700-7.~~4~~3 ~~Connection Method~~Installation: Install a fixed base connection in accordance with the manufacturer's instructions. Install portable base connections only for temporary applications at school crossings where a crossing guard is present during school arrival and departure times or when children are present.

~~**700-7.5 Method of Measurement:** Quantities to be paid will be per each assembly.~~

~~**700-7.6 Basis of Payment:** Price and payment will be full compensation for all work and materials specified in this Section, including connection hardware.~~

~~Payment will be made under:~~

~~Item No. 700- 15 In-Street Sign, per Assembly~~

700-8 Warranty.

Refer to Section 608 for Contractor Requirements. Transfer all warranties from the Manufacturer to the Department.

700-9 Method of Measurement.

700-9.1 Single Column Ground Sign Assembly: Measurement will be made per each and will consist of all signs mounted on a single column (post). Area measurement for an assembly will include the total sheeting area, excluding any reflective sign strips.

700-9.2 Multi-Column Ground Sign Assembly: Measurement will be made per each and will consist of all sign panels and columns for a multi-column ground sign. Area measurement for an assembly will include the total sheeting area, excluding any reflective sign strips.

700-9.3 Sign Panel: Measurement for each sign panel will be the length times width of the sheeting area. No separate payment will be made for any panels on a new sign assembly.

700-9.4 Overhead Static Sign Structure: Sign panels will be paid separately from the overhead static support structures. For signs mounted on a span wire or mast arm, payment for the structure will be paid under the applicable items in Section 634 or Section 649. Measurement for all other overhead static sign structures will be made per each.

700-9.5 Enhanced Highway Sign Assembly: Measurement for Enhanced Highway Sign Assembly will be made per each.

700-9.5.1 Sign Beacon: No separate measurement will be made for a sign beacon mounted on a new Enhanced Sign Assembly. Separate measurement for retrofit, per each sign beacon, will be made for installation on an existing sign panel or sign assembly.

Separate payment for removal will be made only when the sign panel or sign assembly is to remain.

700-9.5.2 Highlighted Signs: No separate measurement will be made for a highlighted sign as part of a new Enhanced Sign Assembly. Separate measurement for retrofit, per each highlighted sign, will be made for installation on an existing post or other structure. Measurement for Highlighted Sign will be made per each sign completed.

700-9.5.3 Electronic Display Sign: No separate measurement will be made for an EDS as part of a new Enhanced Sign Assembly. Separate measurement for retrofit, per each

EDS, will be made for installation on an existing post or other structure. Measurement for EDS will be made per each sign completed.

700-9.6 Internally Illuminated Signs: Measurement for Internally Illuminated Sign will be made per each completed sign, regardless of whether the sign has one or more illuminated faces.

700-9.7 Embedded Dynamic Message Sign: Measurement for Embedded Dynamic Message Sign will be made for each completed sign, regardless of the number of embedded sign messages or housings mounted on a single or multi-post foundation.

700-9.8 Front Access Dynamic Message Sign: Measurement for Front Access Dynamic Message Sign will be made for each completed sign, regardless of the number of sign messages or housings mounted on a single or multi-post foundation.

700-9.9 Walk-in Dynamic Message Sign: Measurement for Embedded Dynamic Message Sign will be made for each completed sign.

700-9.10 Dynamic Message Sign Support Structure: Measurement for Dynamic Message Sign Support Structure will be made for each completed sign structure, regardless of the number of static and/or dynamic message signs supported.

700-9.11 Retroreflective Strip: Measurement for the retroreflective sign strip will be per each.

700-9.12 In Street Sign Assembly: Measurement will be made per each.

700-9.13 Removal and Relocation Operations: Measurement for removal or relocation operations of single column and multi-column signs will be made per each. Measurement for overhead sign structure will be made per each.

Measurement, per each, for removal of sign panels will only be made for signs not on an assembly.

700-10 Basis of Payment.

700-10.1 Single Column Ground Sign Assembly: The Contract unit price per each for single column ground mounted signs will include the sign panels, sheeting, support structure, foundation, hardware, and labor necessary for a complete and accepted installation. For flip-up signs, the assembly includes the hinge and any additional hardware.

700-10.2 Multi-Column Ground Sign Assembly: The Contract unit price per each for multi-column ground mounted signs will include the sign panels, support structure, foundation, hardware, and labor necessary for a complete and accepted installation.

700-10.3 Sign Panel: The Contract unit price per each sign panel will include the aluminum panel, sheeting, support structure, foundation, hardware, and labor necessary for a complete and accepted installation.

700-10.4 Overhead Static Sign Structure: The Contract unit price for each overhead static sign structure will include the support structure, foundation, hardware, and labor necessary for a complete and accepted installation.

700-10.5 Enhanced Highway Sign Assembly: The Contract unit price per each will include sign, electronics, cabinet, support structure, foundation, hardware, power system, and labor necessary for a complete and accepted installation.

700-10.5.1 Sign Beacon: The Contract unit price per each for sign beacon will consist of the flashing beacons, cabinet, housing, controller, hardware, and labor necessary for a complete and accepted installation. Signal cable from the cabinet to the signs will be paid separately under the applicable item for signal cable.

When solar power is specified in the Contract Documents, the Contract unit price will include the solar panel, auxiliary pole, batteries, and electronics.

700-10.5.2 Highlighted Signs: The Contract unit price per each for highlighted signs, furnished and installed, will include furnishing the sign, electronics, cabinet, support structure, foundation, hardware, and labor necessary for a complete and accepted installation. When solar power is specified in the Contract Documents, the Contract unit price will include the solar panel, auxiliary pole, batteries, and electronics.

Highlighted Signs used for Wrong Way sign installations do not include the Wrong Way Detection System; measurement and payment for the detection system will be made in accordance with Section 660.

700-10.5.3 Electronic Display Sign: The Contract unit price per each for electronic display sign will include static sign panels as required, electronic display, support structure, foundation, housing, cabinet, controller, speed detector, hardware, electrical connection, and labor necessary for a complete and accepted installation.

When the electronic display sign is ground mounted, the Contract price will include the support structure and foundation. All other mounting will include the hardware necessary to complete the attachment to the support structure; the span wire, monotube, or mast arm structure will be paid separately.

When solar power is specified in the Contract Documents, the Contract unit price will include the solar panel, auxiliary pole, and batteries.

700-10.6 Internally Illuminated Signs: The Contract unit price ~~per each~~ for each ~~i~~Internally ~~i~~Illuminated ~~s~~Sign~~s, furnished and installed,~~ will include ~~furnishing~~ the sign ~~panels~~, housing, hardware, electrical connection, and labor necessary for a complete and accepted installation. ~~When the internally illuminated sign is ground mounted, the Contract price will include the support structure and foundation.~~ All other mounting will include the hardware necessary to complete the attachment to the support structure; the span wire, monotube, or mast arm structure will be paid separately.

700-10.7 Embedded Dynamic Message Sign: The Contract unit price per each for Embedded DMS will include the sign, all hardware and software, testing, and warranty for a completed installation.

700-10.8 Front Access Dynamic Message Sign: The Contract unit price per each for Front Access DMS will include the sign, all hardware and software, testing, and warranty for a completed installation.

700-10.9 Walk-in Dynamic Message Sign: The Contract unit price per each for Walk-in DMS will include the sign, all hardware and software, testing, and warranty for a completed installation. When shown in the Contract Documents, payment for the Walk-in DMS will also include the Uninterruptible Power Supply.

700-10.10 Dynamic Message Sign Support Structure: The Contract unit price for each support structure will include posts and supports, catwalks, handrails, footings, foundation, excavation, site grounding, painting, and incidentals necessary for a complete and accepted installation.

700-10.11 Retroreflective Sign Strip: The Contract unit price per each will include the retroreflective sign strip, hardware, and labor necessary for a complete and accepted installation.

700-10.12 In Street Sign Assembly: The Contract unit price per each will include the vertical panel, retroreflective sign sheeting, rebounding boot support, and a base, for a complete and accepted installation.

700-10.13 Removal and Relocation Operations: The Contract unit price for removal of signs will include the removal of the support and footing. Restore the area to the condition of the adjacent area.

The Contract unit price for relocation of signs will consist of removing the existing sign assembly, including foundation removal and area restoration, and installing the sign at the new location shown in the Plans.

For the relocation of existing ground-mounted signs to be relocated or removed, after removing the sign panel from the assembly, remove supports and footings.

For the removal of overhead static sign structures, the Contract unit price will include the removal of the foundation: when partial foundation removal is called for, remove the support structure, and foundation to a minimum depth of four feet below existing grade; when complete foundation removal is called for, completely remove the support structure including the foundation.

700-10.14 Payment Items: Payment will be made under:

Item No. 700- 1- Single Column Ground Sign Assembly, each.
Item No. 700- 2- Multi-Column Ground Sign Assembly, each.
Item No. 700- 3- Sign Panel, each.
Item No. 700- 4- Overhead Static Sign Structure-, each.
Item No. 700- 5- Internally Illuminated Signs, each.
Item No. 700- 7- Embedded Dynamic Message Sign - each.
Item No. 700- 8- Front Access Dynamic Message Sign - each.
Item No. 700- 9- Walk-in Dynamic Message Sign - each.
Item No. 700- 10- Dynamic Message Sign Support Structure - each.
Item No. 700- 13- Retroreflective Sign Strip, each.
Item No. 700- 14- Enhanced Highway Sign Assembly, each.
Item No. 700- 15- In Street Sign Assembly, each.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 29, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **901**
Proposed Specification: **9010102 Coarse Aggregate.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by John Shoucair from the State Materials Office to change the maximum allowed minus 200 and remove duplicate language in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

COARSE AGGREGATE.
(REV 6-1-22)

SUBARTICLE 901-1.2 is deleted and the following substituted:

901-1.2 Deleterious Substances: All coarse aggregates shall be reasonably free of clay lumps, soft and friable particles, salt, alkali, organic matter, adherent coatings, and other substances not defined which may possess undesirable characteristics. The weight of deleterious substances shall not exceed the following percentages:

Coal and lignite (AASHTO T 113)	1.00
Soft and friable particles (AASHTO T 112)*	2.00
Clay lumps (AASHTO T 112)*	2.00
Plant root matter (visual inspection in AASHTO T 27)****	0.005
Wood and wood matter (visual inspection in AASHTO T 27)****	0.005
Cinders and clinkers	0.50
Free shell**	1.00
Total Material passing the No. 200 sieve (FM 1-T011)	
At Source with Los Angeles Abrasion less than or equal to 30	2.50
At Source with Los Angeles Abrasion greater than 30	1.75
At Redistribution Terminal for Aggregates Certified for Concrete Products Only	2.50
At Point of Use	3.75
Fine-Grained Organic Matter (AASHTO 194)	0.03
Chert (less than 2.40 specific gravity SSD) (AASHTO T 113)***	3.00

* The maximum percent by weight of soft and friable particles and clay lumps together shall not exceed 3.00.

** Aggregates to be used in asphalt concrete may contain up to 5% free shell. Free shell is defined as that portion of the coarse aggregate retained on the No. 4 sieve consisting of loose, whole, or broken shell, or the external skeletal remains of other marine life, having a ratio of the maximum length of the particle to the shell wall thickness exceeding five to one. Coral, molds, or casts of other shells, and crushed clam and oyster shell indigenous to the formation will not be considered as free shell.

*** This limitation applies only to coarse aggregates in which chert appears as an impurity. It is not applicable to aggregates which are predominantly chert.

**** Plant root matter, and wood and wood matter shall be considered deleterious when any piece exceeds two inches in length or 1/2 inch in width.

The weights of deleterious substances for reclaimed Portland cement concrete aggregate shall not exceed the following percentages:

Bituminous Concrete	1.00
Bricks	1.00
Wood and other organic substances (by weight)*****	0.1

Reinforcing Steel and Welded Wire Reinforcement 0.1
Plaster and gypsum board 0.1
Joint Fillers.....0.1
***** Supersedes requirement for other coarse aggregate

SUBARTICLE 901-2.3 is deleted and the following substituted:

901-2.3 Limestones, Dolomite and Sandstone: Coarse aggregates may be produced from limestone, dolomite, sandstones, and other naturally occurring hard, durable materials meeting the requirements of this Section. When used as a friction course, crushed limestone shall have a minimum acid insoluble content of 12% (FM 5-510). Other materials must meet the approval requirements for friction course determined by Rule 14-103.005(1), Florida Administrative Code (FAC).

Pre-Cenozoic limestones and dolomite shall not be used as coarse crushed stone aggregates ~~either coarse or fine~~ for asphalt concrete friction courses, or any other asphalt concrete mixture or surface treatment serving as the final wearing course. This specifically includes materials from the Ketone Dolomite (Cambrian) Newala Limestone (Mississippian) geologic formations in Northern Alabama and Georgia.

~~As an exception to the above, up to 20% fine aggregate from these materials may be used in asphalt concrete mixtures other than friction courses which serve as the final wearing course.~~

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 7, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **916**
Proposed Specification: **9160300 Bituminous Materials.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Wayne Rilko from the State Materials Office to add FM 5-624 Re-emulsification of Asphalt Emulsions to the requirements in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

BITUMINOUS MATERIALS.
(REV 6-23-22)

ARTICLE 916-2 is deleted and the following substituted:

916-2 Superpave PG Asphalt Binder.

916-2.1 Requirements: Superpave Performance Graded (PG) asphalt binders, identified as PG 52-28, PG 58-22, PG 67-22, polymer modified asphalt (PMA) binders, PG 76-22 (PMA) and High Polymer, and asphalt rubber binders (ARB), PG 76-22 (ARB), shall meet the requirements of 916-2 and AASHTO 332~~-20~~. When the Contract Documents specify either a PG 76-22 (PMA), PG 76-22 (ARB), or PG 76-22 binder, either binder can be used interchangeably at no additional cost to the Department. All PG asphalt binders shall meet the following additional requirements:

1. The intermediate test temperature at 10 rad/sec. for the Dynamic Shear Rheometer (DSR) test (AASHTO T 315~~-20~~) shall be 26.5ºC for PG grades PG 67 and higher.
2. An additional high temperature grade of PG 67 is added for which the high test temperature at 10 rad/sec for the DSR test (AASHTO T 315~~-20~~) shall be 67ºC.
3. All PG asphalt binders having a high temperature designation of PG 67 or lower shall be prepared without modification.
4. All PMA binders having a high temperature designation higher than PG 67 shall only be produced with a styrene-butadiene-styrene (SBS) or styrene-butadiene (SB) elastomeric polymer modifier and the resultant binder shall meet all requirements of this Section.
5. Polyphosphoric acid may be used as a modifier not exceeding 0.75% by weight of asphalt binder for PG 76-22 (PMA) and PG 76-22 (ARB) binders. Polyphosphoric acid may not be used in High Polymer binder.
6. PG 76-22 (ARB) shall meet the additional requirements of 916-2.1.1.
7. All PG asphalt binders having a high temperature designation of PG 67 or lower shall not have a high temperature true grade more than 5.9°C higher than the specified PG grade, (for example, if a PG 58-22 is specified, do not supply a PG 64-22 or higher).
8. The use of waste oil is prohibited in the modification of any PG binder grade. Waste oil shall be defined as recycled oil products that have not been processed through a vacuum tower and have an initial boiling point of 385°C (725°F) or lower when tested in accordance with ASTM D6352~~-19~~.
9. Re-refined engine oil bottoms (REOB)/vacuum tower asphalt extenders (VTAE) may be used as a modifier not exceeding 8.0% by weight of asphalt binder. REOB/VTAE are materials as defined in Asphalt Institute document IS-235.

For all PG binder used in all hot mix asphalt, silicone may be added to the PG binder at the rate of 25 cubic centimeters of silicone mixed to each 5,000 gallons of PG binder. If a disbursing fluid is used in conjunction with the silicone, the resultant mixture containing the full 25 cubic centimeters of silicone shall be added in accordance with the manufacturer's recommendation. The blending of the silicone with the PG binder shall be done by the supplier prior to the shipment. When the asphalt binder will be used with a foaming warm mix technology, refer to the technology supplier's guidance on the addition of silicone.

Where an anti-strip additive is required, the anti-strip additive shall meet the requirements of 916-4. The anti-strip additive shall be introduced into the PG binder by the supplier during loading.

916-2.1.1 Additional Requirements for PG 76-22 (ARB): The following additional requirements apply only to PG 76-22 (ARB):

1. The asphalt binder shall contain a minimum of 7.0% ground tire rubber (GTR) by weight of asphalt binder.
2. The GTR shall meet the requirements of Section 919.
3. Polymer modification is optional for PG 76-22 (ARB).

916-2.1.2 High Polymer Binder Blending: Existing high polymer binder may be blended in an asphalt producer's storage tank to make a PG 76-22 binder provided the following requirements are met:

1. Notify the State Materials Office (SMO) and the local District Materials Office prior to blending.
2. Follow the blending instructions of the high polymer binder supplier.
3. Submit a sample of the blended binder to a SMO approved laboratory for testing. Provide test results to the SMO.
4. Use the newly blended binder only after approval from the SMO.

916-2.2 Compliance with Materials Manual: Producers of Superpave PG binders shall meet the requirements of Section 3.5, Volume II of the Department's Material Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section35V2.shtm.

916-2.3 Reporting: Specification compliance testing results shall be reported for the tests in Table 916-1 below, unless noted otherwise. Quality control (QC) testing results shall be reported for original binder DSR (G/sin δ and phase angle, as applicable).

Table 916-1 SUPERPAVE PG ASPHALT BINDER		
Test and Method	Conditions	Specification Minimum/Maximum Value
Superpave PG Asphalt Binder Grade		Report
APL Number		Report
Modifier (name and type)	Polymer, Ground Tire Rubber with Approved Product List (APL) number, Sulfur, PPA, REOB, and any Rejuvenating Agents	Report
Original Binder		
Solubility, AASHTO T 44~~-14 (2018)~~	in Trichloroethylene	Minimum 99.0% (Not applicable for PG 76-22 (ARB))
Flash Point, AASHTO T 48~~-18~~	Cleveland Open Cup	Minimum 450ºF
Rotational Viscosity, AASHTO T 316~~-19~~	275ºF	Maximum 3 Pa·s[(a)]
Dynamic Shear Rheometer [(b)], AASHTO T 315~~-20~~	$G^*/\sin\delta$	Minimum 1.00 kPa
	Phase Angle, δ[(c)] PG 76-22 (PMA) and PG 76-22 (ARB)[(d)]	Maximum 75 degrees
Separation Test, ASTM D7173~~-20~~ and Softening Point, AASHTO T 53~~-09 (2018)~~	163±5°C 48 hours	Maximum 15°F (PG 76-22 (ARB) only)
Rolling Thin Film Oven Test Residue (AASHTO T 240~~-13 (2017)~~)		
Rolling Thin Film Oven, AASHTO T 240~~-13 (2017)~~	Mass Change %	Maximum 1.00
Multiple Stress Creep Recovery, $J_{nr,\ 3.2}$ AASHTO T 350~~-19~~	Grade Temperature (Unmodified binders only)	"S" = 4.50 kPa^{-1} max
Multiple Stress Creep Recovery, $J_{nr,\ 3.2}$[(d, e, f)] AASHTO T 350~~-19~~	67°C (Modified binders only) 76°C (High Polymer binder only)	"V" = 1.00 kPa^{-1} max Maximum $J_{nr,diff}$ = 75% 0.10 kPa^{-1} max
Multiple Stress Creep Recovery, %Recovery[(d, e)] AASHTO T 350~~-19~~	67°C (Modified binders only) 76°C (High Polymer binder only)	$\%R_{3.2} \geq 29.371\ (J_{nr,\ 3.2})^{-0.2633}$ $\%R_{3.2} \geq 90.0$

Table 916-1 SUPERPAVE PG ASPHALT BINDER		
Pressure Aging Vessel Residue (AASHTO R- 28~~-12 (2016)~~)		
Dynamic Shear Rheometer, AASHTO T 315~~-20~~	$G^*\sin\delta$, 10 rad/sec.	Maximum 6,000 kPa (g,h)
Creep Stiffness, AASHTO T 313~~-20~~	S (Stiffness), @ 60 sec. m-value, @ 60 sec.	Maximum 300 MPa Minimum 0.300
ΔTc, ASTM D7643~~-16~~	20 hours PAV aging S (Stiffness), @ 60 sec. m-value, @ 60 sec.	ΔTc ≥ -5.0°C

(a) Binders with values higher than 3 Pa·s should be used with caution and only after consulting with the supplier as to any special handling procedures, including pumping capabilities.
(b) Dynamic Shear Rheometer (AASHTO T 315~~-20~~) shall be performed on original binders for the purposes of QC testing only. The original binder G*/sin δ shall be performed at grade temperature. Grade temperature for High Polymer binder is 76°C.
(c) The original binder phase angle (AASHTO T 315~~-20~~) shall be performed at grade temperature.
(d) AASHTO T 315~~-19~~ and AASHTO T 350~~-20~~ will be performed at a 2-mm gap for PG 76-22 (ARB).
(e) All binders with a high temperature designation >67 will be tested at 67°C. PG 76-22 (PMA) and PG 76-22 (ARB) shall pass a "V" grade per AASHTO M 332~~-20~~.
(f) A maximum Jnr diff = 75% does not apply for any Jnr value ≤ 0.50 kPa-1.
(g) For 5000 kPa ≤ G*sin δ ≤6,000 kPa, the phase angle, δ, shall be a minimum of 42°.
(h) For PG 67 or higher grades, perform the PAV residue testing at 26.5°C.

SUBARTICLE 916-3.2 is deleted and the following substituted:

916-3.2 Requirements: Use a prime coat meeting the requirements of AASHTO M 140~~-20~~ for anionic emulsions, AASHTO M 208~~-18~~ or AASHTO M 316~~-19~~ for cationic emulsions, or as specified in the Producer's QC Plan. For anionic emulsions, the cement mixing test will be waived. For tack products, the minimum testing requirements shall include percent residue, naphtha content (as needed), one-day storage stability, sieve test, Saybolt Furol viscosity, original DSR, re-emulsification (FM 5-624), and solubility (on an annual basis). Residue testing shall be performed on residue obtained from distillation, AASHTO T 59~~-16~~ or low-temperature evaporation (AASHTO R 78~~-16~~) ~~(2020)~~.

At the direction of the Engineer, sample tack from the distributor used on the project at a minimum frequency of once per project per product. The sample shall be tested by the Department for the following specified material properties: percent residue, contaminants, and the residue property G*/sin δ. Should any of the test results fail the specification requirements, the tack material will be considered defective and shall not to be used on Department projects unless waived by the Engineer. Should a tack sample fail specifications, the Engineer may require three 6-inch diameter roadway cores be obtained from the day of production from which the tack sample was obtained. The roadway cores shall be tested for bond strength in accordance with FM 5-599. Individual bond strength results less than 80 psi will require removal and replacement. Failing bond strength results may result in bond strength testing for additional areas represented by the failing tack material.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 1, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **921**
Proposed Specification: **9210000 Portland Cement and Blended Cement.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Thomas Frank to change "Mill Test Report" to "Test Report" given that not all QC test reports received come from a mill in the Standard Specification. This revision includes additional minor editorial changes.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PORTLAND CEMENT AND BLENDED CEMENT.
(REV ~~6-13~~7-29-22)

SECTION 921is deleted and the following substituted:

921-1 General.

Cement shall conform to the requirements of AASHTO M 85 or AASHTO M 240, as applicable, except as provided in this Section.

921-1.1 Type of Cement: Cement may be Types I, II, II (MH), III, IV, V (as defined by AASHTO M 85), or IL, IP, IS, IT (as defined by AASHTO M 240). Cement type shall be selected based on component and environmental conditions in accordance with Section 346. Different brands of cement, cement of the same brand from different facilities, or different types of cement shall be stored separately, identified, and shall not be mixed.

921-1.2 Heat of Hydration: The cement heat of hydration for Type II (MH), Type IT, and Type IL shall be tested in accordance with ASTM C1702 and reported at three days.

921-2 Definitions.

The following definitions are applicable to the production and Quality Control (QC) of cement:

1. Approved Laboratory: A laboratory that is currently inspected by the Cement and Concrete Reference Laboratory (CCRL), is actively participating in the CCRL proficiency program, and which has all deficiencies noted at the time of inspection corrected. The laboratory must also authorize CCRL to submit their inspection reports to the State Materials Office (SMO).

2. ~~Cement~~ Producer: A cement supplier, including but not limited to a plant, a terminal, or a transfer facility, that has been qualified by the SMO. The Cementitious Materials Production Facility Listing will be maintained by the SMO.

3. ~~Mill~~ Test Report: A certification from the ~~cement supplier~~Producer showing that the cement meets the requirements of Section 921.

The ~~mill~~ test report must include, at a minimum, the following information:

a. The type of cement.
b. The production period.
c. Chemical and physical analysis of the cement.
d. The silo identification where the cement is stored.
e. The base cement phase composition, except for blended cements.
f. Amount of limestone and/or inorganic processing additions used, expressed as a percentage of the cement mass~~, as applicable~~.
g. The oxide composition of the limestone and/or inorganic processing additions~~, as applicable~~.
h. The specific gravity of cement reported as an average of the last twelve~~-~~ monthly tests, updated every six months.
i. The heat of hydration at three days~~, as applicable~~.
j. The approved laboratory that performed all tests.

A~~n a~~cceptable ~~mill~~ test report~~s~~ are~~is~~ available in the appendices~~x~~ of AASHTO M 85 for portland cement and AASHTO M 240 for blended cement, except as modified by the requirements of this Section.

4. Purchaser: The term "purchaser" in the AASHTO requirements shall be taken as the Department.

921-3 Quality Control Program.

921-3.1 General: Develop a Producer QC Program as specified in Section 105.

P~~Cement p~~roducers shall submit a proposed QC Plan to the SMO for acceptance. Complete the Cementitious Materials Producer QC Plan Checklist (Appendix B02) and submit it along with the QC Plan, in a separate file. The checklist can be found on the SMO website: https://www.fdot.gov/materials/quality/programs/qualitycontrol/checklists/index.shtm. In addition to the QC Plan, the P~~p~~roducer must submit monthly ~~mill~~ test reports from an approved laboratory which certifies that the cement in current production or supply conforms to the requirements of this Section.

~~Cement~~ P~~p~~roducers with an accepted QC Plan will appear on the Cementitious Materials Production Facility Listing.

QC test data that does not comply with ~~the specification~~ this Section will not be a reason for rejection of the material if the ~~cement~~ P~~p~~roducer's QC Plan indicated that material will be diverted and not used for Department work.

921-3.2 Sampling and Testing: An approved laboratory shall perform one QC test per day. T~~Mill t~~est reports representing no more than one month's production shall be submitted to the SMO on a monthly basis, for foreign cement, refer to 921-5.

Representatives from the Department may take verification samples at the P~~cement p~~roducer's plant, terminal, distribution facility, or the concrete production facility. Samples shall be obtained by one of the methods described in FM 5-503. Sample size shall be a minimum of one ~~-~~gallon. At the concrete production facility, cement samples shall be jointly obtained by the Department inspector and the concrete producer's representative.

Upon request of the Department, the P~~p~~roducer shall provide split samples of the cement collected for QC testing. Split samples shall be delivered to the SMO and shall be identified as representing a designated LOT of cement.

Notification of failing verification sample test results will be distributed to the P~~cement p~~roducer and concrete producer, if applicable. Split samples of the initial sample may be provided to the ~~cement supplier~~Producer and concrete producer upon request, as available.

921-3.3 Limestone and Inorganic Processing Additions: Producers intending to use limestone and/or inorganic processing additions as component materials in the production of cement shall describe the type, source, and the target amount, expressed as a percentage of cement mass. In addition, the P~~p~~roducer shall display the information required in 921-2 on the ~~mill~~ test report. Samples of any pulverized limestone and/or inorganic processing additions shall be provided to the SMO for evaluation upon request.

921-4 Shipping and Storage.

Cement shall be delivered in bags or in bulk. Portland cement from a P~~p~~roducer on the Cementitious Materials Production Facility Listing shall be shipped on the basis of ~~mill~~ test reports meeting the requirements of this Section. Ensure that each shipment is accompanied by a delivery ticket that is traceable to the ~~mill~~ test report and includes, at a minimum, the following information:

1. FDOT Facility Identifier
2. Type of cement
3. Date shipped

4. Silo Identification

The storage building, bin or silo shall be weatherproofed.

921-5 Foreign Cement Acceptance.

Cement being imported from a foreign source shall conform to all requirements of this Ssection and will be subject the following process:

1. The proposed QC Plan and the QC Plan Check-list (Appendix B02) referenced in 921-3.1 shall be sent to the SMO and will include information regarding the QC, sampling, storage, and handling of the cement at the arrival terminal as well as the shipping control to and from the arrival terminal. In addition, the QC Plan from the foreign source shall be translated to English and will be included with the proposed QC Plan for the arrival terminal.

2. An initial one-gallon sample of the imported cement shall be sent to the SMO for chemical and physical verification testing.

3. When the first ship is being loaded from foreign source, a one-gallon verification sample will be obtained and shipped to the SMO for chemical and physical property testing.

The material will be accepted for use on Department projects provided that the QC Plan has been accepted, and the results of the initial and verification samples have been confirmed to meet the requirements of this Section.

Upon receiving the shipment of cement at the arrival terminal, the Department will be notified, and a Department representative may obtain another verification sample.

TMill test reports representing each shipment shall be sent to the SMO.

921-6 Rejection of Material:

Reject The entire container ofwhich holds cement if itthat does not meet the requirements of this Section, including cement orthat has been damaged, is partially set, lumpy or caked shall be rejected.

Reject bBagged cement which if it varies more than 5% from the designated weight, or if the average weight of 50 randomly selected sacks, taken at random, is less than the designated weight, the cement shall be rejected.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 12, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **921**
Proposed Specification: **9210100 Portland Cement and Blended Cement.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Thomas Frank to remove the Moderate Heat (MH) designation and Type IV cement, for consistency with AASHTO M 85 in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PORTLAND CEMENT AND BLENDED CEMENT.
(REV 6-23-22)

ARTICLE 921-1 is deleted and the following substituted:

921-1 General.

Cement shall conform to the requirements of AASHTO M 85 or AASHTO M 240, as applicable, except as provided in this Section.

921-1.1 Type of Cement: Cement may be Types I, II, ~~II (MH),~~ III, ~~IV,~~ V (as defined by AASHTO M 85), or IL, IP, IS, IT (as defined by AASHTO M 240). Cement type shall be selected based on component and environmental conditions in accordance with Section 346. Different brands of cement, cement of the same brand from different facilities, or different types of cement shall be stored separately, identified, and shall not be mixed.

921-1.2 Heat of Hydration: The cement heat of hydration for Type II ~~(MH)~~, Type IT, ~~and~~ Type IL, Type IP, and Type IS shall be tested in accordance with ASTM C1702 and reported at three days.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 7, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **923**
Proposed Specification: **9230100 Water for Concrete.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Brian Price from Districts 1 and 7 Materials Office to add language allowing the use of blended water sources in the Standard Specification.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

WATER FOR CONCRETE.
(REV 7-25-22)

ARTICLE 923-1 is deleted and the following substituted:

923-1 General Requirements.

Water for use with cement shall be clear and free from oil, and injurious amounts of acid, alkali, chlorides, organic matter, and other deleterious substances. It shall not be salty or brackish. Water that contains quantities of substances which makes it discolored or smell unusual or objectionable, shall not be used unless approved by the Department. Water sources permitted include potable water supplies that are approved by a public health department, open bodies of water, well water, reclaimed water, and recycled water. Reclaimed water shall be as defined in Chapter 62-610, F.A.C. Open bodies of water are defined as naturally occurring rivers, lakes, and ponds. Recycled water includes wash water from mixer washout operations and stored in a lined settling pond. Water sources that meet the requirements of Table 923-1, Table 923-2 or from a public health department may be used alone or blended in a storage tank for use in batching structural or non-structural concrete. All other sources of water not listed above shall be considered recycled and reclaimed water.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 7, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **929**
Proposed Specification: **9290402 Supplementary Cementitious Materials.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Thomas Frank from the State Materials Office to remove the Moderate Heat (MH) designation, for consistency with AASHTO M 85 in the Standard Specification. This revision includes additional minor editorial changes.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

SUPPLEMENTARY CEMENTITIOUS MATERIALS.
(REV 6-23-22)

SUBARTICLE 929-4.2 is deleted and the following substituted:

929-4.2 Acceptance Testing of Slag Cement: Acceptance of slag cement from sources operating under an accepted QC Plan shall be based on the monthly test reports meeting the chemical and physical requirements of ASTM C989 and this Section. The test report shall include:

1. For slag granules, provide X-ray Fluorescence (XRF) elemental analysis of the granules, presented in oxide form. Include CaO, SiO_2, Al_2O_3, MgO, Mn_2O_3, TiO_2, Fe_2O_3, and sulfur (as sulfide).

2. For slag cement, provide XRF elemental analysis, presented in oxide form. Include CaO, SiO_2, Al_2O_3, MgO, Mn_2O_3, TiO_2, Fe_2O_3, sulfur as sulfide (S), sulfate sulfur (SO_3), and total sulfur as sulfate (SO_3).

3. The results of all testing listed under Test Methods section of ASTM C989.

4. Indicate the amount of any additions introduced during grinding of the slag granules and report compliance with Section 6 of ASTM C989.

   a. Amount of limestone added and its $CaCO_3$ content.

   b. Amount of other inorganic processing addition.

5. For calcium sulfate additions, indicate:

   a. Amount of calcium sulfate added.

   b. Form of calcium sulfate.

   c. SO_3 content.

   d. Method used to determine the amount of calcium sulfate that was added.

929-4.2.1 Assessment of Sulfate Resistance: Following guidance in ACI 233R-17 Guide to the Use of Slag Cement in Concrete and Mortar, slag cements with Al_2O_3 contents greater than 11% should be interground with calcium sulfate to avoid an undersulfated cementitious system. Provide ASTM C1012 data with a 50:50 portland cement-slag cement blend, using a Type II ~~(MH)~~ portland cement on the Department's Production Facility Listing, with an alkali content of no more than 0.6%, when any of the following conditions occur:

1.The Al_2O_3 content of the slag cement is equal to or greater than 12%.

2. The slag cement is a blend of slag granules from more than one source that are interground during production of the slag cement and for which one or more of the following are true:

   a. The Al_2O_3 contents of both slag sources are equal to or greater than 12%.

   b. The average Al_2O_3 content of the blend is equal to or greater than 12%.

   c. One of the slag sources has an Al_2O_3 content that is equal to or greater than 14%.

The Department will consider the ASTM C1012 data acceptable when the results indicate no more than 0.10% expansion at 12 months.

The Department may grant provisional acceptance if the expansion does not exceed 0.05% at 6 months.

For any slag cements with Al_2O_3 content equal to or greater than 12%, perform a retest of ASTM C1012 if the monthly test report indicates that any of the following conditions have occurred:

1. The Al_2O_3 content increases by greater than or equal to 1.0% of the content measured during qualification of the sulfate resistance.
2. The sulfate sulfur (SO_3) content decreases by 0.25% less than that measured during qualification of the sulfate resistance.
3. The Blaine fineness increases by 50 m^2/kg greater than that measured during qualification of the sulfate resistance.

The Department may grant provisional acceptance of the slag cement source if ASTM C1012 data is required for any of the above retesting conditions.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 2, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **932**
Proposed Specification: **9320000 Nonmetallic Accessory Materials for Concrete Pavement and Concrete Structures.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Dennis Golabek to delete the requirement to vulcanize external (sole) load plate to composite neoprene bearing pads in the Standard Specification. This revision includes additional minor editorial changes.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

NONMETALLIC ACCESSORY MATERIALS FOR CONCRETE PAVEMENT AND CONCRETE STRUCTURES.
(REV 5-12-22)

SECTION 932 is deleted and the following substituted:

932-1 Joint Materials.

932-1.1 Preformed Joint Filler for Pavement and Structures: Preformed joint filler shall meet the requirements of AASHTO M 153, ASTM D8139, AASHTO M 213, or cellulose fiber types meeting all the requirements of AASHTO M 213 (except for the asphalt content) is acceptable provided they contain minimums of 0.2% zinc borate as a preservative and 1.5% waterproofing wax. For AASHTO M 153, unless a particular type is specified, either Type I, Type II or Type III may be used.

Preformed joint fillers shall have a thickness equal to the width of the joint required, and shall be furnished in lengths equal to the widths of the slabs in which they are to be installed, except ~~that~~ strips which are of a length not less than the distance between longitudinal joints, or between longitudinal joint and edge, may be used if laced or clipped together in a manner approved by the Engineer. The depth and shape of the joint filler shall conform to the dimensions shown in the Plans. For doweled joints, proper provision shall be made for the installation of the dowels.

932-1.1.1 Certification: The Contractor shall submit to the Engineer a certification confirming that the preformed joint filler meets the requirements of this Section. The certification shall conform to the requirements of Section 6.

932-1.2 Joint Sealer for Pavement and Structures:

932-1.2.1 General: This Specification covers joint sealer intended for use in sealing joints in asphaltic concrete pavement and portland cement concrete pavement. These materials may also be used to seal joints in portland cement concrete bridges and other structures.

932-1.2.2 Material: The joint sealant shall be composed of a mixture of materials, typically but not limited to bituminous based, that will melt when heated for application and then solidify to form a resilient and adhesive compound capable of sealing joints in portland cement concrete and asphaltic concrete against the infiltration of moisture and foreign materials throughout normal pavement conditions and at ambient temperatures. The manufacturer shall have the option of formulating the material according to their Specifications. However, the requirements delineated in this Specification shall apply regardless of the type of formulation used. The material shall cure sufficiently to not flow from the joint or be picked up by vehicle tires after 3 hours at 77°F. The material shall be capable of a uniform application consistency suitable for filling joints without the inclusion of large air holes or discontinuities and without damage to the material.

Materials for pavement joints shall be tested according to ASTM D5329.

932-1.2.2.1 Physical Requirements of Joint Sealants for Portland Cement Concrete Only:

Table 932-1	
Parameter	Limits
Pour Point	At least 20°F lower than the safe heating temperature as stated by the manufacturer.
Cone-Penetration, Non-immersed at 77°F, 150 g, 5 s	Less than or equal to 90 mm
Flow at 140°F, 5 h	Less than or equal to 5.0 mm
Bond, Non-immersed, 0°F for 5 cycles*	No cracking, separation, or opening that at any point is over 1/4 inch deep, in the sealant or between the sealant and the substrate.
*The depth of a crack, separation or opening shall be measured perpendicular to the side of the sealant showing the defect. At least two test samples in a group of three representing a given sample of sealant shall meet this requirement.	

932-1.2.2.2 Physical Requirements of Joint Sealants for Portland Cement Concrete and/or Asphaltic Concrete:

Table 932-2	
Parameters	Limits
Pour Point	At least 20° lower than the safe heating temperature as stated by the manufacturer.
Cone-Penetration, Non-immersed at 77°F, 150 g, 5 s	Less than or equal to 90 mm
Flow at 140°F, 5 h	Less than or equal to 3.0 mm
Bond, Non-immersed, -20°F for 3 cycles, 50% extension*	No cracking, separation, or opening that at any point is over 1/4 inch deep, in the sealant or between the sealant and the substrate.
Resilience at 77°F	Recovery greater than or equal to 60%
Asphaltic Concrete Compatibility at 140°F	No failure in adhesion, formation of an oily exudates at the interface between the sealant and the asphaltic concrete, or softening or other deleterious effects on the asphaltic concrete or sealant.
*The depth of a crack, separation or opening shall be measured perpendicular to the side of the sealant showing the defect. At least two test samples in a group of three representing a given sample of sealant shall meet this requirement.	

932-1.2.3 Approved Product List (APL): The joint sealant materials used shall be one of the products listed on the Department's APL. Manufacturers seeking evaluation of their products shall submit product datasheets, performance test reports from an independent laboratory showing the product meets the requirements of this section, and an APL application in accordance with Section 6. Information on the APL application must identify the sealant type.

932-1.2.4 Shipment: The material shall be delivered in containers plainly marked with the manufacturer's name or trademark product name, LOT number and date of expiration.

932-1.2.5 Bond Breaker Rod: The bond breaker rod shall be a closed cell, expanded polyethylene foam rod of the size and dimensions shown in the Plans. It shall be compatible with the joint sealant and no bond or reaction shall occur between the rod and the sealant.

All bond breaker rods installed shall be covered by a sealant at the end of each work-day.

Bond breaker tape approved by the sealant manufacturer may be used in lieu of bond breaker rod when sealing random cracks.

932-1.3 Low Modulus Silicone Sealant Materials:

932-1.3.1 Low Modulus Silicone Sealants: Silicone sealant shall be furnished in a one part or pre-measured two-part formulation meeting the requirements specified herein.

Acetic acid cure sealants are not acceptable. A primer as specified in 932-1.4 for bonding sealant to concrete shall be used if required by the manufacturer. When a manufacturer's product is tested and approved by the Department using a primer, primer will be required for project installation.

Do not use Low Modulus Silicone Sealants Types A, B or C for bridge expansion joints.

Silicones shall be identified in the following manner:

Type A - A low modulus, non-sag (non-self-leveling) silicone formulation, used in sealing horizontal and vertical joints in cement concrete pavements and bridges (i.e., concrete-concrete joints). Tooling is required.

Type B - A very low modulus, self-leveling silicone formulation, used in sealing horizontal joints (including joints on moderate slopes) in cement concrete pavements and bridges (i.e., concrete-concrete joints). Tooling is not normally required.

Type C - An ultra-low modulus, self-leveling silicone formulation, used in sealing horizontal joints (including joints on moderate slopes) in cement concrete pavements and bridges (i.e., concrete-concrete joints). It can also be used to seal the joints between cement concrete pavements and asphalt concrete shoulders (including asphalt-asphalt joints). Tooling is not normally required.

Type D - An ultra-low modulus, self-leveling silicone formulation, cold-applied, rapid-cure, used to seal expansion joints that experience both thermal and/or vertical movements. The material must cure by chemical reaction and not by evaporation of solvent or fluxing of harder particles. Tooling shall not be required. Use in accordance with Standard Plans, Index 458-110 for bridge deck expansion joints with backer rods or as shown in the Plans for other joints with or without backer rods.

932-1.3.2 Physical Requirements:

Table 932-3

Silicone Sealant Type	Test Method	Type A	Type B	Type C	Type D
Flow	ASTM ~~d~~D5893	No Flow			
Slump (maximum)	ASTM ~~d~~D2202	0.3 inches			
Extrusion rate (minimum)	ASTM C1183, Procedure A	20 ml/min	20 ml/min	20 ml/min	20 ml/min
Tack-free time at 77 ± 3ºF and 45 to 55% Relative Humidity	ASTM C679	90 minutes maximum	180 minutes, maximum	180 minutes, maximum	20 – 60 minutes
Specific gravity	ASTM D792, Method A	1.1 to 1.515	1.10 to 1.40	1.1 to 1.5	1.26 to 1.34
Durometer hardness, Shore A (Cured seven days at 77 ± 3ºF and 50 ± 5% Relative Humidity)	ASTM D2240	10-25			

Table 932-3					
Silicone Sealant Type	Test Method	Type A	Type B	Type C	Type D
Durometer hardness, Shore 00 (Cured 21 days at 77 ± 3ºF and 50 ± 5% Relative Humidity)	ASTM D2240		40-80	20-80	
Tensile stress (maximum) at 150% elongation	ASTM D412 (Die C)	45 psi	40 psi	15 psi	
Elongation (Cured seven days at 77 ± 3ºF and 50 ± 5% Relative Humidity)	ASTM D412 (Die C)	800% minimum			600% minimum
Elongation (Cured 21 days at 77 ± 3ºF and 50 ± 5% Relative Humidity)	ASTM D412 (Die C)		800% minimum	800% minimum	
Ozone and Ultraviolet Resistance	ASTM C793	No chalking, cracking or bond loss after 5,000 hours, minimum.			
Bond to cement mortar briquets (primed if required) (Cured seven days at 77 ± 3ºF and 50 ± 5% Relative Humidity)	AASHTO T 132	50 psi minimum			
Bond to cement mortar briquets (Cured 21 days at 77 ± 3ºF and 50 ± 5% Relative Humidity)	AASHTO T 132		40 psi minimum	35 psi minimum	
Movement Capability	ASTM C719	No adhesive or cohesive failure and adhesion, 10 cycles at -50 to +100%			No adhesive or cohesive failure and adhesion, 10 cycles at +100/-50 %

Portland Cement Mortar: Briquets shall be molded and cured 28 days minimum in accordance with AASHTO T 132. Saw cut cured briquets in half, clean, and dry at 230°, plus or minus 5ºF. Bond the two halves together with a thin section of sealant. After cure of sealant, briquets shall be tested in accordance with AASHTO T 132.

932-1.3.3 Field Cure: Six-inch samples of the sealant shall be taken by the Engineer from the joint at the end of a two-week curing period and tested for durometer hardness (by FM-ANSI/ASTM D2240), except that the requirements of a 1-inch sample width shall not apply. A minimum hardness of 7.0 is required as evidence of adequate cure.

932-1.3.4 Approved Product List: The low modulus silicone sealant used shall be one of the products listed on the APL. Manufacturers seeking evaluation of their products shall submit product datasheets, performance test reports from an independent laboratory

showing the product meets the requirements of this Section, an infrared identification curve (2.5 to 15 µm) and an APL application in accordance with Section 6. Information on the APL application must identify the sealant type.

932-1.3.5 Shipment: The material shall be delivered in containers plainly marked with the manufacturer's name or trademark product name, LOT number and date of expiration.

932-1.3.6 Primer: When required by the manufacturer's product, a primer shall be used.

The manufacturer shall perform quality control tests on each LOT of sealant primer material furnished to each project and submit a certified report that each LOT of primer material furnished to a project meets the company's specifications for that product and the primer is suitable for its intended use.

Sealant primer material shall be delivered in containers plainly marked with the manufacturer's name or trademark and product name, LOT number and date of expiration.

932-1.3.7 Backer Rod and Tape Bond Breakers: Backer rods and tape shall be compatible with the joint sealant and approved by the sealant manufacturer. No bond or reaction shall occur between the rod and the sealant.

932-1.3.8 Installation: Installation, material selection, joint dimensions, bond breaker suitability (by type and project) shall be in agreement with the requirements of Standard Plans, Indexes 350-001 and 458-110. Any modifications or exceptions to these requirements shall be shown in the Plans.

For new construction projects or general use where the joints to be sealed have uniform width, a closed cell, expanded polyethylene foam backer rod bond breaker shall be required. For rehabilitation projects and similar joint seals where the joints to be sealed have irregular width, an open cell, expanded polyethylene foam backer rod bond breaker with an impervious skin shall be required.

The backer rod shall be compatible with the joint sealant. No bond or reaction shall occur between the rod and the sealant.

Tape bond breaker approved by the sealant manufacturer may be used in lieu of backer rod bond breaker when sealing joints and/or random cracks, as required.

Type D Silicone sealant shall be placed when the ambient temperature is rising and is between 55°F and 85°F and the temperature is expected to rise for the next three hours minimum to provide to adequate joint opening and compression of the sealant during curing.

All installed bond breakers shall be covered by sealant at the end of each work-day.

A tolerance in cross-sectional height at midpoint of minus 1/16 inches to plus 3/16 inches will be allowed to the nominal values shown for each joint width on the plan sheet. The Engineer shall check one joint for each 1,000 feet of roadway by cutting out specimens. If the cross section of the cut specimen is out of the allowable range, additional specimens shall be taken as follows:

One joint every 100 feet of pavement, not to exceed 500 feet.

If the average of the specimens is out of tolerance, the Contractor shall remove and replace the entire 500-foot section at no additional expense to the Department.

Installation tolerance shall be verified at 1,000-foot intervals.

932-1.4 Pre-cured Silicone Sealant:

932-1.4.1 General: Pre-cured silicone sealants are intended for sealing vertical joints on concrete surfaces. Type V1 sealant is intended for contraction joints or joints with movements less than 1/4 inches. Type V2 sealant is intended for expansion joints not exceeding 200% of the nominal joint opening. Type V2 sealant may be substituted for Type V1 sealant. The joint sealant must be listed on the APL.

932-1.4.2 Physical Requirements: Sealant material shall be a nominal 1/16 inches thick, available in standard widths from 1 inch to 6 inches, colored to match the finish surface coating of the concrete, and meet the following minimum testing requirements:

Table 932-4

Test Property Description	Test Method	Type V1	Type V2
Minimum Movement, Cohesion/Adhesion	ASTM C1523	100%	200%
Dry/Room Temperature Loss of Adhesion/Cohesion	ASTM C1523	None	None
Water Immersion Loss of Adhesion/Cohesion	ASTM C1523	None	None
Frozen Loss of Adhesion/Cohesion	ASTM C1523	None	None
Heat Loss of Adhesion/Cohesion	ASTM C1523	None	None
Artificial Weathering Loss of Adhesion/Cohesion	ASTM C1523	None	None
Tear Propagation	ASTM C1523	NT or PT (No Tear or Partial/Knotty Tear)	NT or PT (No Tear or Partial/Knotty Tear)
Ultimate Elongation	ASTM D412	250%	500%

932-1.4.3 Approved Product List: The pre-cured silicone sealant used shall be one of the products listed on the APL. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6. Applications must include test results, an infrared identification curve (2.5 to 15 μm), and a product data sheet with the recommended adhesive and installation requirements.

932-1.5 Compression Seals and Adhesive Lubricant

932-1.5.1 Preformed Elastomeric Compression Seals: Preformed Elastomeric Compression Seals shall meet the requirements of ASTM D2628 except that immersion oil IRM 903 may be substituted for Oil No. 3 in the Oil Swell test procedure.

932-1.5.2 Compression Seal Adhesive Lubricant: Compression seal adhesive lubricant shall meet the requirements of ASTM D4070. The material shall be fluid from 5°F to 120°F (-15°C to 49°C).

932-1.5.3 Certification: The manufacturer shall submit a certified test report for each LOT of material furnished to each project along with a statement certifying that the material

conforms to this specification and identifying the project number and manufacturer's LOT number.

932-1.5.4 Verification Samples: Provide verification samples in accordance with Section 6.

932-2 Structure Bearing Pads.

932-2.1 General: Furnish elastomeric structure bearing pads as shown in the Contract Documents. Elastomeric bearings as defined herein shall include plain pads (elastomer only) and laminated bearings with steel or fabric laminates. Flash tolerance, finish and appearance of bearings shall meet the requirements of the latest edition of the Rubber Handbook as published by the Rubber Manufacturer's Association, Inc. RMA-F3-T.063 for molded bearings, and RMA-F2 for extruded bearings.

932-2.2 Materials: Use elastomer that is Grade 2 or higher, as defined in the AASHTO LRFD Bridge Design Specifications, crystallization resistant, 100% virgin polychloroprene (neoprene). Use only new materials; reclaimed material is not allowed in the finished product. No wax, anti-ozonants, or other foreign material may accumulate or be applied to the surfaces of the bearing. The steel layers of the laminated pads shall utilize 10--gauge steel sheet (0.1345 inches thick). The steel utilized for the steel layers and for external load bearing plates (if specified) shall meet the requirements of ASTM A36 or ASTM A1011 Grade 36 Type I steel sheet. External load bearing plates shall be finished or machined flat to within 0.01 inches. The bottom surfaces of external load plates (masonry plates) designed to rest on bearing pads shall not exceed an out of flatness value of 0.0625 inches. External load bearing plates shall be protected from rust until all exposed surfaces can be field painted. Any rust inhibitor shall be removed from all surfaces prior to welding.

932-2.3 Sampling: A sampling LOT shall consist of a maximum of 100 bearing pads of a single type of bearing (plain, steel laminates, fabric laminates), of the same design, materials, thickness, and manufacturer, referred to here as "like pads", delivered to the project site or to an offsite storage facility within the State of Florida in reasonable proximity to the project site as determined by the Engineer. Organize stockpiled pads into groups of like pads by LOT so that they can be readily identified and sampled by the Engineer.

932-2.3.1 Ancillary Structure Pads: Sampling is not required, and acceptance is by certification.

932-2.3.2 Bridge Structure Pads: When the total number of like pads, as defined in 932-2, consists of a LOT of 10 or less, sampling is not required, and acceptance is by certification. Submit to the Engineer a certification conforming to the requirements of Section 6 stating that the structure bearing pads meet the requirements of this Section.

For LOT sizes of like pads that exceed 10, two bridge bearing pads per LOT will be selected by the Engineer, one for testing and one for verification in the event of a failing test result. LOTs will be sampled only after all like pads in the LOT are at the project site or in an offsite storage facility. Samples shall consist of complete pads as detailed in the Plans. Furnish additional complete bridge bearing pads to replace those selected for testing. Bridge bearing pads shall be available for sampling a minimum of three weeks prior to their installation. Submit the sample bridge bearing pads to a Department approved independent laboratory for testing. Shipping and testing will be at the Contractor's expense

932-2.4 Dimensional Tolerances: Fabricate elastomeric bearings within the dimensional tolerances specified below or as designated in the Plans. If any of the dimensions are outside the limits specified, the bearing pad shall be rejected.

Table 932-5		
Measurement		Tolerance (inches)
~~1.~~ Overall vertical dimensions	Design thickness ≤1.25 inches	-0, +0.125
	Design thickness >1.25 inches	-0, +0.25
~~2.~~ Overall horizontal dimensions	measurements ≤36 inches	-0, +0.25
	measurements >36 inches	-0, +0.50
~~3.~~ Thickness of individual layers of elastomer (laminated bearings only) at any point within the bearing		±0.125
~~4.~~ Variation from a plane parallel to the theoretical surface (as determined by measurements at the edge of the bearings)	Top (slope relative to bottom)	≤0.005 radians
	Sides	0.25
~~5.~~ Position of exposed connection members		±0.125
~~6.~~ Edge cover of embedded laminates of connection members		-0, +0.125
~~7.~~ Position and size of holes, slots, or inserts		±0.125
Note: If the variation in thickness of individual layers of elastomer is greater than that allowed in the tolerance for Measurement (3) (±0.125 in.), use the following equation to determine compliance: $7.5\theta + v/hr < 0.35$ provided $\theta \leq 0.02$ where θ (radians) and v (in) are absolute values of steel laminate rotation and vertical displacement. If the specified layer elastomeric layer thickness is h_r, the bearing length is L, and H_1 and H_2 are the measured maximum and minimum thicknesses at the edges of the layer, then $v=\lvert h_r-1/2(H_1+H_2)\rvert$ and $\theta=\lvert(H_1-H_2)/2L\rvert$ for interior layers and $\theta=\lvert(H_1-H_2)/L\rvert$ for top and bottom layers provided that the minimum elastomer layer thickness $H_2 \geq 0.2$ in.		

932-2.5 Ancillary Structures - Plain, Fiber Reinforced, or Fabric Laminated Bearing Pads:

932-2.5.1 Plain Pads: Plain pads shall be either molded, extruded, or vulcanized in large sheets and cut to size. Cutting shall not heat the material and shall produce a smooth finish conforming to ANSI B46.1, 6.3 µm (0.248 mils). Plain pads shall be molded or extruded to the finished thickness. Plying pads of lesser thickness together shall not be permitted. External load plates, when used, shall be protected from rusting and shall be hot bonded by vulcanization during the primary molding process. The finished pads shall withstand a minimum uniform compressive load of 1,200 psi when tested in accordance with FM 5-598.

932-2.5.2 Fiber Reinforced or Fabric Laminated Pads: Fiber reinforced pads shall be constructed with a homogeneous blend of elastomer and random-oriented high strength synthetic fiber cords. Bearing pads may be molded and vulcanized in large sheets and cut to size. Cutting shall be performed so as to prevent heating and must produce a smooth finish conforming to ANSI B46.1.

Fabric laminated bearings shall be constructed of multiple layers of fabric and elastomer. The fabric shall be composed of 8-ounce cotton duck and the pads manufactured in accordance with Military Specification MIL-C-882. Ensure the fabric is free of folds or ripples and parallel to the top and bottom surfaces.

Fiber reinforced and fabric pads shall withstand a minimum uniform compressive load of 2,400 psi when tested in accordance with FM 5-598.

932-2.5.3 Certification: The Contractor shall submit to the Engineer a certification conforming to the requirements of Section 6 stating that the ancillary structure pads meet the requirements of this Section and the physical and heat resistance properties of Section 6 of FM 5-598. For bearing pads to be used under metal railings, submit certification indicating

compliance with either, ASTM D2000 M1 BC (suffix grade 1 - basic requirements, type B, class C) or the physical and heat resistance properties of FM 5-598.

932-2.6 Bridge Structures - Elastomeric Bearing Pads: Bearings with steel laminates shall be cast as a unit in a mold and bonded and vulcanized under heat and pressure. Bearings with steel laminates which are designed to act as a single unit with a given shape factor must be manufactured as a single unit. The mold shall have a standard shop practice mold finish. The internal steel laminates shall be blast cleaned to a cleanliness that conforms to SSPC-SP6 at the time of bonding. Plates shall be free of sharp edges and burrs and shall have a minimum edge cover of 0.25 inches. If ~~E~~external load plates (sole plates) ~~shall~~are required (as specified in the Contract Documents) to be hot bonded to the bearing, it shall be done during vulcanization.

Edges of the embedded steel laminates, including the laminate restraining devices and around holes and slots shall be covered with not less than 3/16 inches of elastomer or the minimum edge cover specified in the Plans. All exposed laminations or imperfections that result in less than the specified elastomer cover of any surface of the steel laminations shall be repaired by the manufacturer at the point of manufacture. The repair shall consist of sealing the imperfections flush on the finished pads with a bonded vulcanized patch material compatible with the elastomeric bearing pad. Repairs employing caulking type material or repairing the bearings in the field will not be permitted.

932-2.6.1 Testing: Test bridge bearing pads in accordance with FM 5-598. Laminated bridge bearings must meet a minimum compressive load of 2,400 psi and non-laminated (plain) pads must meet a minimum compressive load of 1,200 psi. If any properties are identified as noncompliant with the criteria specified, the bearing shall be rejected and the verification sample tested. If the verification sample test results are also noncompliant, the LOT shall be rejected. A list of approved testing laboratories can be found on the Department's website. The URL for obtaining this information, if available, is: https://mac.fdot.gov/reports.

932-2.6.2 Marking: Each elastomeric bearing pad shall be permanently marked. The marking shall consist of the order number, LOT number, pad identification number, elastomer type, and shear modulus or hardness (when shear modulus is not specified). Where possible, the marking shall be on a face of the bridge bearing pad that will be visible after erection of the structure.

932-2.6.3 Certified Test Results: For bridge bearing pads, the Contractor shall submit to the Engineer complete certified test results from the independent laboratory for all tests specified, properly identified by LOT and project number.

932-2.6.4 Certification: The Contractor shall submit to the Engineer a certification conforming to the requirements of Section 6 stating that the bearing pads, (plain, fiber reinforced or elastomeric) meet the requirements of this Section. The certification shall designate the bearings in each LOT and state that each of the bearings in the LOT was manufactured in a reasonably continuous manner from the same batch of elastomer and cured under the same conditions.

932-3 Fiber Reinforced Polymer (FRP) Reinforcing Bars.

932-3.1 General: Obtain FRP reinforcing bars from producers currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105.

Use only solid, round, thermoset basalt fiber reinforced polymer (BFRP), glass fiber reinforced polymer (GFRP) or carbon fiber reinforced polymer (CFRP) reinforcing bars. Single or multi-wire CFRP strands are permitted as spirals for reinforcing in concrete piling

where specified in the Contract Documents. Bars shall be manufactured using pultrusion, variations of pultrusion, or other suitable processes noted in the producer's Quality Control Plan, subject to the approval of the State Materials Office (SMO). For BFRP and CFRP bars only vinyl ester or epoxy resin systems are permitted. For GFRP, use only bars manufactured using vinyl ester resin systems and glass fibers classified as E-CR or R that meet the requirements of ASTM- D578.

932-3.2 Bar Sizes and Loads: The sizes and loads of FRP reinforcing bars shall meet the requirements in Table 932-6. The measured cross-sectional area, including any bond enhancing surface treatments, shall be determined according to Table 932-7.

Table 932-6
Sizes and Tensile Loads of FRP Reinforcing Bars

Bar Size Designation	Nominal Bar Diameter (in)	Nominal Cross Sectional Area (in^2)	Measured Cross-Sectional Area (in^2)		Minimum Guaranteed Tensile Load (kips)		
			Minimum	Maximum	BFRP and GFRP Bars	CFRP (Type II) Single & 7-Wire Strands	CFRP (Type I) Bars
2.1-CFRP	0.21	0.028	0.026	0.042	-	7.1	-
2	0.250	0.049	0.046	0.085	6.1	-	10.3
2.8-CFRP	0.280	0.051	0.048	0.085	-	13.1	-
3	0.375	0.11	0.104	0.161	13.2	-	20.9
3.8-CFRP	0.380	0.09	0.087	0.134	-	23.7	-
4	0.500	0.20	0.185	0.263	21.6	-	33.3
5	0.625	0.31	0.288	0.388	29.1	-	49.1
6	0.750	0.44	0.415	0.539	40.9	-	70.7
6.3-CFRP	0.630	0.19	0.184	0.242	-	49.8	-
7	0.875	0.60	0.565	0.713	54.1	-	-
7.7-CFRP	0.770	0.29	0.274	0.355	-	74.8	-
8	1.000	0.79	0.738	0.913	66.8	-	-
9	1.128	1.00	0.934	1.137	82.0	-	-
10	1.270	1.27	1.154	1.385	98.2	-	-

932-3.3 Material Requirements: Producers shall submit to the State Materials Office (SMO), a test report of the physical and mechanical property requirements in Table 932-7 and Table 932-8 as applicable for the types and sizes of FRP reinforcing produced. Qualification testing shall be conducted by an independent laboratory approved by the Department for performing the FRP test methods.

Three production LOTS shall be randomly sampled at the production facility by a designee of the SMO. The minimum number of specimens per production LOT shall be as indicated in Table 932-7 and Table 932-8. The coefficient of variation (COV) for each test result

shall be less than 6%. Outliers shall be subject to further investigation per ASTM E178. If the COV exceeds 6%, the number of test specimens per production LOT may be doubled, a maximum of two times, to meet the COV requirement. Otherwise, the results shall be rejected. A production LOT is defined as a LOT of FRP reinforcing produced from start to finish with the same constituent materials used in the same proportions without changing any production parameter, such as cure temperature or line speed.

Table 932-7
Physical and Mechanical Property Requirements for Straight FRP Reinforcing Bars

Property	Test Method	Requirement	Specimens per LOT
Fiber Mass Fraction	ASTM D2584 or ASTM D3171	≥70%	5[n]
Short-Term Moisture Absorption	ASTM D570, Procedure 7.1; 24 hours immersion at 122°F	≤0.25%	5[m]
Long-Term Moisture Absorption	ASTM D570, Procedure 7.4; immersion to full saturation at 122°F	≤1.0%	5[m]
Glass Transition Temperature (Tg)	ASTM D7028 (DMA) or ASTM E1356 (DSC; T_m)/ASTM D3418 (DSC; T_{mg})	≥230°F ≥212°F	3[m]
Total Enthalpy of Polymerization (Resin)	ASTM E2160	Identify the resin system used for each bar size and report the average value of three replicates for each system	--
Degree of Cure	ASTM E2160	≥95% of Total polymerization enthalpy	3[n]
Measured Cross-Sectional Area	ASTM D7205	Within the range listed in Table 932-6	10[n]
Guaranteed Tensile Load[a]		≥ Value listed in Table 932-6	
Tensile Modulus		≥6,500 ksi for BFRP and GFRP ≥18,000 ksi for CFRP (Type I) Bars ≥ 22,400 ksi for CFRP (Type II) Strands	
Alkali Resistance with Load	ASTM D7705; Procedure B, set sustained load to 30% of value in Table 932-6; 3 months test duration, followed by tensile strength per ASTM D7205	≥ 70% Tensile strength retention for BFRP & GFRP ≥ 95% Tensile strength retention for CFRP	5[m]
Transverse Shear Strength	ASTM D7617	>22 ksi	5[n]
Horizontal Shear Strength[p]	ASTM D4475	>5.5 ksi	5[n]

Table 932-7 Physical and Mechanical Property Requirements for Straight FRP Reinforcing Bars			
Property	Test Method	Requirement	Specimens per LOT
Bond Strength to Concrete, Block Pull-Out	ACI 440.3R, Method B.3 or ASTM D7913	>1.1 ksi for Bars >0.9 ksi for Strands	5[m]
a – Guaranteed tensile load shall be equal to the average test result from all three LOTs minus three standard deviations. n – Tests shall be conducted for all bar sizes produced. m – Tests shall be conducted for the smallest, median, and largest bar size produced. p – Only required for BFRP bars.			

932-3.3.1 Additional Requirements for Bent FRP Bars: For all bars produced by bending straight solid FRP bars before the resin is fully cured, the minimum inside bend radius shall be at least three times the nominal diameters for bar sizes 2 through 8; and four times the nominal diameters for sizes 9 and 10.

The straight portion of a bent FRP reinforcing bar shall be extracted with sufficient length for tensile testing according to Table 932-8. When the bent shape does not allow for the tensile testing of one of its straight portions, test specimens produced at the same time during the same production LOT shall be used.

Table 932-8 Physical and Mechanical Property Requirements for Bent FRP Reinforcing Bars			
Property	Test Method	Requirement	Specimens per LOT
Fiber Mass Fraction – Bent Portion[b]	ASTM D2584 or ASTM D3171	≥70%	5[m]
Short-Term Moisture Absorption – Bent Portion[b]	ASTM D570, Procedure 7.1; 24 hours immersion at 122°F	≤0.25%	5[m]
Long-Term Moisture Absorption – Bent Portion[b]	ASTM D570, Procedure 7.4; immersion to full saturation at 122°F	≤1.0%	5[m]
Glass Transition Temperature – Bent Portion[b]	ASTM E1356 (DSC; T_m) /ASTM D3418 (DSC; T_{mg})	≥212°F	3[m]
Degree of Cure – Bent Portion[b]	ASTM E2160	≥95% of Total polymerization enthalpy	3[m]
Measured Cross-Sectional Area – Straight Portion	ASTM D7205	Within the range listed in Table 932-6	5[m]
Guaranteed Tensile Load[a] – Straight Portion		≥ Value listed in Table 932-6	

Table 932-8 Physical and Mechanical Property Requirements for Bent FRP Reinforcing Bars			
Property	Test Method	Requirement	Specimens per LOT
Tensile Modulus – Straight Portion		≥6,500 ksi for BFRP and GFRP ≥18,000 ksi for CFRP (Type I) Bar ≥ 22,400 ksi for CFRP (Type II) Strand	
Alkali Resistance without Load – Straight Portion	ASTM- D7705; 3 months test duration, followed by tensile strength per ASTM- D7205	≥ 80% Tensile strength retention	5[m]
Strength of 90° Bends	ACI 440.3, Method B.5 or ASTM- D7914	> 60% Guaranteed tensile load listed in Table 932-6	5[m]
Transverse Shear Strength – Straight Portion	ASTM- D7617	>22 ksi	5[m]
Horizontal Shear Strength[p]	ASTM- D4475	>5.5 ksi	5[m]
a – Guaranteed tensile load shall be equal to the average test result from all three LOTs minus three standard deviations. b – Bent portion specimens shall be extracted from a central location within a 90° bend. m – Tests shall be conducted for the smallest, median, and largest bent bar size produced. p – Only required for BFRP bars.			

932-3.4 Material Acceptance: Submit to the Engineer a certificate of analysis for each production LOT from the producer of the FRP reinforcing bars, confirming compliance with the requirements of this Section.

932-3.4.1 Sampling: The Engineer will select a minimum of six straight bars with minimum lengths of 7 feet each and a minimum of five bent bars or spiral bends/revolutions from each shipment, representing a random production LOT, per bar size of FRP reinforcing for testing in accordance with Table 932-9. Testing shall be conducted, at the Contractor's expense, by a Department approved independent laboratory. Each test shall be replicated a minimum of three times per sample. Submit the test results to the Engineer for review and approval prior to installation. Testing will not be required for bars to be used solely as reinforcement for sheet pile bulkheads, but LOT samples will still be selected and retained by the Engineer until final acceptance of the work.

Table 932-9 Testing Requirements for Project Material Acceptance of FRP Reinforcing Bars				
Property	Test Method	Requirement	Test Required for Straight Bar	Test Required for Bent Bar
Fiber Mass Fraction	ASTM D2584 or ASTM D3171	≥70%	Yes	Yes – bent portion[b]
Short-Term Moisture Absorption	ASTM D570, Procedure 7.1; 24 hours immersion at 122°F	≤0.25%	Yes	Yes – bent portion[b]
Glass Transition Temperature	ASTM D7028 (DMA) or ASTM E1356 (DSC; T_m)/ ASTM D3418 (DSC; T_{mg})	≥230°F ≥212°F	Yes	Yes – bent portion[b]
Degree of Cure	ASTM E2160	≥95% of Total polymerization enthalpy	Yes	Yes – bent portion[b]
Measured Cross-sectional Area	ASTM D7205	Within the range listed in Table 932-6	Yes	Yes – straight portion
Guaranteed Tensile Load[a]		≥ Value listed in Table 932-6	Yes	No
Tensile Modulus		≥6,500 ksi for BFRP and GFRP ≥18,000 ksi for CFRP (Type I) Bars ≥22,400 ksi for CFRP (Type II) Strands	Yes	No

a – Guaranteed tensile load shall be equal to the average test result from all three LOTs minus three standard deviations.
b – Bent portion specimens shall be extracted from a central location within a 90° bend.

932-4 FRP Spirals for Concrete Piling.

FRP Spirals for reinforcing in concrete piling shall be CFRP conforming to the requirements of Section 933 or 932-3 for CFRP (Type II).

932-5 Polymer Slurries for Drilled Shafts.

932-5.1 General Requirements: Synthetic polymer slurry are products that can be used to facilitate the construction of drilled shafts. The type of synthetic polymers used in drilling slurry are long chain-like hydrocarbon molecules which interact with each other, with the soil, and with the water to effectively increase the viscosity of the fluid. Commercial polymer products may come in powder, granular or liquid forms and shall be fully mixed with potable water prior to introducing it to the drilled shaft excavation.

932-5.2 Product Acceptance: All materials shall be one of the products listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of products for

inclusion on the APL shall submit an application in accordance with Section 6 and including documentation that meets the requirements of Table 932-10. A separate application must be submitted for each product type to be evaluated, showing that the product meets the applicable requirements.

Table 932-10
Documentation Requirements

Documentation	Requirements
Installation Instructions	Include mixing and disposal instructions and the Safety Data Sheet (SDS).
Product Photo	Displays the significant features of the product as required in this section. Displays location of Manufacturer name and model number.
Product Label Photo	Displays the Product Name
Technical Data Sheet	Uniquely identifies the product and includes product specifications, storage instructions, and recommended installation materials and equipment as applicable.
Test Reports	Submit test results and reports as required by Materials Manual, Vol 2 Section 2.4

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 21, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **960**
Proposed Specification: **9600201 Post – Tensioning Components.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Teddy Theryo from the Structures Design Office to update requirements for testing of post-tensioning anchorages and addressing the presence of water and moister within ducts for tendons with flexible filler.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

POST-TENSIONING COMPONENTS
(REV 9~~7~~-20~~11~~-22)

SUBARTICLE 960-2.1 is deleted and the following substituted:

960-2.1 Anchorage Assembly:

1. Construct anchorages from ferrous metal.

2. Anchorages shall develop at least 95~~96~~% of PT steel actual ultimate strength when tested in an unbonded state, without exceeding anticipated anchor set.

3. Average concrete bearing stress shall be in compliance with AASHTO LRFD Bridge Design Specifications and AASHTO LRFD Bridge Construction Specifications.

4. Test anchorages with typical local zone reinforcement shown in system drawings.

5. Test anchorages in accordance with AASHTO LRFD Bridge Construction Specifications, or the European Assessment Document Post-Tensioning Kits for Prestressing of Structures (EAD 160004-00-0301, September 2016 Edition) with the exception that the design concrete strength used in the testing will be 6,500 psi. For anchorages that will be used for tendons with flexible filler, test anchorages in accordance with EAD 160004-00-0301 Section C.3 Resistance to Fatigue.

6. Anchorages with grout or flexible filler outlets shall be suitable for inspection from either top or front of anchorage. Anchorages may be fabricated to facilitate both inspection locations or may be two separate anchorages of the same type, each providing singular inspection entry locations.

7. Geometry of grout and flexible filler outlets must facilitate access for borescope inspection directly behind wedge plate using a straight 3/8 inch diameter drill bit.

8. Ferrous metal components of an anchorage that are to be embedded in concrete shall be galvanized in accordance with Section 962. Other anchorage assembly components, including wedges, wedge plates, and local zone reinforcement need not be galvanized.

9. All anchorages shall have a permanent vented anchorage cap bolted to the anchorage.

SUBARTICLE 960-2.2.2.1 is deleted and the following substituted:

960-2.2.2.1 Anchorage Caps:

1. Provide permanent anchorage caps made of stainless steel, nylon, polyester, or Acrylonitrile Butadiene Styrene (ABS).

2. The anchorage cap must encapsulate the entire wedge plate and be fastened directly to the anchorage bearing plate. Fastening the anchorage cap to the wedge plate is not permitted.

~~2~~3. Seal Anchorage cap with "O"-ring seals or precision fitted flat gaskets placed against the bearing plate.

~~3~~4. Provide~~Place a vent~~ hole~~s~~ of 3/8 inch minimum diameter at the top and bottom of the cap. The holes must be suitable for filler venting, draining water, and inspection of the content inside the anchorage cap from the top, bottom or front of the anchorage cap as appropriate (e.g. anchorage caps not accessible from the front after filler injection must have a vent at the top of the cap). Anchorage caps may be fabricated with top/bottom holes on

both the front face and outside perimeter the cap to facilitate ~~both~~ venting, draining and inspection ~~locations~~.

5. Install the anchorage cap such that the top and bottom holes form a vertical axis oriented 90 degrees from horizontal.

~~4~~6. Anchorage caps shall have a minimum pressure rating of 150 psi.

~~5~~7. Stainless steel bolts shall be used to attach cap to anchorage.

~~6~~8. Certified test reports documenting steel chemical analysis shall be submitted when stainless steel anchorage caps are used.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **962**
Proposed Specification: **9620000 Structural Steel and Miscellaneous Metal Items (Other Than Aluminum).**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Tim McCullough from the State Materials Office to update the most current standards. Several standards have differing levels of quality. Good quality materials were provided to avoid material and maintenance issues. Several standards have varying requirements for certification, so the requirements were written to ensure the material order can be quickly and consistently checked for approval. This proposal is associated with the proposed revision to Section 700.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment

cc: Florida Transportation Builders' Assoc.
State Construction Engineer

STRUCTURAL STEEL AND MISCELLANEOUS METAL ITEMS (OTHER THAN ALUMINUM)
(REV 67-2713-22)

SECTION 962 is deleted and the following substituted:

962-1 General.

This Section covers the material and fabrication requirements for structural steel and miscellaneous metal components. All steel must be melted and manufactured in the United States and meet Section 6-5.2. All overhead cantilevers, monotubes, trusses and gantries, iron castings, steel gratings, fencing, field splices filler metals, and bridge components (including steel castings, steel forgings, and bearing material) supplied under this Specification shall be from producers currently on the Department's Production Facility Listing. Producers seeking inclusion on the Department's Production Facility Listing must meet the requirements of Section 105. Provide certifications that meet the applicable section and 962-12.

962-12 Structural Steel.

962-12.1 Structural Steel Materials: ~~Unless otherwise specified in the Contract Documents, p~~Provide structural steel for bolted or welded construction ~~in accordance with Structural Steel for Bridges, ASTM A709~~that meets the requirements of Table 962-1.1 and 962-1.2 when impact testing is specified. Grade HPS 70W shall not be substituted for Grade HPS 50W. Weathering steel shall not be substituted for non-weathering steel without Engineer approval.

Do not apply heat treatment unless approved by the Engineer.~~If the grade is not shown elsewhere in the Contract Documents, provide the grade as directed by the Engineer.All grades, as specified in the Contract Documents, are to conform to ASTM A709, as shown in Table 962-2.1 below:~~ When galvanizing is specified, provide galvanizing in accordance with 962-11.1.

Table 962-1
Structural Steel Materials

Product	ASTM	Grade/Style	Reportable Properties	Supplementary Requirements
Plate	A709	36	Composition, Yield Strength, Tensile Strength, Elongation, Killed,	None
		50		
		50S		Carbon Equivalency
		50CR		Heat-treating temperatures
		50W	Composition, Yield Strength, Tensile Strength, Elongation, Killed, Fine Grain	Corrosion Resistance Index
		HPS 50W		Corrosion Resistance Index, Heat Treatment Temperatures
		HPS 70W		

~~ASTM A709 Grade~~	~~Product Form*~~	~~Yield Strength (ksi)~~	~~Tensile Strength (ksi)~~
~~36~~	~~P, S, B~~	~~36 min~~	~~58-80~~
~~50~~	~~P, S, B~~	~~50 min~~	~~65 min~~
~~50W~~	~~P, S, B~~	~~50 min~~	~~70 min~~
~~50S~~	~~S~~	~~50-65~~	~~65 min~~
~~HPS 50W~~	~~P, S, B~~	~~50 min~~	~~70 min~~
~~HPS 70W~~	~~P, B~~	~~70 min~~	~~85-110~~
~~HPS100W (2-1/2 in or less)~~	~~P, B~~	~~100 min~~	~~110-130~~
~~HPS100W (over 2-1/2 in)~~	~~P, B~~	~~90 min~~	~~100-130~~

~~* P = plates, S = structural shapes, B = bars~~

962-~~1~~2.2 ~~Testing~~Impact Requirements: Structural steel subject to tensile stress for main load-carrying members shall meet the impact requirements listed in Table 962-2. Mill test reports shall identify average impact test values. Provide certifications that meet this section and 962-12. ~~For structural steel subjected to tensile stress used for main load-carrying members or components (as defined in Section 460), meet the ASTM A709 impact test requirements for non-fracture and fracture critical tension components as specified in the Contract Documents. Meet the requirements for Zone 1 (Minimum Service Temperature 0ºF).~~

~~If not specified elsewhere in the Contract Documents,~~For non-fracture and fracture critical tension components, provide structural steel in accordance with ASTM A709 ~~requirements for non-fracture and fracture critical tension components as directed by the Engineer~~.

Table 962-2
Requirements for Impact Testing Structural Steel

Product	ASTM	Grade	Zone	Minimum Average Energy (ft*lbf)	
				Non-Fracture Critical	Fracture Critical
Structural Steel	A709	36	1	15 at 70°F	25 at 70°F
		50 50W 50S		15 at 70°F (≤ 2.0”t) 20 at 70°F (> 2.0”t)	25 at 70°F (≤ 2.0”t) 30 at 70°F (> 2.0”t)
		50CR		15 at 70°F	25 at 70°oF
		HPS 50W		20 at 10°F (≤ 2.0”t) 25 at 50°F (> 2.0”t)	30 at 10°F (≤ 2.0”t) 35 at 50°F (> 2.0”t)
		HPS 70W		25 at -10°F	35 at -10°F
Structural Steel Tubing	A500	B, C, D		15 at 70°F	25 at 70°F
	A501	A, B			
	A847	Round, Square, Rectangle, Special			

Note: If yield ≥15 ksi above specified grade, test temperature must drop 15°F for each 10 ksi above grade.

962-~~2~~3 Steel Castings.

Provide carbon steel and corrosion resistant castings in accordance with this section and Table 962-3.

962-~~2~~3.1 Carbon Steel Castings: Perform heat treatments by annealing, normalizing, normalizing & tempering, or quenching & tempering after castings have been allowed to cool from the pouring temperature to below the transformation temperature range as regulated by the use of pyrometers. Class 1 castings shall be used if post-weld heat treatment is specified in the contract documents.~~Provide carbon steel castings that conform to the requirements of ASTM A27. Unless otherwise specified in the Contract Documents, all castings are to be Grade 65-35 or Grade 70-36.~~

962-~~2~~3.2 Corrosion Resistant Steel Castings: ~~Provide corrosion resistant Iron-Chromium or Iron-Chromium-Nickel castings that conform to the requirements of ASTM A743. Unless otherwise specified in the Contract Documents, all castings are to be Grade CA-15M.~~ Perform heat treatments by air cooling and tempering; or annealing as defined in ASTM A743 Table 1.

Table 962-3
Requirements for Steel Castings

Product	Standard	Grade	Class	Reportable Properties	Supplementary Requirements
Carbon Steel	ASTM A27	65-35, 70-36	1, 2	Composition, Tensile, Class	None
Corrosion Resistant Steel	ASTM A743 AASHTO M 163	CA 15M	All	Composition, Heat Treatment	S11, S12

962-~~3~~4 Steel Forgings.

Provide carbon steel and alloy steel forgings from which pins, rollers, trunnions, shafts, gears, or other forged parts are fabricated in accordance with this section and Table 962-4. ~~that conform to ASTM A668. Unless otherwise specified in the Contract Documents, all forgings are to be Class C, D, F, or G.~~

The manufacturer may elect to choose from any of the class specific heat treatments identified in the Table 962-4, provided that the controlling cross-sectional thickness meets mechanical property test requirements. Retreatment by re-austenitizing a lot is allowed up to three times when the mechanical properties have not been met. Re-testing of the mechanical properties is required on any lot subject to retreatment.

Table 962-4 Requirements for Steel Forgings				
Product	Standard	Class	Reportable Properties	Supplementary Requirements
Steel Forgings	ASTM A668 AASHTO M 102	C, D, F, G	Composition, Tensile, Yield, Elongation, Hardness	S7

962-45 Iron Castings.

Provide iron castings that conform to the requirements of this section and Table 962-5. Use producers listed on the Department's Production Facility Listing for galvanizing.

962-45.1 Gray Iron Castings: Provide gray iron castings that conform to the requirements of this section and Table 962-4. AASHTO HL-93 load testing may be substituted for tensile testing when specified in the contract documents. When Alternative G castings are specified, provide a composition that precludes the possibility of embrittlement during the normal thermal cycle of hot-dip galvanizing. ~~AASHTO M105. For frames, grates, rings, and covers for inlets, manholes, and other structures placed in areas of vehicular traffic, conform to the requirements of AASHTO M306. Unless otherwise specified in the Contract Documents, provide gratings, manhole covers and frames to Class 35B and machinery parts to Class 30.~~

962-45.2 Ductile Iron Castings: ~~Provide ductile iron castings that conform to the requirements of ASTM A536. Unless otherwise specified in the Contract Documents, provide castings to Grade 414-276-18. In addition to the specified test coupons, test specimens from parts integral with the castings, such as risers, are to be tested for castings with a mass more than 1,000 pounds to determine that the required quality is obtained in the castings in the finished condition.~~Perform full ferritizing anneal to remove carbides or stabilized pearlite. AASHTO HL-93 load testing may be substituted for tensile testing when specified in the contract documents.

962-54.3 Malleable Iron Castings: ~~Provide malleable iron castings that conform to the requirements of ASTM A47. Unless otherwise specified in the Contract Documents, provide castings to Grade 24118.~~Perform heat treatments in the same production furnace and in the same cycles as the castings they represent. Produce a microstructure consisting of temper carbon nodules distributed through a ferritic matrix and free of excessive pearlite, massive carbides, and primary graphite. When critical sections of the production castings differ appreciably from that of the central portion, the time cycle for tempering may be altered from that of the production lot in order to obtain similar microstructures, or hardness, or both.

When Alternative G castings are specified, provide a composition that precludes the possibility of embrittlement during the normal thermal cycle of hot-dip galvanizing, or provide heat treatment that immunizes the casting against embrittlement during the normal thermal cycle of hot-dip galvanizing.

Table 962-5 Requirements for Iron Castings				
Product	Standard	Grade/Class	Reportable Properties	Supplementary Requirements
Gray Iron Traffic Service	AASHTO M 105 & AASHTO M 306	35B	Tensile*	None
Gray Iron Machinery	AASHTO M 105	30	Tensile	None
Ductile Iron	ASTM A536	60-40-18	Tensile*, Yield, Elongation, Heat Treatment	Additional Tensile test for castings > 1,000 lbs.
Malleable Iron	ASTM A47	30518 [24118]	Tensile, Yield, Elongation, Heat Treatment	None
*AASHTO HL-93 may be substituted for tensile testing of vaned gratings, when specified in the contract.				

962-65 Bolts, Nuts and Washers Not Designated as High-Strength.

Provide bolts, nuts, and washers not designated as high strength meeting the requirements listed in this Section and Table 962-6. When galvanizing is specified in the contract documents, provide galvanizing in accordance with 962-11.3.1.~~Provide bolts that conform to the requirements of ASTM A307 or ASTM A449. Provide nuts that conform to the requirements of ASTM A563 and washers that conform to ASTM F436, unless specified as ordinary rough or machine bolts as approved by the Engineer. Washers provided to ASTM F844 and nuts to ASTM A194 may be used with the Engineer's approval.~~

Use double nuts, when ordinary rough or machine bolts are specified in the Contract Documents. Bolted assemblies shall be made of similar coating composition. When weathering material is used, provide the entire assembly in weathering steel. Bolts meeting the requirements of ASTM A193, washers meeting the requirements of ASTM F844 and nuts meeting the requirements of ASTM A194 or AASHTO M292 may be used with the Engineer's approval.

Table 962-6 Bolts, Nuts, and Washers Not Designated as High-Strength				
Product	Standard	Grade	Style	Reportable Properties
Bolts	ASTM A307	A, B	Heavy Hex, Threaded Rod	Size, Composition, Hardness, Tensile
	ASTM A449	1, 3	Hex, Threaded Stud	Size, Composition, Tensile, Proof Load, Hardness

Table 962-6 Bolts, Nuts, and Washers Not Designated as High-Strength				
Product	Standard	Grade	Style	Reportable Properties
	ASTM F593	Group 2 316 or 316L	Condition A CW1 or SH1	Alloy, Group, Condition
	ASTM A193*	B7, B16	Any	Size, Composition, Hardness, Heat Treatment, Macroetch results
Nuts	ASTM A563	A	Hex	Size, Composition, Proof Load, Hardness
		C, C3, DH, DH3	Heavy Hex	
	ASTM F594	Group 2 316 or 316L	CW	Alloy, Group, Condition
	ASTM A194*	2, 2H	Hex, Heavy Hex	Composition, Hardness, Proof Load
	AASHTO M 292*	2, 2H	Hex, Heavy Hex	Size, Composition, Hardness, Heat Treatment, Macroetch results
Washers	ASTM F436	1, 3	Circular, Beveled, Clipped, Extra Thick	Size, Hardness
	N/A	316 or 316L	Any	Alloy, Size
	ASTM F844*	Plain	Round, Miscellaneous	Size
	ASTM A36	All	N/A	Killed, Thickness
Shims	ASTM A1011	Any	Any	None
	ASTM A109	Any	Any	None
	ASTM B36	Brass	Any	None

962-76 High-Strength Bolts, Nuts, Washers and Direct-Tension-Indicator (DTI) Devices.

~~Use~~Provide high-~~-~~strength bolts, nuts, washers and DTI devices ~~meeting the following requirements:~~in accordance with this Section and Table 962-7. High-strength bolts shall have identifying marks meeting ASTM F3125 Table 2 and ASTM A563. High-strength bolted assemblies shall be made of similar coating composition. When galvanizing is specified in the contract documents, provide galvanizing in accordance with 962-11.3.2. Bolts meeting the requirements of ASTM F3125 Grade A490, washers meeting the requirements of ASTM F844, and nuts meeting the requirements of ASTM A194 or AASHTO M 292 may be used with the Engineer's approval.

~~Bolts: Grade A325 or Grade A490, Heavy Hex. Only use Grade A490 high strength bolts with the approval of the Engineer.~~

~~Nuts: ASTM A563, Heavy Hex. Select nuts in accordance with ASTM F3125 (Table 1). If grade C, D or C3 nuts are selected, provide with a minimum Rockwell hardness of 89 HRB or a minimum Brinell hardness of 180 HB. Use nuts meeting the requirements of ASTM A194 only when approved by the Engineer.~~

~~Washers: ASTM F436 and ASTM F3125 (Table 1). Use washers meeting the requirements of ASTM F844 only when approved by the Engineer.~~

~~Identifying Marks: in accordance with ASTM F3125 (Table 1) and ASTM A563.~~

~~DTI devices: meeting the requirements of ASTM F959. Furnish plain DTI devices for use with plain bolts if the finish coat of paint is applied after installation and testing of the DTI device and will cover the remaining gap. Otherwise, coat the DTI device in accordance with the manufacturer's recommendations.~~

~~When the Contract Documents call for uncoated weathering steel in any component of the connected part, provide Type 3 bolts and washers, and nuts with weathering characteristics. If one side of the assembly is coated and the other exposed weathering steel, coat the fastener assembly on the coated side similarly (Such as the case for weathering steel tub girders coated on the inside only).~~

~~Ensure that fastener assemblies are properly lubricated in accordance with ASTM A563 Supplementary Requirements S1 and S2.~~

Table 962-7
Requirements for High-Strength Steel Fastener Assemblies

Products	Standard	Grade	Type/ Style	Reportable Properties	Supplementary Requirements
Bolts	ASTM F3125	A325	Heavy Hex	Size, Composition, Tensile, Proof Load, Hardness,	None
		A490*		Size, Composition, Tensile, Proof Load, Hardness, Magnetic Particle, Carburization/ Decarburization	
	ASTM A193	B7, B16	Any	Size, Composition, Hardness, Heat Treatment, Macroetch results	S5
Nuts	ASTM A563	DH, DH3	Heavy Hex	Size, Composition, Proof Load, Hardness	S1, S2 min. 89 HRB or 180 HB
	ASTM A194*	2H	Heavy Hex	Size, Composition, Hardness	Max HRC32

Table 962-7 Requirements for High-Strength Steel Fastener Assemblies					
Products	Standard	Grade	Type/ Style	Reportable Properties	Supplementary Requirements
	AASHTO M 292*	2H	Heavy Hex	Size, Composition, Hardness, Heat Treatment, Macroetch results	Max HRC32
Washers	F436	Circular, Beveled, Clipped, Extra Thick	1, 3	Size, Hardness	None
	F844*	Round, Miscellaneous	Plain	Size	None
	ASTM A709	36, 50	Any	Yield, Tensile, Elongation, Killed	None
DTI Devices	F959	A325	1	Size, Composition, Compression Load, Hardness	None
			3	Size, Composition, Compression Load, Hardness, Corrosion Resistance Index	
*Requires Engineer Approval.					

962-8~~7~~ Anchor Rods and Bridge Bearing Materials.

962-8.1 Bearing and Masonry Plate: Meet the requirements of Table 962-8. Masonry plates and bearings shall be welded in accordance with AASHTO/AWS D1.5 Bridge Welding Code. When galvanizing is specified meet the requirements of 962-11.1. Use producers listed on the Department's Production Facility Listing for galvanizing.

~~Provide anchor rods, washers, masonry plates, bearings and other miscellaneous metal components that conform to the following requirements:~~

~~Provide anchor rods that conform to the requirements of ASTM F1554 unless the Engineer approves the use of anchor rods meeting the requirements of ASTM A307, with nuts that meet the requirements of ASTM A563, Hex Nuts, Heavy and with a finish consistent with the rod. Nuts meeting the requirements of ASTM A194 may be used only with the Engineer's approval.~~

~~Use washers meeting the requirements of ASTM F436, with a finish consistent with the rod. Washers meeting the requirements of ASTM A844 may be used only with the Engineer's approval.~~

Table 962-8 Requirements for Bearings and Masonry Plate					
Product	ASTM	Grade	Style	Reportable Properties	Supplementary Requirements
Plate	A709	50W	All	Yield, Tensile, Elongation, Killed, Fine Grain	Corrosion Resistance Index
Laminates	A240	316	Gage 16	Yield, Tensile, Elongation, Hardness	None
	A1011	36	HSLAS, Class 1	Designation, Style	None
	A36	All	All	Yield, Tensile, Elongation, Killed	None

962-8.2 Anchor Rods and Bearing Hardware: Provide anchor rods and other bearing hardware in accordance with this section and Table 962-9. All fastening components shall be made of similar composition. When galvanizing is specified in the contract documents, provide galvanizing in accordance with Section 962-11.3.1. Anchor rods meeting the requirements of ASTM A307, washers meeting the requirements of ASTM F844, and nuts meeting the requirements of ASTM A194 may be used with the Engineer's approval.

Table 962-9 Requirements for Anchor Rods and Bearing Hardware					
Product	ASTM	Grade	Style	Reportable Properties	Supplementary Requirements
Bolts	F1554	36	Threaded Rod	Lot, Size, Tensile	None
		55		Lot, Size, Tensile, Carbon Equivalency	S1
		105		Lot, Size, Tensile, Carbon Equivalency	S3
	A307*	A, B	Threaded Rod	Size, Composition, Hardness, Tensile	S1
Nuts	A563	DH	Heavy Hex	Size, Composition, Proof Load, Hardness	None
	A194*	2H	Heavy Hex	Size, Composition, Hardness	None
Washers	F436	1, 3	Circular, Beveled, Clipped, Extra Thick	Size, Hardness	None
	F844*	Plain	Round, Miscellaneous	Size	None
Plate	A36	All	All	Yield, Tensile, Elongation, Killed	None

Table 962-9 Requirements for Anchor Rods and Bearing Hardware					
Product	ASTM	Grade	Style	Reportable Properties	Supplementary Requirements
Shim	A653	All	Min. G30	Grade	None
	A1008 A36	All	A153, F2329	None	None
*Requires Engineers Approval.					

962-89 Overhead Signs.

Provide overhead sign materials in accordance with this section Table 962-2, and Table 962-10. When galvanizing is specified, meet the requirements of 962-11.1. Produce welds using E7018 electrode, in accordance with AWS D1.1 Structural welding Code.

Table 962-10 Requirements for Overhead Signs					
Product	Standard	Grade	Type/ Style	Reportable Properties	Supplementary Requirements
Upright Pipe	API 5L	X42R, X42N, X42M, X46N, X46M, X52N, X52M, X56N, X56M, X60N, X60M, X65M, X70M	PSL2	Killed, Fine Grain, Tensile, CVN Test	N/A
	A500	B, C	Round Structural	Composition, Yield, Tensile, Elongation	UT Seam Weld, (per API 5L) CVN Test per 962-2
Chords	A500	B, C	Round Structural	Composition, Yield, Tensile, Elongation	N/A
Plate, Angles & Handhole Frame	A709	50	Plates & Shapes	Composition, Yield, Tensile, Elongation	N/A
	A36	36			Yield > 50ksi
Poles	A1011	50, 55, 60, 65	Any	Designation, Grade	N/A
	A572	50, 55, 60, 65	1, 2, 3, 5	Composition, Tensile, Type, Killed	N/A

Table 962-10 Requirements for Overhead Signs					
Product	Standard	Grade	Type/ Style	Reportable Properties	Supplementary Requirements
	A595	A, B	Any	Composition, Tensile, Type, Killed	N/A

962-108 Miscellaneous Metal Items.

962-10.1 General: Unless otherwise specified in the cContract dDocuments, provide miscellaneous metal components in accordance with this section and Table 962-11, Table 962-12, Table 962-13, or Table 962-14. Structural tubing subject to tensile stresses, as defined in Section 460, shall meet Table 962-2.2 for tension components, Zone 1. Welding shall be done in accordance with the most current AWS D1.1 structural welding code. When galvanizing is specified in the contract documents, provide galvanizing in accordance with the contract documents.

Requirements for concrete reinforcement are contained in Section 931.

Requirements for steel guardrail are contained in Section 967.

~~the following specific materials.~~

Table 962-11 Requirements for Miscellaneous Metals				
Product	Standard	Grade	Type/ Style	Reportable Properties
Steel Sheet Piling	A328	All	Cold Rolled, Heat Treated	Composition, Tensile, Killed
	A572	42, 50, 55, 60, 65	1, 2, 3, 5	Composition, Tensile, Size, Killed
	A690	All	All	Composition, Tensile, Killed
Steel Pipe Piling	A252	3	All	Composition, Tensile, Size
	API 5L	X46, X52, X56, X60, X65, X70	PSL1	Tensile
			PSL2	Killed, Fine Grain, Tensile
Structural Tubing	A500	Round	B, C	Composition, Tensile, Flattening Test, Impact (Zone 1), Size
		Shaped		Composition, Tensile, Impact (Zone 1), Size
	A501	Square, Round, Rectangular, Special	A, B	Composition, Tensile, Impact (Zone 1), Size
	A847	Round	Welded, Seamless	Composition, Tensile, Flattening, Impact (Zone 1), Size
		Square, Rectangle, Special	Welded, Seamless	Composition, Tensile, Impact (Zone 1), Size

Table 962-11 Requirements for Miscellaneous Metals				
Product	Standard	Grade	Type/ Style	Reportable Properties
Pipe Railing	A53	A, B	E, S	Composition, Mechanical Testing (Tensile, Bend, Flattening), Size

~~**962-8.1 Pipe Railings:** Provide steel pipe conforming to the requirements of ASTM A53 for Standard Weight Pipe.~~

~~**962-8.2 Steel Sheet Piling:** Provide steel sheet piles conforming to the requirements of ASTM A328, ASTM A572 or ASTM A690.~~

~~**962-8.3 Steel Sign Supports and Accessories:** Provide steel members for sign supports that meet the material requirements specified in the Contract Documents.~~

~~**962-8.4 Structural Tubing:**~~

~~**962-8.4.1 Materials:** Provide steel structural tubing as one of the following:~~
~~Cold-formed, welded or seamless conforming to the requirements of ASTM A500, Grade B or C, coated in accordance with the Contract Documents;~~
~~Hot-formed, welded or seamless tubing conforming to the requirements of ASTM A501, coated in accordance with the Contract Documents;~~
~~ASTM A847 when weathering characteristics are required; or~~
~~As indicated elsewhere in the Contract Documents.~~

~~**962-8.4.2 Testing:** Structural steel tubing subjected to tensile stresses used in main load carrying members or components (as defined in Section 460) shall meet the impact test requirements of ASTM A709 for non-fracture and fracture critical tension components for Zone 1. Minimum Average energy shall be 15 ft-lbf at 70°F (non-fracture critical); or 25 ft-lbf at 70°F (fracture critical).~~

~~**962-8.5 Steel for Concrete Reinforcement:** Requirements for concrete reinforcement are contained in Section 931.~~

~~**962-8.6 Steel Guardrail:** Requirements for steel guardrail are contained in Section 967.~~

962-108.27 Field Splice Filler Materials: Provide field splice filler materials in accordance with the cContract dDocuments. If unspecified and less than 3/16 inches thick filler splice materials in accordance with this section and Table 962-12. Filler plates may also meet the appropriate grades specified in 962-2. When galvanized plate is specified, use producers listed on the Department's Production Facility Listing for galvanizing.
~~provide ASTM A606 or ASTM A1011.~~

Table 962-12 Requirements for Field Splice Filler Materials				
Product	Standard	Grade	Type/ Style	Reportable Properties
Filler Sheet	A1011	50	HSLAS, Class 1	Designation, Grade

962-10.3 Fencing Material: Provide fencing materials in accordance with this section and Table 962-13. When galvanizing is specified, provide galvanizing in accordance with the

contract documents. Use producers listed on the Department's Production Facility Listing for Coated Steel Fencing.

Table 962-13 Material Requirements for Fencing				
Product	Standard	Grade / Type	Style	Reportable Properties
Fabric	A116	60	No. 9	Breaking Strength, Coating Weight
		175	No. 12-1/2	
	A584	175	No. 12-1/2	
	M181	1, 2, 4	No. 9	
	A392	All	No. 9	
	A491	All	No. 9	
	F668	All	No. 9	
Posts	A702	50	Carbon, Rail	Tensile or Hardness
Pipe, Tube	A53	A, B	E, F, S	Grade, Finish
	F1083	Schedule 40	High Strength	Schedule
	F1043	1C	All	Group, Coating, Type
		1A	High strength	
Beam	A36	36	All Shapes	Grade, Killed
	A572	42		
	A992	50		
Sheets	A1011	36, 45, 50	HSLAS, HSLAS-F, SS	Designation, Style

~~**962-8.8 Steel Pipe Piling:** Provide seamless, or longitudinal or helical welded pipe conforming to the requirements of API 5L Grade L320, X46 or higher, or ASTM A252 Grade 3. Provide longitudinal or helical welded pipe with only complete joint penetration (CJP) welds conforming to the requirements of API 5L or AWS D1.1.~~

962-108.49 Steel Grades: Provide steel grating in accordance with this section and Table 962-14. When vaned gratings are specified, AASHTO HL-93 load testing may be substituted for tensile testing when specified in the contract documents. When Alternate G is specified, provide galvanizing in accordance with 962-11.1.~~Grade 50 steel per ASTM A242/A242 M, A572/A572 M or A588/A588 M for grates. Galvanize grates in accordance with 962-9 when "Alt. G" grates are specified in the Plans.~~

Use producers listed on the Department's Production Facility Listing for galvanizing.

Table 962-14 Requirements for Steel Grating				
Product	Standard	Grade	Type/ Style	Reportable Properties
Steel Grating	A242	50	1	Composition, Tensile*, Killed
	A572		1, 2, 3, 5	Composition, Tensile*, Size, Killed
	A588		A, B, K	Composition, Tensile*, Fine Grain
	A1011	Any	SS, HSLAS, HSLAS-F	Designation, Style
* AASHTO HL-93 may be substituted for tensile testing for vaned gratings when specified.				

962-11~~9~~ Galvanizing.

962-11~~9~~.1 Plates, Structural Shapes, Bars, and Strip: When galvanizing is specified in the Contract Documents for ferrous metal products, ~~other than fasteners and hardware items,~~ provide galvanizing in accordance with the requirements of ASTM A123, ~~Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products~~ Zinc composition shall meet "Intermediate Grade" in accordance with ASTM B6. Use galvanizers listed on the Department's Production Facility Listing for hot-dip galvanizing.

Table 962-15 Requirements for Galvanizing Bath Composition			
Product	Zinc (Zn)	Lead (Pb)	Tin (Sn)
Galvanizing Bath	≥ 99.00%	≤ 0.50%	≤ 0.10%

962-11.2 Castings: When Alternative G castings are specified in the contract documents, provide galvanizing in accordance with the requirements of ASTM A123. Zinc composition shall meet 962-11.1.

962-11~~9~~.3~~2~~ Fasteners and Hardware:

962-11.3.1 Fasteners and Hardware Designated Not High-Strength: When zinc coating is required in the c~~C~~ontract d~~D~~ocuments~~, fasteners and hardware items shall be galvanized~~ provide galvanizing of stell or malleable iron in accordance with the requirements of ASTM A153.~~, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware, except for high strength fasteners as noted below:~~

~~1. Do not galvanize Grade A490 bolts.~~

~~2. Mechanically galvanize Grade A3125 Type 1 bolts in accordance with ASTM B695, Class 55.~~

~~3. For all anchor rods and hardware treat the coated rods, nuts and washers with chromate after coating in a water solution containing 0.2% sodium dichromate 3 ounces/10 gallons. Coat the bolt, nut and washer used in the fastener assembly by the same zinc process, and submit a test report on the zinc coating thickness.~~

~~4. For anchor rods fabricated from material having a yield strength greater than 80,000 psi, apply an electroplated zinc coating SC 3, Type II in accordance with ASTM B633.~~

~~**962-9.3 Qualifications of Galvanizer:** Use galvanizers listed on the Department's Production Facility Listing. Producers seeking inclusion shall meet the requirements of Section 105.~~

962-11.3.2 Fasteners and Hardware Designated as High-Strength: When zinc coating is required in the Contract Documents, provide galvanizing in accordance with Table 962-16. Coating of ASTM F3125, A490 bolts is prohibited. Bake all hot dipped or electroplated bolt, rod, or bar with a tensile strength greater than or equal to 150 ksi to remove any residual hydrogen.

Table 962-16
Coating Requirements for Fastener and Hardware Designated as High-Strength

Product	ASTM	Grade	Type/Style	Coating Finish
Bolts	F3125	A325	1	ASTM B695, Class 55 ASTM F2329
		A490	All	Do Not Galvanize
Anchor Rods	F3125	A325	1	ASTM B633 SC 3, Type II
		A490	All	Do Not Galvanize
	F1554	105	All	ASTM B633 SC 3, Type II
Anchor Rods	F1554	36, 55	All	ASTM B695 Class 55 ASTM F2329
Nuts	A563	A, C, D, C3, DH, DH3	Hex, Heavy Hex	
	A194	1, 2	All	
Washers	F436	Circular, Beveled, Clipped, Extra Thick	1	
	F844	Round, Miscellaneous	A	
DTI Devices	F959	A325	1	

962-120 Certifications and Verification.

962-120.1 General: Provide certifications for steel directly from the Mill. Mill certifications shall show compliance to the specification and include the reportable properties and supplementary requirements from the applicable sections listed above.

When secondary processing, or testing has occurred, in addition to the mill certificate, provide a certified mill analysis signed by a quality control representative that show compliance with and the test results of the applicable sections listed above.

When material meeting "Buy America" is specified, the mill certification or certified mill analysis shall identify that the included material meets the Source of Supply-Steel requirements in Section 6. ~~Supply a certified mill analysis to the Engineer for all metal materials to be used in fabrication, including but not limited to plates, bars, shapes, and fasteners in accordance with their respective ASTM or AASHTO specification. Show or attach the full and complete designation of the project for which the materials are intended for use and specifically cross-identify each furnished piece to the order material.~~

~~Material meeting equivalent AASHTO and ASTM specifications may be supplied under either specification. Provide materials in accordance with the latest edition of the specifications shown below, as approved by the Engineer.~~

~~**962-10.2 Conformance:** The certified mill analysis will indicate that the material is in conformance with the applicable material specification and will include actual values from required tests. Check the certified mill analysis against the appropriate specification to ensure that materials conform to Contract Documents.~~

~~**962-10.3 Certified Mill Analysis Source:** The certified mill analysis must originate from the producer of the material and not from a supplier. Material from stock may only be accepted if it can be positively identified and the appropriate documentation is submitted.~~

~~962-11 Heat Treatments.~~

~~Provide procedures and perform heat treatments in accordance with Section 460.~~

STRUCTURAL STEEL AND MISCELLANEOUS METAL ITEMS (OTHER THAN ALUMINUM)
(REV 7-13-22)

SECTION 962 is deleted and the following substituted:

962-1 General.

This Section covers the material and fabrication requirements for structural steel and miscellaneous metal components. All steel must be melted and manufactured in the United States and meet Section 6-5.2. All overhead cantilevers, monotubes, trusses and gantries, iron castings, steel gratings, fencing, field splices filler metals, and bridge components (including steel castings, steel forgings, and bearing material) supplied under this Specification shall be from producers currently on the Department's Production Facility Listing. Producers seeking inclusion on the Department's Production Facility Listing must meet the requirements of Section 105. Provide certifications that meet the applicable section and 962-12.

962-2 Structural Steel.

962-2.1 Structural Steel Materials: Provide structural steel for bolted or welded construction that meets the requirements of Table 962-1.1 and 962-1.2 when impact testing is specified. Grade HPS 70W shall not be substituted for Grade HPS 50W. Weathering steel shall not be substituted for non-weathering steel without Engineer approval.

Do not apply heat treatment unless approved by the Engineer. When galvanizing is specified, provide galvanizing in accordance with 962-11.1.

Table 962-1
Structural Steel Materials

Product	ASTM	Grade/Style	Reportable Properties	Supplementary Requirements
Plate	A709	36 50	Composition, Yield Strength,	None

		50S	Tensile Strength, Elongation, Killed	Carbon Equivalency
		50CR		Heat-treating temperatures
		50W	Composition, Yield Strength, Tensile Strength, Elongation, Killed, Fine Grain	Corrosion Resistance Index
		HPS 50W		Corrosion Resistance Index, Heat Treatment Temperatures
		HPS 70W		

962-2.2Impact Requirements: Structural steel subject to tensile stress for main load-carrying members shall meet the impact requirements listed in Table 962-2. Mill test reports shall identify average impact test values. Provide certifications that meet this section and 962-12.

For non-fracture and fracture critical tension components, provide structural steel in accordance with ASTM A709.

Table 962-2
Requirements for Impact Testing Structural Steel

Product	ASTM	Grade	Zone	Minimum Average Energy (ft*lbf)	
				Non-Fracture Critical	Fracture Critical
Structural Steel	A709	36	1	15 at 70°F	25 at 70°F
		50 50W 50S		15 at 70°F (≤ 2.0”t) 20 at 70°F (> 2.0”t)	25 at 70°F (≤ 2.0”t) 30 at 70°F (> 2.0”t)
		50CR		15 at 70°F	25 at 70°oF
		HPS 50W		20 at 10°F (≤ 2.0”t) 25 at 50°F (> 2.0”t)	30 at 10°F (≤ 2.0”t) 35 at 50°F (> 2.0”t)
		HPS 70W		25 at -10°F	35 at -10°F
Structural Steel Tubing	A500	B, C, D		15 at 70°F	25 at 70°F
	A501	A, B			
	A847	Round, Square, Rectangle, Special			

Note: If yield ≥15 ksi above specified grade, test temperature must drop 15°F for each 10 ksi above grade.

962-3 Steel Castings.

Provide carbon steel and corrosion resistant castings in accordance with this section and Table 962-3.

962-3.1 Carbon Steel Castings: Perform heat treatments by annealing, normalizing, normalizing & tempering, or quenching & tempering after castings have been allowed to cool from the pouring temperature to below the transformation temperature range as regulated by the

use of pyrometers. Class 1 castings shall be used if post-weld heat treatment is specified in the contract documents.

962-3.2 Corrosion Resistant Steel Castings:
Perform heat treatments by air cooling and tempering; or annealing as defined in ASTM A743 Table 1.

Table 962-3
Requirements for Steel Castings

Product	Standard	Grade	Class	Reportable Properties	Supplementary Requirements
Carbon Steel	ASTM A27	65-35, 70-36	1, 2	Composition, Tensile, Class	None
Corrosion Resistant Steel	ASTM A743 / AASHTO M 163	CA 15M	All	Composition, Heat Treatment	S11, S12

962-4 Steel Forgings.

Provide carbon steel and alloy steel forgings from which pins, rollers, trunnions, shafts, gears, or other forged parts are fabricated in accordance with this section and Table 962-4.

The manufacturer may elect to choose from any of the class specific heat treatments identified in the Table 962-4, provided that the controlling cross-sectional thickness meets mechanical property test requirements. Retreatment by re-austenitizing a lot is allowed up to three times when the mechanical properties have not been met. Re-testing of the mechanical properties is required on any lot subject to retreatment.

Table 962-4
Requirements for Steel Forgings

Product	Standard	Class	Reportable Properties	Supplementary Requirements
Steel Forgings	ASTM A668 / AASHTO M 102	C, D, F, G	Composition, Tensile, Yield, Elongation, Hardness	S7

962-5 Iron Castings.

Provide iron castings that conform to the requirements of this section and Table 962-5. Use producers listed on the Department's Production Facility Listing for galvanizing.

962-5.1 Gray Iron Castings: Provide gray iron castings that conform to the requirements of this section and Table 962-4. AASHTO HL-93 load testing may be substituted for tensile testing when specified in the contract documents. When Alternative G castings are specified, provide a composition that precludes the possibility of embrittlement during the normal thermal cycle of hot-dip galvanizing.

962-5.2 Ductile Iron Castings: Perform full ferritizing anneal to remove carbides or stabilized pearlite. AASHTO HL-93 load testing may be substituted for tensile testing when specified in the contract documents.

962-5.3 Malleable Iron Castings: Perform heat treatments in the same production furnace and in the same cycles as the castings they represent. Produce a microstructure consisting of temper carbon nodules distributed through a ferritic matrix and free of excessive pearlite, massive carbides, and primary graphite. When critical sections of the production castings differ appreciably from that of the central portion, the time cycle for tempering may be altered from that of the production lot in order to obtain similar microstructures, or hardness, or both.

When Alternative G castings are specified, provide a composition that precludes the possibility of embrittlement during the normal thermal cycle of hot-dip galvanizing, or provide heat treatment that immunizes the casting against embrittlement during the normal thermal cycle of hot-dip galvanizing.

Table 962-5
Requirements for Iron Castings

Product	Standard	Grade/Class	Reportable Properties	Supplementary Requirements
Gray Iron Traffic Service	AASHTO M 105 & AASHTO M 306	35B	Tensile*	None
Gray Iron Machinery	AASHTO M 105	30	Tensile	None
Ductile Iron	ASTM A536	60-40-18	Tensile*, Yield, Elongation, Heat Treatment	Additional Tensile test for castings > 1,000 lbs.
Malleable Iron	ASTM A47	30518 [24118]	Tensile, Yield, Elongation, Heat Treatment	None

*AASHTO HL-93 may be substituted for tensile testing of vaned gratings, when specified in the contract.

962-6 Bolts, Nuts and Washers Not Designated as High-Strength.

Provide bolts, nuts, and washers not designated as high strength meeting the requirements listed in this Section and Table 962-6. When galvanizing is specified in the contract documents, provide galvanizing in accordance with 962-11.3.1.

Use double nuts, when ordinary rough or machine bolts are specified in the Contract Documents. Bolted assemblies shall be made of similar coating composition. When weathering material is used, provide the entire assembly in weathering steel. Bolts meeting the requirements of ASTM A193, washers meeting the requirements of ASTM F844 and nuts meeting the requirements of ASTM A194 or AASHTO M292 may be used with the Engineer’s approval.

Table 962-6 Bolts, Nuts, and Washers Not Designated as High-Strength				
Product	Standard	Grade	Style	Reportable Properties
Bolts	ASTM A307	A, B	Heavy Hex, Threaded Rod	Size, Composition, Hardness, Tensile
	ASTM A449	1, 3	Hex, Threaded Stud	Size, Composition, Tensile, Proof Load, Hardness
	ASTM F593	Group 2 316 or 316L	Condition A CW1 or SH1	Alloy, Group, Condition
	ASTM A193*	B7, B16	Any	Size, Composition, Hardness, Heat Treatment, Macroetch results
Nuts	ASTM A563	A	Hex	Size, Composition, Proof Load, Hardness
		C, C3, DH, DH3	Heavy Hex	
	ASTM F594	Group 2 316 or 316L	CW	Alloy, Group, Condition
	ASTM A194*	2, 2H	Hex, Heavy Hex	Composition, Hardness, Proof Load
	AASHTO M 292*	2, 2H	Hex, Heavy Hex	Size, Composition, Hardness, Heat Treatment, Macroetch results
Washers	ASTM F436	1, 3	Circular, Beveled, Clipped, Extra Thick	Size, Hardness
	N/A	316 or 316L	Any	Alloy, Size
	ASTM F844*	Plain	Round, Miscellaneous	Size
	ASTM A36	All	N/A	Killed, Thickness
Shims	ASTM A1011	Any	Any	None
	ASTM A109	Any	Any	None
	ASTM B36	Brass	Any	None

962-7 High-Strength Bolts, Nuts, Washers and Direct-Tension-Indicator (DTI) Devices.

Provide high-strength bolts, nuts, washers and DTI devices in accordance with this Section and Table 962-7. High-strength bolts shall have identifying marks meeting ASTM F3125 Table 2 and ASTM A563. High-strength bolted assemblies shall be made of similar coating composition. When galvanizing is specified in the contract documents, provide galvanizing in accordance with 962-11.3.2. Bolts meeting the requirements of ASTM F3125 Grade A490, washers meeting the requirements of ASTM F844, and nuts meeting the requirements of ASTM A194 or AASHTO M 292 may be used with the Engineer's approval.

Table 962-7
Requirements for High-Strength Steel Fastener Assemblies

Products	Standard	Grade	Type/ Style	Reportable Properties	Supplementary Requirements
Bolts	ASTM F3125	A325	Heavy Hex	Size, Composition, Tensile, Proof Load, Hardness,	None
		A490*		Size, Composition, Tensile, Proof Load, Hardness, Magnetic Particle, Carburization/ Decarburization	
	ASTM A193	B7, B16	Any	Size, Composition, Hardness, Heat Treatment, Macroetch results	S5
Nuts	ASTM A563	DH, DH3	Heavy Hex	Size, Composition, Proof Load, Hardness	S1, S2 min. 89 HRB or 180 HB
	ASTM A194*	2H	Heavy Hex	Size, Composition, Hardness	Max HRC32
	AASHTO M 292*	2H	Heavy Hex	Size, Composition, Hardness, Heat Treatment, Macroetch results	Max HRC32
Washers	F436	Circular, Beveled, Clipped, Extra Thick	1, 3	Size, Hardness	None
	F844*	Round, Miscella neous	Plain	Size	None

Table 962-7 Requirements for High-Strength Steel Fastener Assemblies					
Products	Standard	Grade	Type/ Style	Reportable Properties	Supplementary Requirements
	ASTM A709	36, 50	Any	Yield, Tensile, Elongation, Killed	None
DTI Devices	F959	A325	1	Size, Composition, Compression Load, Hardness	None
			3	Size, Composition, Compression Load, Hardness, Corrosion Resistance Index	
*Requires Engineer Approval.					

962-8 Anchor Rods and Bridge Bearing Materials.

962-8.1 Bearing and Masonry Plate: Meet the requirements of Table 962-8. Masonry plates and bearings shall be welded in accordance with AASHTO/AWS D1.5 Bridge Welding Code. When galvanizing is specified meet the requirements of 962-11.1. Use producers listed on the Department's Production Facility Listing for galvanizing.

Table 962-8 Requirements for Bearings and Masonry Plate					
Product	ASTM	Grade	Style	Reportable Properties	Supplementary Requirements
Plate	A709	50W	All	Yield, Tensile, Elongation, Killed, Fine Grain	Corrosion Resistance Index
Laminates	A240	316	Gage 16	Yield, Tensile, Elongation, Hardness	None
	A1011	36	HSLAS, Class 1	Designation, Style	None
	A36	All	All	Yield, Tensile, Elongation, Killed	None

962-8.2 Anchor Rods and Bearing Hardware: Provide anchor rods and other bearing hardware in accordance with this section and Table 962-9. All fastening components shall be made of similar composition. When galvanizing is specified in the contract documents, provide galvanizing in accordance with Section 962-11.3.1. Anchor rods meeting the requirements of ASTM A307, washers meeting the requirements of ASTM F844, and nuts meeting the requirements of ASTM A194 may be used with the Engineer's approval.

Table 962-9 Requirements for Anchor Rods and Bearing Hardware					
Product	ASTM	Grade	Style	Reportable Properties	Supplementary Requirements
Bolts	F1554	36	Threaded Rod	Lot, Size, Tensile	None
		55		Lot, Size, Tensile, Carbon Equivalency	S1
		105		Lot, Size, Tensile, Carbon Equivalency	S3
	A307*	A, B	Threaded Rod	Size, Composition, Hardness, Tensile	S1
Nuts	A563	DH	Heavy Hex	Size, Composition, Proof Load, Hardness	None
	A194*	2H	Heavy Hex	Size, Composition, Hardness	None
Washers	F436	1, 3	Circular, Beveled, Clipped, Extra Thick	Size, Hardness	None
	F844*	Plain	Round, Miscellaneous	Size	None
Plate	A36	All	All	Yield, Tensile, Elongation, Killed	None
Shim	A653	All	Min. G30	Grade	None
	A1008 A36	All	A153, F2329	None	None
*Requires Engineers Approval.					

962-9 Overhead Signs.

Provide overhead sign materials in accordance with this section Table 962-2, and Table 962-10. When galvanizing is specified, meet the requirements of 962-11.1. Produce welds using E7018 electrode, in accordance with AWS D1.1 Structural welding Code.

Table 962-10 Requirements for Overhead Signs					
Product	Standard	Grade	Type/ Style	Reportable Properties	Supplementary Requirements
Upright Pipe	API 5L	X42R, X42N, X42M, X46N, X46M, X52N, X52M,	PSL2	Killed, Fine Grain, Tensile, CVN Test	N/A

Table 962-10 Requirements for Overhead Signs					
Product	Standard	Grade	Type/ Style	Reportable Properties	Supplementary Requirements
		X56N, X56M, X60N, X60M, X65M, X70M			
	A500	B, C	Round Structural	Composition, Yield, Tensile, Elongation	UT Seam Weld, (per API 5L) CVN Test per 962-2
Chords	A500	B, C	Round Structural	Composition, Yield, Tensile, Elongation	N/A
Plate, Angles & Handhole Frame	A709	50	Plates & Shapes	Composition, Yield, Tensile, Elongation	N/A
	A36	36			Yield > 50ksi
Poles	A1011	50, 55, 60, 65	Any	Designation, Grade	N/A
	A572	50, 55, 60, 65	1, 2, 3, 5	Composition, Tensile, Type, Killed	N/A
	A595	A, B	Any	Composition, Tensile, Type, Killed	N/A

962-10 Miscellaneous Metal Items.

962-10.1 General: Unless otherwise specified in the contract documents, provide miscellaneous metal components in accordance with this section and Table 962-11, Table 962-12, Table 962-13, or Table 962-14. Structural tubing subject to tensile stresses, as defined in Section 460, shall meet Table 962-2.2 for tension components, Zone 1. Welding shall be done in accordance with the most current AWS D1.1 structural welding code. When galvanizing is specified in the contract documents, provide galvanizing in accordance with the contract documents.

Requirements for concrete reinforcement are contained in Section 931.

Requirements for steel guardrail are contained in Section 967.

Table 962-11 Requirements for Miscellaneous Metals				
Product	Standard	Grade	Type/ Style	Reportable Properties
Steel Sheet Piling	A328	All	Cold Rolled, Heat Treated	Composition, Tensile, Killed

Table 962-11 Requirements for Miscellaneous Metals				
Product	Standard	Grade	Type/ Style	Reportable Properties
	A572	42, 50, 55, 60, 65	1, 2, 3, 5	Composition, Tensile, Size, Killed
	A690	All	All	Composition, Tensile, Killed
Steel Pipe Piling	A252	3	All	Composition, Tensile, Size
	API 5L	X46, X52, X56, X60, X65, X70	PSL1	Tensile
			PSL2	Killed, Fine Grain, Tensile
Structural Tubing	A500	Round	B, C	Composition, Tensile, Flattening Test, Impact (Zone 1), Size
		Shaped		Composition, Tensile, Impact (Zone 1), Size
	A501	Square, Round, Rectangular, Special	A, B	Composition, Tensile, Impact (Zone 1), Size
	A847	Round	Welded, Seamless	Composition, Tensile, Flattening, Impact (Zone 1), Size
		Square, Rectangle, Special	Welded, Seamless	Composition, Tensile, Impact (Zone 1), Size
Pipe Railing	A53	A, B	E, S	Composition, Mechanical Testing (Tensile, Bend, Flattening), Size

962-10.2 Field Splice Filler Materials: Provide field splice filler materials in accordance with the contract documents. If unspecified and less than 3/16 inches thick filler splice materials in accordance with this section and Table 962-12. Filler plates may also meet the appropriate grades specified in 962-2. When galvanized plate is specified, use producers listed on the Department's Production Facility Listing for galvanizing.

Table 962-12 Requirements for Field Splice Filler Materials				
Product	Standard	Grade	Type/ Style	Reportable Properties
Filler Sheet	A1011	50	HSLAS, Class 1	Designation, Grade

962-10.3 Fencing Material: Provide fencing materials in accordance with this section and Table 962-13. When galvanizing is specified, provide galvanizing in accordance with the contract documents. Use producers listed on the Department's Production Facility Listing for Coated Steel Fencing.

Table 962-13 Material Requirements for Fencing				
Product	Standard	Grade / Type	Style	Reportable Properties
Fabric	A116	60	No. 9	Breaking Strength, Coating Weight
		175	No. 12-1/2	
	A584	175	No. 12-1/2	
	M181	1, 2, 4	No. 9	
	A392	All	No. 9	
	A491	All	No. 9	
	F668	All	No. 9	
Posts	A702	50	Carbon, Rail	Tensile or Hardness
Pipe, Tube	A53	A, B	E, F, S	Grade, Finish
	F1083	Schedule 40	High Strength	Schedule
	F1043	1C	All	Group, Coating, Type
		1A	High strength	
Beam	A36	36	All Shapes	Grade, Killed
	A572	42		
	A992	50		
Sheets	A1011	36, 45, 50	HSLAS, HSLAS-F, SS	Designation, Style

962-10.4 Steel Grates: Provide steel grating in accordance with this section and Table 962-14. When vaned gratings are specified, AASHTO HL-93 load testing may be substituted for tensile testing when specified in the contract documents. When Alternate G is specified, provide galvanizing in accordance with 962-11.1.

Use producers listed on the Department's Production Facility Listing for galvanizing.

Table 962-14 Requirements for Steel Grating				
Product	Standard	Grade	Type/ Style	Reportable Properties
Steel Grating	A242	50	1	Composition, Tensile*, Killed
	A572		1, 2, 3, 5	Composition, Tensile*, Size, Killed
	A588		A, B, K	Composition, Tensile*, Fine Grain
	A1011	Any	SS, HSLAS, HSLAS-F	Designation, Style
* AASHTO HL-93 may be substituted for tensile testing for vaned gratings when specified.				

962-11 Galvanizing.

962-11.1 Plates, Structural Shapes, Bars, and Strip: When galvanizing is specified in the Contract Documents for ferrous metal products, provide galvanizing in accordance with the requirements of ASTM A123, Zinc composition shall meet "Intermediate Grade" in accordance with ASTM B6. Use galvanizers listed on the Department's Production Facility Listing for hot-dip galvanizing.

Table 962-15
Requirements for Galvanizing Bath Composition

Product	Zinc (Zn)	Lead (Pb)	Tin (Sn)
Galvanizing Bath	≥ 99.00%	≤ 0.50%	≤ 0.10%

962-11.2 Castings: When Alternative G castings are specified in the contract documents, provide galvanizing in accordance with the requirements of ASTM A123. Zinc composition shall meet 962-11.1.

962-11.3 Fasteners and Hardware:

962-11.3.1 Fasteners and Hardware Designated Not High-Strength: When zinc coating is required in the contract documents provide galvanizing of stell or malleable iron in accordance with the requirements of ASTM A153.

962-11.3.2 Fasteners and Hardware Designated as High-Strength: When zinc coating is required in the Contract Documents, provide galvanizing in accordance with Table 962-16. Coating of ASTM F3125, A490 bolts is prohibited. Bake all hot dipped or electroplated bolt, rod, or bar with a tensile strength greater than or equal to 150 ksi to remove any residual hydrogen.

Table 962-16
Coating Requirements for Fastener and Hardware Designated as High-Strength

Product	ASTM	Grade	Type/Style	Coating Finish
Bolts	F3125	A325	1	ASTM B695, Class 55 ASTM F2329
		A490	All	Do Not Galvanize
Anchor Rods	F3125	A325	1	ASTM B633 SC 3, Type II
		A490	All	Do Not Galvanize
	F1554	105	All	ASTM B633 SC 3, Type II
Anchor Rods	F1554	36, 55	All	ASTM B695 Class 55 ASTM F2329
Nuts	A563	A, C, D, C3, DH, DH3	Hex, Heavy Hex	
	A194	1, 2	All	
Washers	F436	Circular, Beveled, Clipped, Extra Thick	1	
	F844	Round, Miscellaneous	A	
DTI Devices	F959	A325	1	

962-12 Certifications and Verification.

962-12.1 General: Provide certifications for steel directly from the Mill. Mill certifications shall show compliance to the specification and include the reportable properties and supplementary requirements from the applicable sections listed above.

When secondary processing, or testing has occurred, in addition to the mill certificate, provide a certified mill analysis signed by a quality control representative that show compliance with and the test results of the applicable sections listed above.

When material meeting “Buy America” is specified, the mill certification or certified mill analysis shall identify that the included material meets the Source of Supply-Steel requirements in Section 6.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **965**
Proposed Specification: **9650200 General Provisions for Aluminum Items (Including Welding).**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Tim McCullough from the State Materials Office to provide material recommendations for roadway signs and sign uprights based on maintenance issues and a change to the Standard Plans. This proposal is associated with the proposed revision to Section 700.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

GENERAL PROVISIONS FOR ALUMINUM ITEMS (INCLUDING WELDING).
(REV 6-21-22)

ARTICLE 965-2 is deleted and the following substituted:

965-2 Fabrication.

Provide fabricated components in accordance with AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, the Design Plans, and this section. Verify the strength of each Lot by tensile test. Alternate testing will not be accepted. Protect against damage and marring during transit and delivery. Provide an anodic coating (minimum 0.0002 inch) and chromate seal all hardware.

Table 965-1
Material Requirements for Aluminum Components

Product	Test Method	Alloy/Temper	Reported Properties
Pole, Arm, Extrusions	ASTM B221	6061-T6	Alloy, Temper, Thickness, Tensile Strength
		6063-T6	
Pedestal, Posts	ASTM B429	6061-T6	
Bars, Plates, Stiffeners, Backing Ring, Shims, Shapes	ASTM B221	6063-T6 6061-T6	
	ASTM B209	6061-T6	
	ASTM B308		
Railing	ASTM B221	6351-T5	
		6061-T6	
	ASTM B241		
	ASTM B210		
	ASTM B429		
J-Arm Tube	ASTM B429	6061-T6	
	ASTM B221		
J-Arm Connection Plate	ASTM B209	6061-T6	
Sheet	ASTM B209	6061-T6 5154-H38 5052-H38	
Structural Shapes	ASTM B308	6061-T6	
	ASTM B221		
Single Column Ground Sign Sand Castings	ASTM B26	A356-T6	
	ASTM B108	A356-T61	
Washers	ASTM B221	7075-T6 2024-T4	
Button Head or Flat Head Bolts	ASTM F468	2024-T4 6061-T6	S2 Lot Testing, Alloy, Temper
Hex Nuts	ASTM F467	6061-T6 6262-T9	S2 Lot Testing, Alloy, Temper

		2024-T4	

965-2.1 Light Poles: Provide aluminum lighting poles in accordance with this section and Table 965-1. Weld arms and poles in the T4 condition, using the filler metal ER4043, ER4047, ER5183, ER5356, or ER5556 in accordance with AWS D1.2 Aluminum Structural welding Code. Weld to castings in accordance with 965-2.3. Heat treat the arm and pole, until aged to the T6 condition. Transverse welds are only allowed at the base. Equip poles with a vibration damper, when specified in the contract documents.

Provide exterior surface with a clean, uniform silvery appearance, free of dark streaks and discoloration. Finish the pole and arm with a satin rubbed finish.

965-2.2 Overhead Sign Components: Provide aluminum toll gantry J-arms in accordance with this section and Table 965-1. Weld tube to plate connections in the T4 or T6 condition, using the filler metal ER4043, ER4047, ER5183, ER5356, or ER5556 in accordance with AWS D1.2 Aluminum Structural welding Code. Heat treat tube and plate in the T4 condition until aged to the T6 condition.

Provide exterior surface with a clean, uniform silvery appearance, free of dark streaks and discoloration.

965-2.3 Castings: Provide aluminum castings in accordance with this section and Table 965-1. Weld aluminum castings to itself or aluminum tube to castings using the filler metal ER4043, in accordance with AWS D1.2 Aluminum Structural welding Code. Heat treat the castings, until aged to the T6 condition.

965-2.4 Railing: Provide aluminum railing in accordance with this section and Table 965-1. Weld aluminum railing using the filler metal ER4043, ER4047, ER5183, ER5356, or ER5556 in accordance with AWS D1.2 Aluminum Structural welding Code.

965-2.5 Static Sign Assemblies: Provide aluminum sheet, plate and structural shapes in accordance with this section and Table 965-1. Weld structural profiles to itself or aluminum components using ER4043, ER4047, ER5183, ER5356 or ER5556 in accordance with AWS D1.2 Aluminum Structural Welding Code. Heat treat the structural profiles, until aged to the T6 condition.

965-2.6 Transformer Bases (Excluding Lighting):

965-2.6.1 Product Acceptance: Manufacturers seeking evaluation of products for inclusion on the APL shall submit an application in accordance with Section 6 and include the following documentation, showing that the product meets the applicable requirements.

Table 965-2
Submittal Compliance Requirements

Documentation	Requirements
Certified Test Report	Shows that product meets Moment Capacity
Installation Instructions	Include installation instructions
Product Identification Photo	Display's the manufacturer's name or logo and the model number.
Product Photo	Displays the significant features of the product as required in this section.
Technical Data Sheet or Product Drawing	Uniquely identifies the product and includes product details, notes, material specifications, dimensions, and sizes meeting the specification

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 18, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **975**
Proposed Specification: **9750000 Structural Coating Materials.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Tim McCullough from the State Materials Office to modify the approval process for bridge coating material requirements and testing criteria.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

STRUCTURAL COATING MATERIALS
(REV 10~~7~~-5~~28~~-22)

SECTION 975 is deleted and the following substituted:

975-1 General Requirements.

975-1.1 General: Upon curing, all coatings and/or coating systems must produce an adherent coating that is visually uniform. The composition of the coating is left to the discretion of the manufacturer but the finished product shall meet all requirements of this Section. All coats of multi-coat systems shall be supplied by the same manufacturer. Multi-component coatings shall be prepackaged in the required ratios.

975-1.2 Environmental Requirements: Coating materials and their waste shall be characterized as non-hazardous as defined by Resource Conservation and Recovery Act (RCRA) Subarticle C rules, Table 1 of 40 CFR 261.24 Toxicity Characteristic.

Volatile Organic Compounds (VOC) shall be less than 3.5 pounds per gallon when tested in accordance with ASTM D3960.

975-1.3 Approved Product List (APL): All polymeric coating materials except the materials in 975-4 shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their products shall submit the product data sheets, performance test reports from NTPEP or an independent laboratory showing that the product meets the requirements of this Section, a Product SDS or performance test reports showing percent weight compositional analysis including Chemical Abstract Number, ACGIH time weighted average and ceiling exposure limits for all components, lower and upper explosive limits, flash point, boiling point, amount of volatile organic compounds by weight, and specific gravity for each component of the coating system, and a APL application in accordance with Section 6.

975-1.4 Packaging and Labeling: Materials shall be shipped in containers legibly marked with application instructions, lot number, batch number, date of manufacture, shelf life, and Department APL number. Each lot or batch manufactured must have a unique number.

975-1.5 Coating Identification: When applicable, the Department will conduct Fourier Transform Infrared Spectroscopy (FTIR) analysis on coating system components for material identification.

975-2 Structural Steel Coating Systems.

975-2.1 General: Structural steel coatings shall meet the application requirements of Section 560. Prepare and coat sixteen flat and four composite test panels in accordance with AASHTO R-31 (~~(FED-STD-595,~~in color ~~Shade~~ White, ~~X6134~~ Grey or ~~X4062~~Green) for each coating system proposed for approval and submit to the State Materials Office (SMO). Samples will be subject to verification testing by the Department, as identified in 975-2.2. In addition, submit a 1~~one~~ quart wet sample of each component of each coating system, one container of compatible caulk to the SMO.

975-2.2 Performance Requirements: Each coating system will be subject to the testing identified in 975-2.2.1 and 975-2.2.2. All coatings, regardless of color, shall meet the requirements in Table 975-1.

975-2.2.1 Random Laboratory Verification Testing: Prepare and coat twelve flat test panels for random laboratory verification testing.

975-2.2.2 Outdoor Exposure Testing: Prepare and coat eight test panels (four flat and four composite) for exposure at the Department's outdoor test site. Panels will be tested in accordance with ASTM G7.

Table 975-1 Structural Steel Coating System Performance Requirements		
Laboratory Testing		
Property	Test Method	Acceptance Criteria
Slip Coefficient	AASHTO R 31 Test No. 1	Min. Class B (primer only)
Salt Fog Resistance	AASHTO R 31 Test No. 2 ASTM D610	Blister Value = 10 Average Rust Creep at the Scribe ≤ ~~0.1 inches~~3/32" Rust grade ≥ 9S, 9G, 9P after 8,760~~5000~~ hours
Salt Fog Resistance Unscribed		Blister Value = 10 Rust grade ≥ 9S, 9G, 9P after 8,760 hours
Cyclic Weathering Resistance	AASHTO R 31 Test No. 3	Blister Value = 10 Average Rust Creep at the Scribe ≤ 6/32"~~0.2 inches~~, Color Retention $\Delta E^*_{ab} \leq 8.0$, Gloss loss ~~less than~~ ≤ 33%~~0 units~~ after 15 cycles – 336 hours each cycle
Abrasion Resistance	AASHTO R 31 Test No. 4	Wear Index ≤ 2.7 mg/cycle
Adhesion	~~AASHTO R31 Test No. 5~~ASTM D4060 1,000 Cycles, CS-17 Wheel, 1 kg. Weight	Avg. system tensile strength ≥ 800 psi
~~Freeze Thaw Stability~~	~~AASHTO R 31 Test No. 6~~	~~Avg. tensile strength ≥ 800 psi~~
~~Impact Resistance~~	~~ASTM D2794~~	~~Greater than 25 inch/lbs, 1/2" impact, intrusion~~
~~Flexibility~~	~~AASHTO R 31, ASTM D522, 1 inch cylindrical mandrel~~	~~No cracking~~
2-Year Outdoor Testing		
Property	Test Method	Acceptance Criteria
Rusting	ASTM D610 ASTM D1654 a (scribed) ASTM D1654 (un-scribed)	Rust Grade ≥ 9S, 9G, 9P ~~after 5 years~~ Rating of Failure at Scribe ≥ 9 ~~after 5 years~~ After 2-Years~~Rust Grade ≥ 9 after 5 years~~
Blistering	ASTM D714	Blister Value = 10 After 2-Years~~after 5 years~~

Table 975-1 Structural Steel Coating System Performance Requirements		
Laboratory Testing		
Property	Test Method	Acceptance Criteria
Adhesion	ASTM D4541; annex A4	Avg. Tensile Strength ≥ 800 psi (un-scribed area) After 2-Years~~after 5 years~~
Color Retention	ASTM D2244	Avg. $\Delta E^*_{ab} \leq 8.0$ After 2-Years~~after 2 years~~
Gloss	ASTM D523	Avg. ≤ 3~~0~~% loss of gloss After 2-Years~~units after 2 years~~

975-2.3 Structural Steel Coating Systems for New Structures: Systems must meet the general composition requirements of Table 975-2 and this section.

Table 975-2 Structural Steel Coating System General Composition Requirements			
Primer	Intermediate	Finish	Clear (Optional)
Inorganic Zinc-Rich Ethyl Silicate	None	Inorganic Ethyl Silicate	Manufacturers Recommendation
Inorganic Zinc-Rich Ethyl Silicate	Cycloaliphatic Amine Epoxy Or Polyamide Epoxy	Polyurethane	
		Polysiloxane	
		Acrylic	
		Fluoropolymer	
Inorganic Zinc-Rich Ethyl Silicate	Polyurethane (Epoxy Stripe)	Fluoropolymer	

975-2.3.1 High Performance Coating Systems (Color Pigmented):

975-2.3.1.1 Prime Coat: Provide inorganic zinc-rich primers consisting of zinc dust, functional additives, and an inorganic binder, with appropriate solvents. The composition of the primer shall consist of an inorganic self-curing vehicle, that contains solvent-reducible silicates, titanates, and polymeric versions of the silicates. Zinc dust pigment shall contain~~be~~ a minimum of 77% zinc dust by weight and a maximum lead level of 0.01%~~Type II~~ in accordance with ASTM D520. ~~Inorganic zinc rich primers shall meet the requirements of the Society for Protective Coatings (SSPC) Paint 20, Type I, Level 2.~~ The manufacturer shall identify the amount of zinc dust on the product label. The performance requirements for gloss and color retention are not applicable.

975-2.3.1.2 Intermediate Coat: Intermediate coatings must meet Table 975-2. Epoxies must be a cycloaliphatic amine or polyamide.~~, when required by the manufacturer, shall be a component of the full coating system.~~

975-2.3.1.3 Finish Coat: The finish coat shall provide the color and gloss required for the completed coating system. A finish coat may be comprised of a single pigmented coat or a pigmented coat with a clear coat that meets Table 975-2. ~~The clear coat shall contain a dissipating colorant. The dissipating colorant shall be visible for a minimum of 12 hours after application and shall completely dissipate within 96 hours after application.~~

975-2.3.1.4 Clear Coat: The clear coat may contain a dissipating colorant. The dissipating colorant shall be visible for a minimum of 12 hours after application and shall completely dissipate within 96 hours after application.

975-2.3.2 ~~Inorganic Zinc Coating System:~~ ~~Zinc dust pigment shall be a minimum of Type II in accordance with ASTM D520. Inorganic zinc rich primers shall meet the requirements of SSPC Paint 20, Type I, Level 2. The performance requirements for gloss and color retention are not applicable.~~

~~975-2.3.3~~ Interior Box Girder Coating: The interior coat shall be one coat of white epoxy paint meeting 975-2.3.1.2 ~~polyamide or cycloaliphatic amine epoxy coating~~and listed on the Department's APL.~~.~~ ~~The f~~Faying surfaces and areas to be stud welded are to be masked off and coated with a zinc-rich primer from the APL. The performance requirements for gloss and color retention are not applicable.

975-2.4 Structural Steel Coating Systems for Existing Structures: Systems must meet the general composition requirements of Table 975-3 and this section.

Table 975-3
Structural Steel Coating System General Composition Requirements

Primer	Intermediate	Finish	Clear (Optional)
Organic Zinc-Rich Epoxy Or Inorganic Zinc-Rich Ethyl Silicate	None	Inorganic Ethyl Silicate	Manufacturers Recommendation
Organic Zinc-Rich Epoxy Or Inorganic Zinc-Rich Ethyl Silicate	Cycloaliphatic Amine Epoxy Or Polyamide Epoxy	Polyurethane	
		Polysiloxane	
		Acrylic	
		Fluoropolymer	

975-2.4.1 Prime Coat: Provide inorganic or organic zinc-rich primers consisting of zinc dust, functional additives, and an organic binder with appropriate solvents. The composition of the primer shall consist of an organic vehicle that may chemically cure or may dry by solvent evaporation. Zinc dust pigment shall contain~~be~~ a minimum of 77% zinc dust by weight and a maximum lead level of 0.01%~~Type II in~~ accordance with ASTM D520. ~~Organic zinc rich primers shall meet the requirements SSPC Paint 20, Type II, Level 2.~~

Organic z~~Z~~inc-rich primers shall be used as galvanizing repair compounds for areas greater than 100 square inches.

975-2.4.2 Intermediate Coat: Intermediate coatings must meet Table 975-3 E. Epoxies must be a cycloaliphatic amine or polyamide~~, when required by the manufacturer, shall be a component of the full coating system~~.

975-2.4.3 Finish Coat: Finish coating shall provide the color and gloss required for the completed coating system. A finish coat may be comprised of a single pigmented coating or a pigmented coating with a clear coat. ~~The clear coat shall contain a dissipating colorant. The dissipating colorant shall be visible for a minimum of 12 hours after application and shall completely dissipate within 96 hours after application.~~

975-2.4.4. Clear Coat: The clear coat may contain a dissipating colorant. The dissipating colorant shall be visible for a minimum of 12 hours after application and shall completely dissipate within 96 hours after application.

975-3 Galvanized Steel Coating System.

Coatings applied over galvanized steel shall meet the ~~outdoor exposure~~ requirements of Table 975-2~~.2~~ with the exception that test panels shall be galvanized in accordance with ASTM A123 prior to application of subsequent coatings.

Coatings applied over galvanized steel strain poles, mast arms, and monotube assemblies shall meet the requirements of Section 649 and 975-4.

975-4 Paint for Galvanized Steel Strain Poles, Mast Arms, Monotube Assemblies, Conventional Light Pole Assemblies, and Aluminum Poles, Pedestals, and Posts.

Paint systems shall meet the color requirements as specified in the Contract Documents. All paint systems shall possess physical properties and handling characteristics that are compatible with the application requirements of Section 649 for galvanized steel and Section 646 and 715 for aluminum. Materials shall be specifically intended for use over galvanized steel or aluminum, as appropriate. Paint systems shall exhibit no loss of adhesion or total color difference (ΔE^*_{ab}) greater than 8.0 units for five years after final acceptance as specified in 5-11. Cumulative surface area of delamination in excess of 100 square inches will constitute an adhesion failure. Delamination shall be defined as any area of exposed metal surface subsequent to hand tool cleaning in accordance with SSPC-SP2. A ΔE^*_{ab} value exceeding 8.0 units per the International Commission on Illumination L*a*b* 1976 (CIELAB) space and color difference formula, measured in accordance with ASTM D2244, will constitute a color retention failure.

The Department will measure and enter in the Department's database the CIELAB color chromaticity coordinates for the color of the top coat of sample coupons provided as required by 649-4.3 using a BYK-Gardner Handicolor colorimeter using D65 illuminant and 2-degree geometry settings. The Department-measured CIELAB chromaticity coordinates shall define the initial color and will be used for resolution of color retention failures and the resolution of color retention disputes.

975-5 Elastomeric Coatings.

975-5.1 General: Use an elastomeric coating system to provide a waterproof barrier over post-tensioning anchorages or other areas designated in the Plans. The components of the coating system shall be supplied by a single manufacturer and sold as a waterproof coating system. The surface preparation and application of the coating system shall be performed in strict accordance with the manufacturer's specifications. Upon request, submit a one quart wet sample of each component of each coating system to the SMO.

975-5.2 Physical Properties: The use of an epoxy prime coat is dependent upon the requirements of the manufacturer's waterproofing system. The polyurethane chemistry may be either waterborne aromatic (moisture-curing) or aromatic (moisture-sensitive). The elastomeric coating shall meet the requirements in Table 975-4~~2~~.

Table 975-4~~2~~
Elastomeric Coatings Performance Requirements

Property	Test Method	Acceptance Criteria

Table 975-42 Elastomeric Coatings Performance Requirements		
Property	Test Method	Acceptance Criteria
Hardness, Shore A	ASTM D2240	Between 60 and 90
Tensile Strength	ASTM D412	≥750 psi
Elongation	ASTM D412	≥400%
Tear Strength	ASTM C957	>70 psi
Abrasion Resistance H-18 wheels 1,000 gm/wheel	ASTM C957	≤350 mg loss / 1,000 revs.
Crack Bridging 1,000 Cycles	ASTM C957	System Passes
Elongation Recovery	ASTM C957	≥94%

975-5.3 System Modifications for Use on Exposed External Anchorages: Provide the elastomeric coating system with a 100% acrylic aliphatic polyurethane top coating where required as shown on Standard Plans Index 462-002, or when applied to other exposed external surfaces. Manufacturers of the elastomeric coating system shall include the acrylic top coating as part of the elastomeric coating system for approval.

975-6 Class 5 Applied Finish Coatings.

975-6.1 General: All coatings shall possess physical properties and handling characteristics compatible with the application requirements of Section 400. Unless otherwise specified, the color of the finish coat shall meet FED-STD-595, Table VIII, Shade No. 36622, or No. 36642 for uncoated weathering steel bridges.

975-6.2 Coating Requirements: Prepare four, 4 inch by 8 inch (except as required below) fiber cement test panels with a mass of 7 to 9 pounds per square foot of surface area to perform the laboratory tests. Apply the finish coating to each test panel at a rate of 50 square feet per gallon, plus or minus 10 square feet per gallon. Seal the corners of all test panels with a high build epoxy or equivalent to prevent moisture ingress at corners and cut edges. Submit the samples to an independent laboratory for testing. Coating performance shall meet the requirements in Table 975-53. Upon request, submit a one quart wet sample of each component of each coating system to the SMO.

Table 975-53 Class 5 Applied Finish Coatings Performance Requirements		
Laboratory Testing		
Property	Test Method	Acceptance Criteria
Resistance to Wind Driven Rain	ASTM D6904	No visible water leaks, and if the rear face of the block is damp, the average gain in weight of the three 8”x16”x2” blocks must be less than 0.2 lb.
Freeze thaw resistance	AASHTO R 31	No disbondment
Water Vapor Transmission	ASTM D1653; Method B, Condition C	WVT≥10 perms

Table 975-53 Class 5 Applied Finish Coatings Performance Requirements		
Laboratory Testing		
Property	Test Method	Acceptance Criteria
Abrasion Resistance	ASTM D968, 3,000 liters of sand	No loss of coating thickness ASTM D6132
Salt Spray (fog) resistance	ASTM B117, 2,000 hours	No disbondment
Fluorescent UV-Condensation Exposure	ASTM D4587, 2000 hours, 4 hours UV, 4 hours condensation	No blistering (ASTM D714), cracking (visual), or delamination (visual). chalking (ASTM D4214Method D) rating no less than 8.
Fungal Resistance	ASTM D3273	Rating of 10, ASTM D3274

975-7 Anti-Graffiti Coating Materials.

975-7.1 General Requirements: Anti-graffiti coatings intended for use under this specification shall be of a composition capable of preventing the adhesion of and facilitating the removal of acrylic, polyurethane, and alkyd spray paint. All anti-graffiti coatings shall possess the physical and handling characteristics that are compatible with the requirements of Section 563. The manufacturer shall designate non-sacrificial products as water cleanable in accordance with this Section.

Anti-graffiti coatings shall contain less than 5.0 pounds per gallon volatile organic compounds (VOC) as defined by 40 CFR Part 59, Subpart D, evaluated as per ASTM D3960.

The manufacturer shall supply the following additional information:

1. Technical data sheet that includes installation instructions and graffiti removal instructions by pressure washing with water.
2. Sacrificial Coating Removal instructions, as applicable.
3. Certification that non-sacrificial anti-graffiti coating shall not blister, crack, check, chalk, delaminate, or exhibit a color change of more than 8 dE94 (or dE76) CIE LAB units for a period of one year after installation.

975-7.2 Performance Requirements: For laboratory testing, use flat test panels prepared in accordance with AASHTO R 31.

Outdoor exposure testing will be performed by the Department, if applicable. Submit four, 4 inch by 8 inch fiber cement test panels to the SMO. Panels will be exposed at the Department's outdoor test site in accordance with ASTM G7. Coating performance shall meet the requirements in Table 975-64.

Upon request, submit a one quart wet sample of each component of each coating system to the SMO.

Table 975-64 Anti-Graffiti Coatings Performance Requirements		
Outdoor Exposure Testing – Non-Sacrificial		
Property	Test Method	Acceptance Criteria

Table 975-64 Anti-Graffiti Coatings Performance Requirements		
Graffiti Resistance (water cleanable)	FM 5-580: 6 months exposure at FDOT test site (2500 psi using pressure washer)	Complete removal of solvent based acrylic, and alkyd based spray paint. No delamination or visual defects.

Laboratory Testing - Sacrificial		
Property	Test Method	Acceptance Criteria
Cyclic Weather Testing	AASHTO R 31: no salt fog, 95°F, 0%- 90% Relative Humidity, 500 hours, alternating RH every 100 hours	No melting or disbondment
Outdoor Exposure Testing - Sacrificial		
Property	Test Method	Acceptance Criteria
Sacrificial Coating removability	FM 5-580: 6 months exposure at FDOT test site (2500 psi using pressure washer)	Complete removal of solvent based acrylic, and alkyd based spray paint from substrate

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 7, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **982**
Proposed Specification: **9820200 Fertilizer.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Awilda Merced from the State Materials Office to update the language that a certified test report is not needed for fertilizer as the information from the label is sufficient.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

FERTILIZER.
(REV 7-22-22)

ARTICLE 982-2 is deleted and the following substituted:

982-2 Certification.

The ~~Contractor shall submit to the~~ Engineer shall collect a ~~certified test report from the manufacturer of the commercial fertilizer confirming that the requirements of this Section are met~~copy of the fertilizer label and retain according to the FDOT retention policy. The ~~certified test report~~label shall ~~conform to the requirements of Section 6 and include test results for total~~include guaranteed values for total nitrogen, available phosphoric acid, water-soluble potash, and sulfur. ~~Each certification shall cover one batch per type for dry type fertilizer.~~

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 27, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **990**
Proposed Specification: **REVISED 9900200 Temporary Traffic Control Device Materials.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by James McGinnis from the Office of Roadway Design to update the language to provide clarification. The revision is associated with spec revision 1020100 Maintenance of Traffic.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

TEMPORARY TRAFFIC CONTROL DEVICE MATERIALS.
(REV ~~7~~10-~~13~~27-22)

ARTICLE 990-2 is deleted and the following substituted:

990-2 Retroreflective Sheeting for Temporary Traffic Control Devices.

~~**990-2.1 Approved Product List (APL):** Sheeting for use on Temporary Traffic Control Devices shall be one of the products listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.~~ **990-2.1~~.1~~ Bands for Temporary Tubular Markers, Vertical Panels, Barricades, and other Devices:** Bands for temporary tubular markers, vertical panels, barricades, and other devices shall meet the requirements of ASTM D4956 for Type III or higher retroreflective sheeting materials identified in Section 994.

990-2.~~1.~~2 Collars for Traffic Cones: Collars for traffic cones shall meet the requirements of ASTM D4956 Type III or higher retroreflective prismatic sheeting materials identified in Section 994 including supplementary requirements for reboundable sheeting. The outdoor weathering shall be for 6 months for all sheeting types.

990-2.~~1.~~3 Drums: Drums shall meet the requirements of ASTM D4956 for Type III or higher retroreflective sheeting materials identified in Section 994 including supplementary requirements for reboundable sheeting.

990-2.~~1.~~4 Sign Panels: Meet the requirements of 990-8.

SUBARTICLE 990-3.1 is deleted and the following substituted:

990-3.1 General: All portable devices shall meet the physical display and operational requirements of the Manual on Uniform Traffic Control Devices (MUTCD) and be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product must~~shall~~ submit ~~an application in accordance with Section 6 and include~~ the following:

1. Certification showing that the product meets the requirements of this Section.

2. Drawings of the device along with technical information necessary for proper application, field assembly, and installation.

Portable devices shall meet the following requirements:

3. Ensure that all assembly hardware less than 5/8 inch in diameter, including nuts, bolts, external screws and locking washers are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws and studs shall meet ASTM F593. Nuts shall meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter shall be galvanized. Bolts, studs, and threaded rod shall meet ASTM A307. Structural bolts shall meet ASTM F3125, Grade A325.

4. The controllers and associated on-board circuitry shall meet the requirements of the Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise by Class A digital devices. All electronic assemblies shall meet the requirements of NEMA TS-4-2016 Section 2.

5. The controller and associated on-board circuitry shall not be affected by mobile radio, or any other radio transmissions.

6. An operator's manual shall be furnished with each unit.

7. All portable devices shall be permanently marked with, manufacturer's name or trademark, model/part number, and date of manufacture or serial number.

8. Portable devices and trailers shall be delineated on a permanent basis by affixing retroreflective sheeting in a continuous line on the face of the trailer as seen by oncoming road users.

990-3.1.1 Electrical Systems:

990-3.1.1.1 Solar Powered Unit: The solar powered unit shall meet the following:

1. The unit shall provide automatic recharging of power supply batteries to normal operating levels with meters showing charge.

2. Solar array recovery time for arrow boards and regulatory signs shall be accomplished in a maximum of three hours.

3. Arrow boards and changeable message signs shall be designed to provide 180 days of continuous operation with minimum onsite maintenance.

990-3.1.1.2 Battery Life Test: Meet the following:

1. The photovoltaic unit shall be designed to provide 21 days of continuous operation without sunlight with a minimum of onsite maintenance for arrow boards and changeable message signs, or 10 days of continuous operation without sunlight with a minimum of onsite maintenance for regulatory signs and radar speed display units, or 2 days of continuous operation without sunlight with a minimum of onsite maintenance for Automated Flagger Assistance Devices signs.

2. The battery shall be equipped with a battery controller to prevent overcharging and over-discharging. An external battery level indicator shall be provided.

3. The battery, controller, and power panel shall be designed to be protected from the elements and vandalism.

4. Automatic recharging of power supply batteries shall be provided with charge indicator meter.

5. An AC/DC battery charger unit shall be provided.

990-3.1.2 Display Panel and Housing:

1. The display housing assembly shall be weather-tight.

2. Except for Automated Flagger Assistance Devices, the display assembly shall be equipped with an automatic dimming operational mode capable of a minimum of 50% dimming and a separate manual dimmer switch

3. The display panel background and frame for the display assembly shall be painted flat black and shall meet Federal Specification TT-E-489.

4. The display panel for arrow boards and changeable message signs, when raised in the upright position, shall have a minimum height of 7 feet from the bottom of the panel to the ground, in accordance with the MUTCD. The display panel for radar speed display units, when raised in the upright position, will have a minimum height of 5 feet from the bottom of the panel to the ground.

5. The regulatory speed sign panel for regulatory signs and radar speed display units, when raised in the upright position, shall have a minimum height of 7 feet from the bottom of the regulatory sign panel to the ground.

6. The unit shall have an accessible mechanism to easily raise and lower the display assembly. A locking device shall also be provided to ensure the display panel will remain in the raised or lowered position.

7. The display panel for changeable message signs shall have a safety system to protect against the panel falling from the trailer to the roadway should the panel separate from the lift system.

990-3.1.3 Controller: The Controller shall meet the following:

1. Controller and control panel shall be housed in a weather, dust, and vandal resistant lockable cabinet.

2. Controller and associated on-board circuitry shall meet the requirements of the FCC Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise by Class A digital devices.

3. For changeable message signs and arrow boards ensure that the sign control software provides an on-site graphical representation that visibly depicts the message displayed on the sign face.

4. For changeable message signs, if remote communication is included, ensure that the sign controller is addressable through the Ethernet communications network using software that complies with the National Transportation Communications for ITS Protocol (NTCIP) 1101 base standard, including all amendments as published at the time of contract letting, the NTCIP Simple Transportation Management Framework, and conforms to Compliance Level 1. Ensure that the software implements all mandatory objects in the supplemental requirement SR-700-4.1.1-01, FDOT Dynamic Message Sign NTCIP Requirements, as published on the FDOT State Traffic Engineering and Operations Office web site at the time of contract letting. Ensure that the sign complies with the NTCIP 1102v01.15, 2101 v01.19, 2103v02.07, 2201v01.15, 2202 v01.05, and 2301v02.19 standards. Ensure that the sign complies with NTCIP 1103v02.17, section 3. Ensure that additional objects implemented by the software do not interfere with the standard operation of mandatory objects.

990-3.1.4 Support Chassis: The support chassis shall meet the following:

1. The support chassis shall be self-contained and self-supporting without the use of additional equipment or tools.

2. Both trailer and truck-mounted units are allowed for arrow boards and changeable message signs. Trailer mounted units are required for regulatory signs and radar speed display units. Automated Flagger Assistance Devices may be trailer or non-trailer units.

a. Trailer mounted unit:

1. The sign, power supply unit and all support systems shall be mounted on a wheeled trailer.

2. The trailer shall be equipped with Class A lights, using a plug adaptor.

3. The trailer shall be equipped with adjustable outrigger leveling pads, one on each of the four frame corners.

4. The trailer shall be designed to be set up at the site with its own chassis and outriggers, without being hitched to a vehicle.

5. The trailer shall be equipped with fenders over the tires and shall be made from heavy-duty material sufficient to allow a person to stand and operate or perform maintenance on the unit.

6. The trailer shall meet all equipment specifications set forth in Chapter 316 of the Florida Statutes, and by such rule, regulation or code that may be adopted by the Department of Highway Safety and Motor Vehicles.

SUBARTICLE 990-4.12 is deleted and the following substituted:

990-4.12 Removability: Ensure that the manufacturer shows documented reports that the removable tape is capable of being removed intact or in substantially large strips after being in place for a minimum of 90 days and under an average daily traffic count per lane of at least 5,000 vehicles per day at temperatures above 40ºF, without the use of heat, solvents, grinding or blasting.

ARTICLE 990-6 is deleted and the following substituted:

990-6 Temporary Glare Screen.

990-6.1 Design and Installation: Manufactured glare screen systems may be modular or individual units listed on the APL and shall meet the following requirements:

1. Glare screen units shall be manufactured in lengths such that when installed the joint between any one modular unit will not span barrier sections. Color shall be green, similar to FED-STD-595-34227.

2. Blades, rails and/or posts shall be manufactured from polyethylene, fiberglass, plastic, polyester or polystyrene, and be ultraviolet stabilized and inert to all normal atmospheric conditions and temperature ranges found in Florida.

3. For paddle type designs, the blade width shall not be more than 9 inches. Blades or screen for individual or modular systems shall be 24 inches to 30 inches high and capable of being locked down at an angle and spacing to provide a cut-off angle not less than 20 degrees.

4. For glare screen mounted on temporary concrete barrier, a strip (minimum 3 inch width and minimum 72 square inches) of reflective sheeting as specified in 994-2 must be placed on each side of a panel, centered in each barrier section (at a spacing not to exceed 15 feet) and positioned in such a manner as to permit total right angle observation by parallel traffic.

5. Prior to approval an impact test shall be performed by the manufacturer to verify the safety performance of the proposed system. The minimum impact strength of the posts, blades, rail and the barrier attachment design shall be sufficient to prevent the unit from separating from the barrier when impacted by a 3 inches outside diameter steel pipe traveling at 30 mph and impacting mid-height on the glare screen assembly.

6. All hardware shall be galvanized in accordance with ASTM A123 or stainless steel in accordance with AISI 302/305.

7. The anchorage of the glare screen to the barrier must be capable of safely resisting an equivalent tensile load of 600 pounds per foot of glare screen with a requirement to use a minimum of three fasteners per barrier section.

Alternative designs for temporary glare screen may be submitted as a Cost Savings Initiative Proposal in accordance with 4-3.9.

ARTICLE 990-8 is deleted and the following substituted:

990-8 Work Zone Signs.

990-8.1 Post Mounted Sign Supports:

~~:~~ **990-8.1.1 General:** Provide steel u-channel posts that conform to ASTM A499 Grade 60. For each u-channel post, punch or drill 3/8 inch diameter holes on 1 inch centers through the center of the post, starting approximately 1 inch from the top and extending the full length of the post. Ensure that the weight per foot of a particular manufacturer's post size does not vary more than plus or minus 3.5% of its specified weight per foot. Taper the bottom end of the post for easier installation. Machine straighten the u-channel to a tolerance of 0.4% of the length. ~~Use only non-corrosive metal, aluminum, or galvanized steel attachment hardware.~~

990-8.2 Portable Sign Stands: Provide portable sign stands that meet the requirements of MASH TL-3.

990-8.2.1 Product Application: Manufacturers seeking inclusion on the APL must submit the following:

1. Product Drawing, which at a minimum includes:
    a. Model Number
    b. Sign panel size
    c. Allowable sign panel substrate material
    d. Height to bottom of sign panel
    e. Any field assembly details and technical information necessary for proper application and installation
2. Crash testing reports.
3. All relevant FHWA Eligibility Letters.

990-8.3 Sign Panels: Use signs that meet the material and process requirements of ASTM D4956 and Section 994. Use ~~the~~ Type VI sheeting for vinyl signs. Mesh signs must meet the color, daytime luminance, and non-reflective requirements of Section 994, Type VI. Use Type IV sheeting for fluorescent orange work zone signs. Use Type IV and Type XI sheeting for all other work zone signs.

ARTICLE 990-14 is deleted and the following substituted:

990-14 Pedestrian Longitudinal Channelizing Devices.

990-14.1 General: Provide pedestrian Longitudinal Channelizing Devices (LCDs) in accordance with the MUTCD and the Standard Plans.

990-14.2 Product Application: Manufacturers seeking inclusion of pedestrian LCDs on the APL must submit the following:

~~a~~1.~~.~~ Installations Instructions

~~b~~2.~~.~~ Photographs

3~~e~~. Drawings (may be included in Installations Instructions) of sufficient detail to distinguish between similar devices

4~~d~~. Any field assembly details and technical information necessary for proper application and installation

5~~e~~. Crash testing reports demonstrating the device meets MASH TL-3

6~~f~~. All relevant FHWA Eligibility Letters

SECTION 990 is expanded by the following:

990-17 Type III Barricade.

990-17.1 General: Provide type III barricades in accordance with the requirements of the MUTCD and the dimensions shown in the Standard Plans.

990-17.2 Product Application: Manufacturers seeking inclusion of type III barricades on the APL shall submit the following:

1. Installations Instructions
2. Photographs
3. Drawings (may be included in Installation Instructions) of sufficient detail to distinguish between similar devices
4. Any field assembly details and technical information necessary for proper application and installation
5. Crash testing reports demonstrating the device meets MASH TL-3
6. All relevant FHWA Eligibility Letters

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **991**
Proposed Specification: **9910100 Channelizing Device Materials.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by David Amato to revise testing requirements for tubular markers to reflect recent changes to the test vehicle used by NTPEP. The category of "Standard Tubular Markers" was removed and "Durable Tubular Markers" were renamed to "Tubular Markers".

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

9910100
All Jobs

CHANNELIZING DEVICE MATERIALS.
(REV 9-26-22)

ARTICLE 991-1 is deleted and the following substituted:

991-1 ~~Durable~~ Tubular Markers.

991-1.1 General: This subarticle describes the material requirements for tubular markers installed in accordance with Section 704. All ~~Durable~~ Tubular Marker products shall be listed on the Department's Approved Products List (APL).

991-1.2 Dimensions: The post shall have a minimum diameter of 3 inches. The base of the tubular marker shall have a maximum diameter, width, or length of 8 inches. The height of the tubular marker above the pavement surface shall be 36 inches.

991-1.3 Color: Tubular Marker color must be uniform and integral throughout entire height of the post. The base may be black in color.

991-1.3.1 White: The yellowness index shall not exceed 12, tested in accordance with ASTM E313. The daytime 45 degrees, 0 degrees luminance factor, Cap Y, shall be a minimum of 70, tested in accordance with ASTM E1349.

991-1.3.2 Yellow: The daytime 45 degrees, 0 degrees luminance factor, Cap Y, shall be a minimum of 60, tested in accordance with ASTM E1349.

991-1.4 Retroreflective Sheeting: The color of the retroreflective sheeting shall match the color of the tubular marker. The retroreflective sheeting shall be abrasion resistant Type IV or Type V and meet the requirements of Section 994. The retroreflective sheeting shall meet supplementary requirements for reboundable sheeting as stated in section S.2 of ASTM D4956. The sheeting shall wrap around the entire circumference of the tube and have a minimum vertical dimension of 10 inches. The top of sheeting shall be 1-1/2 inches plus or minus 1/2 inch below the top of post.

991-1.5 Product Testing: Manufacturers seeking evaluation of ~~Durable~~ Tubular Markers must include test reports from the National Transportation Product Evaluation Program (NTPEP) documenting the product meets the requirements of this Section. NTPEP impact testing must be performed on ~~each substrate (concrete and open-graded friction course asphalt)~~ concrete in accordance with NTPEP Evaluation of Temporary Traffic Control Devices: Flexible Delineators for the category of High Speed Applications and for hot weather test temperature only.

Impact tests shall be performed only on tubular markers measuring 36 inches above the pavement surface.

Products listed on the IPL for Managed Lane Markers prior to July 2021 will be acceptable on projects until June 30, 2024 to allow a grace period to complete the required testing.

Acceptable products are those meeting the following requirements after receiving an average of ~~7~~45 bumper impacts per sample and an average of 1~~7~~50 tire impacts per sample:

1. All posts shall self-restore to within 15 degrees list or lean from vertical.

2. All posts shall have a minimum of 50% of its cross-section, at any point along the post height, free of tears or cracks.

991-1.6 Approved Product List Submission Requirements: Manufacturers seeking evaluation of ~~Durable~~ Tubular Marker products for inclusion on the APL shall submit an application in accordance with Section 6 and include the following documentation.

Table 991-1	
Documentation	Requirement
Installation Instructions	Include mounting surface preparations, and touch-up and repair procedures. Separate installation instructions are required for different substrates. Identify adhesive types and mechanical anchor types for attachment of base to substrate.
National Testing Product Evaluation Program (NTPEP) audit report	See Section 991-1.5
Product Label Photo	Displays the Product Name. Displays additional label requirements, if needed.
Product Photo	Displays the significant features of the product. Displays location of Manufacturer name and model number.
Technical Data Sheet, marker	Uniquely identifies the product and includes product specifications, storage instructions, and recommended installation materials and equipment as applicable.
Product Sample	Upon request from the Department, submit a sample of the tubular marker mounting material or hardware. If the product is a system comprised of multiple parts, a sample of each part must be submitted.

ARTICLE 991-2 is deleted.

~~**991-2 Standard Tubular Markers.**~~

~~**991-2.1 General:** This subarticle describes the material requirements for tubular markers installed in accordance with Section 704. All Standard Tubular Marker products shall be listed on the Department's Approved Products List (APL). Standard Tubular Markers must be approved for project-specific use with an issued project-specific pay item.~~

~~**991-2.2 Dimensions:** The post shall have a minimum diameter of 2 inches. The minimum height of the tubular marker above the pavement surface shall be 36 inches.~~

~~**991-2.3 Color:** Tubular Marker color must be uniform and integral throughout entire height of the post. The base may be black in color.~~

~~**991-2.3.1 White:** The yellowness index shall not exceed 12, tested in accordance with ASTM E313. The daytime 45 degrees, 0 degrees luminance factor, Cap Y, shall be a minimum of 70, tested in accordance with ASTM E1349.~~

~~**991-2.3.2 Yellow:** The daytime 45 degrees, 0 degrees luminance factor, Cap Y, shall be a minimum of 60, tested in accordance with ASTM E1349.~~

~~**991-2.4 Retroreflective Sheeting:** The color of the retroreflective sheeting shall match the color of the tubular marker. The retroreflective sheeting shall be abrasion resistant Type IV or Type V and meet the requirements of Section 994. The retroreflective sheeting shall meet supplementary requirements for reboundable sheeting as stated in section S.2 of ASTM D4956.~~

The sheeting shall wrap around the entire circumference of the tube and have a minimum vertical dimension of 15 inches. The top of sheeting shall be 1-1/2 inches plus or minus 1/2 inch below the top of post.

991-2.5 Product Testing: Manufacturers seeking evaluation of Standard Tubular Markers must include test reports from the National Transportation Product Evaluation Program (NTPEP) documenting the product meets the requirements of this Section. NTPEP impact testing must be performed on each substrate (concrete and open-graded friction course asphalt) in accordance with NTPEP Evaluation of Temporary Traffic Control Devices: Flexible Delineators for the category of High Speed Applications and for hot weather test temperature only.

Impact tests shall be performed only on tubular markers measuring 36 inches above the pavement surface.

Acceptable products are those meeting the following requirements after receiving an average of 50 bumper impacts per sample and an average of 50 tire impacts per sample:

1. Six out of eight posts shall self-restore to within 15 degrees list or lean from vertical.

2. All posts shall have a minimum of 50% of its cross-section, at any point along the post height, free of tears or cracks.

991-2.6 Approved Product List Submission Requirements: Manufacturers seeking evaluation of Standard Tubular Marker products for inclusion on the APL shall submit an application in accordance with Section 6 and include the following documentation.

Table 991-2

Documentation	Requirement
Installation Instructions	Include mounting surface preparations, and touch-up and repair procedures. Separate installation instructions are required for different substrates. Identify adhesive types and mechanical anchor types for attachment of base to substrate.
National Testing Product Evaluation Program (NTPEP) product testing report	See Section 991-2.5
Product Label Photo	Displays the Product Name. Displays additional label requirements, if needed.
Product Photo	Displays the significant features of the product. Displays location of Manufacturer name and model number.
Technical Data Sheet, marker	Uniquely identifies the product and includes product specifications, storage instructions, and recommended installation materials and equipment as applicable.
Product Sample	Upon request from the Department, submit a sample of the tubular marker mounting material or hardware. If the product is a system comprised of multiple parts, a sample of each part must be submitted.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 24, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **995**
Proposed Specification: **REVISED 9950100 Traffic Control Signal and Device Materials.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to move all the material requirements from Division II to Division III. Separating manufacturer's requirements from contractor's requirements to help with review of APL product submittals as well as clarify field installation, inspection, and acceptance criteria. This change is associated with the proposed changes to Section 660, 671, 676, 687, and 680.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

TRAFFIC CONTROL SIGNAL AND DEVICE MATERIALS.
(REV 10~~6~~-24~~15~~-22)

SECTION 995 is deleted and replaced with the following:

995-1 Description.

995-1.1 General: This Section governs the requirements for all permanent traffic control signals and devices. All equipment shall be permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.

995-1.2 Product Acceptance: All specified products shall be items listed on the Department's Approved Product List (APL), unless otherwise noted below. Manufacturers seeking evaluation of products for inclusion on the APL shall submit an application in accordance with Section 6 and include the following documentation. A separate application must be submitted for each product to be evaluated, showing that the product meets the applicable requirements.

Table 995-1

Documentation	Requirements
Assembly and Installation Instructions	Include any surface preparations, assembly/installation instructions, operation manual, troubleshooting guides, and repair procedures.
Independent Laboratory Test Results	Product meets requirements of this Section.
Product Label Photo	Labeling shows the manufacturer's name, trademark, and product model number/name. Label shows the date of manufacture and/or the manufacturer's batch number. Additional label requirements, as listed within this Section.
Product Photo	Displays the significant features of the product as required in this section.
Compliance Matrix	Include completed compliance matrix at https://www.fdot.gov/traffic/traf-sys/product-specifications.shtm
Manufacturer's Product Specifications	Include product specifications showing electrical requirements, voltages, etc.
Product Drawings or Cut Sheet	Show mounting points, mechanical details, block diagrams, schematics, etc.
Parts List	List major parts and field serviceable components.

995-1.3 Abbreviations: The following abbreviations are used in this Section:

Acrylonitrile butadiene styrene (ABS)
Alternating Current (AC)
Direct Current (DC)
Electronic Industries Alliance (EIA)
Global Positioning System (GPS)

Hypertext Transfer Protocol (HTTP)
Institute of Transportation Engineers (ITE)
Internet Protocol (IP)
Local Area Network (LAN)
Network Time Protocol (NTP)
Telecommunications Industry Association (TIA)
Uniform Code Flash (UCF)
Uniform Resource Locator (URL)
Ultraviolet (UV)

995-2 Vehicle Detection Systems.

995-2.1 General: ~~All vehicle detection systems shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.~~

~~All equipment shall be permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.~~ All parts shall be constructed of corrosion-resistant materials, such as UV stabilized or UV resistant plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements shall be Type 304 or 316 passivated stainless steel.

If the assembly includes a cabinet, ~~the cabinet must be currently listed on the APL or meet the applicable cabinet material requirements listed in~~ meet the requirements of Section 676.

Detectors shall meet the environmental requirements of NEMA TS-2-~~2016~~2021.

995-2.2 Inductive Loop Detector Units: Rack mount inductive loop detector units shall meet the requirements of NEMA TS-2-~~2016~~2021. Shelf mount detector units shall meet the requirements of NEMA TS-1-1989.

995-2.3 Video Vehicle Detection System (VVDS):

995-2.3.1 Configuration and Management: The VVDS shall be provided with software that allows local and remote configuration and monitoring. The system shall be capable of displaying detection zones and detection activations overlaid on live video inputs. The VVDS shall meet the following criteria:

1. Allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.

2. Retains its programming in nonvolatile memory. The detection system configuration data shall be capable of being saved to a computer and restored from a saved file. All communication addresses shall be user programmable.

3. Offers an open Application Programming Interface (API) and software development kit available to the Department at no cost for integration with third party software and systems.

995-2.3.2 Detection Camera: Camera shall be recommended by the video detection system manufacturer. Cameras that are integrated and included in a VVDS shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-C/section-200.216.

995-2.3.3 Machine Vision Processor: The VVDS shall include a machine vision processor that allows video analysis, presence detection, data collection, and interfaces for inputs and outputs as well as storage and reporting of collected vehicle detection data.

995-2.3.4 Communications: The VVDS shall include a minimum of one serial or Ethernet communications interface and shall meet the following criteria.

1. Serial interface and connectors shall conform to ~~Telecommunications Industry Association (~~TIA~~)~~-232 standards. Ensure that the serial ports support data rates up to 115200 bps; error detection utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).

2. Wired Ethernet interfaces shall provide a 10/100 Base TX connection. Verify that all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA-568.

3. Wireless communications shall be secure and wireless devices shall be Federal Communications Commission (FCC) certified. The FCC identification number shall be displayed on an external label and all detection system devices shall operate within their FCC frequency allocation.

4. Cellular communications devices shall be compatible with the cellular carrier used by the agency responsible for system operation and maintenance.

5. The system shall be configured and monitored via one or more communications interface.

995-2.3.5 Video Inputs and Outputs: Analog video inputs and outputs shall utilize BNC connectors.

995-2.3.6 Solid State Detection Outputs: Outputs shall meet the requirements of NEMA TS2-~~2016~~2021, 6.5.2.26.

995-2.3.7 Electrical Requirements: The system shall operate using a nominal input voltage of 120 V of alternating current (V_{AC}) and with an input voltage ranging from 89 to 135 V_{AC}. If a system device requires operating voltages other than 120 V_{AC}, a voltage converter shall be supplied.

995-2.4 Microwave Vehicle Detection System (MVDS): Sidefire MVDS sensors shall have a minimum 200-foot range and the capability to detect a minimum of 8 lanes of traffic.

995-2.4.1 Configuration and Management: The MVDS shall be provided with software that allows local and remote configuration and monitoring. The system software shall be capable of displaying detection zones and detection activations in a graphical format. The MVDS shall meet the following criteria:

1. Allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.

2. Retains its programming in nonvolatile memory. Ensure that the detection system configuration data can be saved to a computer and restored from a saved file. Ensure that all communication addresses are user programmable.

3. Detection system software offers an open API and software development kit available to the Department at no cost for integration with third party software and systems.

995-2.4.2 Communications: Major components of the detection system (such as the sensor and any separate hardware used for contact closures) shall include a minimum of one serial or Ethernet communications interface and shall meet the following criteria:

1. The serial interface and connector conforms to TIA-232 standards and the serial ports support data rates up to 115200 bps; error detection utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).

2. Wired Ethernet interfaces provide a 10/100 Base TX connection. Verify that all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA-568.

3. Wireless communications are secure and that wireless devices are FCC certified. The FCC identification number is displayed on an external label and all detection system devices operate within their FCC frequency allocation.

4. Cellular communications devices are compatible with the cellular carrier used by the agency responsible for system operation and maintenance.

5. The system can be configured and monitored via one or more communications interface.

6. Cameras that are integrated and included in a MVDS shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-C/section-200.216.

995-2.4.3 Solid State Detection Outputs: Outputs shall meet the requirements of NEMA TS2-~~2016~~2021, 6.5.2.26.

995-2.4.4 Electrical Requirements: The microwave detector shall operate with a nominal input voltage of 12 V_{DC} and with an input voltage ranging from 89 to 135 V_{AC}. If any system device requires operating voltages other than 120 V_{AC}, a voltage converter shall be supplied.

The detector shall be FCC certified and has been granted authorization to operate within a frequency range established and approved by the FCC. The FCC identification number shall be displayed on an external label.

995-2.5 Wireless Magnetometer Detection System (WMDS):

995-2.5.1 Configuration and Management: The detection system shall be provided with software that allows local and remote configuration and monitoring and shall meet the following criteria.

1. Allows a user to edit previously defined configuration parameters.

2. Retains its programming in nonvolatile memory and the detection system configuration data can be saved to a computer and restored from a saved file. All communication addresses shall be user programmable.

3. The detection system software offers an open API and software development kit available to the Department at no cost for integration with third party software and systems.

995-2.5.2 Communications: Components of the detection system (such as sensors, access points, and contact closure cards) shall include a minimum of one serial or Ethernet communications interface and shall meet the following criteria.

1. The serial interface and connector conforms to TIA-232 standards and the serial ports support data rates up to 115200 bps; error detection utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).

2. Wired Ethernet interfaces provide a 10/100 Base TX connection and all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA-568.

3. Wireless communications are secure and that wireless devices are FCC certified. The FCC identification number is displayed on an external label and all detection system devices operate within their FCC frequency allocation.

4. Cellular communications devices are e-compatible with the cellular carrier used by the agency responsible for system operation and maintenance.

5. The system can be configured and monitored via one or more communications interface.

995-2.5.3 Solid State Detection Outputs: Outputs shall meet the requirements of NEMA TS2-~~2016~~2021, 6.5.2.26.

995-2.5.4 Electrical Requirements: The WDMS shall operate with an input voltage ranging from 89 to 135 V_{AC}. If any system device requires operating voltages other than 120 V_{AC}, a voltage converter shall be supplied.

995-2.6 Automatic Vehicle Identification (AVI):

995-2.6.1 Configuration and Management: The detection system shall be provided with software that allows local and remote configuration and monitoring.

995-2.6.2 Communications: Components of the detection system (such as sensors, controllers, and processing hardware) shall include a minimum of one serial or Ethernet communications interface and shall meet the following criteria.

1. The serial interface and connector conforms to TIA-232 standards and the serial ports support data rates up to 115200 bps; error detection utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).

2. Wired Ethernet interfaces provide a 10/100 Base TX connection and all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA-568.

3. Wireless communications are secure and that wireless devices are FCC certified. The FCC identification number is displayed on an external label and all detection system devices operate within their FCC frequency allocation.

4. Cellular communications devices are compatible with the cellular carrier used by the agency responsible for system operation and maintenance.

5. The system can be configured and monitored via one or more communications interface.

995-2.6.3 Probe Data Detector Requirements:

1. Transponder Readers shall be compatible with multiple tag protocols, including Allegro and the protocol defined in ISO18000-6B.

2. Bluetooth Readers shall be capable of operating using either solar power or AC power.

3. License Plate Readers shall not require the use of visible strobes or other visible supplemental lighting.

995-2.6.4 Electrical Requirements: The AVI shall operate with an input voltage ranging from 89 to 135 V_{AC}. If any system device requires operating voltages other than 120 V_{AC}, a voltage converter shall be supplied. For solar powered devices, the detection system must operate for 5 days without solar assistance.

995-2.7 Wrong Way Vehicle Detection Systems (WWVDS):

995-2.7.1 Configuration and Management: The WWVDS shall be provided with software that allows local and remote configuration and monitoring. That the system shall have the capability to display detection zones and detection activations. The WWVDS shall meet the following criteria:

1. WWVDS controllers shall support either an on-board real-time clock/calendar with on-board battery backup, or the controller's internal time clock can be

configured to synchronize to a time server using the network time protocol (NTP) in order to maintain the current local date/time information. For NTP, the synchronization frequency must be user configurable and permit polling intervals from once per minute to once per week in one-minute increments. For NTP, the controller must allow the user to define the NTP server by ~~internet protocol (~~IP~~)~~ address.

2. Allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.

3. Retains its programming in nonvolatile memory. The detection system configuration data shall be capable of being saved to a computer and restored from a saved file. All communication addresses shall be user programmable.

4. Offers an open Application Programming Interface (API) or software development kit available to the Department at no cost for integration with third party software and systems.

995-2.7.2 Communications: Major components of the WWVDS (such as the sensor and any separate hardware used for contact closures) shall include a minimum of one serial or Ethernet communications interface and shall meet the following criteria:

1. The serial interface and connector conforms to TIA-232 standards and the serial ports support data rates up to 115200 bps; error detection utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).

2. Wired Ethernet interfaces provides, at a minimum, a 10/100 Base TX connection. Verify that all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA-568.

3. Wireless communications are secure and that wireless devices are FCC certified. The FCC identification number is displayed on an external label and all WWVDS devices operate within their FCC frequency allocation.

4. Cellular communications devices are compatible with the cellular carrier used by the agency responsible for system operation and maintenance.

5. The system can be configured and monitored via one or more communications interface.

6. The WWVDS is compatible with the Department's SunGuide® software. The SunGuide software requirements are listed in supplemental requirement SR-995-2.7.2-01, Supplemental Wrong Way Vehicle Detection System SunGuide HTTP Protocol, as published on the Department's State Traffic Engineering and Operations Office website at the following URL: https://www.fdot.gov/traffic/Traf-Sys/Product-Specifications.shtm.

7. For WWVDS installed on ramps, the device shall:

a. Send an alert to the SunGuide® software when the wrong-way vehicle is detected.

b. Send a sequence of images for up to ten seconds to the SunGuide software that covers a configurable time before and after the wrong-way vehicle detection.

c. Activate all highlighted signs associated with the WWVDS.

8. For WWVDS installed on mainline lanes, the device shall send an alert to the SunGuide® software when the wrong-way vehicle is detected.

9. Cameras that are integrated and included in a WWVDS shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain

telecommunications and video surveillance services or equipment https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-C/section-200.216.

995-2.7.3 Electrical Specifications: Equipment shall operate on solar power or with an input voltage ranging from 89 to 135 V_{AC}. If the device requires operating voltages of less than 120 V_{AC}, supply the appropriate voltage converter. Solar powered systems shall be designed to operate for minimum of 5 activations per day and provide 10 days of operation without sunlight.

995-2.8 Vehicle Presence Detection System Performance Requirements: Presence detectors shall provide a minimum detection accuracy of 98% and shall meet the requirements for modes of operation in NEMA TS2-~~2016~~2021, 6.5.2.17.

995-2.8.1 Vehicle Presence Detection Accuracy: To verify conformance with the accuracy requirements in this Section and as a precondition for listing on the APL, sample data collected from the vehicle detection system will be compared against ground truth data collected during the same time by human observation or by another method approved by the FDOT Traffic Engineering Research Laboratory (TERL). Ensure sample data is collected over several time periods under a variety of traffic conditions. Weight each data sample to represent the predominant conditions over the course of a 24-hour period. Samples will consist of 15- and 30-minute data sets collected at various times of the day. Representative data periods and their assigned weights are provided in Table 995-~~1~~2.

Table 995-~~1~~2
Data Collection Periods

Period	Intended To Represent	Duration	Weight
Early morning (predawn) [EM]	12:30 a.m. – 6:30 a.m.	15 minutes	24
Dawn [DA]	6:30 a.m. – 7:00 a.m.	30 minutes	2
AM Peak [AMP]	7:00 a.m. – 8:00 a.m.	15 minutes	4
Late AM Off-Peak [LAOP]	8:00 a.m. – 12:00 p.m.	15 minutes	16
Noon [NO]	12:00 p.m. – 1:00 p.m.	15 minutes	4
Afternoon Off-Peak [AOP]	1:00 p.m. – 5:00 p.m.	15 minutes	16
PM Peak [PMP]	5:00 p.m. – 6:00 p.m.	15 minutes	4
Dusk [DU]	6:00 p.m. - 6:30 p.m.	30 minutes	2
Night [NI]	6:30 p.m. - 12:30 a.m.	15 minutes	24
Total Sum of Weights			96

For example, the sample gathered for the Late AM Off-Peak period is intended to represent typical traffic conditions between 8:00 a.m. and 12:00 p.m. Since the sample period's duration is 15 minutes and the actual period of time represented is 4 hours, the multiplication factor or weight assigned is 16, the number of 15-minute intervals in a 4 hour period.

995-2.8.2 Calculation of Vehicle Presence Detection Accuracy: Determine individual lane presence detection accuracy per period by subtracting from 100 percent the absolute difference of the total time monitored and the cumulative error time, divided by total time, expressed as a percentage.

In the equation in 995-2.8.2.1, “EM” represents the early morning period. The variable “i” represents a detector or detection zone and could vary from 1,…, N, where “N” is the total number of detectors observed. Substitute other detector numbers and periods as necessary to determine accuracy for all detectors during each period (i.e., dawn, AM peak, late AM off peak, etc.).

Variables used in the following equations are identified as follows:

PA = Presence detection accuracy

TT = Total time

CET = Cumulative Error Time (duration of all false and missed calls)

N=Total number of detectors observed

995-2.8.2.1 Early Morning Vehicle Presence Detection Accuracy for a Single Detector Expressed as a Percentage:

$$PA_{EM,\det_i} = 100 - \frac{\left|TT_{EM,\det_i} - CET_{EM,\det_i}\right|}{TT_{EM,\det_i}} x100$$

where:

$PA_{EM,\det_i}$ = Presence detection accuracy of detector *i* during the early morning period.

$TT_{EM,\det_i}$ = Total time that detector *i* was monitored (for instance, the 15-minute minimum duration specified in Table 995-~~1~~2 for the early morning period).

$CET_{EM,\det_i}$ = Cumulative time that detector *i* was in an error state (indicating a detection with no vehicle present or not indicating a detection when vehicle present) during the monitoring period using human observation or another method approved by the Engineer.

The period accuracy will be the arithmetic mean of all individual detector accuracies.

In the equation in 995-2.8.2.2, “EM” represents the early morning period and “*N”* is the total number of detectors tested. Substitute other periods as necessary to determine the accuracy for each period (i.e., dawn, AM peak, late AM off-peak, etc.).

995-2.8.2.2 Early Morning Vehicle Presence Detection Accuracy for All Detectors Expressed as a Percentage:

$$PA_{EM} = \left(\frac{\sum_{i=1}^{N} PA_{EM,\det_i}}{N} \right)$$

Where:

PA_{EM} = Average accuracy of all detectors during the early morning.

$PA_{EM,\det_i}$ = Accuracy of detector *i* during early morning.

Calculate the roadway segment accuracy over all periods using the equation in 995-2.7.2.3.

995-2.8.2.3 Total Vehicle Presence Detection Accuracy for All Detectors Expressed as a Percentage:

$$PA_{Total} = \frac{\left[PA_{EM}x24 + PA_{DA}x2 + PA_{AMP}x4 + PA_{LAOP}x16 + PA_{NO}x4 + PA_{AOP}x16 + PA_{PMP}x4 + PA_{DU}x2 + PA_{NI}x24\right]}{96}$$

Where:

PA_{Total} =Accuracy for all detectors for all periods

PA_{EM} = Accuracy of all detectors during early morning traffic conditions

PA_{DA} = Accuracy of all detectors during dawn traffic conditions

PA_{AMP} = Accuracy of all detectors during AM peak traffic conditions

PA_{LAOP} = Accuracy of all detectors during late AM off-peak traffic conditions

PA_{NO} = Accuracy of all detectors during noon traffic conditions

PA_{AOP} = Accuracy of all detectors during afternoon off-peak traffic conditions

PA_{PMP} = Accuracy of all detectors during PM peak traffic conditions

PA_{DU} = Accuracy of all detectors during dusk traffic conditions

PA_{NI} = Accuracy of all detectors during night traffic conditions

995-2.9 Traffic Data Detection System Acceptance Requirements:

995-2.9.1 Data Accuracy: The vehicle detection system shall be capable of meeting the minimum total roadway segment accuracy levels of 95% for volume, 90% for occupancy, and 90% for speed for all lanes, up to the maximum number of lanes that the device can monitor as specified by the manufacturer.

To verify conformance with the accuracy requirements in this Section and as a precondition for listing on the APL, sample data collected from the vehicle detection system will be compared against ground truth data collected during the same time by human observation or by another method approved by the TERL. Sample data shall be collected over several time periods under a variety of traffic conditions. Weight each data sample to represent the predominant conditions over the course of a 24-hour period. Samples shall consist of 15- and 30-minute data sets collected at various times of the day. Representative data periods and their assigned weights are provided in Table 995-~~1~~2.

995-2.9.2 Calculation of Volume Accuracy: Determine individual lane volume accuracy per period by subtracting from 100 percent the absolute difference of the total volume measured by the detector and the ground truth volume measurement, divided by the ground truth volume measurement, expressed as a percentage.

In the equation in 995-2.9.2.1, “EM” represents the early morning period. The subscript “*i”* represents a lane at the detection zone on the roadway segment and could vary from 1,…, N, where “N” is the maximum number of lanes being detected. Substitute other lane

numbers and periods as necessary to determine the accuracy for each lane during each period (i.e., dawn, AM peak, late AM off-peak, etc.).

Variables and subscripts used in the equations below are identified as follows:

VT = Total volume
VD = Vehicle detection data (in this case, count data)
GT = Ground truth measurement ~~utilizing a reliable method approved by the Engineer.~~
VA = Volume accuracy

995-2.9.2.1 Early Morning Volume Accuracy for a Lane Expressed as a Percentage:

$$VA_{EM,\ln_i} = 100 - \frac{\left|VT_{EM,VD,\ln_i} - VT_{EM,GT,\ln_i}\right|}{VT_{EM,GT,\ln_i}} x100$$

Where:

VA_{EM,ln_i} = Volume accuracy for early morning traffic conditions in the i th lane.

VT_{EM,VD,ln_i} = Total volume for the 15-minute early morning period using the vehicle detector in the i th lane.

VT_{EM,GT,ln_i} = Total volume for the 15-minute early morning period in the i th lane using human observation or another method approved by the Engineer.

The period volume accuracy will be the arithmetic mean of the lane volume accuracy over all lanes.

In the equation in 995-2.9.2.2, "EM" represents the early morning period and "*N*" is the total number of lanes of detection on the roadway segment under test. Substitute other periods as necessary to determine the accuracy for each period (i.e., dawn, AM peak, late AM off-peak, etc.).

995-2.9.2.2 Early Morning Volume Accuracy Expressed as a Percentage:

$$VA_{EM} = \left(\frac{\sum_{i=1}^{N} VA_{EM,\ln_i}}{N} \right)$$

Where:

VA_{EM} = Average volume accuracy for early morning traffic conditions for all lanes.

VA_{EM,ln_i} = Volume accuracy for early morning traffic conditions in the i th lane.

Calculate the total volume accuracy over all periods using the equation in 995-2. ~~8~~9.2.3.

995-2.9.2.3 Total Volume Accuracy Expressed as a Percentage:

$$VA_{Total} = \frac{\left[VA_{EM}x24 + VA_{DA}x2 + VA_{AMP}x4 + VA_{LAOP}x16 + VA_{NO}x4 + VA_{AOP}x16 + VA_{PMP}x4 + VA_{DU}x2 + VA_{NI}x24\right]}{96}$$

Where:

VA_{Total} = Volume accuracy for all lanes for all periods
VA_{EM} = Volume accuracy for early morning traffic conditions
VA_{DA} = Volume accuracy for dawn traffic conditions
VA_{AMP} = Volume accuracy for AM peak traffic conditions
VA_{LAOP} = Volume accuracy for late AM off-peak traffic conditions
VA_{NO} = Volume accuracy for noon traffic conditions
VA_{AOP} = Volume accuracy for afternoon off-peak traffic conditions
VA_{PMP} = Volume accuracy for PM peak traffic conditions
VA_{DU} = Volume accuracy for dusk traffic conditions
VA_{NI} = Volume accuracy for night traffic conditions

995-2.9.3 Calculation of Speed Accuracy: For computing the accuracy of the detector speed measurement, the average speed readings obtained from the detection system are compared to ground truth values.

The equation in 995-2.9.3.1 represents the ground truth average speed computation procedure for a particular lane during a specific time period. The equation in 995-2.9.3.2 represents the average speed computation procedure for a particular lane during a specific time period using data gathered from the detection system.

In the equations in 995-2.9.3.1 and 995-2.9.3.2, the time period described is the early morning period, represented by "EM", and the subscript "k" represents a vehicle traveling on the roadway and could vary from 1,…, K, where "K" is the total number of vehicles in lane i during the time period under consideration. The subscript "i" represents a lane in a roadway and could vary from 1,…, N, where "N" is the total number of lanes of detection on the roadway segment. Substitute other lanes and periods as necessary and compute the accuracy for each lane for all time periods.

Variables and subscripts used in the equations below are identified as follows:

SA = Speed accuracy
S = Speed of an individual vehicle
K = Total number of vehicles in lane during time period
veh = Vehicle

995-2.9.3.1 Early Morning Average Ground Truth Speed:

$$S_{Avg,EM,GT,\ln_i} = \frac{1}{K}\sum_{k=1}^{K} S_{EM,GT,\ln_i,veh_k}$$

Where:

SA_{Avg,EM,GT,ln_i} represents the average ground truth vehicle speed for the *i* th lane during the early morning period.

S_{EM,GT,ln_i,veh_k} represents the ground truth speed for the k^{th} vehicle in the i^{th} lane during the early morning period using human observation or another method approved by the Engineer.

995-2.9.3.2 Early Morning Average Vehicle Detector Speed:

$$S_{Avg,EM,VD,\ln_i} = \frac{1}{K}\sum_{k=1}^{K} S_{EM,VD,\ln_i,veh_k}$$

Where:

S_{Avg,EM,VD,ln_i} represents the average speed recorded by the vehicle detector for the ith lane during the early morning period.

S_{EM,VD,ln_i,veh_k} represents the speed for the k th vehicle in the i th lane during the early morning period using the vehicle detector.

Determine lane speed accuracy per period by subtracting from 100 percent the absolute difference of the average lane speed measured by the detector and the average lane ground truth speed, divided by the average lane ground truth speed, expressed as a percent.

In the equation in 995-2.9.3.3, "EM" represents the early morning period. The subscript "*i*" represents a lane of detection on a roadway and could vary from 1,…,N, where "N" is the total number of lanes of detection on the roadway segment. Substitute other lanes as necessary to determine the accuracy for each period (i.e., dawn, AM peak, late AM off-peak, etc.).

995-2.9.3.3 Early Morning Lane Speed Accuracy Expressed as a Percentage:

$$SA_{Avg,EM,\ln_i} = 100 - \frac{\left|S_{Avg,EM,VD,\ln_i} - S_{Avg,EM,GT,\ln_i}\right|}{S_{Avg,EM,GT,\ln_i}} \times 100$$

Where:

SA_{Avg,EM,ln_i} represents the average speed accuracy during early morning traffic conditions for all vehicles that traveled in lane i of the roadway segment.

The period speed accuracy will be the arithmetic mean of the lane speed accuracy, computed using the equation in 995-2.9.3.3, over all lanes.

In the equation in 995-2.9.3.4, "EM" represents the early morning period. The subscript "i" represents a lane of detection on a roadway and could vary from 1,…, N, where "N" is the maximum number of lanes on the roadway segment. Substitute data as

necessary to determine the accuracy for each period (i.e., dawn, AM peak, late AM off-peak, etc.).

995-2.9.3.4 Early Morning Speed Accuracy Expressed as a Percentage:

$$SA_{EM} = \left(\frac{\sum_{i=1}^{N} SA_{Avg,EM,\ln_i}}{N} \right)$$

Where:

SA_{EM} represents the average speed accuracy during early morning traffic conditions for all lanes of detection on the roadway segment.

Calculate detector speed accuracy for the roadway segment over all periods using the equation in 995-2.9.3.5.

995-2.9.3.5 Total Roadway Segment Accuracy Expressed as a Percentage:

$$SA_{Total} = \frac{[SA_{EM}x24 + SA_{DA}x2 + SA_{AMP}x4 + SA_{LAOP}x16 + SA_{NO}x4 + SA_{AOP}x16 + SA_{PMP}x4 + SA_{DU}x2 + SA_{NI}x24]}{96}$$

Where:

SA_{Total} = Speed accuracy for all lanes for all periods
SA_{EM} = Speed accuracy for early morning traffic conditions
SA_{DA} = Speed accuracy for dawn traffic conditions
SA_{AMP} = Speed accuracy for AM peak traffic conditions
SA_{LAOP} = Speed accuracy for late AM off-peak traffic conditions
SA_{NO} = Speed accuracy for noon traffic conditions
SA_{AOP} = Speed accuracy for afternoon off-peak traffic conditions
SA_{PMP} = Speed accuracy for PM peak traffic conditions
SA_{DU} = Speed accuracy for dusk traffic conditions
SA_{NI} = Speed accuracy for night traffic conditions

995-2.10 Probe Data Detection System Performance Requirements: Probe data detectors shall establish a unique and consistent identifier for each vehicle detected and the time and location that the vehicle was detected and shall provide the following:

1. A minimum match rate of 5% for probe data detection systems that match upstream and downstream detection of the same vehicle
2. A minimum total roadway segment speed and travel time accuracy level of 90%. Verify system performance over several time periods under a variety of traffic conditions as described in 995-2.9.1.

995-2.10.1 Calculation of Match Rate: Match rate is the percentage of the total vehicle population of a road segment that is detected and matched at consecutive probe data detection sites.

995-2.10.1.1 Early Morning Match Rate Expressed as a Percentage:

$$MR_{EM} = 100 - \frac{\left| M_{EM,VD} - V_{EM,GT} \right|}{V_{EM,GT}} \times 100$$

Where:

MR_{EM} = Match Rate for early morning.

$M_{EM,VD}$ = Number of matched detections between two probe vehicle detection sites (typically a pair of sites at each end of a roadway segment) during early morning.

$V_{EM,GT}$ = Total volume of vehicles that pass the detection area for the 15-minute early morning period using human observation or another method approved by the Engineer.

995-2.11 Wrong Way Vehicle (WWVDS) Detection System Performance Requirements: To verify conformance with the accuracy requirements in this Section and as a precondition for listing on the APL, the wrong way detection system will be evaluated at the FDOT Traffic Engineering Research Lab (TERL). Under controlled conditions at the TERL facility, the wrong way detection system must be capable of meeting the detection accuracy of 100% and zero false positive readings, using a sample size of 200 vehicles.

995-3 Loop Sealant.

~~Loop sealant shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.~~

Loop sealant shall be furnished in a premeasured two-part formulation and meet the following requirements:

Table 995-3
Loop Sealant Properties

Property	Test Method	Performance Criteria
Self-leveling		
Viscosity	ASTM D562 @77°F	Sealant shall not run out of unlevel slots
Adhering to concrete and asphalt	Install in 3/8 inch by 3-inch saw cut, cure for 2 weeks at 77°F	Visual inspection: sealant shall securely adhere to concrete and asphalt No visible signs of shrinkage after curing when tested for shrinkage using a dimensional measurement
Curing	ASTM C679 at 77°F	Tack-Free at 2 hours from time of application
Resistance to Fluids	ASTM D570	Sealant shall resist weather, oils, gasoline, antifreeze, and brake fluid when tested for absorption for water, No. 3 oil, gasoline, antifreeze, and brake fluid for 24 hours

Penetration	ASTM D2240 Shore A	Sealant shall resist penetration of foreign materials when tested for durometer hardness for 24 hours
Expansion Cracking	ASTM D412	Sealant shall resist cracking caused by expansion and contraction due to temperature changes when tested for tensile strength and elongation
Cracking	ASTM C1246	Sealant shall not become brittle with age or temperature extremes when tested for weight loss, cracking, and chalking
Shelf Life	Manufacturer's Recommendations	Sealant shall have a minimum shelf life of 12 months when stored in accordance with the manufacturer recommendations

~~1. Sealant shall be self-leveling when applied and designed to be installed flush with the roadway surface. Sealant shall not run out of unlevel slots when tested for viscosity in accordance with ASTM D562 at 77°F. Sealant shall be tack free in a maximum of two hours from time of application and cured when tested for tack free time in accordance with ASTM C679 at 77°F.~~

~~2. When installed in a 3/8 inch by 3 inch saw cut and cured for two weeks at 77°F:~~

~~a. using visual inspection, sealant shall securely adhere to concrete and asphalt.~~

~~b. sealant shall show no visible signs of shrinkage after curing when tested for shrinkage using a dimensional measurement.~~

~~3. Sealant shall resist weather, oils, gasoline, antifreeze, and brake fluid when tested for absorption for water, No. 3 oil, gasoline, antifreeze, and brake fluid for 24 hours in accordance with ASTM D570. Sealant shall resist penetration of foreign materials when tested for durometer hardness for 24 hours in accordance with ASTM D2240 Shore A.~~

~~4. Sealant shall resist cracking caused by expansion and contraction due to temperature changes when tested for tensile strength and elongation in accordance with ASTM D412.~~

~~5. Sealant shall not become brittle with age or temperature extremes when tested for weight loss, cracking, and chalking in accordance with ASTM C1246.~~

~~6. Sealant shall have a minimum shelf life of 12 months when stored in accordance with the manufacturer recommendations.~~

~~7. Sealant containers shall be clearly labeled with name or trademark of the manufacturer, model number, date of manufacture or manufacturer's batch number, and installation instructions.~~

995-4 Vehicular Traffic Signal Assemblies.

995-4.1 General: ~~Vehicular traffic signal assemblies shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.~~

Vehicular traffic signal assemblies must meet the requirements of Section 603 and the ~~Institute of Transportation Engineers (~~ITE~~)~~ Standard for Vehicle Traffic Control Signal Heads.

Fastening hardware such as bolts, screws, nuts, washers, latches, and studs must be SAE Type 316 or 304 stainless steel.

Horizontal signal assemblies must be constructed so the door hinges, when installed, are located on the bottom of the signal assembly. Vertical mounted five-section cluster assemblies must be constructed so that the door hinges, when installed, are located along the outside edges of the complete assembly and each section opens away from the horizontally adjacent section.

~~Vehicular traffic signal assemblies must be permanently marked with the manufacturer's name or trademark, part or model number and date of manufacture or serial number.~~

995-4.2 Twelve Inch Signal Head Assemblies: Construct the assembly of materials and alloys specified in the ITE Standard for Vehicle Traffic Control Signal Heads.

Construct signal housings to allow adjustment in multiple directions for proper signal alignment. If a serrated connection is used for positioning and alignment of the signal, the top and bottom opening of each signal head section must include a circular 72-tooth serrated connection (2-inch nominal I.D.) capable of providing positive positioning and alignment in 5-degree increments. When assembled and tightened, these connections must prevent rotation or misalignment of the signal head as well as misalignment between sections. The serrated area must start at the outside of the 2-inch hole and be at least 1/8 inch wide. The teeth must have a minimum depth of 3/64 inch between peaks and valleys, be free from burrs or other imperfections, and provide positive locking with the grooves of mating sections, framework, and brackets. The serration on the top circular connection of a signal section must have a valley at the 0-degree position and the serration on the bottom circular connection must have a peak at the 0-degree position, both aligned perpendicular to the front of the section. Connections must permit the assembly of a multi-section signal with the front of each section aligned within 1 degree.

Provide at least two latching points with latch pads and manual Type 316 or 304 stainless steel latching devices that are tamper resistant.

If backplates are mechanically attached, each signal section must have four backplate mounting attachment points on the back of the signal, on or no more than three inches from each section corner. Attachment points must be capable of accepting No. 10-16x3/8 inch or No. 10-24x3/8 inch Type 316 or 304 stainless steel screws for attaching backplates.

Tri-stud washers, when utilized to secure signal sections, must have a minimum thickness of 0.090 inches. For five-section cluster assemblies, tri-stud washers used to attach the top signal section to the multi-signal bracket and the multi-signal bracket to the bottom four signal sections must have a minimum thickness of 3/8 inches. When fastened together, washer distortion is not allowed.

Design each signal section to prevent the accumulation of standing water within the assembly. All sections comprising a single multi-section assembly must be securely fastened together to form a rigid and weather-proof unit.

995-4.2.1 Doors: Construct each signal section with at least two hinges for mounting a door. Hinge pins must be captive. Doors must remain captive and secure at all times and be capable of either left or right swing. The door latch must hold the door tightly closed. The door must include slotted pads that allow the door to be opened and closed by engaging or disengaging the latching device. The outside face of the door must include four holes equally spaced around the circumference of the lens opening for the attachment of a visor. The lens opening in the door must have a diameter of 11 to 11-1/2 inches.

995-4.2.2 Visors: The rear of the visor must have four tabs, notches, or holes for securing the visor to the signal housing door. The visor mounting method must permit the visor to be rotated and secured at 90 degrees for horizontal signal head installations. All visors must have a minimum length of 9-1/2 inches, and a minimum downward tilt of 3.5 degrees measured from the center of the lens. Tunnel visors must encircle and shield the lens from 300 degrees, plus or minus 10 degrees. Louvers may only be used in combination with full circle visors. Light must not escape between the visor and the door.

995-4.2.3 Gaskets: Gaskets must be constructed of weather-resistant material and be glued or sealed where they meet to provide one continuous length of gasket capable of providing a weatherproof seal for the signal assembly. Provide seals between the housing and door, between the lens and the door, and between any other mating surfaces where dust and moisture could enter. Gasket material must meet NEMA 250 and be constructed of temperature stabilized material that prevents any residue from collecting on the internal surfaces of the signal head.

995-4.2.4 Terminal Blocks: Provide at least one five-connection terminal block in all three or more section signal head assemblies and at least three five-connection terminal blocks in all five section signal head assemblies. Terminal block connections in the signal assembly must not require any tools other than a screwdriver.

Mount terminal blocks to the signal housing with Type 316 or 304 passivated stainless steel hardware. Use only non-corrosive wire attachment screws approved by the Department.

995-4.2.5 Color and Finish: The housing, doors, visors and backplates must be powder coated dull black (Federal Standard 595-37038) with a reflectance value not exceeding 25 percent as measured by ASTM E1347. For plastic heads, the black color must be incorporated into the plastic material before molding.

The finish on interior and exterior surfaces of aluminum signal head assemblies, visors, doors, and housing, must be painted in accordance with Military Standard MIL-PRF-24712A or American Architectural Manufacturers Association (AAMA) -2603-02 and must meet the requirements of ASTM D3359, ASTM D3363, and ASTM D522. Surface erosion, flaking, or oxidation must not occur within the normal life expectancy under typical installation conditions.

995-4.2.6 Plastic Signal Housings and Visors: Construct signal housing assembly, door, and visors of UV stabilized plastic with a minimum thickness of 0.1 inches, plus or minus, 0.01 inches, with the following physical properties:

Table 995-4
Plastic Signal Housings and Visors

Test	Minimum Requirement	Method
Specific Gravity	1.17	ASTM D792
Vicat Softening Temp.	305-325°F (152 – 163°C)	ASTM D1525
Brittleness Temp.	Below -200°F (-129°C)	ASTM D746
Flammability	Self-extinguishing	ASTM D635
Tensile Strength	Yield, 8500 psi (58 MPa)	ASTM D638
Elongation at yield	5.5 - 8.5%	ASTM D638
Shear Strength	Yield, 5500 psi (38 MPa)	ASTM D732
Izod impact strength	15ft-lb/in (800 J/m)	ASTM D256
Fatigue strength	950 psi (6.5MPa) at 2.5 mm cycles	ASTM D671

Fatigue strength	950 psi (6.5MPa) at 2.5 mm cycles	ASTM D671

~~1. Specific Gravity: 1.17 minimum, as per ASTM D792~~
~~2. Vicat Softening Temperature: 305-325 F (152-163 C), as per ASTM D1525~~
~~3. Brittleness Temperature: Below -200 F (-129 C), as per ASTM D746~~
~~4. Flammability: Self-extinguishing, as per ASTM D635~~
~~5. Tensile Strength, yield: 8500 PSI (58 MPa) minimum, as per ASTM D638~~
~~6. Elongation at yield: 5.5-8.5 %, as per ASTM D638~~
~~7. Shear, strength, yield: 5500 PSI (38 Mpa) minimum, as per ASTM D732~~
~~8. Izod impact strength, [notched, 1/8 inch]: 15 ft-lb/in (800 j/m) minimum, as per ASTM D256~~
~~9. Fatigue strength at 2.5 mm cycles: 950 PSI (6.5 MPa) minimum, as per ASTM D671~~

995-4.2.7 Backplates: Backplates may be constructed of either aluminum or plastic. Minimum thickness for aluminum backplates is 0.060 inch and the minimum thickness for plastic backplates is 0.120 inch. The required width of the top, bottom, and sides of backplates must measure between five to six inches. Color of backplates must be black in accordance with 995-4.2.5. Backplate thickness measurement must not include the retroreflective sheeting thickness.

If backplates are mechanically attached, provide a minimum of four corner mounting attachment points per signal section (for example, a three-section signal assembly would have 12 mounting points). Attachment points must not interfere with the operation of traffic signal section doors. Backplate outside corners must be rounded and all edges must be de-burred.

If louvers are provided, louver orientation must be vertical on sides and horizontal on top and bottom of the backplate and must be at least 1/2 inch from the inner and outer edge of the backplate panel. Universal backplates must fit all traffic signals listed on the APL.

Mount the backplate securely to the signal assembly with Type 316 or 304 passivated stainless steel installation hardware. Backplates, if mechanically attached, must be marked in accordance with 995-~~4.~~1, on the long sides of the backplate.

Backplates must include retroreflective borders using Type IV yellow retroreflective sheeting listed on the APL. Place a 2-~~-~~inch border on the entire outer perimeter of the backplate panel, no closer than 1/2 inch from any louvers.

All materials must be designed for exterior use and be UV stable.

995-4.2.7.1 Flexible Backplates: Flexible backplates must allow the entire length of longer portions of the backplate to flex 90 degrees, or until the backplate width is reduced to 2.5 inches or less, when influenced by high wind conditions, and return to zero degrees after the wind conditions subside. Flexible backplates must maintain visibility of the retroreflective border to approaching traffic, with up to 40 mph winds.

995-4.2.8 Light-Emitting Diode Optical Unit: The LED optical unit must conform to the requirements of ITE's Performance Specification, Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Circular Signal Supplement, dated June 27, 2005 or

Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement, dated July 1, 2007, with the following exceptions.

~~995-4.2.8.1 Physical and Mechanical Requirements:~~1. Retrofit LED signal modules must be compatible with all traffic signal housings listed on the APL. The rear of the LED signal module must be marked in accordance with 995-4.1.

~~995-4.2.8.2 LED Signal Module Lens:~~2. The lens must be tinted with an appropriate color (red, amber, or green) to reduce sun phantom affect and enhance on/off contrast. The tinting must be uniform across the face of the lens and be free from streaks, wrinkles, chips, bubbles, or other imperfections. If a polymer lens is used, a surface coating must be incorporated to provide abrasion resistance.

~~**995-4.2.8.3 Minimum Maintained Luminous Intensity Values:**~~3. Red and green modules must meet the requirements of ITE's Performance Specification, Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Circular Signal Supplement, dated June 27, 2005, with the exception that yellow modules must be 1.7 times brighter than the ITE specification. Arrow modules must meet the requirements of ITE's Performance Specification, Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement, dated July 1, 2007.

995-4.2.9 Electrical: Electrical conductors for LED signal modules must be a minimum of 36 inches in length. Each lead from the LED module must be terminated with insulated slide-on terminals. The conductors must be color coded to identify the color of the module as follows:

1. White must identify the neutral lead.
2. Red circular signals must be identified with a red lead, yellow circular signals with a yellow lead, and green circular signals with a green lead.
3. Red arrows must be identified with a red and black tracer lead, yellow arrows with a yellow and black tracer lead, and green arrows with a green and black tracer lead.

995-5 Pedestrian Signal Assemblies.

995-5.1 General: ~~Pedestrian signal assemblies shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.~~

Pedestrian signal assemblies must meet the requirements of Section 603, the ~~latest edition of the Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (~~MUTCD~~)~~, and the ~~Institute of Transportation Engineers (~~ITE~~)~~ standard for Pedestrian Traffic Control Signal Indications.

995-5.2 Housing and Visor: The housing must be weatherproof, sectional and may consist of as many sections as optical units. The housing must prevent light from escaping from one unit to another. The top and bottom opening of the housing must include a circular 72-tooth serrated connection (2-inch nominal I.D.) capable of providing positive positioning and alignment in 5 degree increments. When assembled and tightened, these connections must prevent rotation or misalignment. The serrated area must start at the outside of the 2-inch hole and be at least 1/8 inch wide. The teeth must have a minimum depth of 3/64 inch between peaks and valleys, free from burrs or other imperfections, and provide positive locking with the grooves of mating sections, framework, and brackets. The serration on the top circular connection of a signal section must have a valley at the 0-degree position and the serration on the bottom circular connection must have a peak at the 0-degree position, both aligned perpendicular to the front of the section. Housings must include latch pads and manual stainless

steel latching devices that are captive, or non-removable. Housings must have at least two latching points.

Reinforce all mounting points and adjacent housing material. The door enclosing the lens must be hinged and held securely to the housing. Provide a gasket meeting the requirements of ASTM D1056, Grade 2B2 between the housing and door and between the lens and door. If the fitting between the housing and door is weather-tight, the gasket may be omitted.

Provide a visor or egg-crate louver that eliminates sun phantom for each signal face. Visor must be three-sided and extend a minimum of 7 inches at the top from the face of the lens. The visor must be constructed of noncorrosive No. 18 gauge sheet metal, not less than 0.05 inch thick, or 0.1 inch thick polycarbonate.

All metal housings and visors must be powder-coat painted black in accordance with Military Standard MIL-PRF-24712A or AAMA-2603-02 with a reflectance value not exceeding 25 percent as measured by ASTM E97. For polycarbonate heads, the black color must be incorporated into the material before the molding process.

The housing must be constructed of a non-corrosive material. Cast metal parts must have a minimum tensile strength of 1 ksi (117 MPa) and sheet metal parts a minimum tensile strength of 27 ksi (186 MPa).

995-5.2.1 Die Castings: Meet the requirements in ASTM B85 for the physical characteristics and chemical content for alloys S12A, S12B, SC84A, SC84B, SG100A and SG100B.

995-5.2.2 Sand Castings: Meet the requirements in ASTM B26 for the physical characteristics and chemical content for alloys S5A and CS72A.

995-5.2.3 Permanent Mold Castings: Meet the requirements in ASTM B108 for the physical characteristics and chemical content for alloys S5A and CS72A.

995-5.2.4 Polycarbonate: Polycarbonate housing assemblies, doors and visors must be molded from ultraviolet stabilized polycarbonate plastic with a minimum thickness of 0.1 inches, plus or minus 0.01 inch, and provide the following physical properties:

Table 995-~~2~~5
Polycarbonate Housing Assemblies, Doors, and Visors

Test	Minimum Requirement	Method
Specific Gravity	1.17	ASTM D792
Vicat Softening Temp.	305-325°F (152 – 163°C)	ASTM D1525
Brittleness Temp.	Below -200°F (-129°C)	ASTM D746
Flammability	Self-extinguishing	ASTM D635
Tensile Strength	Yield, 8500 psi (58 MPa)	ASTM D638
Elongation at yield	5.5 - 8.5%	ASTM D638
Shear Strength	Yield, 5500 psi (38 MPa)	ASTM D732
Izod impact strength	15ft-lb/in (800 J/m)	ASTM D256
Fatigue strength	950 psi (6.5MPa) at 2.5 mm cycles	ASTM D671

995-5.3 Light Emitting Diode (LED) Pedestrian Signal Optical Unit (State Standard): Provide a countdown pedestrian signal module meeting the requirements of the latest ITE LED Pedestrian Signal Specifications.

995-5.4 Electrical: Wiring and terminals must meet the size, insulation, length, and color-coding of the current ITE Pedestrian Traffic Control Signal Indicators LED specification. Wires must not have bare wiring exposed where wires are secured.

The pedestrian signal must include a terminal block containing a minimum of three circuits, each with two noncorrosive screw-type terminals. Each terminal must accommodate three No. 18 AWG conductors and be labeled for ease of identification. The terminal block must not be obstructed and be visible when the housing is open.

995-5.5 Hardware: All brackets used to mount pedestrian signals must be an aluminum alloy cast fitting, pipe, or equivalent material approved by the Department. Aluminum and aluminum alloy bars, rods, wires, profiles, and tubes must meet ASTM B221. Aluminum-alloy sand casting must meet ASTM B26. All mounting hardware must be painted black with a reflectance value not exceeding 25 percent as measured by ASTM E97.

Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless Steel bolts, screws and studs must meet ASTM F593. Nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

995-6 Midblock Crosswalk Enhancement Assemblies.

995-6.1 General: ~~Midblock crosswalk enhancement assemblies shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.~~

Midblock crosswalk enhancement assemblies are classified as the following types: In-Roadway Light Assemblies and Rectangular Rapid Flashing Beacon Assemblies (RRFB).

995-6.2 In-Roadway Light Assemblies: In-roadway light assemblies must meet the physical and operational requirements of the latest edition of the MUTCD, Chapter 4N.

In-roadway light assemblies can include a passive detector in addition to a pedestrian pushbutton. In-roadway light assemblies must be normally dark and initiate operation upon pedestrian actuation via a pedestrian pushbutton or a passive detector. The In-roadway light assembly will cease operation at a predetermined time after the pedestrian actuation. If a passive detector is used, the In-roadway light assembly may cease operation after the pedestrian clears the crosswalk. The duration of the predetermined period shall be programmable and capable of matching the pedestrian clearance time for pedestrian signals as determined by MUTCD procedures. The timer that controls flashing must automatically reset each time a pedestrian call is received.

In-roadway light assemblies must have a minimum luminance of 101 candelas and a minimum viewing angle of 20 degrees.

995-6.3 Rectangular Rapid Flashing Beacon (RRFB): RRFB must include two rapidly and alternately flashed rectangular yellow indications having LED-array based pulsing light sources. Each rectangular yellow indication must be a minimum of five inches wide by two inches high. RRFB installations shall comply with the use and technical conditions of FHWA MUTCD Interim Approval 21 – Rectangular Rapid-Flashing Beacons at Crosswalks. The two RRFB indications shall be aligned horizontally, with the longer dimension horizontal and with a minimum space between the two indications of approximately 7 inches measured from inside edge of one indication to inside edge of the other indication.

995-6.3.1 Beacon Flashing Requirements: The light intensity of the yellow indications shall meet the minimum specifications of ~~Society of Automotive Engineers (~~SAE~~)~~ Standard J595 for Class 1 (Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles) dated January 2005. Ensure RRFB assemblies are capable of automatically dimming to reduce brightness of the LEDs at nighttime.

The flash rate of each individual yellow indication, as applied over the full on-off sequence of a flashing period of the indication, shall not be between 5 and 30 flashes per second. When activated, the two yellow indications in each RRFB shall have a flash rate of 75 flash cycles per minute using the following sequence: left side beacon on for 50 milliseconds (msec), both beacons off for 50 msec, right side beacon on for 50 msec, both beacons off for 50 msec, left side beacon on for 50 msec, both beacons off for 50 msec, right side beacon on for 50 msec, both beacons off for 50 msec, both beacons on for 50 msec, both beacons off for 50 msec, both beacons on for 50 msec, both beacons off for 250 msec. No other flash patterns shall be selectable via hardware or software.

995-6.3.2 RRFB Operation: RRFB can include a passive detector in addition to a pedestrian pushbutton. RRFBs must be normally dark and initiate operation only upon pedestrian actuation via a pedestrian pushbutton, or a passive detector. The RRFB will cease operation at a predetermined time after the pedestrian actuation. If the passive detector is used, the RRFB may cease operation after the pedestrian clears the crosswalk. The duration of the predetermined period shall be programmable and capable of matching the pedestrian clearance time for pedestrian signals as determined by MUTCD procedures. The timer that controls flashing must automatically reset each time a pedestrian call is received.

All RRFBs associated with a single crosswalk (including those with an overhead or advance crossing sign, if used) shall simultaneously commence operation of their alternating rapid flashing indications and shall cease operation simultaneously.

RRFBs must include an instruction sign (FTP-68C-21) mounted adjacent to or integral with each pedestrian pushbutton, in accordance with the Standard Plans, Index No. 654-001.

A confirmation light directed at and visible to pedestrians in the crosswalk must be installed integral to the RRFB to give confirmation that the RRFB is in operation.

995-6.3.3 Midblock Accessible Pedestrian Pushbutton: ~~If an accessible pedestrian pushbutton is shown in the Plans, t~~The assembly must contain a speaker, audio amplifier, and noise monitoring microphone for auto volume control.

The accessible pedestrian pushbutton detector must meet 995-9.3 for the locator tone feature. The pushbutton must not include a vibrotactile indication or percussive indications. The audible message must be programmable.

995-6.4 Cabinets, Housings, and Hardware: Cabinets used as part of the midblock crosswalk enhancement assembly must be currently listed on the APL or meet the ~~applicable criteria~~requirements of Section 676.

All housings other than approved cabinets must be powder coat painted dull black FED-STD-595-37038) with a reflectance value not exceeding 25 percent as measured by ~~American Society for Testing and Material~~ASTM -E1347. Cabinets and housings must prevent unauthorized access.

Pole-mount assemblies shall allow installation on 4-1/2 inch outer diameter posts.

Ensure all assembly hardware, including nuts, bolts, external screws, and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless

steel bolts, screws, and studs must meet ASTM F593. Stainless steel nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Carbon steel bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

995-6.5 Electrical Specifications: Equipment must operate on solar power or a nominal voltage of 120 ~~V alternating current (~~V_{AC}~~)~~. If the device requires operating voltages of less than 120 V_{AC}, supply the appropriate voltage converter. Solar powered systems must be designed to operate for minimum of 100 activations per day and provide 10 days of operation without sunlight. Each activation must be 30 seconds in duration. Solar powered systems must automatically charge batteries and prevent overcharging and over-discharging. Solar powered systems must include a charge indicator.

995-6.6 Environmental Specifications: All electronic assemblies shall operate as specified during and after being subjected to the transients, temperature, voltage, humidity, vibration, and shock tests described in ~~National Electrical Manufacturers Association (~~NEMA~~)~~ TS2, 2.2.7, 2.2.8, and 2.2.9. Electronics must meet ~~Federal Communications Commission (~~FCC~~)~~ Title 47, Subpart B, Section 15. The optical portion of the housing shall be sealed to provide an IP 67 rating.

995-7 Mast Arm, Span Wire, and Pole Mounting Assemblies.

995-7.1 General: ~~Mast arm, span wire, and pole mounting assemblies shall be listed on the Department's Approved Product List (APL) and meet the requirements of Section 603. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.~~

Fastening hardware such as bolts, nuts, washers, set screws, studs, u-bolts, cable and cable swags, must be provided by the mounting assembly manufacturer, must be SAE Type 316 or 304 stainless steel. Hardware (studs, bolts and u-bolts) must be a minimum of 5/16 inch diameter unless otherwise specified in this Section. SAE Grade 8 bolts and nuts are also acceptable. Metallic mounting assemblies must meet ASTM B117 for corrosion resistance.

Connections that provide an entrance to the interior of a traffic device must be weather-resistant.

All assemblies must be constructed to support the weight of any combination of signal indications with all accessories such as back plates and visors.

Connections between signal, disconnect and disconnect hanging hardware must be of the tri-stud design unless otherwise specified in this Section. Tri-stud washers must be a minimum 0.090 inches thick unless otherwise specified in this Section.

Connections must be designed to mate with a standard traffic signal's ~~two~~2-inch I.D. opening and must be capable of providing positive positioning and alignment of the traffic device. Connection type may be a 72-~~-~~tooth serrated edge or other connection type as long as all other specifications are met. For 72-~~-~~tooth serrated edge connections, the teeth must be clean, sharp, and at least 1/8 inch wide and 3/64 inch deep. All connection types must be weather resistant.

All mounting assemblies must be capable of providing adjustment in multiple directions for proper alignment of the attached traffic device and to prevent rotation around the vertical axis or misalignment after installation.

Use studs that are either cast directly into the aluminum during the casting process or tapped and locked with a locking material. In each case, a pull-out force must be provided. Messenger wire clamps must be extruded aluminum six inches long or cast U-bolt type.

Torque specifications must be included for all fastening hardware with the assembly installation instructions.

995-7.2 Product Identification: Mounting assemblies must be permanently marked ~~with the name or trademark of the manufacturer, part number and date of manufacture~~in accordance with 995-1. Identification must be cast into, or metal-marked on, the assembly in a legible manner. When the assembly is made up of multiple components, each component must be identified with the manufacturer's name or trademark.

995-7.3 Finish: Unless otherwise specified, mounting assemblies and components must be supplied with a natural finish with mill scale removed in accordance with Military Standard MIL-PRF-24712A or AAMA 2603-02 and must meet the requirements of ASTM 3359 and ASTM D3363. Disconnect (interior and exterior) and disconnect hub must be powder-coat painted dull black (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent as measured by ASTM E97. All finished surfaces must have a smooth finish free from cracks, blow-holes, shrinks, excessive material, and other flaws.

995-7.4 Mast Arm Mounting Assemblies: Mast arm mounting assemblies must include the following components: mast arm saddle, swivel, attachment cables (with cable clamp mechanism) or bands. Unless the assembly uses a free-swinging mounting method, mast arm mounting assemblies must include the support tube, and top and bottom support arms. Mast arm mounting assemblies must be designed to be attached to a mast arm by cables or bands. All connections must be designed to prevent movement when 250 pounds of downward force is applied to the completed vehicular traffic signal assembly.

995-7.4.1 Saddle: Saddles must be aluminum or stainless steel and must have a minimum yield strength of 16 ksi and a minimum ultimate tensile strength of 23 ksi in accordance with ASTM B26, ASTM B108, ASTM B85 or ASTM A240.

995-7.4.2 Swivel: Swivels must be aluminum or stainless steel and must have a minimum yield strength of 16 ksi and a minimum ultimate tensile strength of 23 ksi in accordance with ASTM B26, ASTM B108, ASTM B85 or ASTM A240. The swivel must provide at least two connection devices to secure the support tube to the swivel and be configured to permit the support tube to provide adjustment in multiple directions in a plane parallel to the mast arm. Any castings used to attach the support tube to the swivel must be manufactured from the same alloy as the swivel.

995-7.4.3 Saddle Attachment Cables and Bands: Mast arm saddle attachment cables must be 3/16--inch minimum diameter, Type 316 or 304 stainless steel aircraft type wire strand cable. The swage at the ends of the cable (used to tighten the cable against the saddle) must be Type 316 or 304 stainless steel with a minimum 3/8--inch diameter thread. The swage must permit use of a wrench to prevent rotation while tightening the nut at the end of the swage. If the attachment cable does not have swaged clamp screws at each end (double-ended), the unclamped end of the cable must be sintered, welded, or otherwise secured without adhesives to prevent unraveling of the cable. Banding must use two Type 304 or 201 series stainless steel 3/4 inch wide bands and Type 316 stainless steel buckles (clamp screws). De-burr the edges of the bands.

995-7.4.4 Cable Clamp Mechanism: Mast arm mount components used to secure the cable to the saddle must be aluminum or stainless steel and must have a minimum yield strength of 23 ksi and a minimum ultimate tensile strength of 30 ksi in accordance with ASTM B26, ASTM B221, ASTM B85 or ASTM A240.

995-7.4.5 Support Tube: Support tubes used in mast arm mounting assemblies must be aluminum or stainless steel and must have a minimum yield strength of 25 ksi and a minimum ultimate tensile strength of 30 ksi in accordance with ASTM B221 or ASTM A240. A gusseted hollow design may be used to provide for the routing of necessary wiring. The tube cross-sectional area's principal moments of inertia must average; at a minimum, that of a ~~1-1/2~~ 1.5-inch standard aluminum Schedule 40 pipe and the cross-sectional metal area must not be less than that of a ~~1-1/2~~1.5-inch Schedule 40 pipe. The bottom portion of the tube that supports the vertical load of the hanging device must be threaded using National Pipe Thread Taper (NPT), National Pipe Thread Straight (NPS), non-threaded U-bolt secured, or a continuous arm support tube. Threaded support tubes that are fully slotted must have an aluminum insert in the 3/4-inch slot extending a minimum of 1/2-inch beyond the threaded section. To provide easy installation of wiring, the tube must have a minimum 0.562-inch wire entrance slot running the full length of the tube, or either stopping a minimum of 8 inches above the threaded or U-bolt secured end. Edges of slot must be supported with internal gusseting. The tube interior and slot must be free of sharp edges that may damage wiring. Provide an easily installed and removable UV stabilized seal to completely fill the wire entrance slot after installation.

995-7.4.6 Top Support Arm: The top support arm of the mounting assembly must be of one-piece solid construction, or continuous arm with support tube, and capable of holding the signal head firmly in place. Top support arms must be aluminum with a minimum ultimate tensile strength of 30 ksi and minimum yield strength of 18 ksi in accordance with ASTM B26, or be die cast with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi.

A one or two piece top arm is acceptable. For a one-piece top arm, use at least two 1/4-inch minimum diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube. When a two-piece top arm is used, hardware required to connect components of the top arm must be 3/8-inch minimum diameter, Type 316 or 304 stainless steel.

The top support arm must have three 1/4 inch - 20 UNC-2B threaded holes to accept bolts for a tri-stud washer and gasket, or at least one imbedded or tapped and locked 5/16 inch - 18 threaded stud within the industry's standard 72-tooth serrated circular design that facilitates 5 degree increment positioning. Provide 0.090-inch thick (minimum) Type 316 or 304 stainless steel washers, nuts, and lock washers for attaching signal heads. A rubber washer, with dimensions similar to the large stainless-steel washer, must be provided for traffic signals. When mast arm clamps are used to support illuminated signs with tri-stud arrangements, a rubber washer with dimensions similar to the steel washer must also be used.

995-7.4.7 Bottom Support Arm: The bottom support arm, when not continuous arm with support tube, must be hollow to allow the routing and enclosing of all signal wiring. Bottom support arms must be aluminum with a minimum ultimate tensile strength of 30 ksi and minimum yield strength of 18 ksi in accordance with ASTM B26, or be die cast with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi. Plastic bottom arm covers must be constructed of ABS with a UV inhibitor and be strong enough to contain the signal cable in the bottom arm cavity without bending during installation and warping over time.

The end of the bottom support arm that attaches to the support tube must have a ~~1-1/2 inch~~1.5-inch steel coupling imbedded and cast directly into the part during the solidification of the aluminum, or a 1-1/2 inch NPT or NPS pipe thread cut directly into the casting. For non-threaded versions, the arm must allow the support tube to sit a minimum of

2 inches into an arm pocket and be secured to the arm with minimum 5/16 inch full U-shape U-bolt to distribute the load evenly to the lower arm casting.

The end of the bottom support arm that connects to the signal must have either three equally spaced and plumb imbedded 5/16 inch Type 316 or 304 stainless steel threaded studs located in the center of the 72 tooth serrated circular design, or three 1/4 inch – 20 UNC-2B tapped holes to accept bolts for a tri-stud washer.

995-7.4.7.1 Arms with Steel Coupling: If a threaded steel coupling is imbedded into the casting, the bottom arm must be aluminum alloy 535.0-F in accordance with ASTM B26, with a minimum ultimate tensile strength of 23 ksi, meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. The end of the bottom support arm must have at least two 1/4 inch diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube.

995-7.4.7.2 Threaded Arms: If threads are cut directly into the casting, the bottom arm must be aluminum alloy 535.0-F in accordance with ASTM B26, with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a ~~two~~ 2-inch section, meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. As an alternative, the arm can be die cast in aluminum with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi. The end of the bottom arm must have at least two 1/4 inch minimum diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube.

995-7.4.7.3 Non-threaded Arms: Lower arm must be aluminum 356 having a minimum ultimate tensile strength of 30 ksi and meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. The arm must have a locator tab to receive the support tube and be secured by a U-bolt.

995-7.4.7.4 Continuous Arm Support Tube: The continuous arm support tube must be of single form construction to support the weight of any combination of signal indicators with all accessories such as backplates and visors. Continuous support tubes must be Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A554, or aluminum with a minimum yield strength of 25 ksi and a minimum ultimate tensile strength of 30 ksi in accordance with ASTM B221.

The continuous arm support tube attachment to the signal head must have a minimum of two 5/16-18 Type 316 or 304 stainless steel bolts, nuts and washers. A rubber seal must be provided between the support tube and signal head.

995-7.5 Span Wire Mounting Assemblies: Span wire mounting assemblies must include a span wire clamp, a hanging device such as a drop pipe, adjustable hanger, or adjustable pivotal hanger with extension bar, messenger clamp, disconnect hanger, and multi-brackets.

995-7.5.1 Span Wire Clamp: Span wire clamps must be aluminum or stainless steel and must have a minimum ultimate tensile strength of 32 ksi and minimum yield strength of 22 ksi in accordance with ASTM B28, ASTM B108, ASTM B85, or ASTM A240.

995-7.5.2 Drop Pipe: Drop pipe hangers must be galvanized ~~1-1/2~~1.5-inch steel aluminum having a minimum yield strength of 35 ksi and a minimum ultimate tensile strength of 42 ksi in accordance with ASTM B221 and have NPT on each end for assembly.

995-7.5.3 Aluminum Adjustable Hanger: Aluminum adjustable hangers must be aluminum alloy 535.0-F in accordance with ASTM B26 with a minimum ultimate tensile

strength of 35 ksi and elongation of 9.0% in a two-inch section, meeting the chemical composition listed in Table 1 and material mechanical properties listed in Table 2 in ASTM B26.

995-7.5.4 Stainless Steel Adjustable Hanger: Stainless steel adjustable hangers must be Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A276.

995-7.5.5 Aluminum Adjustable Pivotal Hanger: Aluminum pivotal hangers must be aluminum alloy 535.0-F in accordance with ASTM B26 with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a two-inch section, meeting the chemical composition listed in Table 1 and material mechanical properties listed in Table 2 in ASTM B26.

995-7.5.6 Stainless Steel Adjustable Pivotal Hanger: Stainless steel pivotal hangers must be either Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A276.

995-7.5.7 Aluminum Extension Bar: Extension bars used to extend the length of the adjustable hanger must be T6061-T6 extrusion aluminum having a minimum yield strength of 35 ksi and a minimum ultimate tensile strength of 42 ksi in accordance with ASTM B221.

995-7.5.8 Stainless Steel Extension Bar: Stainless steel extension bar used to extend the length of adjustable hangers must be Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A276.

995-7.5.9 Disconnect Hanger: The disconnect hanger must be supplied with the following as a minimum:

1. Wired screw type/compression terminal block and wiring rated at 600 V_{AC} Root Mean Square (rms) with 12 or 18 circuits. The terminal block must be easily accessible for connection of the field wiring. Attach the terminal block to the disconnect with Type 316 or 304 stainless steel or brass fastening hardware.

2. Weather resistant grommets in each signal cable entrance of the disconnect hanger to prevent insect and animal access and to protect the signal cable from chafing.

3. A ~~two~~2-inch opening in the top of the disconnect hanger with an integral serrated area (or ~~1-1/2~~ 1.5-inch NPT threaded top section) to interface with the hanger method employed above it.

4. A securable door that allows access to all areas of the interior. The door securing device must be Type 316 or 304 stainless steel and captive. Hinge or groove pins for the door must be Type 316, 304, 303, or 302 stainless steel.

995-7.5.10 Multi-Brackets: Top and bottom (multi) brackets used in the assembly of span wire mounted multi-directional signals must be constructed of aluminum having a minimum yield strength of 13 ksi and a minimum ultimate tensile strength of 23 ksi per ASTM B26.

Top brackets must be of one-piece hollow design, with a cross-sectional diameter of at least 1-1/2 inch I.D. for receiving signal wires. The wall thickness must be at least 3/16 inch. Each top bracket (2-~~-~~way, 3-way, and 4-way) must have a two-inch diameter hole (with integral serrated boss as specified above) in the top side of the bracket for receiving a 1-1/2 inch entrance fitting. The underside of the top bracket must have a covered hole of at least three inches in diameter for the installation of the signal wires.

Bottom brackets must be of one-piece solid construction and must hold the signal heads firmly in place.

For the five-section cluster configuration, provide 3/8--inch--thick Type 316 or 304 stainless steel tri-stud washers and nylock nuts with lock washers to secure the top and lower signal sections of the cluster to the top multi bracket. Washer distortion must not occur after assembly of the five-section cluster. Multi-brackets must include all fastening hardware necessary to attach to the signal.

995-7.6 Pole (Pedestal and Post) Mounting Assemblies: All trunnions, brackets, and suspensions used in mounting vehicular and pedestrian signals to concrete, steel, aluminum, or wood poles must be an aluminum alloy cast fitting, pipe or equivalent as approved by the Engineer. The aluminum alloy must have a minimum ultimate tensile strength of 35 ksi in accordance with ASTM B221, ASTM B85, or ASTM B26.

Pole side-mount brackets used for pedestrian signals may be constructed of polycarbonate material.

995-7.7 Mounting Assemblies for Signs, Cameras, Detectors, and Other Traffic Control Devices: Mounting assemblies or assembly components used for signs, cameras, detectors, and other traffic control devices must be constructed of the same material~~,~~ and meet the same mechanical and chemical properties as mounting assemblies for signals.

995-7.8 Miscellaneous Mounting Components: Miscellaneous mast arm, span wire, and pole mounting components and accessories included with assemblies must meet the mechanical properties for its associated main assembly components or be listed separately on the APL. Mounting assemblies not approved with a specific primary device (such as a camera, detector, etc.), must be approved and listed separately on the APL.

995-8 Signal Priority and Preemption Systems.

995-8.1 General: ~~Signal priority and preemption system equipment shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.~~

Signal priority and preemption system equipment may utilize optical, GPS, and radio frequency ~~based~~ technologies.

995-8.2 Functional Requirements: Ensure that in-vehicle equipment operates without requiring any action from the vehicle operator or occupants once power is applied.

995-8.2.1 Security: The system must include features that secure the system and restrict its configuration and operation to authorized users and vehicles only.

995-8.2.2 Vehicle Identification: The system must be able to assign a unique identifier for each authorized vehicle. The system must be able to associate the identifier with vehicle information such as vehicle classification (e.g., fire, police, rescue, transit), owner/operator, and priority level.

995-8.2.3 Configuration and Management: The system must allow authorized local and remote users to set and read all user-programmable features and retrieve data collected by the system. The manufacturer must provide computer software required to configure, operate, and maintain the system at no additional cost to the Department.

995-8.2.4 Logging: The system installed in the field cabinet must store a record of events, including time, vehicle ID, class, priority level, and approaching direction for all vehicles detected. The log must operate on a first-in, first out (FIFO) principle with a minimum capacity of 5,000 events.

995-8.2.5 Detection Range and Accuracy: The priority and preemption system must be capable of detecting and identifying multiple authorized vehicles at various ranges up to 2,500 feet. The system must be able to determine the approaching direction of authorized

vehicles. The detection range and programming of emergency (high priority) and transit signal (low priority) preemption shall be adjustable from within the traffic signal cabinet. High priority calls must override low priority calls.

The system must service preemption calls having equal priority on a first-come, first-served basis.

995-8.3 Preemption System Cabinet Electronics: The priority and preemption system must be compatible with NEMA TS 1, NEMA TS 2, Type 170, and Type 2070 traffic signal controllers and their respective cabinets.

The system must be able to provide calls to the controller via input file and detector rack. The system must include two channel or four channel detector card units compatible with NEMA TS 2-2003 v02.06. The system must include a shelf mount option.

The system must be able to provide emergency preemption (high priority) and transit signal (low priority) preemption calls to the controller. Detectors must include programmable timers that allow the operator to configure detector call extension as well as limit the length of channel output calls.

Channel outputs must deliver a constant signal while emergency vehicles are detected for high priority preemption activation. Channel outputs must deliver a pulsed output for low priority preemption activation. Inputs and outputs must be optically isolated.

995-8.3.1 Serial Interface: Ensure that the serial ports support data rates up to 115 kbps; error detection procedures utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2). Serial interface ports may utilize RJ-45 connectors, D-sub connectors, or screw terminals.

995-8.3.2 Network Interface: Ensure that ~~local area network (~~LAN~~)~~ connections support the requirements detailed in the ~~Institute of Electrical and Electronics Engineers (IEEE)~~ IEEE 802.3 Standard for 10/100 Ethernet ~~connections~~Connections. Ensure that the connector complies with applicable ~~Electronic Industries Alliance (EIA) and Telecommunications Industry Association (~~TIA~~)~~ requirements.

995-8.4 Optical Preemption Detectors: Optical preemption detectors must respond to light impulses generated from a visible or infrared light source.

995-8.5 Intersection Radio/GPS Modules: Radio/GPS preemption systems must include radio/GPS modules that transmit a beacon signal and receive data transmitted by Radio/GPS vehicle equipment.

995-8.6 Mechanical Specifications: ~~Ensure equipment is permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.~~

Ensure that every conductive contact surface or pin is gold-plated or made of a noncorrosive, conductive metal. Do not use self-tapping screws on the exterior of the assembly.

All external parts must be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

Detector cards must include indicators for power and vehicle detection. Detector cards must include a test switch that can be used to manually generate detector calls that the system provides during normal operations.

995-8.7 Electrical Specifications: Provide equipment that operates on a nominal voltage of 120 volts ~~alternating current (~~V_{AC}~~)~~. If the device requires operating voltages of less than 120 V_{AC}, supply the appropriate voltage converter.

995-8.8 Environmental Specifications: Ensure system electronics perform all required functions during and after being subjected to the environmental testing procedures described in

NEMA TS 2, Sections 2.2.7, 2.2.8, and 2.2.9. Detectors and detector connections that are exposed to the elements must be weatherproof and designed for outdoor use.

995-9 Pedestrian Detection System.

995-9.1 General: ~~Pedestrian detection system equipment shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.~~

~~Pedestrian detection systems are classified into three categories: Standard Pedestrian Pushbutton Detectors, Accessible (Audible/Tactile) Pedestrian Pushbutton Detectors, and Passive Detectors.~~ The components of the pedestrian detection system include pushbuttons, pedestrian actuation signs, electronics, wiring, and mounting hardware.

995-9.2 Standard Pedestrian Pushbutton Detector: Pushbuttons must be raised from or flush with their housings and be a minimum of 2 inches in the smallest dimension. The pushbutton must require no more than 5 pounds of force to activate. The detector must be weather-tight and tamper resistant.

995-9.2.1 Housing: The housing must be a two-piece unit consisting of a base housing and a removable cover. The housing must be cast aluminum meeting the physical characteristics and chemical content established in ASTM B26 for alloys S5A and CS72A.

The housing or adapter (saddle) must conform to the shape of a pole and provide a flush, secure fit. Saddles must be of the same material and construction as the housing. Pushbuttons for wood pole mounting must have threaded holes for 1/2~~-~~inch conduit provided in the housing top or bottom. A 3/4~~-~~inch hole with an insulated bushing shall be provided through the back of the housing. Unused openings shall be closed with a weatherproof closure and painted to match the housing.

The housing must have a powder-coat finish and painted in accordance with Military Standard MIL-PRF-24712A. ~~The housing must be permanently marked with manufacturer name or trademark, part number, date of manufacture, and serial number.~~

995-9.2.2 Pushbutton: The pushbutton must include a normally open, mechanical phenolic enclosed, positive-acting, spring-loaded, audible (i.e., click) snap-action switch with single pole, single throw contacts, or a Piezo driven solid state switch rated for a minimum of 50 V. The Piezo driven solid state switch, when activated, must give an audible (i.e., two-tone chirp) indication of actuation. A visual indication of actuation is optional. The visual indication must remain illuminated until the pedestrian's WALKING PERSON (symbolizing WALK) signal indication is displayed. Switch connections inside the housing must allow wiring and installation without binding. The switch must have a design life of one million operations (minimum) at rated load.

995-9.2.3 Electrical Requirements: The wiring must be No. 18 AWG stranded (minimum) with 600 V outdoor insulation rating.

995-9.3 Accessible (Audible/Tactile) Pedestrian Pushbutton Detector: The accessible pedestrian pushbutton detector must consist of all electronic control equipment, wiring, mounting hardware, pushbuttons, and pedestrian actuation signs designed to provide both a pushbutton with a raised, vibrating tactile arrow on the button as well as a variety of audible indications for differing pedestrian signal functions.

995-9.3.1 Electronic Control Equipment: The accessible pedestrian pushbutton detector must include electronic control equipment that is programmable and adjustable using a laptop computer or vendor supplied programmer. Electronic control equipment must be able to be installed within a traffic controller cabinet or within a pedestrian signal housing. Electronic

control equipment installed within a traffic controller cabinet must allow the use of up to 16 pushbuttons (4 maximum per channel) with a single traffic controller cabinet. The accessible pedestrian pushbutton detector must receive timing from Walk and Don't Walk signals.

995-9.3.1.1 Audible Messages: Audible messages must be programmable. All audible messages and tones must emanate from the accessible pedestrian pushbutton housing. The accessible pedestrian pushbutton detector must utilize digital audio technology. The system shall have, at a minimum, three programmable locator tones. The accessible pedestrian pushbutton detector must have independent minimum and maximum volume limits for the Locator Tone, Walk, and Audible Beaconing features. The Wait message must only annunciate once per actuation.

995-9.3.1.2 Pushbutton locator tone: The accessible pedestrian pushbutton detector must provide independent ambient sound adjustment for the locator tone feature. The accessible pedestrian pushbutton detector must allow the locator tone to be deactivated.

995-9.3.1.3 Vibrating Pushbutton (VPB): The accessible pedestrian pushbutton detector must include a Vibrating Pushbutton (VPB). The VPB must be a single assembly containing an ADA compliant, vibro-tactile, directional arrow button, weatherproof audible speaker, and pedestrian actuation sign with optional placard Braille messages. The VPB tactile arrow must be 2 inches in length, be field adjustable to two directions, and require no more than 5 pounds of applied force to activate.

995-9.3.1.4 Conflict Monitoring: The accessible pedestrian pushbutton detector must monitor the Walk condition for conflict operation. The accessible pedestrian detector system must disable the Walk functionality if a conflict is detected.

995-9.3.1.5 Cabinet Control Unit (CCU): The accessible pedestrian pushbutton detector may include a CCU for interfacing and connecting the system. The CCU shall have labeled LED indicators for each channel operation. The CCU must reset upon loss of internal communication.

995-9.3.2 Inputs and Outputs: All inputs and outputs must use Mil-Spec Multi-pin connectors.

995-9.3.2.1 Inputs: Walk and Don’t Walk inputs must be optically isolated 80-150 volts AC/DC, 5mA max. General purpose inputs must be optically isolated 10-36 volts AC/DC, 10mA max.

995-9.3.2.2 Outputs: Outputs must be optically isolated 36 volts AC/DC peak, 300mA solid state fused contact closures. CCUs must include a normally open relay contact fault output.

995-9.3.3 Communication: The CCU must include an Ethernet interface. The CCU must have an integral web server that provides information on audible/tactile pedestrian-pushbutton detector status, access to event logs, and provides for remote Configuration of accessible pedestrian pushbutton detector system options. VPBs must include an Ethernet, serial, USB, or Bluetooth programming interface.

995-9.4 Passive Detectors: The passive detector must consist of all electronic control equipment, wiring, and mounting hardware.

995-9.4.1 General: A passive detector system uses one or more sensors and analytics hardware and software to detect the presence and direction of pedestrians and activate the traffic control device without any required action by the pedestrian.

995-9.4.2 Configuration and Management: Ensure that the passive detector is provided with software that allows local and remote configuration and monitoring. Ensure that the system can display detection zones and detection activations overlaid on live passive detector inputs. Ensure that the passive detector allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.

Ensure that the passive detector retains its programming in nonvolatile memory. Ensure that the detection system configuration data can be saved to a computer and restored from a saved file. Ensure that all communication addresses are user programmable.

995-9.4.3: Solid State Detection Outputs: Ensure outputs meet the requirements of NEMA TS2-~~2016~~2021, 6.5.2.26.

995-9.4.4: Electrical Requirements: Ensure the system operates using a nominal input voltage of 120 ~~V of alternating current (~~V_{AC}~~)~~. Ensure that the system will operate with an input voltage ranging from 89 to 135 V_{AC}. If a system device requires operating voltages other than 120 V_{AC}, supply a voltage converter.

995-9.5 Electrical: All wiring must meet applicable NEC requirements. The accessible pedestrian pushbutton detector must operate using a nominal input voltage of 120 ~~V alternating current (~~V_{AC}~~)~~. If any device requires nominal input voltage of less than 120 V_{AC}, furnish the appropriate voltage converter.

Accessible pedestrian pushbutton detector control electronics that are mounted in a pedestrian signal head must be able to receive power from the Walk and Don't Walk circuits of the signal head. Control electronics shall not require more than four wires for each pushbutton connection, and no more than two wires for each controller pedestrian input. Voltage at the pushbutton shall not exceed 24 V_{AC}.

995-9.6 Mechanical: ~~Equipment must be permanently marked with manufacturer name or trademark, part number, date of manufacture, and serial number.~~ Do not use self-tapping screws on the exterior of the assembly.

Ensure that all parts are made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8~~-~~-inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws and studs must meet ASTM F593. Nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8~~-~~-inch in diameter must be galvanized. Bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

Enclosures must have a NEMA 4X rating. Pushbutton housings for intersections must be black.

995-9.7 Environmental: Ensure equipment performs all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2-~~2016~~2021, Sections 2.2.7, 2.2.8, and 2.2.9.

SECTION 995 is expanded by the following new Articles:

995-10 Traffic Controllers.

Traffic controllers must meet the industry standards in Table 995-6.

Table 995-6
Traffic Controller Standards

Device	Standard
NEMA TS2 Controller	NEMA TS2-2021
Model 2070 Controller	CALTRANS TEES, 2020
Note: All controllers must meet AASHTO/ITE/NEMA ATC 5201, v06.25.	

All controllers must provide functionality that meets or exceeds operational characteristics, including NTCIP support, as described in NEMA -TS2-2021.

All controllers must:

1.Capture all mandatory event-based data elements listed in supplemental requirement SR-671-2, Supplemental Traffic Controller High Resolution Data Logging Requirements, as published on the Department's State Traffic Engineering and Operations Office website at the following URL: https://www.fdot.gov/traffic/Traf-Sys/Product-Specifications.shtm.

2. Provide and make Management Information Bases (MIBs) available for Traffic Signal Controller Broadcast Messages (TSCBM) to local agencies and FDOT that are compatible with SAE J2735 2016-03.

3. Support programming of destination Internet Protocol (IP) addresses via controller front panel for interface with Roadside Units (RSU) and other devices or systems.

995-11 Traffic Cabinets.

995-11.1 General: Cabinets must be permanently marked with a label including the manufacturer's name or trademark, model/part number, and the year and month of manufacture. Place the label on the inside of the main door using a water-resistant method. The label must be visible after installation.

Painted and unpainted cabinets must meet the applicable requirements in Aluminum Cabinets, NEMA TS-2-2016, 7.7.2.

995-11.2 NEMA Traffic Signal Controller Cabinets: Provide NEMA traffic signal controller cabinets with all terminals and facilities necessary for traffic signal control meeting the following requirements:

NEMA TS1 Controller Cabinet NEMA TS-1-1989
NEMA TS2 Controller Cabinet NEMA TS 2 2016

995-11.2.1 Documentation: Provide four paper copies of the cabinet wiring diagram with each cabinet. The nomenclature of signal heads, vehicular movements and pedestrian movements on the wiring diagram must be in accordance with the signal operating plan.

Documentation must include a list identifying the termination points of cables used for vehicular and pedestrian signal heads, detector loop lead-ins, and pedestrian pushbutton wires.

A heavy duty, resealable plastic opaque bag must be mounted on the backside of main cabinet door for storing cabinet documentation.

995-11.2.2 Police Switches: Provide the following police switches with Type 3 and larger controller cabinets. The switches must be mounted on the police panel and identified as to their function.

1. AUTO-FLASH: When this switch is in the FLASH position, all signal indications must immediately transfer to the flashing mode. AC power shall be removed from the load switches and stop timing applied to the controller unit. When this switch is placed in the AUTO position the controller unit must operate in accordance with the appropriate specification.

2. MANUAL ON-OFF: When this switch is in the on position, a logic ground must be applied to the manual control enable input of the controller unit.

3. MANUAL JACK: Install a manual jack on the police panel. The jack must mate with a three circuit, 1/4 inch diameter phone plug. Connect the tip and ring (middle) circuits of the jack to the logic ground and the interval advance inputs of controller unit. When the manual hand cord is plugged into the jack and the pushbutton is pressed, logic ground must be connected to the interval advance input of the controller unit.

Provide a manual pushbutton with Type 3 and larger cabinets. The pushbutton cord must have a minimum length of six feet with a 1/4 inch diameter three circuit plug connected to one end and a hand held manual pushbutton at the other end. With the exception of the vehicular yellow and all red clearance intervals, a complete cycle (push-release) of the manual pushbutton shall terminate the controller unit interval that is active. Cycling the push-button during the vehicular yellow or all red clearance intervals must not terminate the timing of those intervals.

995-11.2.3 Service Switches: Service switches must be mounted on the service panel or other locations approved by the Department and identified as to their functions. Provide the following service switches with Type 3 and larger cabinets.

1. SIGNALS ON-OFF: When this switch is in the off position, AC power shall be removed from all signal heads. The SIGNALS ON-OFF switch must be connected to the control input of a contactor (displacement relay). Current supplied to the switch must not exceed five amperes (amps) total. Do not directly route the main signal head power bus and cabinet power through the service or police switches.

2. AUTO-FLASH: When this switch is in the FLASH position, all signal indications must transfer to the flashing mode in accordance with the Uniform Code Flash (UCF) requirements. AC power shall be removed from the load switches when the signal indications transfer to the flashing mode. The controller unit must operate in accordance with appropriate specifications during the flashing mode. When the switch is placed in the AUTO position, transfer from the flash mode to normal operation shall be made in accordance with UCF requirements.

3. CONTROLLER ON-OFF: When this switch is in the off position, AC power shall be removed from the controller.

4. AUX POWER ON-OFF: When this switch is in the off position, AC power shall be removed from all circuits of the cabinet except for the duplex receptacle, cabinet light and ventilation fan.

5. VEHICLE DETECTORS: A detector test switch must be provided for each phase of the controller unit. Detector test switches must include a position for normal operation (phase receives calls from detectors), a position that provides a constant call, and a position that provides a momentary call.

995-11.2.4 Doors and Locks: Provide Type 3 and larger cabinets with a hinged, rain tight and dust tight police door which allows access to the police switches and manual jack.

Locate the police door in the bottom half of the main door for Type 3 and 4 pole mount cabinets. Locate the police door in the upper half of the main door for Type 4 and larger base mount cabinets.

Hinges and hinge pins must be constructed of stainless steel and prevent the door (main or police) from sagging. Hinges for the main and police doors must be 14 gauge and be located on the right side (viewed from the front).

Type 3 and larger cabinets must be furnished with a three point draw roller latching system consisting of the following latching points:

1. Center of the cabinet (lock)
2. Top of the cabinet--controlled by the door handle
3. Bottom of the cabinet--controlled by the door handle

The latching points on the top and bottom of the cabinet must remain in the locked position until the main cabinet door lock is unlocked. The locking mechanism must be equipped with nylon rollers to secure the top and bottom of the door.

Type 3 and larger cabinets must be furnished with a door stop which retains the main door open in a 90 degree and 120 degree position.

995-11.2.5 Police and Service Panels: Provide a police service panel with Type 3 and larger cabinets. The panels may be constructed of either sheet aluminum or cast aluminum. Locate the police panel behind the police door attached to the main door. The service panel must be mounted on the back side of the police panel. The police panel must have the following minimum dimensions:

1. Height – 4 inches
2. Width – 8 inches
3. Depth – 2-1/2 inches

995-11.2.6 Ventilation: Type 1 and 2 cabinets must be vented to allow dissipation of the heat generated by the equipment housed inside the cabinet.

Type 3 and larger cabinets must have dual, UL listed, thermostatically controlled fans, rated for continuous duty with a service life of at least three years. Mount thermostats on the inside top of the cabinet. Thermostats must be user adjustable to allow temperature settings ranging from a minimum of 70°F to a maximum of 140°F and capable of activating the fans within plus or minus 5 degrees of the set temperature. The intake vent must be rain tight, located on the bottom half of the cabinet, and covered with a removable filter.

995-11.2.7 Shelves: Type 2 cabinets must be furnished with one shelf. Type 3 and larger cabinets must be furnished with two adjustable shelves. Shelves must be adjustable in a maximum of 2-inch increments from the top of the load panel to 12 inches from the top of the controller cabinet.

995-11.2.8 Mounting Hardware: Type 1, 2, and 3 cabinets must be supplied with hardware for attaching the top and bottom half of the cabinet onto a flat or round surface. Optional wall or pole mount hardware must be provided for mounting Type 4 cabinets in specific installations.

Type 4 cabinets must have rigid tabs attached to the bottom of the cabinet. Type 5 cabinets must have rigid brackets attached to the bottom of the cabinet. Rigid brackets and tabs must be constructed of the same material used for the cabinet.

Type 4 and larger cabinets must be provided with one of the following alternatives for fastening to a concrete base:

1. Galvanized anchor bolts, nuts, lock washers, and flat washers in accordance with ASTM A153. The anchor bolts must be at least 1/2 inch in diameter, seven inches in vertical length with at least three inch horizontal, or
2. Heavy duty machine bolt anchors, flat washers, lock washers and machine screws with at least 1/2 inch thread diameter.

995-11.2.9 Electrical: Fabricate ground busbars of copper or aluminum alloy material compatible with copper wire and provide at least two positions where No. 2 AWG stranded copper wire can be attached.

Mount a ground busbar on the side of the cabinet wall adjacent to the power panel for the connection of AC neutral wires and chassis ground wires.

If more than one ground busbar is used in a cabinet, a minimum of a No. 10 AWG copper wire must be used to interconnect them.

995-11.2.9.1 Wiring: All wiring must be laced. All conductors in the cabinet must be stranded copper.

All inputs and outputs must be terminated on terminal strips. A connector harnesses for the controller, conflict monitor, vehicle detectors, and other controller accessory equipment must be furnished and wired into the cabinet circuitry.

A vehicle detector harness or rack must be furnished with the cabinet. Terminal strip circuits must be provided for connection of the loop lead-in cable.

995-11.2.9.2 Terminal Strips: The voltage and current rating of terminal strips must be greater than the voltage and current rating of the wire which is terminated on the terminal strip.

Conductors must be terminated on terminal strips with insulated terminal lugs. A calibrated ratchet crimping tool must be used to terminate the conductor in the terminal lug.

When two or more conductors are terminated on field wiring terminal strip screws, a terminal ring lug shall be used for termination of those conductors. All terminal strip circuits must be numbered.

995-11.2.9.3 Cabinet Light and Receptacle: For Type 3 and larger cabinets, provide one or more light fixtures that illuminate the entire interior of the cabinet. All lighting fixtures must automatically turn on when the cabinet doors are opened and off when the doors are closed.

Mount and wire a three-wire 115 V_{AC} duplex receptacle in all cabinets. The receptacle must be protected by a 15A circuit breaker. Do not mount the receptacle on the main cabinet door or police and service switch panels.

995-11.2.9.4 Main Circuit Breaker: Provide a 15A circuit breaker with Type 1 and 2 cabinets, and a 30A circuit breaker with Type 3 and larger cabinets.

The main circuit breaker must turn off all power to the cabinet and shall not be used for the power switch located in the service panel.

995-11.2.9.5 Radio Interference Suppression: A radio interference suppressor must be provided in series with the AC power before it is distributed to any equipment inside the cabinet. The suppressor must provide a minimum attenuation of 50 decibels over a frequency range of 200 kHz to 75 MHz when used with normal installations and shall be hermetically sealed in a metal case.

The radio interference suppressor must have the same minimum current rating as the main circuit breaker.

The ground connection of the radio interference suppressor must be connected only to AC neutral and shall not be connected to earth ground directly.

995-11.2.9.6 Optically Isolated Inputs: The Opto common input is the common reference pin for four optically isolated inputs.

The Opto inputs are intended to provide optical isolation for pedestrian detector and remote interconnect inputs. The Oepto inputs are intended to connect through external 27 K ohmkS, 1 W resistors for 120 V_{AC} operation and are intended for direct connection to 12 V_{AC} from the cabinet power supply for pedestrian detector applications. These inputs may alternatively be used for low-true DC applications when the Oepto common pin is connected to the 24 V supply.

The Oepto inputs shall provide electrical isolation of 10 megohmsMS minimum resistance and 1000 V_{AC} RMS minimum breakdown to all connector pins except the Oepto common pin. These inputs shall exhibit nominal impedance to the Oepto common pin of 5 K ohmkS', plus or minus 10 percent, and shall require 2.4 mA, plus or minus 10 percent, from a nominal 12 V_{AC} supply. The Oepto inputs shall not recognize 3 V_{AC} RMS or less relative to the common input and recognize 6 V_{AC} RMS or more relative to the common input. Any steady state voltage applied between an Oepto input and the Oepto common shall not exceed 35 V_{AC} RMS. Oepto inputs shall not be acknowledged when active for 25 ms or less, and shall be acknowledged when active for 50 ms or more.

995-11.2.9.7 Load Resistors: A load resistor or capacitor must be installed between the AC (common) and each signal field wiring terminal for the yellow, green and walk indication. All load resistors and capacitors must be on the front side of any panel used in the cabinet.

995-11.2.9.8 Surge Protection: Furnish surge protective devices (SPDs) for the main AC power input, all signal head field wiring terminals, interconnect cable terminals and loop lead-in cable terminals which are located in the cabinet. SPDs must be unobstructed and accessible from the front side of any panel used in the cabinet. Cabinets utilizing Din rail mounted SPDs must be grounded with a conductor to the cabinet bussbar.

The SPD for the main AC power input of the cabinet must be connected on the load side of the cabinet circuit breaker.

SPDs for signal and interconnect cable field wiring terminals must meet the following:

1. Clamp the surge voltage to a level no greater than twice the peak operating voltage of the circuit being protected.

2. Withstand a surge current of 1000A with an 8 by 20 µs waveform six times (at 1 second intervals between surges) without damage to the suppressor.

SPDs for loop lead-in cables must be designed in accordance with the following requirements:

1. Protect the detector unit loop inputs against differential (between the loop lead) surges, and against common mode (between loop leads and ground) surges.

2. Clamp the surge voltage to 25 V or less when subjected to repetitive 300A surges.

3. Withstand repetitive 400A surges with an 8 by 20 µs waveform without damage.

SPDs must be installed according to the SPD manufacturer's instructions and not affect the operation of detectors. SPD leads must be kept as short as possible.

995-11.3 Type 170 Traffic Signal Controller Cabinets: Provide Type 170 traffic signal controller cabinets with all terminals and facilities necessary for traffic signal control and meeting the following requirements:

Model 332, 334 and 336S Cabinets

CALTRANS TEES 2009

Model 336S cabinet must incorporate input surge protection mounted on a fold-down termination panel at the input file.

Model 332 cabinets must incorporate a lower input termination panel. Model 332 and 334 cabinets must be base mounted. The Model 332 cabinet must have an auxiliary MODEL 420 output file, and be configured for 8 vehicle, 4 pedestrian, and 4 overlaps.

Model 552A designation is given to Model 332 cabinet assemblies that include a swing-out EIA 19-inch rack cage.

Model 662 designation is given to Model 552A cabinets with a 66 inch height.

Cabinets must comply with figures for traffic control signals and devices available on the Department's State Traffic Engineering and Operations Office website at the following URL:
https://www.fdot.gov/traffic/Traf_Sys/Product-Specifications.shtm.

All terminals and facilities on panels must be clearly identified using permanent silk-screened text.

995-11.3.1 Base Plate and Mounting Brackets: Provide cabinets with a standard base mounting bolt pattern and a minimum of two aluminum plates welded inside for anchoring to a concrete or composite base.

995-11.3.2 Output File: Fabricate the output file using a "hard wired" harness. Printed board circuit boards are not acceptable.

995-11.3.3 Shelf: Provide an aluminum shelf with storage compartment in the rack below the controller (for remote secondary monitor/lap top computer use). The storage compartment must have telescoping drawer guides for full extension. The compartment top must have a non-slip plastic laminate attached. Provide an RS-232 connector for communications to the C2S port.

995-11.3.4 Loads: Provide dummy loads consisting of 4.7k resistors rated at five watts minimum for Greens, Peds, and Yellows. The dummy loads must be mounted on a terminal block in the rear of the output file or other approved location. Wire one side of each dummy load to AC return in a manner that allows a technician to easily attach the load to outputs from selected load switches.

995-11.3.5 Cabinet Light: Provide one or more light fixtures that illuminate the entire interior of the cabinet. All lighting fixtures must automatically turn on when the cabinet doors are opened and off when the doors are closed.

995-11.3.6 Surge Protection: Provide each cabinet with devices to protect equipment from surges. Surge protector termination panels must be attached to the cabinet rack assembly and allow sufficient space for connections, access, and surge protector replacement. AC isolation terminals must be on the same side of the cabinet as the AC service inputs. DC terminals and loop detector terminals must be installed on the opposite side of the cabinet from the AC power lines.

Surge protection for 332A cabinets must be mounted on the lower input termination panel.

Surge protection for 336S cabinets must be mounted on a custom fold down termination panel at the input file.

Under no circumstance (normal operation or short-circuit condition) shall the amperage capacity of the internal wiring and printed circuit board traces be less than the protecting threshold of circuit breakers and surge protectors provided.

995-11.3.6.1 Power Distribution Assembly Protection: The power distribution assembly (PDA) SPD must be a two--stage series/parallel device that meets or exceeds the following:

1. Maximum AC line voltage: 140 V_{AC}
2. 20 pulses of peak current, each of which will rise in 8 microseconds and fall in 20 microseconds to one-half the peak: 20kA.
3. The protector must include the following terminals:
   a. Main line (AC Line first stage terminal)
   b. Main Neutral (AC Neutral input terminals)
   c. Equipment Line Out (AC Line second stage output terminal, 10A)
   d. Equipment Neutral Out (Neutral terminal to protected equipment)
   e. Ground (Earth connection)
4. The main AC line in and the equipment line outer terminals must be separated by a 200 microhenry (minimum) inductor rated to handle 10A AC service
5. The first stage clamp shall be between Main Line and ground terminals
6. The second stage clamp shall be between Equipment Line Out and Equipment Neutral
7. The protector for the first and second stage clamp must have a metal oxide varistor (MOV) or similar solid state device, rated 20 kA.

The main neutral and equipment neutral output shall be connected together internally, and shall have an MOV (or similar solid state device, or gas discharge tubes) rated at 20 kA between main neutral and ground terminals.

The PDA SPD must have a peak clamp voltage of 250V at 20 kA (voltage measured between equipment line out and equipment neutral out terminals, current applied between main line and ground terminals with ground and main neutral terminals externally tied together).

The PDA SPD must have a maximum let through voltage not exceeding 500 Vpk using an 8 by 20 µs/1.2 by 50 µs; 6 kV, 3 kA surge. The SPD must either be epoxy-encapsulated in a flame retardant material or utilize thermally protected varistors and be designed for continuous service current of 10A at 120 V_{AC} RMS. Power to the Type 170E controller and to the 24V power supply must be provided from the equipment line out terminal of the PDA SPD.

995-11.3.6.2 Inductive Loop Detector Protection: Protect each inductive loop detector input channel with an external SPD that meets or exceeds the following:

1. The SPD must be a three-terminal device, two of which shall be connected across the signal inputs of the detector. The third terminal shall be connected to chassis ground to protect against common mode damage.

2.The SPD must instantly clamp differential mode surges (induced voltage across the loop detector input terminals) via a semiconductor array. The array shall be designed to appear as a very low capacitance to the detector.

3. The SPD must clamp common mode surges (induced voltage between the loop leads and ground) via solid state clamping devices.

4. Peak Surge Current

a. Differential Mode: 400A (8 by 20 µs)

b. Common Mode: 1000A (8 by 20 µs)

c. Estimated Occurrences: 500 @ 200A

5. Response Time: 40 ns

6. Input Capacitance 35 pF typical

7. Clamp Voltage

a. 30V max @ 400A (Differential Mode)

b. 30V max @1000A (Common Mode)

995-11.3.6.3 Signal Load Switch Protection: The outputs of each load switch in the output file shall be provided with a MOV connected from the AC positive field terminal to the chassis ground. The MOV must be rated 150 V_{AC} and shall be a V150LA20A (or approved equal).

995-11.3.6.4 Communication Input Protection: Each low voltage communication input must be protected as it enters the cabinet with a hybrid two-stage SPD that meets or exceeds the following:

1. The SPD must be a dual pair (four-wire) module with a double-sided, gold-plated printed circuit board connector.

2. The SPD must be installed in a ten-circuit card edge terminal block (PCB1B10A).

3. The SPD must be utilized as two independent signal pairs. The data circuits must pass through the SPD in a serial fashion.

4. Peak Surge Current

a. 10kA (8 by 20 µs)

b. Occurrences at 2000A: greater than 100

5. Response Time: less than 1 ns

6. Clamp Voltage: 30V maximum

7. Series Resistance: greater than 15 ohms per line

8. Primary Protector: 3 element gas tube

9. Secondary Protector: Solid state clamp (1.5 kW minimum)

The line side of the SPD must be connected to the communication field wires, the load side connected to the communication connector of the controller, and the ground terminal connected to chassis ground.

995-11.3.6.5 Low Voltage DC input protection: Each DC input must be protected by an SPD that meets or exceeds the following:

(a) The SPD must be a 5 terminal device. Two terminals must be connected to the line side of the low voltage pair, two terminals must be connected to the input file side, and the fifth terminal connected to chassis ground.

(b)Peak Surge Current

2 kA (8 by 20 µs)

Occurrences at peak current: 100 (typical)
(c) Response Time: 5-30 ns
(d) Shock: Must withstand 10-foot drop on concrete
(e) Clamp Voltage: 30V
(f) Series Resistance: greater than 15 ohms each conductor

995-11.3.6.6 Preemption and 115V AC signal input protection: Each preemption or AC signaling input channel must be protected by an external SPD that meets or exceeds the following requirements:

(a) The SPD must be a 3 -terminal device
(b) Peak Surge Current
2000A (8 b 20 µs)
Occurrences at peak current: 25 (minimum)
(c) Response Time: less than 200 ns
(d) Peak Surge Trip Point: less than 890V nominal

995-11.3.7 Model 210 Conflict Monitor with Absence of Red Monitoring: The conflict monitor must be a Model 210 "PLUS" conflict monitor capable of detecting fault sequencing of signals on a per channel basis (i.e., short or absence of yellow interval and/or simultaneous dual indications). All integrated circuits having 14 pins or more must be socket mounted.

995-11.3.7.1 Absence of Red Monitoring: The conflict monitor must be capable of monitoring for the absence of voltage on all of the inputs of a channel (defined here as red, yellow, and green). If an output is not present on at least one input of a channel at all times, the unit shall begin timing the duration of this condition. If this condition exists for less than 700 milliseconds, the unit shall not trigger. If this condition exists for more than 1000 milliseconds, the unit shall trigger as if a conflict had occurred, causing the intersection to transfer immediately into a flashing mode, and "stop-time" to be applied to the controller. A red signal shall require the presence of a minimum of 60 $V_{AC,}$ plus or minus 10 $V_{AC,}$ to satisfy the requirements of a red indication. The red input signals shall be brought into the conflict monitor through an auxiliary connector on the monitor's front panel. Provide a similar connector on the output file, with a removable harness connecting the two. Provide an indicator on the front panel of the monitor to identify the triggering of the monitor in response to the absence of red condition.

995-11.3.7.2 Red Monitor Harness: A connector and terminal assembly designated as P20 for monitoring the absence of red, shall be an integral part of the output file. The connector must terminate, and be compatible with, the cable and connector of a Type 170 conflict monitor unit (CMU), capable of monitoring the absence of red. Provide the pin assignments of the P20 connector and terminal assembly with the cabinet plans. The P20 connector shall be physically like the cable and connector of a Type 170 CMU to prevent the absence of red cable connector from being inserted into the P20 connector 180 degrees out of alignment.

995-11.3.7.3 Programming of Unused Red Channels: Provide all cabinet assemblies with a means of programming unused red channels by installing jumpers from red monitor inputs to 115 V_{AC}. The connecting terminals for the jumpers must be accessible and located in the same terminal block for all 16 channels to assure full compatibility of all cabinet assemblies with "210 Plus" conflict monitor units.

995-11.3.8 Police Door and Panel: Provide cabinets with police doors and panels. The police panel must include text informing officers that yellow and all-red clearance intervals are timed internally.

Police switch panels must include a manual jack. The jack must mate with a three circuit, 1/4-inch diameter phone plug. Connect the tip and ring (middle) circuits of the jack to the logic ground and the interval advance inputs of controller unit. When the manual hand cord is plugged into the jack and the pushbutton is pressed, logic ground must be connected to the interval advance input of the controller unit.

The pushbutton cord must have a minimum length of six feet with a 1/4-inch diameter three circuit plug connected to one end and a hand held manual pushbutton at the other end. With the exception of the vehicular yellow and all red clearance intervals, a complete cycle (push-release) of the manual pushbutton shall terminate the controller unit interval that is active. Cycling the push-button during the vehicular yellow or all red clearance intervals must not terminate the timing of those intervals.

995-11.3.9 Technician Service Panel: Provide cabinets with a technician service panel which is mounted on the back side of the police panel (inside the main cabinet front door).

There must be two switches located on the technician service panel, clearly labeled according to the following functions:

(a) UCF – This toggle switch shall:

Place the intersection into Flashing Operation.

After meeting requirements for Flashing Operations, all power shall be removed immediately from signal load switches.

(b) Signal On/Off – This toggle switch shall disconnect all power to the signal lights through the use of a 60A contact switch placed in series with the load switch packs.

Labels must be silk screened directly on the panel.

995-11.3.10 Swing-out Rack Assembly: Provide 552-A cabinets with a pullout and rotatable rack assembly as well as an interface panel mounted on the top of the rack assembly and attached to the top shelf. The rack assembly must be constructed to house components designed to be installed in a standard EIA 19-inch rack and shall house the Controller, Input File, Output File No. 1, PDA No. 2, and a storage compartment.

Construct the rack and slide/hinged mounting brackets so that when the rack assembly (fully loaded) can be pulled out with one hand with complete ease of operation including rotation of the assembly.

The rack assembly must have a spring-loaded latch mechanism to secure the rack assembly inside the cabinet while in the "rest" position. When pulled out of the cabinet at any point from its resting position (inside cabinet) to its full extension and rotation, the fully loaded rack assembly shall not cause any member of the assembly to bend, warp or bind. The rack must be made of one-inch square aluminum tubing with welded joints and extend and retract smoothly without noticeable friction or stress on roller guides, extension brackets, or other mechanical components. Maximum deflection of the entire rack assembly (with all equipment installed) shall not exceed 1/8 inch.

The rack assembly must have 12 technician test switches mounted to the interface frame assembly. Technician test switches must be of the momentary type and shall have eight vehicle and four pedestrian inputs.

The front of the rack assembly must be tapped with 10-30 threads with EIA universal spacing for 19-inch electrical equipment racks.

The rack assembly must be attached to the left cabinet wall through combination slide/hinged mounting brackets.

The slide/hinged mounting brackets must be fabricated from aluminum and/or stainless steel only.

Mounting bracket guides must utilize 7/8-inch stainless steel ball bearing rollers and allow extension and retraction of a loaded rack with minimal effort.

The rack assembly must be capable of rotating 210 degrees from its rest position after full extension from the cabinet.

The rack assembly must have a minimum 7/16-inch diameter aluminum rack stop rod attached to the inside left cabinet wall from the left side of the rack assembly to lock the rack into final position.

All cabinet harnesses must be long enough to maintain cabinet connections and functionality when the rack assembly is fully extended and rotated to its maximum limit. Harnesses must not bind or crimp when the rack is fully retracted, extended, or in motion.

995-11.3.11 Service Panels for 552A: The 552A cabinet must include a field service panel, auxiliary field service panel, and interface panel, all constructed of aluminum with a 1/8-inch minimum thickness. All components must be accessible from the front of the panels. Do not mount components or attach wires behind panels.

995-11.3.11.1 Field Service Panel: The field service panel must consist of terminal strips, circuit breakers, transient protection devices, load resistors, capacitors, cable tie mounts and associated wiring for making all field wiring connections. Mount the field service panel in the cabinet on the lower right exterior cabinet wall.

The field service panel must provide the necessary interconnecting junction points between the rack assembly and cabinet for the field service wires. The panel must be grouped for internal connections (jumpers) between terminals boards, wiring from the panel to the rack assembly, and wiring from the panel to the cabinet.

The field service panel wiring harness must have flexible wire covered by a flexible non-metallic conduit from the field service panel to the PDA, output file, and interface panel. The harness must have a metal clamp with a rubber grommet center attached to the field service panel to secure the harness to the panel for proper orientation of the harness with the rack assembly. Terminal strips for the panel shall be as listed below:

a) TBS1 - Terminal Block, Deadfront type, 3 position, No. 4 to No. 14 AWG wire range, 70A, 600V.

b) TBS2 - Terminal Block, Barrier, 16 position, .375 Density, 5-40 x 3/16 BH Screw, Open Bottom, Double Row, No. 16 AWG (max), 15A, 250V.

c) TBS3 - Terminal Block, Barrier, 20 position, .375 Density, 5-40 x 3/16 BH Screw, Open Bottom, Double Row, No 16 AWG (max), 15A, 250V.

d) TBS4 &TBS5 - Terminal Block, Barrier, 12 position, .438 Density, 6-32 x 1/4 BH Screw, Open Bottom, Double Row, No. 14 AWG (max), 20A, 250V.

The panel must have a main cabinet circuit breaker rated at 30A and a cabinet accessory circuit breaker rated at 15A for cabinet fans and light. Mount the circuit breakers near the back cabinet door on the panel.

The panel must include load resistors for all Walk, Green, Green Arrow, Yellow and Yellow Arrow Switch Pack outputs to prevent the conflict-voltage monitor from going into "Flash" due to a failed signal lamp. Load resistors must be 2K, 10 watt.

MOVs must be physically tied to one side of each terminal on TBS4 and TBS5 and be physically secured to the field service panel with a 6-32 screw.

995-11.3.11.2 Auxiliary Field Service Panel: The auxiliary field service panel must be mounted on the lower left interior cabinet wall and consist of a minimum of four terminal strips, 18 detector surge protectors and one pedestrian button isolation board assembly. The 18 surge protectors must be a three-terminal device, two of which are connected across the signal inputs of the detector for differential mode protection and the third terminal is grounded to protect against common mode damage. Mount the pedestrian button isolation board on the auxiliary field service panel. Terminal strips for the panel shall be Terminal Block, Barrier, 12 position, .438 Density, 6-32 x 1/4 BH Screw, Open Bottom, Double Row, No. 14 AWG (max), 20A, 250V.

Install a four-button pedestrian isolation board on the auxiliary field service panel to provide for the connection of the pedestrian buttons on phases 2, 4, 6 and 8. The board must provide electrical isolation of the field wiring to the internal cabinet wiring. The inputs to this isolation board shall be wired to terminal block TBA5 for connection to field wiring. The outputs of this board shall be carried through the harness to the input file to the proper wires that go to the interface extension panel of the controller.

The pedestrian button isolation board must include a PC board mounted on an aluminum panel with the following minimum dimensions:

Height: 2 inches
Width: 8 inches
Thickness: 1/8 to 3/16 inch

995-11.3.11.3 Interface Panel: The interface panel must consist of eight terminal strips, one telephone line suppressor and mounting fixture, two 24 V_{DC} relays and mounting fixtures, and all associated wiring for connecting the required interface equipment modules.

The front of the panel must be covered by a 1/4-inch clear plexiglass sheet, supported from the panel by four 1-1/2 inch standoffs. Secure the panels and cover using wing nuts that are removable without the use of tools. The plexiglass cover shall have 1/2-inch slot, centered over each of the terminal strips. All covers and panels must be interchangeable.

The panel wiring must provide the necessary interconnecting junction points between interface equipment cable harnesses and controller cabinet input and output signal. The panel wiring provides the functional wiring information for connecting the interface equipment in the cabinet.

The panel wiring must be grouped for internal connections (jumpers between terminal boards) as well as wiring from the controller and related cabinet functions to the terminal boards on the interface panel.

Ground wires must be No. 14 AWG wire, minimum. The internal harnesses must be located between TB1, TB2 and TB3. The external and internal wiring must be located outside of TB1 and TB4, between TB2 and TB3.

Terminal strips shall be Barrier type, .375 Density, 5-40 x 3/16 BH Screw, Open Bottom, Double Row, No. 16 AWG (max), 15A, 250V. Terminals must use

nickel/cadmium plated brass screws. All terminals and facilities on panels must be clearly identified using permanent silk-screened

The K1P and K2F relays shall be 15A miniature relays with polycarbonate cover, 2 form C (CO) contact arrangement, DC coil input, socket mount, .187 inch quick connect/solder terminals, AgCdO (15A) contacts, and 24 V_{AC} coil voltage with matching socket and hold down spring. All screws on the relay socket must be brass with nickel/cadmium plating.

995-11.3.12 Storage Compartment: Mount an aluminum storage compartment in the rack assembly. The storage compartment must have telescoping drawer guides for full extension of drawer from rack assembly and have a continuous front lip for opening the compartment top for storage. The top of the compartment must be non-slip plastic laminate.

Install a communication port on the right hand side of the drawer at the front for connecting to the communications port of the controller unit via the cabinet harness.

995-11.3.13 Cabinet Rails: Provide the cabinet with four cabinet rails for mounting wiring panels and various brackets. Rails must be keyhole design with slots 2 inches on center with a top opening diameter of 5/8 inches to allow the insertion of a 5/8 inch by 1 inch carriage bolt. The rails must be approximately 1-1/2 to 2 inches wide by 1/2 inch deep. Do not use unistruts or other rails.

995-11.3.14 Electrical: Do not use printed circuit boards in any controller cabinet subsystem file or panel, including but not limited to the output file (except for the red monitor program board), service panel, interface panel, and input file.

995-11.3.14.1 Wiring: Cut all wires to the proper length and neatly laced into cables with nylon lacing. No wire shall be doubled back to take up slack. Cables in the cabinet must not interfere with the routing and connection of field wiring. Cables must be secured with nylon cable clamps, unless specified otherwise. The position of cables between the components must be such that when the door is closed, it does not press against the cables or force the cables against the various components inside the controller cabinet.

Fabricate ground buss bars of a copper or aluminum alloy material compatible with copper wire and provide at least two positions where a No. 2 AWG stranded copper wire can be attached. Mount a 6 inch ground buss bar with screw terminals on the bottom flange on each side of the cabinet for connection of AC neutral wires and chassis ground. Attach a flexible ground strap between the left side ground buss bar and the left side bottom rear of the rack assembly. Wiring harnesses must be covered by a flexible non-metallic conduit. Panel wire size must be a minimum of No. 18 AWG unless otherwise specified.

995-11.3.14.2 Terminals: Terminal connections must be soldered or constructed using a calibrated ratchet type crimping tool. Wiring must be traceable and without entanglement.

995-11.4 Controller Cabinet Flashing Operation: When a non-emergency flashing operation is required, the selected operation shall be performed by the UCF format. The following shall utilize UCF format:

a) Flash Switch located on the cabinet service panel
b) Time Base Coordination Flash
c) Time Switch

When flashing operation is initiated, the controller assembly shall transfer from normal operation to flashing operation only at the end of the common major street red interval, the common minor street yellow interval, or the all red interval.

UCF shall be an internal function of the controller unit and must not be inhibited by the hold command. External logic will not be allowed to provide this function.

In the event of an emergency when flashing operation is required, the controller assembly shall immediately place the intersection on flash. Emergency flash may be initiated by the following:

a) Auto/Flash Switch - A switch located on the cabinet police panel

b) Conflict-Voltage Monitor senses a conflicting indication or system error

The transfer of the controller assembly from flashing operation to normal operation shall cause the controller unit to revert to its start-up sequence unless the conflict-voltage monitor has transferred the controller assembly to flashing operation. If transferred to flashing operation by the conflict-voltage monitor, the controller assembly shall remain in flashing operation until the monitor unit is reset and automatic operation can be implemented through the normal start-up sequence.

995-11.5 Intelligent Transportation System Cabinets: The cabinet shell must conform to NEMA 3R requirements, be constructed of unpainted sheet aluminum alloy 5052-H32 with a minimum thickness of 0.125 inch and have a smooth, uniform natural aluminum finish without rivet holes, visible scratches or gouges on the outer surface. Other finishes are acceptable if approved.

The dimensions for cabinets are listed below.

Table 995-~~6~~7
Cabinet Dimensions in Inches

Cabinet Type	Height	Width	Depth
340	66” - 68”	44” - 46”	26” - 28”
336	36” - 39”	24” - 26”	20’ - 22”
336S	46” - 48”	24” - 26”	22” - 24”
334	66” - 68”	24” - 26”	30” - 32”
332D	66” - 68”	48” - 50”	30” - 32”
P44	55” - 59”	44” - 46”	26” - 29”

The cabinet must be weather resistant and constructed with a crowned top to prevent standing water. All exterior cabinet welds must be gas tungsten arc (TIG) welds and all interior cabinet welds must be gas metal arc (MIG) or TIG welds. All exterior cabinet and door seams must be continuously welded and smooth and all inside and outside edges of the cabinet must be free of burrs, rounded and smoothed for safety. All welds must be neatly formed and free of cracks, blow holes and other irregularities. Use ER5356 aluminum alloy bare welding electrodes conforming to AWS A5.10 requirements for welding on aluminum. Procedures, welders and welding operators must conform to AWS requirements as contained in AWS B3.0 and C5.6 for aluminum.

The cabinet must have a lifting eye plate on both sides of the top of the cabinet for lifting and positioning it. Each lifting eye must be secured with a minimum of two bolts to the cabinet body and have a lift point opening diameter of 0.75 inch and capable of supporting a weight load of 1,000 pounds. All external bolt heads must be tamperproof.

Ground-mount cabinets must include a removable base plate and two aluminum plates, welded inside, for anchoring the cabinet. Fabricate the plates from aluminum alloy

5052-H32 a minimum of 4 inches wide by 0.125 inch thick. Provide the cabinet with four 1 inch diameter holes for anchoring.

995-11.5.1 Doors: Provide cabinets with front and rear doors, each equipped with a lock and handle. Doors must be full size, matching the height and width dimensions of the cabinet enclosure, with no fewer than three Type 4 or larger stainless steel hinges or; alternately, one full-length "piano" hinge. Hinges must be constructed of 14 gauge stainless steel with stainless steel hinge pins that are spot-welded at the top. Mount the hinges so that they cannot be removed from the door or cabinet without first opening the door. Brace the door and hinges to withstand 100 pounds per vertical foot of door height load applied to the outer edge of the door when standing open. Ensure there is no permanent deformation or impairment of any part of the door or cabinet body when the load is removed.

Door opening must provide a flange that allows the door gasket to mate with a flat surface. Include a gasket made of closed-cell material resistant to UV, weathering, elevated temperatures, and permanent deformation that is permanently bonded to the inside of each door forming a weather-tight seal when the door is closed.

995-11.5.2 Latches: Provide all cabinets with a three-point draw roller latching system for the doors. The latching system must have the following latching points.

1. Center of the cabinet (lock).
2. Top of the cabinet – controlled by the door handle.
3. Bottom of the cabinet – controlled by the door handle.

The latching points on the top and bottom of the cabinet must remain in the locked position until the main cabinet door lock is unlocked. The locking mechanism must be equipped with nylon rollers to secure the top and bottom of the door.

Provide the cabinet with a door stop that retains the main door open in a 90 degree and 120 degree position.

Outfit the doors with an industrial standard pin tumbler lock with No. 2 key, or an approved alternate, and hardware that allows the door to be secured using a padlock. Provide two keys for each cabinet lock.

995-11.5.3 Rails: Provide the cabinet with four cabinet rails that form a cage for mounting miscellaneous wiring panels and various mounting brackets. Use rails constructed of either 0.1345 inch thick plated steel or 0.105 inch thick stainless steel that extend the length of the cabinet's sides, starting from the bottom of the enclosure. Rails must be keyhole designed with slots 2 inches on center with a top opening of 5/8 inch in diameter to allow the insertion of a 5/8 inch by 1 inch carriage bolt. Rails must be 1-1/2 to 2 inches wide by 1/2 inch deep, drilled and tapped for 10-32 screws or rack screws with EIA universal spacing. Do not use unistruts or other rail types.

995-11.5.4 Racks: The cabinet must include a standard 19-inch EIA/TIA equipment rack centered in the cabinet for mounting devices to be installed inside. Clearance in the rack between the rails must be 17-3/4 inches.

995-11.5.5 Shelf: Provide a level, rollout internal shelf with a minimum work area measuring 10 inches by 10 inches. The shelf must be capable of sustaining a constant 20 pound load and the shelf position must be adjustable.

995-11.5.6 Sunshield: Sunshields must be mounted with tamper resistant hardware to standoffs that provide an air gap of at least one inch between the exterior cabinet walls and the sunshields. Sunshield standoffs located on the roof of the cabinet must be welded

to the cabinet body. Construct sunshields of 0.125 inch thick 5052-H32 aluminum sheet with corners that are rounded and smoothed for safety.

995-11.5.7 Ventilation: Provide ventilation through the use of a louvered vent at the bottom of the door. Vent depth must not exceed 0.25 inch. Provide an air filter a minimum of 192 square inches and 1 inch thick behind the vent. The filter must be removable and held firmly in place so that all intake air is filtered.

Provide a bottom trough and a spring-loaded upper clamp to hold the filter in place. The bottom trough must drain any accumulated moisture to the outside of the field cabinet.

ITS field cabinets must have dual thermostatically controlled fans, with one thermostat per fan, rated for continuous duty with a service life of at least three years. Mount thermostats on the inside top of the cabinet. Thermostats must be user adjustable to allow temperature settings ranging from a minimum of 70°F to a maximum of 140°F and capable of activating the fans within plus or minus 5 degrees of the set temperature. Use UL listed exhaust fans having a minimum air flow rating of 100 cubic feet per minute. Electric fan motors must have ball or roller bearings. Vent the exhaust air from openings in the roof of the field cabinet.

995-11.5.8 Electrical Requirements: All equipment must conform to applicable UL, NEC, EIA, ASTM, ANSI, and IEEE requirements. SPD's must be accessible from the front of any panel used in the cabinet. Connect the SPD for the cabinet's main AC power input on the load side of the cabinet circuit breaker. All wiring must be laced. All conductors must be stranded copper.

995-11.5.8.1 Service Panel Assembly: Provide a service panel assembly to function as the entry point for AC power to the cabinet and the location for power filtering, transient suppression and equipment grounding. Provide branch circuits, SPDs, and grounding as required for the load served by the cabinet, including ventilation fans, internal lights, electrical receptacles, etc.

995-11.5.8.2 Terminal Blocks: Terminate electrical inputs and outputs on terminal blocks. The voltage and current rating of the terminal block must be greater than the voltage and current rating of the wire fastened to it.

Terminate conductors on terminal blocks using insulated terminal lugs large enough to accommodate the conductor to be terminated. When two or more conductors are terminated on field wiring terminal block screws, use a terminal ring lug for termination of those conductors. Number all terminal block circuits and cover the blocks with a clear insulating material to prevent inadvertent contact.

995-11.5.8.3 Ground Buss~~-~~ Bar: Fabricate ground buss~~-~~bars of copper or aluminum alloy material compatible with copper wire and provide at least two positions where a No. 2 AWG stranded copper wire can be attached.

Mount the ground buss~~-~~bar on the side of the cabinet wall adjacent to the service panel assembly for the connection of AC neutral wires and chassis ground wires. If more than one ground buss~~-~~bar is used in a cabinet, use a minimum of a No. 10 AWG copper wire to interconnect them. Connect the equipment rack to the ground buss~~-~~bar in the cabinet to maintain electrical continuity throughout the cabinet.

Follow the PANI recommendations of USDA-RUS-1751 for connections to the ground buss~~-~~bar. Producer (P) or electrical power and sources of stroke current connections shall be on the left end of the buss~~-~~bar. Absorbing (A) or grounding wires shall be connected immediately right of the P connections. Non-isolated (N) connections such as

doors and vents shall be connected to the right of the A connections. Isolated (I) equipment grounds from equipment in the cabinet shall be connected on the right end of the buss bar.

995-11.5.8.4 Power Distribution Assembly: Furnish a power distribution assembly that fits in the EIA 19-inch rack and provides for protection and distribution of 120 V_{AC} power.

995-11.5.8.5 Interior Lighting: Provide one or more light fixtures that illuminate the entire interior of the cabinet. All light fixtures must automatically turn on when the main cabinet door is opened and turn off when the door is closed.

995-11.5.9 Adapter Bracket: Provide an adapter bracket for pole mounted cabinets that is slotted or otherwise designed to allow banding straps to be installed to avoid pole handholes.

995-11.6 Generator and Auxiliary Power Connection: Traffic signal controller cabinets and ITS cabinets must include a generator and auxiliary power connection.

Cabinets with generator and auxiliary power connection must include provisions for the connection of an external power source, such as a portable generator, through a weatherproof, secure interface. This feature must allow authorized personnel to access, connect, and secure an external power source to the cabinet in order to restore power within five minutes of arrival time at the cabinet. A 10 AWG, 600V UL rated cable, fabricated with L5-30 connectors, a minimum of 12 feet in length, must be supplied with cabinet assemblies for field connection between generator and cabinet. The generator access door and cable entrance must include means to prevent access to insects when cable is not present.

995-11.6.1 Automatic Transfer Switch: The transfer switch must meet UL 1008 and be rated equal to or higher than the design load of the cabinet's main breaker and the generator input twist-lock connector rating. The transfer switch must provide a means of switching between normal utility power and auxiliary backup generator power. Switching time cannot exceed 250 milliseconds. Ensure that the transfer switch does not allow simultaneous active power from more than one source and does not allow generator backflow into normal utility AC circuits.

995-11.6.2 Generator Access Panel: Include a generator connection panel consisting of, at a minimum, the automatic transfer switch with a three-prong, 30 amp L5-30P twist-lock connector with recessed male contacts for generator hookup. Locate the access panel as close as possible to the main AC circuit breaker with the bottom of the access panel no less than 24 inches above the bottom of the cabinet. Do not place the generator access panel on the main cabinet door or back door. Locate and label the transfer switch and twist lock connector on a panel easily accessible behind a weatherproof lockable exterior access door equipped with a tamper-resistant hinge. Label this access door "Generator Access Door". Provide the access door with a No. 2 lock.

The access door and cable entrance must include means to prevent access to insects when cable is not present. The generator hookup compartment must be recessed no more than six inches into the cabinet but be deep enough to allow closing and locking of the access door when the generator cable is connected. Avoid blocking access to any other equipment in the cabinet.

995-11.7 Small Equipment Enclosures: Small equipment enclosures must be a minimum NEMA 3R rated and smaller than 16 inches wide by 24 inches tall by 12 inches deep. The enclosure must be constructed of aluminum or non-metallic materials. Enclosures must include a safe means of removing power from the installed equipment for servicing and

replacement, such as a switch, fuse, or breaker. Discrete markings, such as manufacturer name and model, are permitted on the outside of small enclosures.

All fasteners less than 5/8 inch exposed to the elements must be Type 304 or 316 stainless steel.

Construct aluminum enclosures of 5052 sheet aluminum alloy with a minimum thickness of 0.090 inch. Aluminum enclosures must have a uniform natural finish or be powder coat painted in accordance with AAMA-2603-02 specifications. All welds, bends, and seams must be neatly formed and free of cracks, blow holes and other irregularities. All inside and outside edges of the enclosure must be free of burrs, rivet holes, visible scratches, and gouges and have a smooth, uniform finish.

Non-metallic enclosures must be UL 508A listed, be rated for outdoor use, and resist chemicals, corrosion, and ultraviolet rays.

Enclosure doors must include a vandal resistant hinge and be secured with a locking latch or a minimum of two quick-release Type 304 or 316 stainless steel latches with padlock hasps. Removal of the hinge or hinge pin must not be possible while the enclosure is closed. Provide two sets of keys with each lock.

Enclosures may be vented. Holes larger than 1/8 inches must be covered by heavy duty screen.

Post mounted enclosures must be supplied with mounting hardware for attaching the enclosure to a 4-1/2 inch (OD) aluminum post.

995-12 Traffic Controller Accessories.

995-12.1 General: Traffic controller accessories must meet the industry standards in Table 995-8.

Table 995-8
Traffic Controller Accessory Standards

Device	Standard
Conflict Monitor	NEMA TS1-1989, Section 6
Malfunction Management Unit	NEMA TS2-2021, Section 4
Power Supply	NEMA TS2-2021, Section 5.3.5
Load Switch	NEMA TS2-2021, Section 6.2
Flasher	NEMA TS2-2021, Section 6.3
Bus Interface Unit	NEMA TS2-2021, Section 8
Model 206L Power Supply Unit	CALTRANS TEES, 2020, 3.4
Model 208 Monitor Unit	CALTRANS TEES, 2020, 3.5
Model 210 Monitor Unit	CALTRANS TEES, 2020, 3.6
Power Distribution Assembly	CALTRANS TEES, 2020, 6.4.3
Input File	CALTRANS TEES, 2020, 6.4.4

995-12.2 Time Switch: Ensure the time switch is a 24-hour timer which controls the daily switching operation of circuit contacts at preselected times.

Type 1 time switches must contain a single circuit contact and a solid state timer with at least 48 programmable on and off times.

Type 2 time switches must contain two circuit contacts and a solid state timer with at least three independently programmable on and off times per circuit.

Type 3 time switches must contain three circuit contacts and a solid state timer with at least three independently programmable on and off times per circuit.

995-12.2.1 Timing: Solid state timing must be accomplished by digital circuits utilizing the power line 60 Hz frequency as the normal timing reference or GPS Time Sync. Time-of-day must be settable and displayed in maximum increments of one minute.

995-12.2.2 Programming: Programming for selection of contact openings or closures must be provided in maximum increments of one minute for Types 1 through 3 time switches.

A day omit device or circuit must be provided with Types 1 through 3 time switches to omit the programmed switching operation for any combination of up to three days of the week. A positive means of indicating the day of the week must be provided with Types 1 through 3 -time switches.

995-12.2.3 Reserve Power: Type 1, Type 2, and Type 3 solid state time switches must be provided with a battery backup circuit which maintains time during a power failure of up to 10 hours. The timing accuracy of battery backup circuits during a power failure must be plus or minus 0.5 seconds.

995-12.2.4 Output Circuit Contacts: Each output circuit contact must be rated for a 3A, 115 V_{AC} load. The output circuit contact must have 115 V_{AC} present when the timer turns the circuit on.

995-12.2.5 Time Switch Housing: Time switches must be enclosed in durable sheet aluminum or approved alternate housing. A terminal strip or screws must be provided with the time switch for AC power and all output circuit contacts.

995-13 System Control Equipment.

995-13.1 Adaptive Signal Control System: Adaptive signal control systems external to the traffic controller place detector calls to the traffic signal controller to adjust signalization timing based on measured traffic conditions independently of the traffic signal controller's preconfigured timings.

The system must interface with the traffic controller using either the Synchronous Data Link Control (SDLC) Port 1 interface and protocol or 24 V_{DC} inputs/outputs available in the traffic controller cabinet. Dynamically modifying controller configuration settings through serial communications is not allowed.

The system must include a user interface that allows the configuration of subcomponents, such as detectors and cameras, and includes remote monitoring and reporting.

The system must include the option of incorporating existing vehicle detection in addition to the primary detection used by the adaptive signal control system.

The system must not affect the normal operation of the traffic signal controller upon any failure of communication, detection, or system component.

Ensure adaptive signal control system hardware is permanently marked with manufacturer name or trademark as well as part number and serial number. Ensure that the markings are visible after installation.

995-13.2 Environmental Requirements: Ensure system control equipment performs all required functions during and after being subjected to the transients, temperature, voltage, humidity, vibration, and shock tests described in NEMA TS2-2021, 2.2.7, 2.2.8, and 2.2.9.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

August 25, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **995**
Proposed Specification: **9951400 Traffic Control Signal and Device Materials.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Derek Vollmer and Daniel Strickland, including a team from the State Traffic Operations Office, State Roadway Design Office, and State Program Management Office to move materials/manufacturer requirements from Section 700. Separating the manufacturer's requirements from the Contractor's requirement will help with the review of APL product submittals, field installations, inspections, and acceptance criteria.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 850-414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

TRAFFIC CONTROL SIGNAL AND DEVICE MATERIALS.
(REV ~~7~~8-~~18~~11-22)

SECTION 995 is expanded by the following new Articles:

995-14 Internally Illuminated Signs.

995-14.1 General: Marking must be accomplished by permanently affixing an indelible label, identification plate, dot peen type stamp, casting, or metal-marking. Signs must not exceed 9 feet in length or be larger than 18.0 square feet or less in area, and must not weigh more than 144 pounds Internally illuminated sign assemblies must be listed to the requirements of UL48 listed. Light emitting diode (LED) retrofit kits must be listed on the APL.

995-14.2 Housing: The sign housing must be constructed of continuous 5052 or 6063-T5 aluminum. All housing, corners, and door seams must be continuously welded. All exterior surfaces of the assembly must be powder-coat painted in accordance with Military Standard MIL-PRF-24712A or AAMA-2603-02. Finish must meet the requirements of ASTM D3359, ASTM D3363, and ASTM D522. Sign housings with any interior airspace must consist of a box type enclosure and separate hinged door assembly. The sign housing must include provisions to prevent water from entering the sign housing. Drain holes in the sign larger than 0.125 inch must be covered by a screen.

Signs must have removable sign faces. The sign face must be secured by a method that holds the sign face securely in place. Slide-in grooves are allowed to secure the sign face if the sign is edge lit.

The sign face must be a translucent lens constructed of 0.125-inch thick high impact strength polycarbonate or acrylic meeting UL48. Background must be translucent retroreflective sheeting coated with a transparent, pressure-sensitive adhesive film. Color must meet the criteria as detailed in Section 994. Retroreflective sheeting must meet the requirements of Section 994 and be listed on the APL.

If a door opens upward, it must have a bracket on each side to secure the door in the open position during maintenance. Doors must be permanently and continuously sealed with a foam gasket listed to UL157 to prevent the entry of water into the sign housing. Each door must be secured from opening by stainless steel rotary action draw latches as follows:

Signs of 5 feet up to 7 feet in length must have a minimum of three latches for each sign door.

Signs over 7 feet up to 9 feet in length must have a minimum of four latches for each door.

The rotary action draw latch must be captive and will not become detached or allow the door to open when the sign housing is torqued or twisted

The sign assembly must be designed and constructed to withstand 150 mph wind loads meeting the requirements of the Department's Structures Manual.

995-14.3 Luminance: The sign face must be illuminated evenly across the entire surface. Contrast ratio between the background and legend must be established by the lowest and the highest color retroreflective measurement and shall be at least 4:1. Measure the retroreflectivity in accordance with ASTM D4956.

995-14.3.1 Background Luminance: Minimum luminance for the legend portion of the street sign face must be no less than 87.5 lux. The luminance must be determined by averaging a minimum of seven readings. Four of the readings must be taken near the midpoint of

a line that would span between the outside corners of the background and the outside corners of the legend. One reading must be taken near the midpoint of a line that would connect the top corner readings. One reading must be taken near the midpoint of a line that would connect the bottom corner readings. One reading must be taken near the vertical and horizontal midpoint of the sign.

995-14.3.2 Border and Lettering Luminance: Minimum luminance of the legend and border must be 350 lux. The luminance must be determined by averaging a minimum of 17 readings. There must be a minimum of one reading from each letter in the legend. Readings within the legend must alternate between the top, middle and bottom portion of each letter. Readings within top and bottom of the border must be perpendicular to the top and bottom readings in the background. Readings within the sides of the border must be taken parallel to the readings taken within each letter.

995-14.4 Mechanical Requirements: All assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8-inch in diameter must be Type 304 or 316 passivated stainless steel. All assembly hardware greater than or equal to 5/8-inch in diameter must be galvanized. Bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

995-14.5 Electrical Requirements: Electrical wiring must meet NEC requirements for the light source provided. All wiring must be copper wire. All internal electrical wiring must be tight and secure. The sign must include an accessible electrical power service entrance compartment (internal or external) for connection of field wiring. External compartments must be weather-tight. All power supplies and ballasts must be Federal Communications Commission (FCC) approved.

Electrical connections must be protected against corrosion. All signs must have provisions for an integrated photocell.

995-14.6 Environmental Requirements: The illuminated sign assembly must operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 4-2016, Section 2.

995-14.7 Warranty: Internally illuminated signs must have a manufacturer's warranty covering defects for five years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

995-15 Highlighted Signs.

995-15.1 General: Highlighted signs must meet the design and functional requirements specified in this Section and Section 2A of the MUTCD. Use LEDs to highlight the sign's shape, color, or message.

Stop, Do Not Enter, Yield, and Wrong Way signs that are highlighted with LEDs must use red LEDs. All other signs must use LEDs which resemble the color of the sign background color.

995-15.2 Performance Requirements: Highlighted signs are capable of automatically dimming to reduce brightness of the LEDs at nighttime.

Highlighted signs that rely upon solar power or batteries must be capable of at least 10 days of continuous operation without the need for charging.

995-15.3 Cabinets: If the highlighted sign includes a cabinet, the cabinet must be currently listed on the APL or meet the requirements of Section 676.

995-15.4 Mechanical Requirements: All assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8-inch in diameter must be Type 304 or 316

passivated stainless steel. All assembly hardware greater than or equal to 5/8-inch in diameter must be galvanized. Bolts, studs, and threaded rod shall meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

995-15.5 Electrical Requirements: Electrical wiring must meet NEC requirements for the light source provided. All wiring must be copper wire. All internal electrical wiring must be tight and secure. The sign must include an accessible electrical power service entrance compartment (internal or external) for connection of field wiring. External compartments must be weather-tight. All power supplies and ballasts must be Federal Communications Commission (FCC) approved.

Electrical connections must be protected against corrosion. All signs must have provisions for an integrated photocell.

995-15.6 Environmental Requirements: The highlighted must operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 4-2016, Section 2.

995-15.7 Warranty: Highlighted signs must have a manufacturer's warranty covering defects for three years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

995-16 Dynamic Message Signs.

995-16.1 General: Dynamic message signs (DMS) must meet the requirements of NEMA TS4-2016. DMS are classified by the type of sign display and the type of mechanical construction. Use only equipment and components that meet the requirements of these minimum specifications and are listed on the APL. DMS LED retrofit kits must be listed on the APL.

995-16.1.1 Front Access DMS: Front access signs must meet the requirements of NEMA TS 4-2016, Section 3.2.6.

995-16.1.2 Walk-In DMS: Walk-in signs must meet the requirements of NEMA TS 4-2016, Section 3.2.8.

995-16.1.3 Embedded DMS: Embedded DMSs must be mounted to ground traffic signs, overhead traffic signs, or overhead cantilever traffic signs.

995-16.2 Sign Housing Requirements for all DMS: The external skin of the sign housing must be constructed of aluminum alloy 5052 H32. The interior structure must be constructed of aluminum. Internal frame connections or external skin attachments must not solely rely upon adhesive bonding or rivets.

The sign enclosure must meet the requirements of NEMA TS 4-2016, Section 3.1.1. All drain holes and other openings in the sign housing must be screened to prevent the entrance of insects and small animals.

The sign housing must comply with the fatigue resistance requirements of the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Design and construct the DMS unit for continuous usage of at least 20 years. The sign assembly must be designed in accordance with the Department's Structures Manual, including a wind load of 150 miles per hour.

The top of the housing shall include multiple steel lifting eyebolts or equivalent hoisting points. Hoist points are positioned such that the sign remains level when lifted. The hoist points and sign frame allow the sign to be shipped, handled, and installed without damage.

All assembly hardware, including nuts, bolts, screws, and locking washers less than 5/8-inch in diameter, must be Type 304 or 316 passivated stainless steel and meet the

requirements of ASTM F593 and ASTM F594. All assembly hardware greater than or equal to 5/8-inch in diameter must be galvanized and meet the requirements of ASTM A307.

All exterior, excluding the sign face, and all interior housing surfaces must be a natural aluminum mill finish. Signs must be fabricated, welded, and inspected in accordance with the requirements of the current ANSI/AWS Structural Welding Code-Aluminum.

The sign housing must meet the requirements of NEMA TS 4-2016, Section 3.2.9 for convenience outlets.

995-16.2.1 Sign Housing for Walk-In DMS: Exterior seams and joints, except the finish coated face pieces, must be continuously welded using an inert gas welding method. Limit the number of seams on the top of the housing to a maximum of three. Stitch weld the exterior housing panel material to the internal structural members to form a unitized structure.

The exterior mounting assemblies must be fabricated from aluminum alloy 6061-T6 extrusions a minimum of 0.1875 inch thick. Include a minimum of three 6061-T6 structural aluminum Z members on the rear of the sign housing in accordance with the Standard Plans. The structural aluminum Z members must run parallel to the top and bottom of the sign housing and are each a single piece of material that spans the full length of the sign. The structural aluminum Z members must be attached to the internal framework of the sign.

The hoist points must be attached directly to structural frame members by the sign manufacturer.

Housing access must be provided through an access door that meets the requirements of NEMA TS 4-2016, Section 3.2.8.1. The access door must include a keyed tumbler lock and a door handle with a hasp for a padlock. The door must include a closed-cell neoprene gasket and stainless steel hinges.

The sign housing must meet the requirements of NEMA TS 4-2016, Section 3.2.8.3 for service lighting. If incandescent lamps are provided, they must be fully enclosed in heavy-duty shatterproof, protective fixtures. The incandescent fixtures must include aluminum housing and base, a porcelain socket, and clear glass inner cover. All removable components must be secured with set screws. If fluorescent lamps are provided, they must be fitted with shatter proof protective guards.

The sign housing must include emergency lighting that automatically illuminates the interior in the event of a power outage. Emergency lighting must be capable of operation without power for at least 90 minutes.

995-16.2.1.1 Walk-In DMS Work Area: The walk-in DMS must have a work area that meets the requirements of NEMA TS 4-2016, Section 3.2.8.2. All edges of the walkway are finished to eliminate sharp edges or protrusions.

995-16.2.2 Sign Housing for Front Access and Embedded DMS: Front access and embedded signs must meet the requirements of NEMA TS 4-2016, Section 3.2.5 and Section 3.2.6. Accessing the sign housing must not require specialized tools or excessive force to open.

995-16.2.3 Housing Face Requirements for all DMS: The sign face must meet the requirements of NEMA TS 4-2016, Section 3.1.3. All sign face surfaces are finished with a matte black coating system that meets or exceeds American Architectural Manufacturers Association (AAMA) Specification No. 2605. Submit certification that the sign face parts are coated with the prescribed thickness. Except for embedded DMS, the sign face must include a contrast border that meets the requirements of NEMA TS 4-2016, Section 3.1.6.

995-16.2.3.1 Housing Face for Walk-In DMS: No exposed fasteners are allowed on the housing face. The display modules shall be easily and rapidly removed from within the sign without disturbing adjacent display modules.

995-16.2.3.2 Housing Face for Front Access and Embedded DMS: Any exposed fasteners on the housing face must be the same color and finish as the housing face. Only captive fasteners may be used on the housing face.

995-16.2.3.3 External Fascia Panels: If the sign includes external fascia panels, they must be constructed using aluminum. Each fascia panel is finished with a matte black coating system that meets or exceeds AAMA Specification No. 2605.

995-16.2.3.4 Lens Panel Assembly: If the sign includes lens panel assemblies, they must be modular in design, removable, and interchangeable without misalignment of the lens panel and the LED pixels. The lens panel assembly must consist of an environmental shielding layer coating to protect and seal the LED and internal electronics. The coating must be a minimum 90% UV opaque. Lens panels must have a matte black coating that meets or exceeds AAMA Specification No. 2605. Lens panels must include a mask constructed of 0.080 inch minimum thickness aluminum. The mask must be perforated to provide an aperture for each pixel on the display module. The apertures must not block the LED output at the required viewing angle.

995-16.2.4 Sign Housing Ventilation System: The ventilation systems for walk-in, front-access, and embedded DMS must meet the requirements of NEMA TS 4-2016, Section 3.1.2.

Air drawn into the sign is filtered upon entry. The ventilation system must be automatically tested once each day and is able to be tested on command from remote and local control access locations. The sign must include a sensor or a sensor assembly to monitor airflow volume to predict the need for a filter change. The ventilation system fans must possess a 100,000 hour, L10 life rating.

995-16.2.4.1 Ventilation System for Walk-In DMS: The sign includes a fail-safe ventilation subsystem that includes a snap disk thermostat that is independent of the sign controller. The thermostat is preset at 130°F. If the sign housing's interior reaches 130°F, the thermostat must override the normal ventilation system, bypassing the sign controller and turning on all fans. The fans must remain on until the internal sign housing temperature falls to 115°F.

995-16.2.5 Sign Housing Temperature Sensor: The sign controller must continuously measure and monitor the temperature sensors. The sign must blank when a critical temperature is exceeded and reports this event when polled. Ensure that remote and local computers can read all temperature measurements from the sign controller.

995-16.2.6 Sign Housing Humidity Sensor: Humidity sensors must detect from 0 to 100% relative humidity in 1% or smaller increments. Sensors must operate and survive in 0 to 100% relative humidity, and have an accuracy that is better than plus or minus 5% relative humidity. Use of a humidistat is not acceptable.

995-16.2.7 Sign Housing Photosensors: The sign must meet the requirements of NEMA TS 4-2016, Section 9.1.3. The sensors must provide accurate ambient light condition information to the sign controller for automatic light intensity adjustment. The automatic adjustment of the LED driving waveform duty cycle must occur in small enough increments that the sign's brightness changes smoothly, with no perceivable brightness change between adjacent levels. Stray headlights shining on the photoelectric sensor at night must not cause LED brightness changes.

The brightness and color of each pixel must be uniform over the sign's entire face within a 30 degree viewing angle in all lighting conditions.

995-16.3 Display Modules: Display modules manufactured by one source and fully interchangeable throughout the manufacturer's sign system shall be provided. The removal or replacement of a complete display module or LED board must be accomplished without the use of special tools.

Display modules must contain solid-state electronics needed to control pixel data and read pixel status.

The sign must have a full matrix display area as defined in NEMA TS 4-2016, Section 1.6.

995-16.3.1 LED and Pixel Specifications: LED lamps must have a minimum viewing angle of 30 degrees.

All pixels in all signs in a project, including operational support supplies, must have equal color and on-axis intensity. The sign display must meet the luminance requirements of NEMA TS 4-2016, Section 5.4, for light emitting signs connected at full power. Amber displays must produce an overall luminous intensity of at least 9200 candelas per square meter when operating at 100% intensity. Provide the LED brightness and color bins that are used in each pixel to the Engineer for approval. The LED manufacturer must demonstrate testing and binning according to the International Commission on Illumination (CIE) 127-1997 Standard.

All LEDs must operate within the LED manufacturer's recommendations for typical forward voltage, peak pulsed forward current, and other ratings. Component ratings must not be exceeded under any operating condition.

Ensure that the operational status of each pixel in the sign can be automatically tested once a day. Ensure that the pixel status test determines the functional status of the pixel as defined by the pixel Failure Status object in National Transportation Communications for ITS Protocol (NTCIP) 1203 v02.39 and does not affect the displayed message for more than half a second.

LEDs must be individually mounted directly on a printed circuit board (PCB).

995-16.3.2 Optical, Electrical, and Mechanical Specifications for Display Modules: The display modules must be rectangular and have an identical vertical and horizontal pitch between adjacent pixels. The separation between the last column of one display module and the first column of the next module must be equal to the horizontal distance between the columns of a single display module. Full matrix DMS must have the ability to display messages with 20mm pixel pitch (resolution).

The LED circuit board must be a NEMA FR4-rated, single 0.062 inch, black PCB. No PCB shall have more than two PCB jumper wires present. All PCBs shall be finished with a solder mask and a component-identifying silk screen.

PCBs with conformal coating meeting the material requirements of IPC-CC-830 or MIL-I-46058C Military Standard, United States Department of Defense (USDOD) must be provided.

Any devices used to secure LEDs must not block air flow to the LED leads or block the LED light output at the required viewing angle. All components on the LED side of a PCB must be black.

There must be a minimum of two power supplies that are wired in a parallel configuration for redundancy. If one, or 25% of the supplies in a group, whichever is

greater, completely fails, the sign shall still be supplied with enough power to run 40% of all pixels at a 100% duty cycle with an ambient operating temperature of 165°F.

The sign controller must continuously measure and monitor all LED module power supply voltages and provide the voltage readings to the TMC or a laptop computer on command.

LEDs must be protected from external environmental conditions, including moisture, snow, ice, wind, dust, dirt, and UV rays. Epoxy must not be used to encapsulate the LEDs.

995-16.3.3 Display Area for Walk-In DMS: The display area must be capable of displaying three lines with a minimum of 15 characters per line, using an 18 inch font that meets the height to width ratio and character spacing in the MUTCD, Section 2L.04, paragraphs 05, 06, and 08.

995-16.4 Characters, Fonts, and Color: The signs must be capable of displaying American Standard Code for Information Interchange (ASCII) characters 32 through 126, including all uppercase and lowercase letters, and digits 0 through 9, at any location in the message line. Submit a list of the character fonts to the Engineer for approval.

All signs must be loaded (as a factory default) with a font in accordance with or that resembles the standard font set described in NEMA TS 4-2016, Section 5.6. For signs with a pixel pitch of 35 mm or less, the sign must be loaded (as a factory default) with a font set that resembles the FHWA Series E2000 standard font.

DMS fonts must have character dimensions that meet the MUTCD, Section 2L.04, paragraph 08.

Full-color signs must display the colors prescribed in the MUTCD, Section 1A.12.

995-16.5 Main Power Supply and Energy Distribution Specifications: A nominal single-phase power line voltage of 120/240 V_{AC} must be provided. The DMS must meet the requirements of NEMA TS 4-2016, Section 10.2.

All 120 V_{AC} wiring must have an overall nonmetallic jacket or be placed in metal conduit, pull boxes, raceways, or control cabinets and installed as required by the NEC. Do not use the sign housing as a wiring raceway or control cabinet.

Surge protective devices (SPD) must be installed or incorporated in the sign system by the manufacturer to guard against lightning, transient voltage surges, and induced current. SPDs must meet or exceed the requirements of Section 996. SPDs must protect all electric power and data communication connections.

995-16.6 Uninterruptible Power Supply (UPS): Walk-in DMS must include a UPS that can be installed within the sign housing or within the ground mounted control cabinet. Front access and embedded signs must include a UPS that can be installed within the ground mounted control cabinet. The UPS system must be capable of displaying the current messages on a sign when a power outage occurs. Signs with an UPS must be able to operate on battery power and display text messages for a minimum of two hours. The system must use sealed absorbed glass mat (AGM) batteries.

995-16.7 Operational Support Supplies: Furnish the operational support supplies listed in Table 995-8. Promptly replace any of the supplies used to perform a warranty repair.

For every group of 10 or fewer DMSs provided or required, provide one set of supplies as follows:

Table 995-9 Operational Support Supplies	
1 each	Sign controller and I/O board(s)
1 per DMS	LED display modules
1 each	Display power supply
1 each	Uninterruptible power supply
2 each	Surge suppression sets
1 each	Fan assembly

995-16.8 Components: All components must meet the requirements of NEMA TS 4-2016, Section 8.

995-16.8.1 Mechanical Components: All fasteners, including bolts, nuts, and washers less than 5/8 inch in diameter, must be passivated stainless steel, Type 316 or 304 and meet the requirements of ASTM F593 and ASTM F594 for corrosion resistance. All bolts and nuts 5/8 inch and over in diameter must be galvanized and meet the requirements of ASTM A307. Self-tapping screws must not be used. All parts must be fabricated from corrosion resistant materials, such as plastic, stainless steel, aluminum, or brass. Construction materials must be resistant to fungus growth and moisture deterioration. All dissimilar metals must be separated with an inert, dielectric material.

995-16.8.2 Sign Controller: The sign controller must monitor the sign in accordance with NEMA TS 4-2016, Section 9. The sign must monitor the status of any photocells, LED power supplies, humidity, and airflow sensors. Sign controllers must use fiber optic cables for data connections between the sign housing and ground-level cabinet.

The sign controller must meet the requirements of NEMA TS 4-2016, Sections 8.3 and 8.4. The sign controller must be capable of displaying a self-updating time and date message on the sign. Sign controllers within ground cabinets must be rack-mountable, designed for a standard Electronic Industries Alliance (EIA) EIA-310 19 inch rack, and includes a keypad and display.

995-16.8.3 Display System Hardware: The sign must utilize a system data interface circuit for communications between the sign controller and display modules. Except for embedded DMS, the following components must reside inside the sign housing: sign controller (master or slave), display system interface circuits, display modules, power supplies, local and remote control switches, LED indicators, EIA-232 null modem cables (minimum of four feet long for connecting laptop computer to sign controller), and surge protective devices.

995-16.8.4 Control Cabinet: A control cabinet that meets the requirements of Section 676 shall be provided. The minimum height of the cabinet must be 46 inches.

A ground control cabinet that includes the following assemblies and components: power indicator, surge suppression on both sides of all electronics, communication interface devices, connection for a laptop computer for local control and programming, a four foot long cable to connect laptop computers, a workspace for a laptop computer, and duplex outlets shall be provided.

All telephone, data, control, power, and confirmation connections between the sign and ground control box, and for any required wiring harnesses and connectors shall be provided.

995-16.8.5 Sign Controller Communication Interfaces: The sign controller must have communication interfaces in accordance with NEMA TS 4-2016, Section 8.3.2. Ensure that EIA-232 serial interfaces support the following:

Table 995-10 Communication Interface Requirements	
Data Bits	7 or 8 bits
Parity	Even, Odd, or None
Number Stop Bits	1 or 2 bit

The sign controller must have a 10/100 Base TX 8P8C port or a 100 Base FX port Ethernet interface.

The TMC or a laptop computer must be able to remotely reset the sign controller.

995-16.9 Message and Status Monitoring: The DMS must provide two modes of operation: (1) remote operation, where the TMC commands and controls the sign and determines the appropriate message or test pattern; and (2) local operation, where the sign controller or a laptop computer commands and controls the sign and determines the appropriate message or test pattern.

The sign must perform the following functions:

1. Control Selection – Ensure that local or remote sign control can be selected. Ensure that there is a visual indicator on the controller that identifies whether the sign is under local or remote control.

2. Message Selection – Ensure that the sign controller can select a blank message or any one of the messages stored in the sign controller's nonvolatile memory when the control mode is set to local.

3. Message Implementation – Ensure that the sign controller can activate the selected message.

Ensure that the sign can be programmed to display a user-defined message, including a blank page, in the event of power loss.

Ensure that message additions, deletions, and sign controller changes may be made from either the remote TMC or a local laptop computer. Ensure that each font may be customized, and modifications to a font may be downloaded to the sign controller from the TMC or a laptop computer at any time without any software or hardware modifications.

Ensure that there is no perceivable flicker or ghosting of the pixels during sign erasure and writing periods.

995-16.10 TMC Communication Specification for all DMS: The sign controller must be addressable by the TMC through the Ethernet communications network using software that complies with the NTCIP 1101 base standard (formerly the NEMA TS 3.2-1996 Standard), including all amendments as published at the time of Contract letting, the NTCIP Simple Transportation Management Framework, and conforms to Compliance Level 1. The software must implement all mandatory objects in the supplemental requirement SR-700-4.1.1, Dynamic Message Sign NTCIP Requirements, as published on the Department's State Traffic Engineering and Operations Office web site at the following URL: https://www.fdot.gov/traffic/Traf-Sys/Product-Specifications.shtm.

The sign must comply with the NTCIP 1102v01.15, 2101v01.19, 2201v01.15, 2202v01.05, and 2301v02.19 Standards. The sign must comply with NTCIP 1103v02.17, Section 3.

Ensure that the controller's internal time clock can be configured to synchronize to a time server using the network time protocol (NTP). NTP synchronization frequency must be user-configurable and permit polling intervals from once per minute to once per week in one-minute increments. The controller must allow the user to define the NTP server by IP address.

995-16.11 Sign Control Software: The sign must be provided with computer software from its manufacturer that allows an operator to program, operate, exercise, diagnose, and read current status of all sign features and functions using a laptop computer. The sign control software must provide a graphical representation that visibly depicts the sign face and the current ON/OFF state of all pixels as well as allows messages to be created and displayed on the sign.

995-16.12 Environmental Requirements: The DMS must meet the requirements of NEMA TS 4-2016, Section 2.

995-16.13 Warranty: The DMS system and equipment must have a manufacturer's warranty covering defects for a minimum of five years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

995-17 Electronic Display Sign.

995-17.1 General: All electronic display signs (EDS) must meet the physical display and operational requirements for warning, guide, or regulatory signs described in the MUTCD and the SHS.

The term EDS refers to a general category of electronically enhanced signs that includes electronic road signs (ERS) with warning, regulatory, or guide legends; electronic speed feedback signs (ESFS); and blank-out signs (BOS).

EDS must allow attachment to vertical and horizontal support structures as part of a single or double sign post configuration. Bolts must be used for load bearing attachments.

995-17.2 Requirements Common to all EDS: All EDS must be designed to withstand the loads defined in the Department's Structures Manual without deformation or damage. EDS, other than BOS, must provide an option to include flashing beacons. Printed circuit boards must be protected with conformal coating. Housings that contain electronics must be constructed of aluminum alloy sheet a minimum of .090 inch thick. Welding used during the construction of EDS must be accordance with Section 965.

Signs included on the APL will be designated with a size and type category and may be listed with restrictions, such as "requires District Traffic Operations Engineer approval", "school zones only", or "low speed only".

995-17.2.1 Electronic Display Sign with Static Sign Panel: EDS that include both a static sign panel and dynamic display may be a modular system comprised of a static sign panel with an attached electronic display. Static sign panels must meet the Department's requirements for highway signing found in this Section.

995-17.2.2 Electronic Display: Electronic displays must appear completely blank (dark) when not energized. No phantom characters or graphics will be allowed under any ambient light conditions.

995-17.2.3 Housing: The housing must protect and seal the dynamic display and other internal electronics. Any polycarbonate material used on the sign face must be a minimum 90% UV opaque and resistant to fading and yellowing. The housing must be NEMA 3R rated

and prevent unauthorized access. The housing must include weather tight cable entry or connection points for any required power or data connections.

995-17.2.4 Cabinet: Any equipment cabinets provided with the EDS must be listed on the APL.

995-17.2.5 Optical, Electrical, and Mechanical Specifications for Display Modules: All LEDs must operate within the LED manufacturer's recommendations for typical forward voltage, peak pulsed forward current, and other ratings. Component ratings must not be exceeded under any operating conditions.

995-17.2.6 LED and Pixel Specifications: All LEDs used in the display must have a wavelength output that varies no more than plus or minus two nanometers from the specified peak wavelength. The display and LED pixel cone of vision must be a minimum of 15 degrees (centered around the optical axis, or zero point, of the pixel). The cone perimeter is defined by the point where light output intensity is 50% of the intensity measured at the zero point of the pixel. For all colors other than white, the sign display must produce an overall luminous intensity of at least 9200 candelas per square meter when operating at 100% intensity. For white or full color matrix displays, the sign display must produce white with an overall luminous intensity of at least 12,400 candelas per square meter when operating at 100% intensity. Submit documentation that indicates the LED brightness and color bins that are used in each pixel. LEDs must be individually mounted on a PCB and must be able to be removed and replaced using conventional electronic repair methods. Encapsulated LEDs within a pixel are not allowed. ERS LEDs must be arranged and powered in a manner that maintains a discernible message in the event of a single LED or pixel failure.

995-17.2.7 Character Size, Fonts, and Graphics: The minimum numeral and letter size of the electronic display must meet or exceed the numeral and letter sizes prescribed in the MUTCD and the SHS. Fonts and graphics must mimic the characteristics of fonts and graphics defined in the MUTCD and SHS.

995-17.2.8 Electronic Display Controller: Any electronic display controller required for the operation of the EDS shall be housed within the sign and be equipped with a security lockout feature to prevent unauthorized use. The controller shall have the capability to provide a stipulated default message upon loss of controller function. A blank message is acceptable.

995-17.2.9 Communication: The electronic display controller shall possess a minimum of one serial, Ethernet, USB, or Bluetooth interface with the ability to connect to a laptop computer. The serial data interface shall support multiple data rates from 9,600 bps to 115,200 bps.

995-17.2.10 Configuration and Management: Ensure that the sign is provided with computer software from its manufacturer that allows a user to program, operate, exercise, diagnose, and read current status of all sign features and functions using a laptop. Configuration and management functions must be password protected.

995-17.2.11 Operation and Performance: Ensure that the EDS is visible from a distance of at least 1/4 mile and legible from a distance of 400 feet for applications on roads with a speed limit less than 45 mph and visible from a distance of at least 1/2 mile and legible from a distance of at least 650 feet for roads with speed limits 45 mph or higher. In both cases, the requirements must be met under both day and night conditions.

The electronic display shall automatically adjust brightness for day and night operation. The EDS must be equipped with a light sensor that accurately measures ambient

light level conditions at the sign location. The EDS must automatically adjust LED intensity based on the ambient light conditions in small enough increments that the sign's brightness changes smoothly, with no perceivable brightness change between adjacent levels. Stray headlights shining on the photoelectric sensor at night must not cause LED brightness changes.

Flashing messages must not exceed 150 flashes per minute.

995-17.2.12 Mechanical Specifications: EDS mounting provisions and mounting hardware must accommodate sign weight and wind loading requirements of the Department's Structures Manual. BOS must be designed to accommodate overhead attachment using a tri-stud signal hanger. Multiple tri-stud attachment points may be used to meet weight and wind loading requirements. Tri-stud attachment points must be weather-tight and structurally reinforced.

995-17.2.13 Fasteners and Attachment Hardware: Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws and studs must meet ASTM F593. Nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

995-17.2.14 Electrical Specifications: All power inputs must be fuse and reverse polarity protected. All EDS must be able to recover from power loss and return to their operational state without user intervention.

995-17.2.14.1 Solar Power: Solar powered signs must be capable of fully autonomous operation 24 hours per day, 365 days per year. Batteries must be a standard 12 volt deep cycle battery suitable for the application and operating environment. Flooded lead-acid batteries are prohibited.

Batteries must be capable of providing 10 days of continuous operation without sunlight. Charging system must use a solar charge controller with temperature compensation. The system must provide for automatic battery charging, overcharge protection, and have indications that display current status and faults.

995-17.2.14.2 AC Power: Fluctuations in line voltage must have no visible effect on the appearance of the display.

995-17.2.15 Environmental Requirements: The EDS assembly must operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 4-2016, Section 2. Fog, frost, or condensation must not form within the dynamic portion of the sign. Electronics must meet FCC Title 47, Subpart B Section 15.

995-17.2.16 Warranty: The EDS systems and equipment furnished must have a manufacturer's warranty covering defects in assembly, fabrication, and materials for a minimum of three years.

995-17.3 Electronic Warning Signs: EWS must include a secure wireless connection to communicate with a nearby laptop.

995-17.3.1 EWS Foreground/Background Colors: If a black background is used on the changeable electronic display, the color used for the legend must match the background color that would be used on a standard sign for that type of legend, in accordance with the MUTCD. Black EWS display backgrounds must be flat black (FED-STD-595-37038) with a reflectance value not exceeding 25%. EWS must utilize yellow LEDs with a peak wavelength of either 585 or 590 nanometers. EWS must have a minimum one-inch contrasting margin around illuminated characters or graphics.

995-17.3.2 Speed Detector: EWS that detect or display the speed of approaching vehicles must be programmable for the posted speed limit and the maximum speed to display. When the detected speed exceeds the maximum programmed speed (high speed cut-off) threshold, the display must automatically blank. Alternately, the display may show an alert message such as "SLOW DOWN" when speeds above the maximum programmed speed threshold are detected.

The EWS must detect when the posted speed is exceeded by one mph and then activate the alert. When the alert is activated, the display shall be able to flash. When no advancing traffic is detected, the display must be blank. The speed detector must not activate alerts for vehicles outside the display cone of vision.

The speed detector must meet the requirements of FCC Title 47, Part 90 and not require an FCC operating license. The speed detector must operate on 10.8 to 16.6 V_{DC} and draw less than three amperes. The EWS must monitor and display the speed of approaching traffic only. The EWS detector must be able to accurately detect and determine the speed of approaching vehicles. The EWS must be capable of measuring and displaying speeds of approaching traffic only between 10 and 99 mph with an accuracy of plus or minus one mph, 1,000 feet in advance of the sign.

995-17.4 Electronic Regulatory Signs: Display modules for ERS must have a minimum two-inch contrasting margin around digits, text, or graphics. ERS must utilize LED technology for the dynamic display.

995-17.4.1 ERS Battery Backup System: AC powered signs must include a battery backup system that maintains full operation of the sign for a minimum of two hours in the event of utility power loss. Operation on battery backup can have no visible effect on the appearance of the display.

995-17.4.2 Variable Speed Limit Signs: Variable speed limit signs (VSLS) must be able to display speed limits from 5-70 mph in five mph increments and mimic the physical appearance of a static regulatory speed limit sign as shown in the MUTCD and SHS. VSLS must use black characters on a white background. VSLS must log the time and date of any speed limit change to internal non-volatile memory. The log must be able to record a minimum of 1,000 events in a first-in, first-out fashion.

995-17.4.2.1 VSLS Controller Communications: VSLS must be equipped with a sign controller that includes a minimum of one Ethernet 10/100 Base TX 8P8C port.

995-17.4.2.2 Configuration and Management Requirements for VSLS: VSLS must support remote management from a TMC and local management using a laptop computer. Remote and local computers must be able to reset VSLS sign controller. VSLS must log and report status, errors, and failures, including data transmission errors, receipt of invalid data, communication failure recoveries, power failures, power recoveries, display errors, fan and airflow status, temperature status, power supply status, and information on the operational status of the temperature, photocell, airflow, humidity, and LED power supply sensors.

The sign controller must be addressable through an Ethernet communication network using software that complies with the NTCIP requirements published online by the Department's Transportation Traffic Engineering Research Laboratory (TERL) at: https://www.fdot.gov/traffic/. The sign must implement any NTCIP standards required to achieve interoperability and interchangeability. Any additional objects implemented by the

software must not interfere with the standard operation of any mandatory objects. VSLS must be compatible with the Department's SunGuide® software.

995-17.5 Blank-Out Signs: BOS must have a black exterior finish (FED-STD-595-37038) with a reflectance value not exceeding 25%. Overhead BOS must include a visor.

995-17.6 Electronic Speed Feedback Signs: The ESFS display background must be flat black (FED-STD-595-37038) with a reflectance value not exceeding 25%. ESFS must utilize amber LEDs with a peak wavelength of 590 nanometers. ESFS shall have a minimum one-inch contrasting margin around illuminated characters or graphics.

995-17.6.1 Speed Detector: The ESFS must be programmable for the posted speed limit and the maximum speed to display. When the detected speed exceeds the maximum programmed speed (high speed cut-off) threshold, the display must automatically blank. Alternately, the display may show an alert message such as "SLOW DOWN" when speeds above the maximum programmed speed threshold are detected. The ESFS must detect when the posted speed is exceeded by one mph and then activate the alert. When the alert is activated, the display must flash at a rate of 50 to 60 cycles per minute. When no advancing traffic is detected, the display must be blank. The speed detector must not activate alerts or display speeds for vehicles outside the display's cone of vision. The ESFS must meet the requirements of FCC Part 90 and not require an FCC operating license. The speed detector must operate on 10.8 to 16.6 V_{DC}. The ESFS must be capable of measuring speeds of approaching traffic between 10 and 99 mph with an accuracy of plus or minus one mph, 1,000 feet in advance of the sign.

995-18 Sign Beacon.

995-18.1 General: Flashing beacon assemblies incorporating a circular traffic signal must meet the design and functional requirements set forth in MUTCD Chapter 4L. All circular beacons must have a minimum nominal diameter of 12 inches and meet the requirements of Section 650. All beacons must use a LED light source.

995-18.1.1 School Zone Beacon: Beacons designed for use with school zone signing must include a means of calendar scheduling to program days and times of operation.

995-18.1.2 Vehicle Activated Beacon: Vehicle activated beacons must utilize a vehicle detection system listed on the APL.

995-18.1.3 Pedestrian Activated Beacon: Pedestrian activated beacons must utilize a pedestrian detector listed on the APL.

995-18.2 Cabinets, Housings, and Hardware: Flashing beacon cabinets must be currently listed on the APL or meet the requirements of Section 676.

All housings, other than pole-mounted cabinets, must be powder coated dull black (FED-STD-595-37038) with a reflectance value not exceeding 25% as measured by ASTM E1347. Cabinets and housings must prevent unauthorized access.

Flashing beacon assemblies must allow installation on 4-1/2 inch outer diameter posts.

Ensure all exposed assembly hardware including nuts, bolts, screws, and locking washers less than 5/8 inch in diameter, is Type 304 or 316 passivated stainless steel and meets the requirements of ASTM F593 and ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized and meet the requirements of ASTM A307.

995-18.3 Electrical Specifications: Provide equipment that operates on solar power or a nominal voltage of 120 V_{AC}. If the device requires operating voltages of less than 120 V_{AC}, supply the appropriate voltage converter. Solar powered beacon systems must be designed to provide 10 days of continuous operation without sunlight and must automatically charge

batteries and prevent overcharging and over-discharging. Solar powered systems must include a charge indicator.

995-18.4 Environmental Specifications: All electronic assemblies must operate as specified during and after being subjected to the transients, temperature, voltage, humidity, vibration, and shock tests described in NEMA TS 4-2016, Section 2. All electronic equipment must comply with FCC Title 47 Subpart B Section 15.

995-18.5 Warranty: Ensure all flashing beacons have a manufacturer's warranty covering defects for a minimum of three years from the date of final acceptance in accordance with 5-11 and Section 608. Ensure the manufacturer will furnish replacements for any part or equipment found to be defective during the warranty period at no cost to the Department or maintaining agency within 30 calendar days of notification.

995-19 In-Street Signs.

995-19.1 General: In-Street signs consist of the R1 6a or R1 6c In Street Pedestrian Crossing Sign assemblies including the sign base.

995-19.2 Materials: The sign assembly includes the vertical panel, retroreflective sign sheeting, a rebounding boot support, and a base. The vertical panel is bolted to a flexible boot which is fastened to a plastic, recycled PVC, or rubber base. The sign assembly shall contain no upright metal parts.

The vertical panel shall yield (bend) fully upon vehicle impact, then return to vertical position plus or minus 10 degrees with no delaminating. The face of the vertical panel shall resist twisting and remain oriented to the installed direction after vehicle impact. The vertical panel shall not split, crack, break, or separate from base. Use only UV stabilized, ozone and hydrocarbon resistant outdoor-grade thermoplastic polymer, polycarbonate, recycled PVC, or HDPE materials. UV stabilization testing shall be in accordance with ASTM D1435.

Use Type XI fluorescent yellow-green retroreflective sign sheeting meeting the requirements of Section 994 on both sides of the vertical panel. The surface of the panel shall be smooth and free of defects, suitable for adherence of appropriate retroreflective sheeting.

995-19.2.3 Base:

995-19.2.3.1 Sign Base (Fixed): The base shall be constructed with high-impact materials using ozone and hydrocarbon resistant outdoor grade thermoplastic polymer, polycarbonate, or HDPE materials meeting the general provisions for all In-Street sign bases.

995-19.2.3.2 Sign Base (Portable): Portable base assemblies shall consist of a lightweight plastic, recycled PVC, or rubber material that may be easily moved or relocated by a single person.

995-19.2.3.3 Color: Sign bases shall be either black, or the same color as the adjacent pavement marking.

995-19.2.4 Approved Product List (APL): In addition to the APL requirements of 995-1.2, provide the following:

1. Product Drawings, which at a minimum includes:
    a. Model Number
    b. Allowable sign panel size and substrate
    c. Dimensions of sign base and mounting heights
2. Crash Test Reports demonstrating MASH compliance
3. All FHWA Eligibility Letters
4. When requested, submit product sample

995-19.3 Vertical Panel Messages: Fabricate vertical panel messages in accordance with Section 994. Vertical panels of 8 inches wide x 28 inches tall or 12 inches x 36 inches are acceptable. See Standard Plans Section 700-102.

995-19.4 Connection Method: Products will be categorized as either Fixed Base or Portable. Fixed base will be installed in accordance with the manufacturer's instructions. Portable base will be limited to temporary applications at school crossings where a crossing guard is present during school arrival and departure times or when children are present.

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 19, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **996**
Proposed Specification: **9960202 Intelligent Transportation System Device Materials.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Matt DeWitt from the Traffic Engineering and Operations Office to move all material requirements from Division II to Division III and clarified lens to be manual focus, auto focus, and automatic iris. This change is associated with the proposed changes to Section 685.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

INTELLIGENT TRANSPORTATION SYSTEM DEVICE MATERIALS.
(REV 7-21-22)

SUBARTICLE 996-2.2.1 is deleted and the following substituted:

996-2.2 CCTV Camera:

996-2.2.1 Camera: CCTV cameras shall be compliant with the John S. McCain National Defense Authorization Act for Fiscal Year 2019, Section 889, Prohibition on Certain Telecommunications or Video Surveillance Services or Equipment. CCTV cameras shall be compatible with the current version of the Department's SunGuide® software system. Camera types include dome pan-tilt-zoom (PTZ), external positioner-PTZ, and fixed. Video types include analog and internet protocol (IP).

~~Analog~~ camera produces National Television System Committee (NTSC) composite video output of 1V peak-to-peak (Vp-p) at 75 ohms with a minimum resolution of 470 horizontal and 350 vertical TV lines.

Analog and IP cameras shall provide the following features and capabilities:

1. Day (color)/night (monochrome) switchover ~~and iris control, with user-selectable manual and automatic control capabilities~~.
2. Manual and automatic focus.
3. Automatic iris.
~~2~~4. Ability to produce clear, detailed, and usable video images of the areas, objects, and other subjects visible from a roadside CCTV field site. Video produced by the camera is true, accurate, distortion free, and free from transfer smear, oversaturation, and any other image defect that negatively impacts image quality under all lighting and weather conditions in both color and monochrome modes.
~~3~~5. User-selectable automatic gain control (AGC) that is peak-average adjustable to 28 dB.
~~4~~,6. A minimum signal-to-noise ratio of 50 dB.
~~5~~7. Automatic color balance that references the white areas of the scene through the lens.
~~6~~8. An automatic electronic shutter that is user selectable from 1/60 to 1/10,000 of a second.
~~7~~9. PTZ cameras shall include a minimum 10x digital zoom.
~~8~~10. PTZ cameras shall include programmable azimuth and compass display with ability to display pan and tilt position with a 1 degree resolution.

CCTV cameras shall provide titling and masking features including, but not limited to, programmable camera title, programmable preset titles for each preset position, and programmable privacy zones. Programmable titles shall allow a minimum of 18 characters per line.

996-2.2.2 Lens: Standard definition PTZ cameras shall include a minimum 22x motorized optical zoom lens with automatic iris. High definition CCTV cameras shall include a minimum 18x motorized optical zoom lens with automatic iris. ~~The lens shall provide automatic and manual focus and iris control.~~ Fixed cameras shall have a 3-9 mm varifocal lens with automatic iris. The lens shall have a maximum aperture of at least f/1.6 and the depth of field shall provide a clear image of roadside areas under all lighting conditions.

SUBARTICLE 996-2.2.8 is deleted and the following substituted:

996-2.2.8 Environmental Requirements: CCTV cameras shall perform all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2 2021, Sections 2.2.7, 2.2.8, and 2.2.9.

All CCTV cameras, mounting hardware, and any other camera-related material that is exposed to the environment shall be designed for 150 mph wind speeds and meet the requirements of the Department's Structures Manual.

SUBARTICLE 996-2.2.9 is deleted and the following substituted:

996-2.2.9 Additional Requirements for IP Cameras:

996-2.2.9.1 Video Encoding: The camera shall utilize the Moving Picture Experts Group's MPEG4 part 10 (H.264) video compression technology in accordance with the ISO and IEC requirements detailed in the ISO/IEC 14496-10:2009 Standard.

Cameras shall establish unicast and multicast sessions using the Real-Time Streaming Protocol (RTSP) and provide for a 99.999% error-free operation. The encoded video shall transmit using programmable bit rates and the camera supports, at a minimum, a fixed bit rate mode.

~~**996-2.2.9.2 Encoded Video Interoperability:** The camera's encoded video shall be able to be displayed using video display control systems listed on the APL.~~

996-2.2.9.~~3~~ 2 Encoded Video Requirements: The camera's encoded video shall support resolutions that include; but are not limited to, those defined in Table 996-1. The camera shall deliver color and monochrome video at 30 frames per second (fps), regardless of resolution.

Table 996-1 Minimum Resolution Requirements	
Format	Vertical Resolutions
H.264	240, 480
Note: The resolutions attained depend on the data transmission rate.	

996-2.2.9.~~4~~ 3 Network Interface: The camera's Local Area Network (LAN) connection shall support the requirements detailed in the IEEE 802.3 Standard for 10/100 Ethernet connections. The camera shall have a minimum of one 10/100 Base-TX connection Ethernet port.

Unshielded twisted pair/shielded twisted pair network cables shall be compliant with the TIA-568 Standard. The network communication shall conform to TCP, UDP, Version 4 of the IP, RTSP, and Version 2 of the Internet Group Multicast Protocol (IGMP), at a minimum. If the camera supports NTCIP, then the camera shall be able to be controlled via TCP/IP or UDP/IP.

996-2.2.9.~~5~~ 4 Configuration Management: The camera shall support local and remote configuration and management via serial login, telnet login, or a web-based

interface. Configuration and management functions shall include access to all user-programmable features including, but not limited to, network configuration, video settings, device monitoring, and security functions.

SUBARTICLE 996-3.2.8 is deleted and the following substituted:

996-3.2.8 Environmental Requirements: MFES shall operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 2 2021, Sections 2.2.7, 2.2.8., and 2.2.9.

SUBARTICLE 996-3.3.7 is deleted and the following substituted:

996-3.3.7 Environmental Requirements: The device server performs all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2 2021, Sections 2.2.7, 2.2.8, and 2.2.9.

SUBARTICLE 996-3.4.15 is deleted and the following substituted:

996-3.4.15 Environmental Requirements: DVEs and DVDs installed in roadside cabinets shall perform all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2 2021, Sections 2.2.7, 2.2.8, and 2.2.9. Hardware DVD installed in a climate-controlled environment, such as a TMC computer room, has an operating temperature range of 32 to 104°F.

SUBARTICLE 996-3.5.5 is deleted and the following substituted:

996-3.5.5 Environmental Requirements: Ensure media converters perform all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2 2021, Sections 2.2.7, 2.2.8, and 2.2.9.

SUBARTICLE 996-4.2.6 is deleted and the following substituted:

996-4.2.6 Environmental Specifications: The SPDs shall operate properly during and after being subjected to the temperature and humidity test described in NEMA TS 2 2021, Section 2.2.7, and the vibration and shock tests described in NEMA TS 2 2021, Sections 2.2.8 and 2.2.9.

SUBARTICLE 996-5.2 is deleted and the following substituted:

996-5.2 Marking: The following information shall be permanently cast or engraved into the top surface of all pull and splice box covers. If used, identification plates shall be UV stable,

mechanically fastened, ~~and~~ bonded with adhesive material suitable for outdoor applications, and capable of installation in the field~~.~~

1. Mark application as follows:
   FDOT TRAFFIC SIGNAL for signalized intersections
   FDOT FIBER OPTIC CABLE for fiber optic cable
   FDOT LIGHTING for highway lighting
   FDOT TRAFFIC MONITORING for traffic monitoring
   FDOT ELECTRICAL for other electrical applications
2. Manufacturer's name or logo
3. FDOT APL approval number
4. TIER rating

The date of manufacture (month/day/year, or date code) shall be permanently located on the top or bottom of the cover. The interior of the box body shall have a permanent marking that includes the manufacturer part/model number and date of manufacture near the top of box in a location that is visible after installation when the cover is removed.

SUBARTICLE 996-5.5 is deleted and the following substituted:

996-5.5 Testing Requirements: Pull and splice boxes shall meet or exceed the American National Standards Institute/Society of Cable Telecommunications Engineers (ANSI/SCTE) 77 2017 Specification for Underground Enclosure Integrity for TIER 15 loading requirements with the following additional clarifications and requirements:

1. Apply all environmental tests to the box and its cover.
2. All flexural testing shall be conducted in accordance with an appropriate ASTM standard and clearly stated in the report.
3. Perform repetitions of Cycle 1 in Table X2.1 of ASTM G154 for a minimum duration of 1000 hours for the simulated sunlight exposure test.
4. Use deflection-measuring devices positioned to measure vertical and lateral deflection (wherever maximum deflection occurs) for the vertical sidewall load test.
5. Conduct the lateral sidewall pressure, vertical sidewall load and cover vertical load tests without any removable or permanent wall to wall supporting beams located in the interior or top of the box opening.

When testing pull and splice boxes of various sizes (width x length x depth), the cover impact test, internal equipment protection test, coefficient of friction test, and all environmental tests, can be completed using a single representative box/cover (instead of samples from all box/cover sizes) as long as the test report indicates the following:

1. Materials of construction, compositions, and manufacturing processes are identical for all box and cover sizes submitted for listing on the APL.
2. Size (width x length x depth) of the representative box/cover.

SECTION 996 is expanded by the following new Article:

996-7 Traffic Control System Auxiliaries.

996-7.1 General: Traffic Control System Auxiliaries shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

996-7.2 Uninterruptible Power Supply (UPS): The UPS shall be either a line interactive or online/double-conversion UPS. UPS assemblies shall be designed for installation in a roadside NEMA 3R enclosure to provide battery backup functionality for traffic control systems, including traffic signal and intelligent transportation system (ITS) devices. UPS assemblies shall include batteries provided by the UPS manufacturer or in accordance with manufacturer's requirements.

Loss of utility power, transfer from utility power to battery power, and transfer back to utility power shall not interfere with normal operation of connected equipment. In the event of UPS failure or battery depletion, connected equipment shall be energized automatically upon restoration of utility power.

The UPS shall operate in hot standby mode with power transfer being accomplished in 40 milliseconds or less.

Removal and replacement of the UPS shall not disrupt the operation of the equipment being protected.

All harnesses necessary to connect and operate the system shall be included. All connectors shall be keyed to prevent improper connection.

996-7.2.1 Configuration and Management: The UPS shall support local and remote configuration and management, including access to all user-programmable features as well as alarm monitoring, event logging, and diagnostic utilities.

Configuration and management functions shall be password protected.

Alarm function monitoring shall include the following: loss of utility power, inverter failure, low battery, and temperature out of range. The UPS shall include an event log that indicates the date and time of the following events: AC high, AC low, AC frequency error, AC fail/blackout, and over temperature. The UPS event log shall be able to store a minimum of 60 events.

The UPS shall include a front panel display and controls that allows programming of configurable parameters, features, and functions without the need for another input device. The UPS shall have visual indications for Power-On, Mode of Operation (utility power or inverter), Battery Status, Alarm Status, Load Levels, and AC Output Voltage.

996-7.2.2 Communication Interfaces: The UPS shall include an Ethernet port (RJ45) for local control using a laptop PC and remote control via a network connection.

996-7.2.3 Batteries: Batteries must be provided by the UPS manufacturer or in accordance with manufacturer's recommendations. Batteries shall be sealed and require no maintenance, cause no corrosion, and be capable of maintaining 80% of original capacity and performance for a minimum of five years.

The UPS shall be supplied with a wiring harness for battery connections. The battery wiring harness shall allow 6 feet of separation between the UPS and its battery bank. Battery terminals shall include a protective covering to prevent accidental spark or shorting.

The UPS shall include battery management functions that includes active or equalized balancing; monitoring of temperature, voltage, and amperage of charge and discharge; and temperature compensated automatic charging to maximize the life of the batteries.

996-7.2.4 Electrical: UPS assemblies used to provide backup power in an ITS cabinet shall provide a minimum of 350 watts (at 120 V_{AC}) of continuous backup power for a minimum of two hours.

UPS assemblies used to provide backup power in a traffic signal controller cabinet shall provide a minimum 400 watts (at 120 V_{AC}) of continuous power for a minimum of 6.5 hours.

Frequency shall be regulated to 60 Hz, plus or minus 0.5 Hz, while the UPS is supplying power. The UPS shall operate on 85 to 140 V_{AC} without requiring assistance from the batteries.

The UPS shall be listed to the requirements of UL 1778. Upstream back feed voltage from the UPS shall be less than 1 V_{AC}.

Double-conversion UPS shall be capable of simultaneously producing fully regenerated and regulated, conditioned, True Sine Wave power and hot standby AC output, and have a minimum operating efficiency of 90%.

996-7.2.5 Traffic Signal UPS Cabinet: Cabinets used to house traffic signal UPS assemblies shall be designed to be mounted to the side of a traffic cabinet or base mounted. Cabinets shall meet the requirements of Section 676 and include shelves and rack rails to house all UPS system components including the UPS, batteries, harnesses, switches, surge protective device, power terminal block and a generator hookup with transfer switch. The UPS cabinet shall allow a maintenance technician to safely insert power for traffic signal operation while the UPS or associated equipment is serviced or replaced.

A surge protective device shall be installed where the supply circuit enters the cabinet in accordance with Section 620-2.

The cabinet shall include a 20 A, 120 volt, 60 Hz GFCI receptacle. The receptacle shall be wired to utility power and not regulated by the UPS module. The cabinet shall include a main breaker and a breaker for the technician GFCI outlet.

996-7.2.5.1 Transfer Switch and Generator Access Panel: The cabinet shall include an automatic transfer switch and generator access panel in accordance with Section 676. The generator access door shall not protrude more than 1 inch when closed.

996-7.2.6 Mechanical: All parts shall be made of corrosion-resistant materials such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements shall be Type 304 or 316 passivated stainless steel.

996-7.2.7 Environmental: UPS assemblies, including batteries, shall provide continuous power with specified wattage and operate properly during and after being subjected to the environmental testing procedures described in NEMA TS2 2021, Sections 2.2.7, 2.2.8, and 2.2.9.

996-7.3 Remote Power Management Unit (RPMU): The RPMU shall be designed for installation in a roadside Traffic Cabinet to provide remote control of electrical receptacles.

996-7.3.1 Configuration and Management: Provide a RPMU that supports local and remote configuration and management, including access to all user-programmable features as well as alarm monitoring, event logging, and diagnostic utilities.

Configuration and management functions shall be password protected.

The RPMU shall include an event scheduler that can store a minimum of 60 events.

The RPMU shall include LED indicators for relay inputs and outlet status.

Upon loss of communications the RPMU shall maintain each receptacle and relay in its currently stored state of operation.

Upon restoration of electrical power after an outage the RPMU shall automatically restore each receptacle and relay to its previously stored state of operation and all configurable parameters shall be retained.

The unit shall support SNMP v2c, including trap notifications of receptacle state changes.

996-7.3.2 Communication Interfaces: The RPMU shall have an Ethernet port (RJ45) for local control using a laptop PC and remote control via a network connection.

996-7.3.3 Electrical: The RPMU shall have a minimum of 6 NEMA 5-15R receptacles, nominal 120 V_{AC}. The RPMU shall have a minimum current capacity of 12 amperes (amps).

996-7.3.4 Mechanical: All parts shall be made of corrosion-resistant materials such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements shall be Type 304 or 316 passivated stainless steel.

996-7.3.5 Environmental: The RPMU shall operate properly during and after being subjected to the environmental testing procedures described in NEMA TS2 2021, Sections 2.2.7, 2.2.8, and 2.2.9.