Section 6.2
Volume II

PRECAST CONCRETE PIPE

6.2.1 PURPOSE

This procedure provides guidance for the development and implementation of the quality control program for the manufacture, storage, and transportation of the precast concrete pipe (Pipe) for the Florida Department of Transportation projects. The Pipe may include, but are not limited to, round concrete pipe, elliptical concrete pipe, mitered end sections, and underdrain pipe.

6.2.2 AUTHORITY

Code of Federal Regulations (CFR), Federal-Aid Policy Guide (FAPG), Subchapter G – Engineering and Traffic Operations, Part 637 – Construction Inspection and Approval, Subpart B – Quality Assurance Procedures for Construction
Sections 20.23(3)(a) and 334.048(3), Florida Statutes.

6.2.3 REFERENCES

Design Standards, Topic No. 625-010-003, Florida Department of Transportation.

Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

American Society for Testing and Materials (ASTM) Standard Test Methods and Specifications, Philadelphia, Pennsylvania.

American Association of State Highway and Transportation Officials (AASHTO), Part I Specifications, and Part II Tests, Washington, D.C.

Approved Product List (APL), Florida Department of Transportation.

Field sampling and Testing Manual, Florida Department of Transportation.

6.2.4 SCOPE

This procedure is used by the Precast Concrete Pipe Manufacturers (Plants). These requirements and activities pertain to the inspections, measurements, and necessary tests to substantiate materials and Pipe in conformity with the ***Contract Documents***. The quality control plans are designed to provide guidelines that are used by the Plants to produce Pipe in conformance with the ***Florida Department of Transportation Specifications*** and other ***Contract Documents***.

6.2.5 GENERAL INFORMATION

The Plants are responsible for the production, inspection, storage, and shipment of the Pipe. The delivered Pipe to the project site shall meet the requirements of the ***Florida Department of Transportation Specifications (Specifications)*** and other ***Contract Documents***.

6.2.6 PLANT QUALIFICATION PROCESS

6.2.6.1 General

Prepare the Plant's proposed quality control plan in accordance with ***Specifications Section 105*** and ***Materials Manual Section 5.6***.

6.2.6.2 Review of Plant's Proposed Quality Control Plan

Submit the proposed quality control plan to the Department's District Materials and Research Office (DMRO) for the District in which the Plant is located. For out-of-state Plants, submit quality control plan to the Department's nearest DMRO. Upon the Plant's submittal of a quality control plan, the DMRO will review the proposed quality control plan and make necessary arrangements for the initial Plant qualification review in accordance with ***Materials Manual Section 6.2.6.3***.

In the quality control plan include the work experience, qualifications, and responsibilities of the Plant's production and quality control personnel. Identify the on-site production manager, plant general manager, quality

control inspectors/technicians, and quality control manager. Identify the responsibilities for monitoring key quality attributes and quality control data. Include the applicable information required in ***Specifications Sections 105, and 449***. In the quality control plan, include a copy of the Plant's available repair methods for repair of minor deficiencies.

The American Concrete Pipe Association's certified Plants may submit the quality control plan that has been approved by the Association as part of the Plant's certification program (QCast Certification Program). In their submittal, the American Concrete Pipe Association (ACPA) certified Plants shall include a statement that the Plants will comply with the requirements of the ACPA approved quality control manual. ***The Florida Department of Transportation Specifications*** and other ***Contract Documents*** will govern, when there is a discrepancy between the ACPA approved quality control plan and ***Florida Department of Transportation Specifications***. Submit any additional information, which is required by this Section of the ***Materials Manual***, but are not included as part of the ACPA guidelines and approved quality control plan. When requested by the Department Inspectors, the ACPA certified Plants are required to provide the two most recent ACPA inspection reports, including the Plant's responses to the deficiency reports, if applicable.

6.2.6.3 Plant Qualification Review

The Department will perform the initial qualification review of Plants that intend to produce Pipe for the Department projects. An initial review includes an in-depth inspection by the Department of a Plant that submits its first quality control plan and Plants that have not produced for the Department projects for more than a year. Upon approval of Plant's quality control plan, the Department will also perform routine, at least quarterly, verification inspections, and Plant qualification reviews, at least annually, on all Plants that have continued to furnish Pipe for the Department projects.

6.2.6.4 Maintenance of Plant Qualification

Upon the Department's satisfactory review of the proposed quality control plan, in compliance with ***Materials Manual Section 5.6***, and satisfactory Plant qualification reviews, the DMRO will accept the proposed quality control plan and include the Plant on the Department's ***Production***

Facility Listing. Immediately notify the DMRO in writing of any changes to the quality control plan. In case of change(s), revise the quality control plan annually in the form of addenda or complete revision of the entire document. Submit the revised quality control plan or its addenda to the DMRO annually.

Plants that are on the Department's ***Production Facility Listing*** will be subject to the Plant qualification review process at any time. The Department will perform at least one in-depth review of the Plant that is producing for the Department projects.

6.2.7 FUNCTIONS AND RESPONSIBILITIES OF PIPE PLANTS

6.2.7.1 General

The Plants are responsible for the quality of the finished Pipe. Provide facilities and qualified quality control personnel to perform specified inspections and tests and maintain an acceptable quality control program in compliance with the requirements specified herein and in ***Specifications Section 449***.

6.2.7.2 Quality Control Manager

The quality control manager shall ensure that the quality of the products at each Plant meets the quality requirements of the ***Contract Documents*****.** The quality control manager may serve in more than one Plant. The responsibilities of the quality control manager include, but not limited to, the following:

(A) Maintains the quality control approval stamp and applies it to acceptable Pipe, or designates a technician, who is working under his/her direct supervision to apply the Plant approval stamp. The Plant approval stamp mark shall be legible and applied to each Pipe before its shipment to the project site.

(B) Be present, or designates a quality control technician/inspector working under his/her direct supervision to be present, during the production of all Pipe products that will be shipped to Department projects.

(C) Performs and/or supervises the quality control testing and inspection.

(D) Ensures that the Plant has a sufficient number of quality control technician(s)/Inspector(s) to maintain adequate inspection and testing during the production of Pipe for Department projects. In lieu of a permanent staff, the Plant may retain the services of an engineering consulting firm or qualified laboratory meeting the requirements of ***Specifications Section 105***.

(E) Ensures that the testing equipment is properly maintained in accordance with the applicable test methods and specifications. Makes readily available, the current certification on testing equipment that is requiring calibration.

(F) Visually inspects or ensures that a qualified technician inspects each Pipe section before it is shipped to the project site.

(G) Ensures that all materials used to manufacture Pipe are from a Department accepted source.

(H) Maintains a daily production log of the manufactured Pipe.

(I) Ensures that all Pipe sections are properly stored and marked with Plant name and number along with other information that is required in the applicable ASTM or AASHTO standards.

(J) Maintains the quality control files of material certifications, test data, and inspection results.

(K) Arranges at least quarterly meetings with the Department's Verification Inspector and representatives of the Plant's production personnel to discuss any deficiencies and quality control issues.

6.2.7.3 Technicians/Inspectors

The quality control technicians may perform any or all of the inspections, sampling, or testing as directed by the quality control manager, and may stamp the Plant approved Pipe, when directed by the quality control manager.

6.2.7.4 Quality Control of Certified Materials

6.2.7.4.1 General

Ensure that all materials used to manufacture of Pipe are from Department approved sources and comply with all requirements as specified herein.

6.2.7.4.2 Reinforcing Steel and Welded Wire Reinforcement

The quality control inspectors shall obtain steel manufacturer's certifications for all welded wire reinforcement and reinforcing steel that are used to manufacture Pipe. These certifications shall indicate compliance with the appropriate ASTM or AASHTO standards for wire, welded wire reinforcement, and for steel bars. Upon request, provide samples for the Department Verification Inspectors, at each Plant, from at least two randomly selected LOTs of reinforcing steel, per year. The Department will perform the testing of these samples. A LOT is a single vehicle load of the reinforcing steel or welded wire fabric of the same grade and manufacturer that is delivered to the Plant. The reinforcing steel shall meet the requirements of ***Specifications Section 415***. Provide access and cooperate with Verification Inspectors during sampling of reinforcing steel.

6.2.7.4.3 Coarse and Fine Aggregates

The DMRO may obtain Verification samples at the source or at the Plant. The aggregates delivery tickets shall include the following information:

(A) Name of producer

(B) Location of mine

(C) Department pit number

(D) Department material code

(E) Delivery date

(F) Aggregate producer's certification statement with each shipment indicating that the shipped products comply with Department specifications.

Maintain each size of aggregate and mine source in separate stockpiles. Each stockpile shall have Department Identification pit number. Prevent the contamination, segregation, or intermingling of stockpiled aggregates of different sizes with each other.

6.2.7.4.4 Cement

Accept the delivered cement on the basis of the cement producer's certification indicating compliance with ***Specifications Section 921***. A certification for each shipment of cement is required. Verification samples may be obtained at the discretion of the District Materials and Research Engineer (DMRE).

6.2.7.4.5 Pozzolans and Slag

Accept pozzolans and ground granulated blast furnace slag on the basis of the supplier's certification indicating compliance with ***Specifications Section 929*** and other ***Contract Documents***. A certificate for each shipment of pozzolans and slag is required. Department Verification Inspectors may take a sample of these supplemental cementitious materials at the Plant or Producer's source.

6.2.7.4.6 Batch Water

Water used for mixing concrete shall comply with Specifications Section 923.

6.2.7.4.7 Chemical Admixtures

Admixtures shall meet the requirements of ***Specifications Section 924.*** The Department allows the use of admixtures by one of the following qualification process:

(A) The admixtures that are listed in the ***Specifications Section 924***, ***Article 924-2*****,** are required to be on the Department's ***Approved Product List (APL)***. The manufacturer shall use the products that are included as part of this list.

(B) As part of the Plant's quality control plan, the DMRO reviews and approves the use of the admixtures that are used for workability, the ease of machine processing, and better consolidation of dry-cast concrete Pipe and other machine formed concrete products. The approval of the admixture as part of the Plant's quality control plan indicates that the admixture has been given contingent approval, as evidenced by

previous tests and its apparent effectiveness under field conditions. This approval will continue as long as the admixture performs as claimed. For the use of reinforced concrete products, the concrete admixtures shall not contain calcium chloride or calcium chloride- based ingredients.

6.2.7.4.8 Gasket Material

The gasket materials shall conform to the requirements of ***Specifications Section 942***. Maintain a copy of the certification of compliance in the Plant's quality control file. The Verification Inspector may sample the rubber gasket material at the discretion of the DMRE.

6.2.7.4.9 Gasket Lubricants

The producers of the gasket lubricant shall provide a certification statement indicating compliance with requirements of ***the Contract Documents.***

6.2.7.4.10 Patching Materials

All patching compounds shall comply with ***Specifications Section 449***. Pre-mixed packaged compounds may be used, when it is listed on the ***APL. The*** cosmetic defects may be repaired in accordance with ***Specifications*** *Section* **450**, when it is approved by the DMRO as part of the Plant's quality control plan.

6.2.7.5 Quality Control of Concrete Production and Placement Equipment

Ensure that the batching and mixing equipment are capable of properly proportioning and mixing the various ingredients into a uniform mixture.

6.2.7.6 Calibration of Equipment

Check all quality control testing equipment and calibrate them, as required in ASTM C 497. A reputable licensed testing laboratory shall calibrate all jacks and gauges for the three-edge-bearing test equipment at least once every twelve-month period.

6.2.7.7 Priming Materials for Elliptical Pipes

For sealing of elliptical Pipe joints, use the cold adhesive preformed plastic gaskets as described ***Specifications Section 942***.

6.2.7.8 Quality Control of Pipe Manufacturing Process

The following are the quality control inspections and testing, related to operations prior to, during, and after concrete placement.

6.2.7.8.1 Concrete Mix Design

Unless otherwise shown on the project Plans or required by the specifications, the concrete mix produced for the manufacture of Pipes shall comply with the strength requirements specified in ***Specifications Section 449***, ASTM C-76 for reinforced concrete culvert, storm sewer Pipe, ASTM C-507 for reinforced concrete elliptical culvert, storm drain, and sewer pipe, ASTM C 985 for non-reinforced concrete Pipes and ASTM C 1450 for fiber reinforced concrete Pipe. When requested, the Plant shall supply the Verification Inspectors a copy of each mix design. The mix design information shall include the source of aggregates, cementitious materials, and admixtures, along with the proportions of all ingredient materials.

6.2.7.8.2 Pipe Materials Storage

Store the rubber gaskets according to ***Specifications Section 942***. Store the reinforcing steel in accordance with ***Specifications Section 415***.

6.2.7.8.3 Forms

Verify the condition of the forms, especially their dented or bent areas. Inspect the rings to be compatible with the approved joint design and meet the requirements of the ***Specifications***. The bands and grooves used to form the gasket recess shall comply with the approved design. The annular space of the joint shall be computed for compliance with the requirements of the specification and other ***Contract Documents***.

6.2.7.8.4 Reinforcing Steel Placement

Randomly check the fabrication, positioning, and minimum concrete cover requirements of steel reinforcement. The quality control inspection shall include the measurements and recording of the length, diameter, and reinforcing area of various sizes of cages currently being fabricated. The quality control inspector shall verify that all steel reinforcement meet the specification requirements. The minimum steel area requirements for Pipe shall be checked according to the following:

(A) ASTM C 76 for Round Pipe

(B) ***Department Standard Index No.280*** for Bell and Spigot ends of Round Pipe.

(C) ASTM C 507 for Elliptical Pipe

(D) Area requirements for special Pipe designs in accordance with the Approved Shop Drawings

6.2.7.8.5 Concrete Mixture and Placement Operation

Mix and place concrete mixture in accordance with ASTM C 76, ASTM C 507, or any other applicable Standards to produce a homogeneous concrete.

6.2.7.8.6 Concrete Curing

The Pipe sections shall be cured in accordance with the applicable curing methods specified in ASTM C 76, ASTM C 507, any other Standard curing methods, or alternative curing method that is included as part of the Plant's quality control plan.

6.2.7.9 Quality Control Testing and Inspection of Pipe

6.2.7.9.1 General

For the acceptance of the Pipe, perform the quality control inspection and tests at the frequencies and LOT (Group) sizes that are specified in the following AASHTO and ASTM Standards***,*** unless ***Specifications Section 449*** and other ***Contract Documents*** have specified otherwise:

(A) ASTM C 76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

(B) ASTM C 507, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

(C) ASTM C 985, Standard Specification for Non-reinforced Concrete Specified Strength Culvert, Storm Drain, and Sewer Pipe.

(D) ASTM C 1765 Steel Fiber Reinforced Concrete Pipe

The quality control plan shall include the quality control test methods, inspections, and minimum frequency of tests that are used as the basis of acceptance of each type of Pipe. The quality control inspectors shall obtain randomly selected samples from each LOT. A LOT is defined as the greater of one day's production or 300 sections of the Pipe. All sections of Pipe in a LOT shall be produced within 30-day time period. If a LOT is composed of Pipe with different strength requirements, the highest strength requirements will be applicable for the acceptance of all Pipe Sections in the LOT. During the annual Plant qualification review, the Plant shall provide test data representing samples of all Pipe sizes that are manufactured during the preceding year. Each LOT of Pipe components is accepted when:

(A) The test results and inspections meet the requirements as specified herein and in the applicable ***Standards and Specifications***.

(B) The Plant has completed all patching and repair work.

(C) The quality control manager or his/her designated technician has stamped each Section of Pipe.

(D) The list of the Pipe is included with each shipment to the project site.

6.2.7.9.2 Absorption Tests

Absorption tests are performed on steel reinforced Pipe at the minimum frequency of once per week for each Class of Pipe. The absorption test requirements are waived for wet cast concrete pipe.

6.2.7.9.3 Hydrostatic Test on Pipe Joints

When requested by the Department, perform the hydrostatic test, in the presence of the quality control and Verification inspectors, in accordance with ASTM C 497. The test shall meet the performance requirements of ASTM C 443, as modified in ***Specification Sections 430 and 449***.

For Pipe with diameters 36 inches or larger, the Plant has the option to perform hydrostatic test on Pipe joint by pressurizing the rubber gasketed joint either internally or externally. The Plant's externally applied test method requires review and approval of the State Materials Office (SMO). Upon the approval, the test method shall be included as part of the Plant's quality control plan.

Table I & II provides the range of pipe sizes. Perform the hydrostatic test on one size within each range.

Table 1									
Hydrostatic Test Approval Size Ranges (Round)									
Range 1				Range 2			Range 3		
12”	15”	18”	21”	24”	27”	30”	33”	36”	42”
Range 4				Range 5			Range 6		
48”	54”	60”		66”	72”	78”	84”	90”	96”
Note: All pipe sizes above 96” must be tested on each individual size.									

Table 2																
Hydrostatic Test Approval Size Ranges (Elliptical)																
Range 1				Range 2				Range 3			Range 4			Range 5		
18”	24”	27”	30”	33”	36”	39”	42”	48”	54”	60”	66”	72”	78”	84”	90”	96”
Note: All equivalent designated pipe sizes above 96” must be tested on each individual size.																

6.2.7.9.4 Appearance and Inspection of Final Finished Pipe

The quality control manager or his/ her designee performs final quality control inspection of the finished Pipe, before the application of the quality control approval stamp. Forms used to manufacture Pipe shall be sufficiently rigid and accurate to maintain the Pipe's designed dimensions and avoid irregularities in its surface. Pipe may be repaired if necessitated by occasional imperfections in the manufacture or damage during handling, and will be considered acceptable if the repairs are sound and properly finished to conform to the dimensional tolerances of the specifications. Dimensional tolerances shall comply with the requirements of the applicable ASTM standards, except as modified in ***Specifications Section 449***.

The quality control inspectors shall perform visual inspection of all finished Pipe, measure the dimensions of at least 20% of the randomly selected units in each LOT, and maintain a record of the inspections, including the deficiencies. Minor deficiencies may be repaired in accordance with the repair methods included as part of the quality control plan. The Plant shall determine the cause of the repetitive nonconformance and develop a corrective action plan. Submit the corrective action plan to address the type of deficiencies and corrective action that will be taken to prevent or minimize the deficiencies.

6.2.7.9.5 Handling and Storage

Pipe shall be handled and stored to prevent damage. The quality control inspectors shall inspect the Pipe handling operations and appropriate practices that will prevent damage. The quality control inspectors shall inspect Pipes during storage to ensure that they are stored in the correct stack and are not being damaged by point loading or stacking too high. Rejected Pipe shall not be stored in the same area with the acceptable Pipe. Rejected Pipe shall be culled and marked as rejected.

6.2.7.9.6 Stamping

Affix the Plant quality control stamp to each section of Pipe. The quality control stamp indicates that the manufactured Pipe meets the requirements of the ***Contract Documents*** and the quality control plan.

The quality control inspector shall inspect the identification and stamp marks on the wall of the Pipe to ensure that they are valid stamp marks. In the QCP include a statement that the Plant's quality control stamp will be applied only on the Pipes that are manufactured for **Department** projects or any other projects that require Department verification inspection.

A copy of a certification statement from the general manger of the Plant shall be included in the quality control plan regarding the stamp configuration.

6.2.7.9.7 Shipment

Address the Plant's shipping policy as part of the quality control plan.

Ensure that at the beginning of each project, the Plant provides a notarized statement to the Department project administrator from a responsible company representative certifying that the Plant will manufacture the products in accordance with the requirements set forth in the ***Contract Documents*** and Plant's approved quality control plan. Ensure that each shipment of Pipe to the project site is accompanied with a signed or stamped delivery ticket providing the description and the list of the products.

The list of the product with each delivery ticket shall be on the Plant's letterhead and shall include as a minimum, project number, date shipped and identification number of Pipe.

The quality control manager or quality control personnel working under the direct supervision of the quality control manager shall stamp the Pipe prior to their shipment to the project site**.** The quality control stamp indicates that the Plant certifies that the Pipe was manufactured in conformance with the Plant's quality control Plan. Each shipment of the Pipe to the project site shall include the list of the Pipe. The Plant shall address the shipping policy as part of the quality control plan.

6.2.7.9.8 Documentation

The quality control manager shall maintain documentation files in each

Plant. Retain these documents for a period of not less than three years after the last delivery of the Pipe to the project site. The quality control documentation shall as a minimum include the following items:

(A) A copy of the quality control plan and its amendments that are approved by the DMRO.

(B) Approved shop drawings (if applicable)

(C) Applicable ASTM and AASHTO standards

(D) ***FDOT Specifications and Design Standards***

(E) Quality control personnel training records

(F) Materials certification records for cement, aggregates, cementitious materials, chemical admixtures, fiber and steel reinforcing materials, welded wire reinforcement, and gasket materials.

(G) Concrete mix designs

(H) Equipment calibration, including concrete batching equipment, water meter, admixture dispensing equipment, concrete compression testing machine, three-edge-bearing testing equipment, hydrostatic testing equipment.

(I) Joint forming equipment and gaskets, and Pipe test results.

(J) LOT number

(K) Number and type of Pipes in each LOT

(L) Applicable test data

(M) Disposition of all manufactured Pipe

(N) Record of the job specific shipping tickets, describing, size, type, and lengths of the delivered Pipe and the required notarized certification statement at the beginning of each project.

(O) Record all deficiencies found as a result of quality control inspection and testing or Verification inspection and testing and the corrective action taken. Maintain a copy of the deficiency reports in the Plant's permanent file.

6.2.8 TRAINING

6.2.8.1 General

The Plant's quality control personnel involved in the inspection and testing of the Pipe shall have the required qualifications in their respective work area as specified herein. The Pipe may include non-reinforced, steel reinforced, and fiber reinforced concrete pipe.

The applicants shall attend a Department accredited Pipe training course and receive a passing grade on the final examination for the course. Ensure that the Plant's quality control plan includes training certification copies for their qualified quality control personnel.

The SMO maintains the list of the accredited Pipe training courses.

6.2.8.2 Quality Control Personnel of Pipe

Ensure that all personnel performing the quality control inspection and testing of the Pipe products at a manufacturing facility have the required qualifications as described herein:

6.2.8.2.1 Level I Quality Control Inspectors

Level I quality control inspectors are those who perform the routine concrete inspection and testing of the precast concrete Pipe products, including, concrete materials, pre-pour form and reinforcing steel/fiber placement inspections, concrete batching, mixing, placement, and post-placement inspections. The quality control inspectors shall be familiar with the precast concrete related plans and specifications and have completed a minimum of 12-hour, Department approved, training course and examination.

6.2.8.2.2 Level II Quality Control Inspectors

Level II inspectors are those who are involved in the design and verification of the concrete mixes and evaluate the needed repair method and its implementation. Advanced knowledge of the shop drawings, specifications, test methods, and Standard Indices are the requirements for Level II qualifications. Ensure that Level II Inspectors have Level I Quality Control Inspector certification and have successfully completed a minimum of additional 5-hour, Department approved course, including the examination.

6.2.8.2.3 Quality Control Managers of Pipes

The quality control managers shall have Pipe- Level II Quality Control Inspector certification and a minimum of two years of experience, directly related to cement concrete production.

6.2.8.3 Re-qualification of the Quality Control Personnel and Department Inspectors

The Level I and II qualifications will expire at the end of five years, during which, the inspectors have the choice of attending the course and retaking the examination or only they take the examination to be re-qualified for an additional five years.

6.2.9 FORMS

There are no forms associated with this procedure.