

Volume I Section 6.1

QUALITY ASSURANCE PROGRAM FOR FLEXIBLE PIPE

6.1.1 PURPOSE

This procedure provides guidance to Florida Department of Transportation (FDOT) personnel who develop and implement quality control (QC) and quality assurance (QA) programs for the manufacture, storage, and transportation of flexible pipe for FDOT projects. Flexible pipe, hereinafter referred to as pipe, includes corrugated metal pipe (CMP), corrugated high-density polyethylene (HDPE) pipe, corrugated polypropylene (PP) pipe, corrugated polyvinyl chloride (PVC) pipe, and steel-reinforced ribbed polyethylene (SRPE) pipe.

6.1.2 AUTHORITY

Sections 20.23(3)(a) and 334.048(3), Florida Statutes.

6.1.3 REFERENCES

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

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

Federal Aid Policy Guide, 23CFR, Subchapter G Engineering Construction Inspection and Approval, Subpart B – Quality Assurance Procedures for Construction, Section 637.209.

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

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

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

Florida Sampling and Testing Methods (FSTM), Florida Department of Transportation.

Plastic Pipe Institute, "Recommended Industry Standards for Manufacturer's Quality Control, Quality Assurance for Corrugated HDPE Pipe," July 1, 2005

6.1.4 SCOPE

Primary offices affected by this procedure include the State Materials Office (SMO), District Materials and Research Offices (DMRO), District Construction Office (DCO) and the State Drainage Office (SDO).

6.1.5 GENERAL INFORMATION

Flexible pipe plants produce, inspect, store, and ship flexible pipe meeting the requirements of ***FDOT Specifications***.

The SMO verifies that manufactured pipe conforms to the requirements of ***FDOT Specifications***, accepts their Quality Control (QC) Plans, and inspects the plants prior to commencement of any work.

6.1.6 STATE MATERIALS OFFICE RESPONSIBILTIES

6.1.6.1 PLANT QUALIFICATION REVIEW PROCESS

6.1.6.1.1 Plant Review

The SMO shall make arrangements for the plant's initial qualification review, including plants that are submitting their first QC Plan, as well as the plants that have not produced for any FDOT projects for more than one year.

The SMO forms the Plant Qualification Review Team (PQRT) and performs the review. The PQRT may be comprised of the District and State Technologists/Engineers, District Materials and Research Engineers/Technologists, District and State Drainage Engineers, the Verification Inspectors, and representative(s) of the Federal Highway Administration. The PQRT reviews the plant's manufacturing process, QC testing, inspection, and documentation. The PQRT shall also review the

plant's QC records, previously conducted audits or inspections, methods of manufacturing, storage, and shipment of the products. The PQRT verifies that plant personnel involved in QC testing and inspection of pipe meet the training requirements as specified in Materials Manual Section 6.1 Volume II and **FDOT Specifications Section 105**.

6.1.6.1.2 Maintenance of Plant Quality Control Plan and Qualification:

Upon satisfactory review of the proposed QC Plan, in compliance with Materials Manual Section 5.6, the SMO will upload the QC Plan and change the QC Plan Status to "Accepted" in MAC. The plant submits, in writing, any changes to the QC Plan to the SMO. The SMO reviews all proposed QC Plan addenda and uploads into MAC once approved.

Plants that are on the FDOT's Production Facility Listing for Flexible Pipe will be subject to a plant qualification review at any time, but at least once per year. If the PQRT or Verification Inspector finds any deficiencies which would result in products not meeting **FDOT Specifications**, they shall be brought to the attention of the Quality Control Manager (QCM) and/or Plant Manager. Plants with "Accepted" QC Plans and satisfactory qualification reviews shall be designated as qualified plants in MAC.

6.1.6.2 INSPECTION AND TESTING

6.1.6.2.1 General

All inspections, sampling, and testing activities are performed as specified in **FDOT Specifications Sections 430, 943, 945, and 948** except as modified in **Table 1** as follows:

TABLE 1- VERIFICATION INSPECTION, SAMPLING, AND TESTING ACTIVITIES	
Raw Material	Minimum Inspection, Sampling, and Testing Frequency
Galvanized Metal Coil	Certification and test one heat per year, six-inch by six-inch samples
Aluminized Metal Coil	Certification and test one heat per year, six-inch by six-inch samples
HDPE and PP Resins	Certification and test one LOT per year, quart-size samples
PVC Resins	Certification and test one LOT per year, ten-pound samples

TABLE 1- VERIFICATION INSPECTION, SAMPLING, AND TESTING ACTIVITIES	
Raw Material	Minimum Inspection, Sampling, and Testing Frequency
Plastic Resin Antioxidants and Carbon Black	Certification, no samples required
Pipe Gaskets	Verify that gaskets are approved in the QC Plan
Zinc Rich Coating	Verify that the coating meets the requirements of <i>FDOT Specifications Section 562</i>
Pipe Dimensions	Verify biannually
Pipe Workmanship	Verify biannually
Pipe Storage, Shipping, and Handling	Verify biannually
Repair Methods	Verify biannually
Disposition of Failing Materials/Products	Verify biannually
Pipe Physical Tests (Refer to ASTM and/or AASHTO as appropriate)	Observe tests and verify plant test records biannually
Training Requirements	Verify biannually
Hydrostatic Test of Pipe Joints	Verify that joint hydrostatic tests are performed in accordance with Materials Manual 6.1 Volume II

The SMO provides verification inspection personnel, who are responsible for documenting findings, in addition to advising the producer on all related requirements of sampling, QC testing, and QC documentation. The Verification Inspector shall take samples of pipe or other materials for purposes of determining compliance with ***FDOT Specifications***.

6.1.6.2.2 Verification Inspections, Sampling, and Testing

6.1.6.2.2.1 General

The Verification Inspector performs inspection and testing of materials and of the manufactured pipe to verify the effectiveness of the plant's QC Plan and to assure acceptability of the finished pipe. The Verification Inspectors do not instruct the plant on how to run its operations. However, they should document and advise the plant against continuation of any observed operation or sequence of operations, which may result in an unsatisfactory product.

The Verification Inspector performs inspection and testing to validate QC test results. The QC test results should be used for acceptance when they compare with the verification results. The QC and verification tests should be considered as comparing when the results of both tests are either passing or failing. The test results should be considered not comparing when one result passes and the other one fails. If the results do not compare, the FDOT and the plant proceed to the resolution inspection and testing.

The Verification Inspector determines whether the plant's QCM and QC Inspectors are performing inspections in compliance with the QC Plan. The Verification Inspector performs random spot checks to ensure that the observed pipe is fabricated in compliance with the requirements of the contract documents. The Verification Inspector shall perform a more in-depth review of any phase of work, as needed.

6.1.6.2.2.2 Materials Verification Reviews

The Verification Inspector performs at least biannual reviews of the plant's records for materials received at the plant and/or incorporated into the fabrication of pipe, including the certified physical property reports, and assures that the records are adequate to verify that all materials meet **FDOT Specifications**. The Verification Inspector takes verification samples in accordance with **Table 1**, logs samples into MAC, and records sample numbers in the Quality Control Program Inspection Report (QCPIR). The Verification Inspector monitors sample status and updates the QCPIR with pass/fail status upon completion of testing.

The Verification Inspector checks the handling and storage for each of the materials during each inspection.

The Verification Inspector shall bring all material deficiencies to the attention of the QCM.

6.1.6.2.2.3 Certified Materials

6.1.6.2.2.3.1

General

The Verification Inspector verifies that the required QC inspection reports, signed shipping tickets, certificate of analysis showing QC test results, and notarized material certification documents are maintained. The Verification Inspector takes samples of pipe materials, as needed.

6.1.6.2.2.3.2

Metal Coil

Each metal coil heat is accepted by QC based on the certified mill analysis provided by the steel plant and periodically verified by FDOT. The Verification Inspector shall take samples during inspections as specified in **Table 1**.

From each of the randomly selected metal coil heats, three six-inch by six-inch samples will be taken. One sample from each heat shall be tested by the SMO. The remaining samples will be properly identified and stored for future testing in the event of a failure of the first sample. If the first sample meets **FDOT Specifications**, the LOT will be accepted based on the certified mill analysis and the results of the verification tests. All metal coil utilized after the previous verification tests are considered acceptable. If the first sample fails to meet **FDOT Specifications**, the second sample shall be tested. If both samples fail to meet **FDOT Specifications**, the heat or LOT of material shall be rejected and replaced with material meeting the requirements. If one sample fails and one sample meets **FDOT Specifications**, the third sample may be tested to confirm material acceptability. The metal coil heat will be rejected if the results are failing on any two samples of the same heat.

Each heat that does not conform to **FDOT Specifications** shall be rejected. All rejected materials shall be marked and handled in such a manner that ensures the avoidance of these materials being used on pipe for FDOT.

At the discretion of the SMO, verification tests may be performed by the Verification Inspector.

Each LOT of material that does not conform to the requirements of the **Contract Documents** shall be rejected.

6.1.6.2.2.3.3

Plastic Resins

Each LOT of plastic resin is accepted by QC based on certified analysis by the resin manufacturer and periodically verified by the FDOT. The Verification Inspector shall take samples during inspections in accordance with **Table 1**.

Compounded raw materials shall have individual components (resins, colors, additives, etc.) represented by separate certified analysis reports on hand and available to the Verification Inspector.

Samples from each LOT shall be tested by the SMO. If the first test passes, the LOT is accepted based on the resin manufacturer's certification and verification test results. If the verification tests and inspections confirm **FDOT Specifications** compliance, all resin deliveries to the plant, after the previous passing verification test, are considered acceptable. If the first test fails to meet **FDOT Specifications**, a second test shall be conducted. If both tests fail, the producer shall be notified that the LOT of material shall be rejected and replaced with material meeting the requirements. If one test fails and one test meets the **FDOT Specifications**, the third test shall be tested to determine material acceptability. The LOT of the plastic resin will be rejected if the test results of the two samples of the same LOT fails.

Each LOT of material that does not conform to the requirements of the **Contract Documents** shall be rejected.

At the discretion of the SMO, the Verification Inspector may take samples of any raw materials.

6.1.6.2.2.4

Verification Testing and Inspection of Pipe

The Verification Inspector shall review the approved **Plans, Standard Indexes, Shop Drawings, and FDOT Specifications**. The Verification Inspector performs random review of the manufacturer's fabrication methods, procedures, workmanship, and QC inspection records. The verification inspections include the

random review and visual inspections of all other major phases of work, such as equipment set-up, calibration and monitoring during production, shaping of the pipe, forming of seams, dimensional checks, handling, storage, and shipping. The Verification Inspector shall document all inspections and advise the manufacturer of any observed manufacturing operations, which may result in unsatisfactory compliance with ***FDOT Specifications***.

The Verification Inspector will perform periodic inspections, sampling, and testing, when pipe is being produced for FDOT projects to ensure the quality and acceptability of the materials, methods, techniques, procedures, and processes being utilized by the manufacturer in the fabrication of the Pipe. If the Production Facility has not produced any FDOT products for six months, the verification inspection frequency may be reduced until the Production Facility resumes production for FDOT projects. If a Production Facility has not been inspected by the Department for more than one year, the QCM must notify the SMO at least seven days before the Production Facility intends to resume production for FDOT, such that a verification inspection can be scheduled prior to production.

The Verification Inspector may select a random pipe sample for observing QC testing in accordance with the applicable ASTM or AASHTO Standards.

The plant shall provide all QC inspection reports, signed shipping tickets, certificate of analysis showing QC test results, notarized material certification documents, and any other pertinent data for each LOT of products upon request by the Verification Inspector.

The Verification Inspector may inspect any finished products, including products that are stored in the plant. Any pipe that does not fully comply with the requirements of the ***FDOT Specifications*** will be rejected and the plant QC labels shall be removed by QC. After each inspection, the Verification Inspectors will provide a list of deficiencies to plant personnel. The list is entered into MAC and will be reflected on the MAC Quality Control Program Inspection Report (QCPIR). The plant shall correct all deficiencies identified within the turnaround time specified by the FDOT in MAC so as not to jeopardize their plant acceptance status. The Verification Inspector shall conduct a follow-up inspection to verify all deficiencies have been resolved.

6.1.6.2.2.5 Hydrostatic Test

The SMO shall observe hydrostatic testing to verify that plant is performing the test in accordance with specified methods. The requirement for the FDOT to witness hydrostatic testing may be waived in accordance with the requirements of Materials Manual 6.1 Volume II. Successful hydrostatic test results will qualify the continued usage of a gasket. Hydrostatic tests shall identify the type of pipe, pipe size, gasket model, manufacturer of gasket, and gasket certified mill analysis. All test reports and gasket documentation shall be continuously included in the QC Plan until another identical test of the same size and gasket has been conducted. Hydrostatic tests shall be performed on all pipe size ranges for each gasket type used. The SMO shall determine the next diameter to be tested within each pipe size range.

6.1.6.2.2.6 Miscellaneous Materials

The Verification Inspector checks the plant's basis for acceptance of miscellaneous pipe materials in accordance with the approved QC Plan. Miscellaneous materials such as pipe lubricant, adhesives, or other hardware are subject to testing and shall be included in the plant's QC Plan.

6.1.6.2.2.7 Finished Pipe Inspections

The Verification Inspector verifies QC testing and inspection records, visually inspects finished pipe, and randomly selects at least one of the LOTs considered acceptable by QC for FDOT projects to determine if the pipe is free from deficiencies.

The Verification Inspector shall also check the dimensions of pipe to verify if they meet the specified dimensional tolerances. The Verification Inspector will perform visual inspection of all finished pipe and measure the dimensions of randomly selected pipe from LOTs considered acceptable by QC for FDOT projects. The Verification Inspector will provide a list of the deficiencies.

If the deficiency rate is greater than three percent, but not more than five percent of the total inspected pipe, the plant shall reject or repair the deficient pipe in accordance with the repair method included as

part of their QC Plan. The plant shall revise the QC Plan to address the type of deficiencies and take corrective action. If the failure rate of the pipe exceeds five percent, the plant's QC Plan will be shown as "Suspended" on the FDOT's Production Facility Listing. Upon completion of satisfactory corrective action, the SMO may update the plant's QC Plan status to "Accepted" on the FDOT's Production Facility Listing for Flexible Pipe Producers. The QCM shall maintain a list of all rejected pipe and their LOT numbers and shall make this information available to the Verification Inspector on request.

6.1.6.2.2.8 Meetings

The Verification Inspector meets with the QCM at the completion of each inspection. During the meetings, the Verification Inspector discusses the product deficiencies found during the inspections and obtains a signature from the QCM or his representative to be added to the Verification Inspection report.

6.1.6.2.2.9 Verification Inspection and Testing Documents

In addition to verification sampling and testing, the Verification Inspector performs reviews of the QC reports and checks the producer's documentation for pipe prior to their shipment. The Verification Inspector visually inspects randomly selected pipe after the plant has completed all work prior to shipment to ensure that proper documentation, including the list of the pipe, is included with each shipment.

The Verification Inspector maintains documentation of each inspection activity in MAC, including key inspection, sampling, and testing activities as well as key discussions with the plant personnel. The Verification Inspector maintains a record of the verification testing and disposition of all material samples taken for testing. For each component, the Verification Inspector reviews the QCM's documentation indicating compliance with the QC Plan. The Verification Inspector shall document the deficiencies that have caused the suspension of the plant's QC Plan and uploads documentation of the plant's corrective actions into MAC.

6.1.6.2.3 Resolution Procedure

When Verification test results do not compare favorably with the Plant's QC test results, the SMO initiates the Resolution Procedure. The Resolution Procedure may consist of Independent Assurance evaluation and/or sampling and testing of the products. Upon the review of the records, test procedures, and additional inspection, sampling and testing, the Resolution Inspector reports the cause of the non-comparable results.

If the Resolution testing compares favorably with the plant's QC data, use the data for acceptance. If the Resolution testing compares favorably with the verification data, use the verification data for acceptance. The test results of a LOT are considered non-comparable when one result passes and the other result fails.

Based on the Resolution results, the SMO determines the disposition of the failed LOT and the LOTs after the previous verification test. The investigations may consist of verification/resolution sampling and testing of the two available LOTs of the pipe that have been manufactured immediately prior to the failed LOT. If any of the LOTs fail, the Verification Inspector shall test two more available LOTs and continue testing backward until the results of the two verification LOTs compare favorably with the results of the QC testing. The Verification Inspector advises the plant to reject all failed verification/resolution LOTs. The Resolution and Verification Inspectors will use the same type of tests that the QC Inspectors are using.

6.1.6.2.4 Independent Assurance Inspection and Testing

Independent Assurance sampling and testing are performed in accordance with Materials Manual Section 5.5.

6.1.6.2.5 Independent Verification

The FDOT may perform Independent Verification at any time by follow-up inspections or sampling and testing any pipe or raw materials. This is a checking function outside of the Verification Program.

6.1.7 DISTRICT MATERIALS AND RESEARCH OFFICE RESPONSIBILITIES

The DMRO may accompany SMO personnel during inspections, or serve as member of a PQRT, when requested.

6.1.8 STATE DRAINAGE OFFICE RESPONSIBILITIES

The State Drainage Engineer reviews the **Plans** for modified or special designs requested by the plant. The SDO reviews and approves the plant's proposed modifications and distributes them to the plant, DCO, DDO, and the SMO.

6.1.9 DISTRICT CONSTRUCTION OFFICE RESPONSIBILITIES

The project personnel shall only accept pipe that are properly marked by the plant's approved QC label. The project personnel will not accept any pipe that has been substantially damaged during delivery or unloading. The project personnel shall immediately contact the SMO if any pipe delivered has not met the FDOT's expectations. All pipe not meeting the requirements shall be isolated, marked, and/or returned to the pipe producer.

The personnel at the project site will ensure that a legible QC label is affixed to each pipe that is received at the job site. The project personnel will ensure that the pipe was produced by a production facility listed on the Contractor QC Plan in MAC prior to the delivery of the pipe to the job site.

The list of pipe shall be on the pipe plant's letterhead and include the following information as a minimum for each shipping ticket:

- (A) Project Number
- (B) Date shipped
- (C) Type of pipe (aluminum, aluminized, galvanized, HDPE, PP, or PVC) and classification (Class I or Class II)
- (D) Quantities of lengths and diameters of the pipe sections
- (E) QC stamp or signature

Prior to the first shipment of pipe to the project, the plant shall submit a notarized material certification statement that all the pipe produced for each specific project shall meet all applicable governing **FDOT Specifications** or

documents. All required QC documentation shall be kept on file at the plant for up to 3 years after the final acceptance of the project.

6.1.10 TRAINING

None required.

6.1.11 FORMS

None required.