

Section 6.1 Volume II

FLEXIBLE PIPE (METAL AND PLASTIC)

6.1.1 PURPOSE

This procedure provides guidance for the development and implementation of the quality control plan for the manufacture, storage, and transportation of flexible pipes for Florida Department of Transportation projects. Flexible Pipes, hereinafter referred to as pipes include corrugated metal pipes, corrugated high-density polyethylene pipes and corrugated polyvinyl chloride pipes.

6.1.2 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
334.044(2), 334.044(10)(a), and 334.048 Florida Statutes

6.1.3 REFERENCES

- A) Design Standards, Topic No. 625-010-003, Florida Department of Transportation
- B) Florida Department of Transportation Standard Specifications for Road and Bridge Construction
- C) American Society for Testing and Materials (ASTM) Standard Test Methods and Specifications, Philadelphia, Pennsylvania
- D) American Association of State Highway and Transportation Officials (AASHTO), Part I Specifications, and Part II Tests, Washington, D.C.
- E) Qualified Products List, Florida Department of Transportation
- F) Field sampling and Testing Manual, Florida Department of Transportation

6.1.4 SCOPE

This procedure is used by the pipe manufacturers (manufacturers) to perform the required inspections and testing of pipes during and after manufacturing. These requirements and activities pertain to the inspections, measurements and necessary tests to substantiate that materials and pipes are in conformity with the **Contract Documents**. The quality control plans are designed to provide guidelines that are used by the manufacturers to produce pipe in conformance with the **Florida Department of Transportation Specifications** and other **Contract Documents**.

6.1.5 GENERAL INFORMATION

Manufacturers are responsible for the production, inspection, documentation, storage and shipment of the pipe. The pipes delivered to the project shall meet the requirements of the **Specifications** and other **Contract Documents**.

6.1.6 PLANT QUALIFICATION PROCESS

6.1.6.1 General

Prepare the proposed quality control plan in accordance with **Specifications Section 105. Materials Manual Section 5.6** may be used as a guideline.

6.1.6.2 Review of Plant's Proposed Quality Control Plan

Submit the proposed quality control plan to the District Materials and Research Office for the District in which the manufacturing facility is located. For out-of-state manufacturers, submit the quality control plan to the nearest District Materials and Research Office. Upon the manufacturer's submittal of a quality control plan, the District Materials and Research Office will review the proposed quality control plan and make necessary arrangements for the initial manufacturing facility qualification review in accordance with **Section 6.1.6.3** below.

In the quality control plan, include the work experience, qualifications, and responsibilities of the manufacturing production and quality control personnel. Identify the on-site Production Manager, 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 Section 105**. In the quality control plan, include a copy of the available minor repair methods for repair of minor deficiencies.

6.1.6.3 Manufacturing Facility Qualification Review

The Department will perform the initial qualification reviews of manufacturing facilities that intend to produce pipes for Department projects. These initial reviews include the reviews of manufacturers that submit their first quality control plan and manufacturers that have not produced for Department projects for more than one year. The Department will also perform routine manufacturing facility qualification reviews at least annually, on all manufacturing facilities that have continued furnishing pipes for Department projects.

6.1.6.4 Maintenance of Manufacturer's Qualification

Upon the Department's satisfactory review of the proposed quality control plan, in compliance with **Materials Manual Section 5.6**, and satisfactory manufacturing facility qualification reviews, the District Materials and Research Office will accept the proposed quality control plan and include the manufacturer on the list of the Department's Producers with Accepted Quality Control Plans. Advise the District Materials and Research Office of any changes in 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 District Materials and Research Office annually.

Manufacturers that are on the Department's list of Producers with Accepted Quality Control Plans will be subject to the manufacturer qualification review process at any time. The Department will perform at least an annual review of the manufacturing facilities that are producing for the Department projects.

6.1.7 PIPE MANUFACTURER FUNCTIONS AND RESPONSIBILITIES

6.1.7.1 General

Manufacturers are responsible for the quality of the finished pipes. Provide facilities and qualified personnel to perform specified inspections and tests

and maintain an acceptable quality control plan in compliance with the requirements specified herein and in **Specifications Section 948**.

6.1.7.2 Quality Control Manager

The Quality Control Manager shall ensure that the quality of the products at each manufacturing facility meets the quality requirements of the **Contract Documents**. The Quality Control Manager may serve in more than one manufacturing facility. The responsibilities of the Quality Control Manager include, but are not limited to, the following:

- 1) Maintain the Quality Control approval label and apply it to acceptable pipes, or designate a qualified quality control technician, who is working under the direct supervision of the Quality Control Manager to apply the plant approval label.
- 2) Be present, or designates a technician/inspector working under the direct supervision of the Quality Control Manager to be present during the production of all pipes that will be shipped to Department projects.
- 3) Perform and/or supervise the Quality Control testing and inspection.
- 4) Ensure that the Manufacturer has a sufficient number of quality control technician(s)/inspector(s) to maintain adequate inspection and testing during the production of pipes for Department projects. In lieu of a permanent staff, the Plant may retain the services of an engineering consulting firm or laboratory meeting the requirements of **Specifications Section 105**.
- 5) Ensure that the testing equipment is maintained and calibrated in accordance with the applicable test methods and the **Specifications**.
- 6) Visually inspect or ensure that a qualified quality control technician inspects each pipe before it is shipped to the project site.
- 7) Ensures that all materials used in the manufacture of the pipes are from sources that meet **Specification** requirements.
- 8) Maintain a daily production log of the pipes showing coil numbers or resin lot numbers, pipe lot numbers, sizes and number of pipes

produced.

- 9) Ensure that all pipes are properly stored and marked with the manufacturer's name and other information that is required in the applicable ASTM or AASHTO Standards.
- 10) Maintain the files of material certifications, test data, and inspection results.
- 11) Arrange quarterly meetings with the verification inspector and representatives of the manufacturer's production personnel.
- 12) Execute certifications attesting to applicable specification compliance and include a detailed listing of the pipe type, size and quantities.
- 13) Completes and signs detailed shipping tickets.
- 14) Ensure that pipe joints comply with the requirements of **Specifications Section 943** and that the required hydrostatic testing is conducted on a periodic basis to ensure continuing compliance. Ensure that hydrostatic tests required by **Specifications Section 943** are conducted by a qualified independent testing laboratory or by the manufacturer in the presence of the Engineer.

6.1.7.2.1 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 quality control label to the approved pipes, when directed by the Quality Control Manager.

6.1.8 QUALITY CONTROL OF CERTIFIED MATERIALS

6.1.8.1 General

Ensure that all materials used in the manufacture of pipes are from approved sources and comply with requirements as specified herein.

6.1.8.2 Metal Coil

The quality control technicians shall obtain metal coil manufacturer's certifications for all metal coils that are used for the manufacture of Pipes. The delivered metal coil shall be accepted on the basis of the metal coil producer's certification indicating compliance with applicable ASTM or AASHTO Specifications. The Department verification inspectors will take samples, at each Manufacturer's facility, from at least two randomly selected LOTs per year. A LOT is the entire volume of metal coil represented by the coil manufacturer's heat number.

6.1.8.3 Plastic Resins

The quality control technicians shall obtain the plastic resin manufacturer's certifications for all plastic resins and resin additives that are used for the manufacture of pipes. The delivered plastic resins shall be accepted on the basis of the resin producer's certification indicating compliance with appropriate ASTM or AASHTO Specifications. A certification for each container of resin is required. The District Materials and Research Engineer may obtain Verification samples at the source or at the pipe manufacturing plant. The plastic resins shall be stored such that mingling and contamination are avoided. Resins shall be identified by the resin manufacturer's LOT number. LOT is defined as the entire volume of material represented by the lot number.

6.1.8.4 Gasket Material

The gasket materials shall conform to the requirements of **Specifications Section 942**. A copy of the certification of compliance shall be maintained in the quality control file. The verification inspector may sample the rubber gasket material at the discretion of the District Materials and Research Engineer.

6.1.8.5 Gasket Lubricants

The producer of the gasket lubricant shall provide a certification statement indicating compliance with requirements of the **Specifications**.

6.1.9 QUALITY CONTROL OF PIPE PRODUCTION EQUIPMENT

Ensure that pipe production equipment is capable of properly forming, shaping or blending materials into pipes that meet the requirements of applicable **Specifications**.

6.1.9.1 Calibration of Equipment

Ensure that all testing apparatus is checked and calibrated for compliance with the requirements of applicable **Specifications**. Use a calibration agency acceptable to the Department. Calibrations must be performed at least annually or more frequently if conditions merit.

6.1.9.2 Quality Control of Pipe Manufacturing Process

Periodically check the fabrication process to ensure that pipe geometry meets **Specifications**. The quality control inspection shall include the measurements of pipe diameter and length, dimensions of the corrugations and pitch of the corrugations and recording of the results. Gage thickness and coating thickness shall be checked for metal pipe. The inner and outer wall thickness shall be checked for plastic Pipe.

6.1.10 PIPE DESIGN, FABRICATION EQUIPMENT AND PRODUCTION RATES

6.1.10.1 Pipe Design

Prior to production, provide documentation that the design of the pipe satisfies all applicable portions of ASTM and AASHTO materials and design Specifications, including **Contract Document** amendments thereto.

6.1.10.2 Pipe Fabrication Equipment

Inspect pipe manufacturing equipment daily and at the beginning of each production run. Inspect all components that are an integral part of the manufacturing equipment. Check all adjustable components for proper adjustment for the type and size of pipe being produced.

6.1.10.3 Production Rates

Operate the pipe manufacturing equipment such that the production speed is within the limitations set by the equipment manufacturer.

6.1.11 QUALITY CONTROL TESTING AND INSPECTION OF PIPES

6.1.11.1 General

Perform the quality control inspections and/or tests specified in the following applicable AASHTO and ASTM Standards for each type of pipe, unless modified by the Specifications. Additionally, for Class II high density polyethylene pipes as defined in **Specifications Section 948**, perform Quality Control/Quality Assurance functions in accordance with the Plastic Pipe Institute's, "Recommended Industry Standards for Quality Control/Quality Assurance of Corrugated High Density Polyethylene Pipe," dated July 1, 2005 or later edition as updated and approved by the Department.

6.1.11.2 Steel Pipe

- (1) AASHTO M 190, Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
- (2) AASHTO M 36, Standard Specification for Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains
- (3) AASHTO M 218, Steel Sheet, Zinc Coated (Galvanized) for Corrugated Steel Pipe
- (4) AASHTO M 232, Zinc Coating (Hot Dip) on Iron and Steel Hardware
- (5) AASHTO M 245, Corrugated Steel Pipe, Polymer-Precoated, for Sewers and Drains
- (6) AASHTO M 274, Steel Sheet, Aluminum-Coated (Type 2) for Corrugated Steel Pipe
- (7) AASHTO T 65, Mass [Weight] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
- (8) AASHTO T 213, Mass [Weight] of Coating on Aluminum-Coated Iron or Steel Articles
- (9) AASHTO M 291, Carbon and Alloy Steel Nuts
- (10) AASHTO T 241, Helical Continuously Welded Seam Corrugated Steel Pipe

- (11) AASHTO M 249, Helical Lock Seam Corrugated Pipe
- (12) ASTM A 780, Repair of Damaged Hot-Dip Galvanized Coatings
- (13) ASTM A796, Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers
- (14) ASTM A 885, Steel Sheet, Zinc and Aramid Fiber Composite Coated for Corrugated Steel Pipe
- (15) ASTM A 929, Steel Sheet, Metallic-Coated by the Hot Dip Process for Corrugated Steel Pipe
- (16) ASTM D 1056, Flexible Cellular Materials-Sponge or Expanded Rubber
- (17) AASHTO Standard Specifications for Highway Bridges, LRFD Section 12

6.1.11.3 Aluminum Pipe

- (1) AASHTO M 196, Corrugated Aluminum Pipe for Sewers and Drains
- (2) AASHTO M 197, Aluminum Alloy Sheet for Corrugated Aluminum Pipe
- (3) AASHTO M 232, Zinc Coating (Hot Dip) on Iron and Steel Hardware
- (4) AASHTO M 291, Carbon and Alloy Steel Nuts
- (5) AASHTO M 298, Coatings of Zinc Mechanically Deposited
- (6) AASHTO M249, Helical Lock Seam Corrugated Pipe
- (7) ASTM B 209, Specification for Aluminum-Alloy Sheet and Plate
- (8) ASTM B 666, Practice for Identification Markings of Aluminum Products

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- (9) American National Standards, H35.2 Dimensional Tolerances for Aluminum Mill Products
 - (10) ASTM B221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
 - (11) ASTM B 316/B, Specification for Aluminum-Alloy Rivet, and Cold Heading Wire and Rods
 - (12) ASTM B 633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 - (13) ASTM B 666/B, Practice for Identification Markings on Aluminum Products
 - (14) ASTM D 1056, Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
 - (15) ASTM F 467, Specification for Nonferrous Nuts for General Use
 - (16) ASTM F 468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
 - (17) ASTM F 568, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
 - (18) ASTM F 593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - (19) ASTM F 594, Specification for Stainless Steel Nuts
 - (20) ASTM F 738, Specification for Stainless Steel Metric Bolts, Screws, and Studs
 - (21) ASTM F 836, Specification for Stainless Steel Metric Nuts
 - (22) AASHTO Standard Specifications for Highway Bridges, LRFD Section 12

6.1.11.4 Polyvinyl-chloride (PVC) Pipe

- (1) AASHTO Standard for Highway Bridges, LRFD Section 12

- (2) ASTM D 949, Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
- (3) ASTM D 618, Method of Conditioning Plastics and Electrical Insulating Materials for Testing
- (4) ASTM D 883, Terminology Relating to Plastics
- (5) ASTM D 1600, Abbreviations of Terms Relating to Plastic
- (6) ASTM D 1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- (7) ASTM D 2122, Method of Determining Dimensions of Thermoplastic Pipe and Fittings
- (8) ASTM D 2152, Test Method for Degree of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
- (9) ASTM D 2321, Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
- (10) ASTM D 2412, Test Method for Determining External Loading Characteristics of Plastic Pipe by Parallel Plate Loading
- (11) ASTM D 2444, Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- (12) ASTM D 3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- (13) ASTM F 312, Terminology Relating to Plastic Piping Systems
- (14) ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

6.1.11.5 High Density Polyethylene (HDPE) Pipe

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- (1) AASHTO Standard Specifications for Highway Bridges, LRFD Section 12
 - (2) AASHTO M 252 Standard Specification for Corrugated Polyethylene Drainage Pipe
 - (3) *AASHTO M 294*, Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm
 - (4) ASTM D 618, Conditioning Plastics and Electrical Insulating Materials for Testing
 - (5) ASTM D 883, Terms Relating to Plastics
 - (6) ASTM D 1693, Environmental Stress Cracking of Plastics
 - (7) ASTM D 1928, Practice for Preparation of Compression-Molded Polyethylene Test Sheets and Test Specimens
 - (8) ASTM D 2122, Determining Dimensions of Thermoplastic Pipe and Fittings
 - (9) ASTM D 2412, Determining of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
 - (10) ASTM D 2444, Test for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
 - (11) ASTM D 3212, Joints for Drain Sewer Pipes Using Flexible Elastomeric Seals
 - (12) ASTM D 3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
 - (13) ASTM D 5397, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolephin Geomembranes Using Notched Constant Tensile Load Stress
 - (14) ASTM F 412, Terms Relating to Plastic Piping Systems
 - (15) ASTM F 477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe

- (16) **Florida Method of Test, FM 5-572**, Standard Test for Determining Slow Crack Growth Resistance of High Density Polyethylene Pipes, Procedure A (Stress Crack Test for Pipe Liner)
- (17) **Florida Method of Test, FM 5-572**, Standard Test for Determining Slow Crack Growth Resistance of High Density Polyethylene Pipes, Procedure B (Stress Crack Test for Pipe Liner/Corrugation Junction)
- (18) **Florida Method of Test, FM 5-572**, Standard Test for Determining Slow Crack Growth Resistance of High Density Polyethylene Pipes, Procedure C (Stress Crack Test for Pipe Longitudinal Profile Features)
- (19) **Florida Method of Test, FM 5-573**, Standard Test for Predicting the Crack-Free Service Life of High Density Corrugated Polyethylene Pipes
- (20) **Florida Method of Test, FM 5-574**, Standard Test for Predicting the Lifetime of Antioxidants and Corrugated High Density Polyethylene Pipes
- (21) **Florida Method of Test, FM 5-575**, Standard Test for Determining Creep Rupture of Corrugated High Density Polyethylene Pipes
- (22) **Florida Method of Test, FM 5-576**, Standard Test for Predicting the Long-Term Tensile Strength of Corrugated High Density Polyethylene Pipes
- (23) **Florida Method of Test, FM 5-577**, Standard Test for Predicting the Long-Term Flexural Modulus of Corrugated High Density Polyethylene Pipes

6.1.11.6 Quality Control Tests

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 pipes. Dimensional checks of corrugations, wall thickness, pipe length and diameter shall be made and recorded at the minimum frequency of twice daily. For plastic pipe, pipe density (weight per linear foot) shall be either continuously monitored or determined twice daily. For plastic pipe, tests of pipe stiffness,

environmental crack resistance and impact resistance shall be made for each production run or at any time the materials LOT or source of supply changes or when the manufacturing process changes. For lock seam metal pipe, the joint cross section shall be visually examined daily to ensure proper forming. Additionally, the tensile strength of lock seam pipe must be determined monthly or at any time visual inspection reveals discrepancies in joint forming. The manufacturer shall ensure that the manufacturing process is such that metal claddings are not visibly damaged in any manner. Pipe with visible damage to the cladding shall be rejected and the cause of such damage shall be identified and eliminated. The District Materials and Research Engineer may approve or direct modifications to the frequency of tests based on the performance history of the manufacturer.

Index tests derived from existing test methods may be developed and implemented by the manufacturer for Quality Control/Quality Assurance purposes subject to the approval of the Director, State Materials Office.

Each LOT of the Flexible Pipes components is accepted when:

- A) The test results and inspections meet the requirements as specified herein and in the **Specifications**.
- B) The manufacturer has completed all patching and repair work.
- C) The Quality Control Manager or his/her designated technician has stamped the pipes.
- D) The list of the pipes and manufacturer's certification statement is included with each shipment of the pipes to the project site. The certification must include the mean pipe inside diameter for each LOT of pipe.
- E) Prior to first shipment to each project, a notarized certification is sent to the project indicating that the pipes meet applicable **Specifications**. (Appropriate **Specifications** must be cited).

A LOT of pipe is defined as a single production run or a maximum of one week production whichever is sooner. Smaller LOTS are acceptable. Each pipe must bear legible markings identifying the pipe LOT number.

6.1.11.7 Hydrostatic Test on Pipe Joints

When requested by the Department, perform a hydrostatic test in accordance with ASTM D 3212 at the pressures appropriate for the application (normally 5psi). Perform such tests in the presence of the quality control technicians and verification inspectors or as otherwise deemed appropriate by the District Materials and Research Engineer. Meet the performance requirements for pipe joints specified in ***Specifications Section 449***.

6.1.12 APPEARANCE AND INSPECTION OF FINAL FINISHED PIPES

Perform final inspection of the finished pipes, before the application of the quality control approval label. Pipes may be repaired if necessitated by occasional minor imperfections in the manufacture or damage during handling, and will be considered acceptable if the repairs are in accordance with the accepted quality control plan and are sound and properly finished to conform to the dimensional tolerances of the ***Specifications***. Comply with dimensional tolerances in conformity with the requirements of the applicable AASHTO and ASTM Standards as appropriate.

Perform visual inspection of all finished pipes. Measure the dimensions of at least 5% 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 or as may be approved by the District Materials and Research Engineer. Determine the cause of the repetitive nonconformance and develop a corrective action plan. Revise the quality control plan to address the type of deficiencies and the corrective action that will be taken to prevent or minimize the deficiencies.

6.1.13 HANDLING AND STORAGE

Handle and store pipes to prevent damage and contamination. Inspect the pipe handling operations and implement appropriate practices that prevent damage. Inspect pipes in storage to ensure that they are stored in the correct stack and are not being damaged by point loading or stacking too high. Do not store rejected pipes in the same area with the acceptable pipes. Store rubber gaskets in accordance with the ***Specifications Section 942***.

6.1.14 Quality Control Labels

The manufacturer shall affix a label to each section of pipe, indicating that the manufactured pipe meets the requirements of the **Contract Documents**. The manufacturer's approval label shall be indelible and legible, and applied to each pipe before its shipment from the manufacturing facility to the project site.

The label shall include the manufacturer's identity, LOT number and the date of final quality control inspection. The date of final quality control inspection shall be written in indelible ink or be mechanically imprinted. The label shall consist of a pre-printed polymer sticker or as may be approved by the District Materials and Research Engineer. A certification statement from the General Manager of the manufacturer shall be included in the quality control plan regarding the label configuration. An example of the label shall be included in the quality control plan.

6.1.15 SHIPMENT

Address the Manufacturer's Shipping Policy as part of the quality control plan.

Ensure that at the beginning of each project, the manufacturer provides a notarized statement to the Project Administrator from a responsible company representative certifying that the manufacturer will manufacture the products in accordance with the requirements set forth in the **Contract Documents** and the manufacturer's accepted quality control plan. Ensure that each shipment of pipes 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 products with each delivery ticket shall be on the manufacturer's letterhead and shall include as a minimum, project number, date shipped, identification and number of pipes and mean diameter of the pipes.

The Quality Control Manager or quality control personnel working under the direct supervision of the Quality Control Manager shall affix labels to the pipes prior to their shipment to the project site. The quality control stamp indicates that the manufacturer certifies that the pipes are manufactured in conformance with the manufacturer's accepted quality control plan. Each shipment of the pipes to the project site shall include the list of the pipes on the manufacturer's letterhead

6.1.16 DOCUMENTATION

The Quality Control Manager shall maintain documentation files. These documents shall be retained for a period of three years after the delivery of the Pipes to the project site. The documentation shall as a minimum include the following items:

- A) A copy of the quality control plan
- B) Approved shop drawings (if applicable)
- C) Applicable ASTM and AASHTO standards
- D) FDOT Standard Specification and Design Standards
- E) Quality control personnel names and qualifications
- F) Materials certification records for pipe materials.
- G) Equipment calibration, including pipe forming machines and test equipment
- H) LOT numbers for materials and pipes
- I) Number and type of pipes in each LOT
- J) Applicable test data
- K) Disposition of all pipes
- L) Record of the list of the delivered pipes
- M) Record all deficiencies found as a result of Quality Control/Quality Assurance inspection and testing or Verification inspection and testing and the corrective action taken. A copy of the deficiency reports shall also be maintained in the Plant's permanent file.

6.1.17 TRAINING

The manufacturer shall utilize only quality control personnel who have met the training and certification requirements of ***Specifications Section 105***. The manufacturer's training course must be approved by the Department.

6.1.17.1 Level I Quality Control Inspectors:

Level I Inspectors are those who are performing routine inspection and testing of pipe products, including, materials, materials processing, manufacturing equipment operation and finished product inspection. The inspectors shall be familiar with flexible pipe related plans and specifications and have completed a minimum of 8-hour, Department approved, training course and examination.

6.1.17.2 Level II Quality Control Inspectors:

Level II inspectors are those who are involved in the verification of materials compliance with specifications including blending of component materials and proper operation of manufacturing equipment. Level II Inspectors evaluate the needed repair method and its implementation. Advanced knowledge of the shop drawings, specifications, test methods, and Standard Indices is required 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.

6.1.17.3 Quality Control Managers:

The Quality Control Managers shall have Pipe- Level II Quality Control Inspector certification and a minimum of two years of experience, directly related to the type of flexible pipe being manufactured.

6.1.17.4 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 they may elect to only take the examination to be re-qualified for an additional five years.