

## **VOLUME I**

### **Section 6.1**

## **QUALITY ASSURANCE PROGRAM FOR FLEXIBLE PIPES**

### **6.1.1 PURPOSE**

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

### **6.1.2 AUTHORITY**

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

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

### **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.

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 Products List, Florida Department of Transportation.

Field sampling and Testing Manual, 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 pipes meeting the requirements of Florida Department of Transportation Specifications.

The District Materials and Research Offices verify that manufactured pipes conform to the requirements of Florida Department of Transportation Specifications.

The Department accepts their quality control plans (QCP) and inspects the Plants prior to commencement of any work.

#### **6.1.6 DISTRICT MATERIALS AND RESEARCH OFFICE RESPONSIBILITIES**

##### **6.1.6.1 PLANT QUALIFICATION REVIEW PROCESS**

###### **6.1.6.1.1 Plant Review**

The District Materials and Research Office makes arrangements for the plant's initial qualification review, including plants that are submitting their first quality control plan, as well as the plants that have not produced for any Department projects for more than one year.

The District Materials and Research Office 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 pipes meet the training requirements as specified in **Materials Manual Section 6.1 Volume 2** and **FDOT Specifications Section 105**.

**6.1.6.1.2 Maintenance of Plant Quality Control Plan and Qualification:**

Upon the satisfactory review of the proposed quality control plan, in compliance with **Materials Manual Section 5.6**, the District Materials and Research Office accepts the proposed QCP and documents the plant's status as "A" on the Department's list of plants with an accepted QCP. The plant submits, in writing, any changes to their QCP to District Materials and Research Office.

Plants that are on the Department's qualified pipe plants list (plants with an accepted QCP) 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 **Specifications** they shall be brought to the attention of the Quality Control Manager (QCM) and/or Plant Superintendent. The Plants with acceptable quality control plans and satisfactory qualification reviews are considered to be qualified plants.

**6.1.6.2 INSPECTION AND TESTING**

**6.1.6.2.1 General**

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

<b>TABLE 1- VERIFICATION INSPECTION, SAMPLING, AND TESTING ACTIVITIES</b>	
<b>Activities</b>	<b>Minimum Inspection, Sampling and Testing Frequency</b>
Metal Coil	Certification and test two lots per year
Plastic Resins	Certification and test two lots per year

Plastic Resin Anti-oxidants and Carbon Black	Certification
Pipe Gaskets	Continuous approval based on successfully passing hydrostatic tests accompanied with mill certification of the gasket
Patching Materials	Certification
Pipe Dimensions	Verify Quarterly
Pipe Workmanship	Verify Quarterly
Pipe Storage, Shipping and Handling	Verify Quarterly
Repair Methods	Verify Quarterly
Disposition of Failing Materials/Products	Verify Quarterly
Pipe Physical Tests (Refer to ASTM and/or AASHTO as appropriate)	Observe tests Quarterly; verify plant test records Quarterly
Training Requirements	Verify Quarterly
Hydrostatic Test of Pipe Joints	Verify that joint hydrostatic tests are performed in the presence of a representative from State Materials Office. The test is required for approval of new gasket or joint design.

The District Materials and Research Office provides verification inspection personnel, who are responsible for documenting findings, and advises 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 **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 pipes to verify the effectiveness of the plant's QCP and to assure acceptability of the finished pipes. 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 favorably with the verification results. The QC and verification tests should be considered as comparing favorably when the results of both tests are either passing or failing. The test results should be considered not comparing favorably when one result passes and the other one fails. If the comparison is not favorable, the Department and the plant proceed to the resolution inspection and testing.

The verification inspection assures that the plant's QCM and QC Inspectors are performing inspections in compliance with the quality control plan. The Verification Inspector performs random spot checks to ensure that the observed pipes are 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 quarterly reviews of the plant's records for materials received at the plant and/or incorporated into the fabrication of pipes, including the certified physical property reports, and assures that the records are adequate to verify that all materials meet the **Specification** requirements. The Verification Inspector takes verification samples of metal coil and plastic resin from at least two lots of each type of material per year and performs the required tests.

Quarterly, the Verification Inspector checks the handling and storage for each of the materials.

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 and material certification documents are maintained. The Verification Inspector takes samples of

metal coil and plastic resin samples and any other pipe materials, as needed.

#### 6.1.6.2.2.3.2

##### **Metal Coil**

Each lot of metal coil is accepted based on the certified mill analysis of the steel plant and Department's verification samples. The Verification Inspector shall take samples from at least two lots per year.

From each of the randomly selected lots of metal coil, three one-foot by one-foot samples will be taken. The samples from each lot shall be sent to the SMO for testing, where one sample will be tested. The remaining samples will be properly identified and tagged and shall be stored for future testing in the event of a failure of the first sample. If the first sample meets the **Specification** requirements, the lot will be accepted based on the manufacturer's certification and the results of the verification tests. All metal coil subsequent to the previous verification tests are considered acceptable. If the first sample fails to meet **Specifications**, the second sample shall be tested. If both samples fail to meet **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 **Specifications**, the third sample may be tested to confirm material acceptability. The lot of the metal coil will be rejected if the results are failing on any two samples of the same lot.

Each lot of material that does not conform to **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 the Department.

At the discretion of the DMRE, 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 based on certified mill analysis of the resin manufacturer and the Department's periodic verification samples. The Verification Inspector shall take samples from at least two lots per year. From each of the two randomly selected lots of plastic resin, three samples shall be taken. Each sample of plastic resin shall consist of a 100 cubic inch container of the as-received material.

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

One of the samples from each lot shall be sent to the SMO for testing and the remaining samples, which will be properly identified and tagged, shall be stored for future testing in the event of failure of the first sample. If first sample passes, the lot is accepted based on the resin manufacturer's certification and verification test results. If the verification tests and inspections confirm **Specification** compliance, all resin deliveries to the plant, subsequent to the previous passing verification test, are considered acceptable. If the first sample fails to meet **Specifications**, the second sample shall be tested. If both samples fail the test, the heat or lot of material shall be rejected and replaced with material meeting the requirements. If one sample fails and one sample meets the **Specifications**, the third sample may be tested to confirm 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 DMRE, the Verification Inspector may take samples of any certified materials.

#### **6.1.6.2.2.4 Verification Testing and Inspection of Pipes**

The Verification Inspector shall review the approved **Plans, Standard Indexes, shop drawings, and Specifications**. The Department's 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 the inspections as part of the project's records and shall advise the manufacturer of any observed manufacturing operations, which may result in unsatisfactory compliance with **Specifications**.

The Verification Inspector will perform periodic inspections, sampling, and testing, not less than once per quarter, when pipes are being produced for Department projects to ensure of the quality and acceptability of the materials, methods, techniques, procedures, and processes being utilized by the manufacturer in the fabrication of the Pipes. Should the producer produce pipe on an infrequent basis, the producer shall be required to notify the DMRE of all future production in order to allow for scheduling of verification inspection.

The Verification Inspector may select a lot of pipe and will observe or perform the tests in accordance with the applicable **ASTM** or **AASHTO Standards**.

The tests will be performed at the plant or at the Department's testing laboratory. The plant shall provide all material certifications, QC test results, 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 the products that are stored in the plant that have been QC stamped/labeled. Any pipe that does not fully comply with the requirements of the **Specifications** will be rejected, the plant QC stamps/labels shall be removed and the rejected pipe will not be re-inspected. After each inspection, the Verification Inspectors or other QA Inspectors will provide a list of deficiencies and obtain a signature from the plant personnel acknowledging all deficiencies. The plant shall correct all deficiencies identified by either QC personnel or the Verification Inspector, IA, or PQRT inspectors in a timely manner 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 Verification Inspector or the SMO shall observe the hydrostatic test to verify that plant is performing the test in accordance with specified methods. 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 mill analysis. All test reports and gasket documentation shall be continuously included in the QCP until such time another identical test of the same size and gasket has been conducted. Hydrostatic tests shall be performed on all pipe sizes for each gasket type used. The District shall determine the frequency of the next size pipe to be tested.

#### **6.1.6.2.2.6 Miscellaneous Materials**

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

#### **6.1.6.2.2.7 Finished Pipe Inspections**

The Verification Inspector verifies the QC testing and inspection records, visually inspects the finished pipes, and randomly selects at least one of the stamped LOTs to determine if the pipes are free from deficiencies.

The Verification Inspector shall also check the dimensions of the pipes to verify if they meet the specified dimensional tolerances. The Verification Inspector will perform visual inspection of all finished pipes and measure the dimensions of at least five percent of the randomly selected pipes in each LOT. The Verification Inspector will provide a list of the deficiencies. If the deficiency rate of the inspected pipes is below two percent of the total inspected pipes, the pipes shall repair the failed pipes in accordance with the repair method included as part of the QCP.

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

included as part of the QCP. The Plant shall revise the QCP to address the type of deficiencies and take corrective action. If the failure rate of the Pipes exceeds five percent, the plant's QCP will be shown as suspended on the Department's list of pipe plants with accepted quality control plans. Upon completion of satisfactory corrective action, the DMRE may update the plant's QCP status to accepted on the Department's list of Flexible Pipe Producers with accepted quality control programs. The QCM shall maintain a list of all rejected pipes 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 Quality Control Manager 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 Quarterly Verification Inspection report.

#### **6.1.6.2.2.9 Verification Inspection and Testing Documents**

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

The Verification Inspector maintains documentation of each inspection activity in a notebook or any other format that reflects 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 assures that Quality Control Manager maintains documents indicating compliance with the QCP. The Verification Inspector shall document the deficiencies that have caused the suspension of the plant's QCP and maintains documentation of the plant's corrective actions.

### **6.1.6.2.3 Resolution Procedure**

The District Materials and Research Office 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 to be non-comparable when one result passes and the other result fails.

Based on the Resolution results, the District Materials and Research Office determines the disposition of the failed lot and the lots subsequent to the previous verification test. The investigations may consist of verification/resolution sampling and testing of the two available lots of the pipes 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 Quality Control 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 Department may perform Independent Verification at any time by sampling and testing any pipe or its material ingredients. This is a checking function outside of the Verification Program.

## **6.1.7 STATE MATERIALS OFFICE RESPONSIBILITIES**

The State Materials Office provides technical support for Districts Materials and Construction personnel. The State Materials Office may accompany District personnel during inspections, Independent Verification, or serve as member of a PQRT.

The SMO provides information regarding **Specification** changes and inspection procedures to the District Materials and Research Office. The SMO staff will coordinate with the plant, District Materials and Research Office personnel, and Construction personnel to discuss any deficiencies of the manufactured pipes.

### **6.1.8 STATE DRAINAGE OFFICE RESPONSIBILITIES**

The State Drainage Engineer reviews of the **Plans** for modified or special designs requested by the plant. The State Drainage Office reviews and approves the plant's proposed modifications and distributes them to the plant, District Construction Office, District Materials and Research Office, and the SMO.

### **6.1.9 DISTRICT CONSTRUCTION OFFICE RESPONSIBILITIES**

The project personnel shall only accept pipes that are properly marked by the plant's approved QC stamp/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 District Materials and Research Office in the event that any pipe delivered has not met the Department'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 stamp/label is affixed to each pipe that is received at the job site.

The list of the pipes 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) Quantities of lengths and diameters of the pipe sections
- (D) QC signed/stamped Shipping ticket, or a duly authorized

representative of the plant may apply the QC stamp/label identified in the plant's QCP.

Prior to the first shipment of pipe to the project the plant shall submit a notarized certification statement that all the pipe produced for each specific project shall meet all applicable governing **Specifications** or documents. All notarized certifications shall be kept on file at the plant for up to 3 years after the last pipe section has been shipped to a project.

#### **6.1.10 TRAINING**

No training is required for implementation of this document.

#### **6.1.11 FORMS**

There are no forms associated with this procedure.