NTPEP Committee Work Plan for

Evaluation of HDPE (High Density Polyethylene) Thermoplastic Drainage Pipe Manufacturers

NTPEP Designation: HDPE-18-01

National Transportation Product Evaluation Program
Program 444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001
NTPEP Committee Work Plan for

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1. SCOPE

1.1. The National Transportation Product Evaluation Program (NTPEP) serves the member departments of the American Association of State Highway and Transportation Officials (AASHTO).

1.2. This NTPEP Committee Work Plan (hereafter referred to as the “work plan”) covers the requirements, auditing and testing criteria for the NTPEP evaluation of profile wall HDPE (High Density Polyethylene) Thermoplastic Pipe Manufacturers. This work plan is intended to be utilized with NTPEP document SP01, Qualification of Highway Product Manufacturers Through the Use of NTPEP Audits, to provide a comprehensive audit program for HDPE pipe.

1.3. The purpose of the program is to provide audit information from manufacturing plants that comply with the quality control and product testing requirements of this program. AASHTO member departments can then use this information in their quality assurance program for Manufacturer/product acceptance. This may include utilizing this information to establish a qualified Manufacturer list, a qualified products list, or both. By participating in this program, the Manufacturer agrees to produce product that meets or exceeds the requirements in the applicable AASHTO/ASTM Designation Standard(s) and follow the minimum quality control provisions of their quality program.

1.4. Testing of the Manufacturer’s product(s) against the applicable standard(s) and auditing the Manufacturer’s in-plant quality control facilities and procedures are included in this program. The Manufacturer agrees that NTPEP may use the test results and audit reports along with other relevant information for review and verification of compliance with this NTPEP program and the applicable AASHTO/ASTM Designation Standard(s).

1.5. This work plan may involve hazardous materials, operations, and equipment. It does not purport to address all safety problems associated with its use. It is the responsibility of the user of this work plan to establish the appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1. AASHTO/ASTM Standards:

- AASHTO M 252 Standard Specification for Corrugated Polyethylene Drainage Pipe
- AASHTO M 294 Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter
- ASTM D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- ASTM D883 Standard Terminology Relating to Plastics
- ASTM D1238 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- ASTM D1505 Standard Test Method for Density of Plastics by the Density-Gradient Technique
- ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics
- ASTM D4218 Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique

ASTM D1603, D4218, or D4883 are permitted, but D4218 will be considered the definitive test in case of a conflict or dispute.

- ASTM D1693 Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- ASTM D2444 Standard Test Method for Determination of Impact Resistance of Thermoplastic Pipe and Fittings by Means of a TUP (Falling Weight)
- ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- ASTM D4883 Standard Test Method for Density of Polyethylene by the Ultrasound Technique
- ASTM F2136 Standard Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe
- ASTM F3181 Standard Test Method for The Un-notched, Constant Ligament Stress Crack Test (UCLS) for HDPE Materials Containing Post-Consumer Recycled HDPE
- ASTM F3308 Standard Practice for Determining Sampling and Testing Frequency for Recycled Materials in Polyethylene Pipe for Non-Pressure Applications

2.2. NTPEP Documents:

- SP01 Qualification of Highway Product Manufacturers Through the Use of NTPEP Audits
3. **TERMINOLOGY**


3.2. **Auditor** – A NTPEP representative to review submittals, coordinates auditing and testing, and report audit findings.

3.3. **Audits** – Documented reviews of a Manufacturer’s plant and associated test facilities by a NTPEP Auditor and any AASHTO transportation agency co-auditor that wishes to participate.

3.4. **Blowout** – A void or hole in the finished pipe.

3.5. **Bonding** – How the inner liner and outer wall stick together. Lack of bonding would cause delaminating.

3.6. **Comparison Testing of Products** – Sample(s) selected from the manufacturing line or stockyard to be tested by the Manufacturer and the NTPEP designated laboratory. The results of both testing locations are then shown for comparison.

3.7. **Independent Laboratory** – An outside laboratory that performs raw material or finished product tests for the Manufacturer. NTPEP reserves the right to audit the independent laboratory for the tests that are being performed for the Manufacturer.

3.8. **Initial Audit** – The first audit conducted at a Manufacturer, which has not had an audit conducted by another independent agency.

3.9. **Manufacturer** – An individual producer of HDPE Thermoplastic pipe. The corporate name (actual location) will be included in the NTPEP program.

3.10. **NTPEP Designated Laboratory** – A laboratory qualified by NTPEP to perform the specific tests as outlined in the Standard Practice and has on site qualified technicians and equipment necessary to perform the tests per the applicable AASHTO/ASTM Designation Standard(s).

3.11. **NTPEP HDPE Thermoplastic Pipe Technical Committee** – The NTPEP Technical Committee that includes transportation agencies of the AASHTO and members of Industry. The members are volunteers who are interested in the advancement of the product. The Technical Committee appoints a Chairman and a Co-Chairman.

3.12. **Post-consumer recycled (PCR) PE** – PE materials from products that have served a previous consumer purpose (for example, laundry detergent bottles, milk bottles and other containers for consumer goods).

3.13. **Post-industrial recycled (PIR) PE** – PE materials diverted from the waste stream during a manufacturing process that have never reached the end user.


3.15. **Resin Lot** – A lot of resin for a pipe manufacturing facility is a railcar or truckload, hopper truckload, or truckload of boxes.
3.16. Recycled Plastic – Post-consumer (detergent bottles, etc.) or post-industrial recycled HDPE (or a mixture of both) used to produce pipe.

3.17. Reprocessed compound – Recycled PE material that has been prepared by melt processing into a cylindrical or spherical pellet or disc. It can be a single- or multi-component blend consisting of post-consumer, post-industrial recycled materials, or both. Reprocessed compounds may include virgin PE, colorants, UV additives, processing aids, or other property enhancing additives.

3.18. Resin Blend – A combination of two or more resins. A resin blend may include carbon black pellets, virgin resin, recycled plastic, reworked material, reprocessed compound or combinations thereof in accordance with the provisions of AASHTO M 252 and M 294.

3.19. Reworked Material – Plastic from a Manufacturer’s own production that has been reground, pelletized, or solvated after having been previously processed by molding, extrusion, etc. (ASTM D883).

3.20. Single-Stream Resin – A feed of one virgin resin, which may include carbon black pellets and reworked material in accordance with the provisions of AASHTO M 252 and M 294.

3.21. AASHTO M 294R - Used in this work plan to designate when M 294 material is being manufactured with recycled resin.

3.22. AASHTO M 294V - Used in this work plan to designate when M 294 material is being manufactured with virgin resin.

Additional terminology can be found in applicable AASHTO/ASTM Designation Standard(s) as well as the NTPEP Standard Practice SP01.

4. ADDITIONAL QUALITY MANAGEMENT SYSTEMS (QMS) REQUIREMENTS

4.1. Handling Raw Materials and Finished Product for DOT Products - The QMS will include a written procedure for handling resins and finished product.

4.1.1. Resin Testing - The pipe Manufacturer will test the polyethylene resins as specified in AASHTO M 252 and M 294, or have it tested at an independent laboratory acceptable to NTPEP. The test requirements will depend on whether the materials are virgin or recycled as further stipulated below.

4.1.1.1. Virgin Resin Testing – Virgin resins will be tested per the requirements specified in Table 1. For every lot of resin, the pipe Manufacturer will maintain, for a minimum period of 7 years, resin test reports and the resin Manufacturer’s lot specific density and melt index data, certificate of analysis (C of A) from the resin supplier or an independent laboratory, and supporting test reports. The pipe Manufacturer will establish a lot number for each lot of resin and carry it through to the finished product. The QMS will include the location and method for sampling resin.
Table 1: Virgin Resin Test Requirements

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Test Performed On</th>
<th>Test Designation</th>
<th>Test Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>virgin resins and virgin resin blends</td>
<td>ASTM D1505 or</td>
<td>one test per lot of resin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM D792 or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM D4883</td>
<td></td>
</tr>
<tr>
<td>Melt Index</td>
<td>virgin resins and virgin resin blends</td>
<td>ASTM D1238</td>
<td>one test per lot of resin</td>
</tr>
<tr>
<td>Notched Constant Ligament-Stress (NCLS)</td>
<td>M 294 product, all resin blends</td>
<td>AASHTO M 294 &amp; ASTM F2136</td>
<td>once on initial use of a resin blend and then quarterly with continued use of the blend</td>
</tr>
</tbody>
</table>

Note 1: ASTM D1505, ASTM D792, or ASTM D4883 are permitted, but ASTM D1505 will be considered the definitive test in case of a conflict or dispute.

4.1.1.2. Recycled HDPE – Recycled HDPE directly used in any proportion to produce M 294 pipe will be tested per the requirements of Table 2. For every lot of resin that is directly used in M 294 pipe production, the pipe Manufacturer will maintain, for a minimum period of 7 years, resin test reports. The pipe Manufacturer will establish a lot number for each lot of resin and carry it through to the finished product. Raw material samples shall be collected for each lot. The frequency and sample size shall correspond to the classification of the incoming recycled HDPE stream and size of shipment, as stipulated in Table 3. The QMS shall include the location and method for sampling resin.

Table 2: Recycled Resin Test Requirements

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Test Performed On</th>
<th>Test Designation</th>
<th>Test Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>recycled HDPE and blends containing recycled HDPE</td>
<td>ASTM D4883</td>
<td>See Table 3</td>
</tr>
<tr>
<td>Melt Index</td>
<td>recycled HDPE and blends containing recycled HDPE</td>
<td>ASTM D1238</td>
<td>See Table 3</td>
</tr>
</tbody>
</table>

Note 2: The raw material testing that is outlined in the Annex A of M 294 was intended for pipe produced with virgin materials. For pipe produced with recycled resin, density and melt index will be conducted as outlined above however the focus of testing on other recycled resin attributes shall be on finished pipe as outlined in Section 4.2.2.
### Table 3: Recycled HDPE Classification, Sampling and Testing Frequency

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Maximum Lot Size</th>
<th>Classification of Recycled HDPE</th>
<th>Sample Size</th>
<th>Sample Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truckload</td>
<td>45,000 lb. (20,412 kg)</td>
<td>Reprocessed (pellets/discs)</td>
<td>0.5 lb. (227 g)</td>
<td>Collect samples from a minimum of 8 random boxes within truckload. Combine and hand mix into homogenized sample. Collect 1.0 lb. [454 g] from the homogenized sample for testing.</td>
</tr>
<tr>
<td>Railcar Compartment</td>
<td>65,000 lb. (29,484 kg)</td>
<td>Reprocessed (pellets/discs)</td>
<td>1.0 lb. (454 g)</td>
<td>Collect a sample from each railcar compartment for testing.</td>
</tr>
<tr>
<td>Bulk Tanker Truck</td>
<td>50,000 lb. (22,680 kg)</td>
<td>Reprocessed (pellets/discs)</td>
<td>0.5 lb. (227 g)</td>
<td>Collect samples from each bulk tanker truck for testing.</td>
</tr>
</tbody>
</table>

4.1.2. **Single-Stream Resin** – If reworked material is added to a single-stream resin, it will have been produced from products meeting or exceeding the resin cell class requirements of the new product being produced. **Recycled plastic is not allowed.**

4.1.3. **Virgin Resin Blend** - If reworked material is added to a virgin resin blend, it will have been produced from products meeting or exceeding the resin cell class requirements of the new product being produced. **Recycled plastic is not allowed.**

4.1.4. **Additional Virgin Resin Requirements for M 252 Products:**

- If produced from a single stream resin, there will be a certificate of analysis indicating the virgin resin meets the melt index and density requirements of M 252. The resin may be used before testing, but the pipe Manufacturer will verify the melt index and density for each lot by subsequent testing.
- If produced from a virgin resin blend the pipe Manufacturer will test the melt index and density of each component resins. The pipe Manufacturer’s test results will be used to determine the blend ratios. Each blend of resin components establishes a lot, and a new lot is established each time a component resin or a component ratio changes more than allowed by the blend tolerances (±1.5%). The final virgin blend must meet M 252 cell class requirements.

4.1.5. Additional Virgin Resin Requirements for M 294 Products:

- Virgin resin blends used to produce M 294 products will meet the requirements of M 294, either through the PPI listing or independent laboratory testing, with component variations limited to ±1.5% of the certified blend components.
- Follow-up testing for melt index and density will be done for each lot to verify the certification matches the resin received by the pipe Manufacturer. Testing can be completed through in-house testing capability or testing at an independent laboratory acceptable to the NTPEP.
- When PPI listed resins are not used, the full cell classification testing including the NCLS test will be performed with the initial use of any lot and then quarterly with continued use.
- Each resin component for a PPI or independent laboratory approved blend will be provided to the NTPEP auditor so that it can be verified it is an approved blend being used to produce the M 294 product.

4.1.6. M 252 and M 294 Fittings and Coupling Resin Requirements

- The QMS will document where fittings and couplings are manufactured, the source of the components, and the fabrication process used.
- All fittings will include indelible markings with the designation number of the specification, M 294 or M 252, and with the Manufacturer’s identification symbol. This procedure will also be included in the QMS.
- The QMS will also document the process used to assure that all resins used to manufacture fittings and couplings meet the material requirements of M 252 and M 294, including those components purchased from another party.

4.1.7. Finished Product - As a minimum the QMS will describe the Manufacturer’s inspection process to conduct visual inspections of: the exterior and interior walls for bonding, blowouts, and workmanship items as described in AASHTO M 252 and M 294, during production. The procedure will require the Manufacturer to monitor the process and finished product and perform and record the results of the following inspections at the minimum frequency indicated:

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workmanship (per AASHTO M 252 and M 294)</td>
<td>Continuous, recorded at least once per shift</td>
</tr>
<tr>
<td>Marking (per AASHTO M 252 and M 294)</td>
<td>One per shift</td>
</tr>
</tbody>
</table>

4.2. Quality Control Inspection - The QMS will include an example of a quality control test report form. The QMS will reference the AASHTO, ASTM, or in house procedures and calibrations. The QMS will describe any Manufacturer procedure used.

Note 3: The Manufacturer’s procedures are subject to review. The Manufacturer’s test procedures which pertain to the tests providing useful information to evaluate the product are included in this requirement.
4.2.1. The QMS will require that the Manufacturer perform and record the results of at least the following quality control measurements and tests, at the minimum frequency indicated on each production run of each pipe diameter, type and machine:

<table>
<thead>
<tr>
<th>Measurement and Tests</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Unit Weight</td>
<td>Two per work shift</td>
</tr>
<tr>
<td>• Wall Thickness (Type “S”, “D”, “SP”, and “DP” (See Appendix X1))</td>
<td>One per work shift with a minimum of two per week conditioned^</td>
</tr>
<tr>
<td>• Carbon Black Content (ASTM D3350)**</td>
<td>One per day^</td>
</tr>
<tr>
<td>• Inner Diameter</td>
<td>One per work shift with a minimum of two per week conditioned^</td>
</tr>
<tr>
<td>• Pipe Length</td>
<td>One per work shift</td>
</tr>
<tr>
<td>• Perforation Locations and Dimensions (Type “CP”, “SP”, and “DP”)</td>
<td>One per work shift</td>
</tr>
<tr>
<td>• Water Inlet Area (Type “CP”, “SP”, and “DP”)</td>
<td>One per work shift</td>
</tr>
<tr>
<td>• Pipe Stiffness</td>
<td>Two per week</td>
</tr>
<tr>
<td>• Pipe Flattening</td>
<td>Two per week</td>
</tr>
<tr>
<td>• Brittleness</td>
<td>Two per week</td>
</tr>
<tr>
<td>• Joint Integrity</td>
<td>One per week</td>
</tr>
<tr>
<td>• NCLS, Finished Product (AASHTO M 294V only)</td>
<td>Semi-annually*</td>
</tr>
</tbody>
</table>

* per plant, per size produced during that half of the year
** The carbon black content shall meet a minimum of 2.00% but not exceed 4.00% for M 294 pipe and 5.00% for M 252 pipe.
^ Carbon Black: for M 294 pipe Types S, SP, D and DP: 2 test specimens (1-from the liner and 1-from the pipe wall) will be tested and the individual & average results reported. For M 294 pipe Types C & CP and all M 252 pipe: 2 test specimens will be tested and the individual & average results reported. Plants may alternate location of specimens per work shift (Ex.: specimens are taken from inner wall during first shift and then specimens are taken from outer wall during second shift).
 sông when an ultra-sonic gauge is used, at a minimum and prior to each shift, a calibrated ball micrometer and the ultra-sonic gauge shall be compared by checking at least eight locations of a destructive sample.
^ this is a calendar week, which begins on the day the manufacturer recognizes as the beginning of the production week. When multiple tests are required, additional tests may be waived if continuous production is less than four shifts (32 hours). If production is not continuous, subsequent sampling and testing shall commence as early as possible on the second calendar day of production.
Refer to SP01, Section 13, “Resubmittal Testing Frequency” for the procedure to follow if a design change occurs.

4.2.2. Additional Requirements for Pipe Produced with Recycled HDPE

4.2.2.1. Finished Product Material Testing - One finished product sample shall be collected for every 45,000lb [20,412 kg] of product produced or every 24 hours, or whenever the material blend ratios are changed by more than 5% or the blend constituents are changed, whichever comes first. Material samples from the finished product shall be tested for the properties in Table 4.
Table 4: Test Requirements for Finished Product Containing Recycled HDPE

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Test Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>ASTM D4883</td>
</tr>
<tr>
<td>Melt Index</td>
<td>ASTM D1238</td>
</tr>
<tr>
<td>Un-notched Constant Ligament Stress (UCLS)</td>
<td>ASTM F3181</td>
</tr>
<tr>
<td>Oxidation Induction Time (OIT)</td>
<td>ASTM D3895</td>
</tr>
<tr>
<td>*Notched Constant Ligament-Stress (NCLS)</td>
<td>ASTM F2136</td>
</tr>
<tr>
<td>Break Strain</td>
<td>ASTM D638</td>
</tr>
</tbody>
</table>

*Note 4: Manufacturer may be allowed to conduct NCLS testing at a reduced frequency, after review by the TC, of quarterly per diameter provided the manufacturer submits sufficient quality control data to demonstrate with 95% statistical confidence that the finished product NCLS values are greater than or equal to 18 hours if tested directly from the liner or greater than or equal to 24 hours if tested from compression-molded plaques made from finished pipes. NCLS testing on a minimum of 100 consecutive lots of material will be considered statistically significant to establish this analysis. The report will include the lot formulation (materials used and respective percentages) along with the NCLS test data for each lot of material.

4.3.  
Labeling and Storage of Finished Product - The QMS will include a written procedure describing how finished product is labeled, packaged and stored to include:

- The Manufacturer’s method for permanently marking the pipe in accordance with the minimum requirements of AASHTO M 252 and/or M 294;
- Detailed explanation of any coding used to mark the pipe; and
- The procedures used to ensure that product handling, storage, and shipping processes will not adversely affect the material composition, characteristics, or product quality.

5.  
NTPEP ON-SITE AUDITS

5.1.  
Quality Control Testing Evaluation - Each Manufacturer will be asked to demonstrate the quality control tests they perform as stated in their QMS. While performing each test, the most current AASHTO or ASTM test methods will be referenced. The equipment used for each test will be examined and applicable records will be reviewed. The auditor will also select three random weeks (within the previous 12 months) of test reports for resin and pipe produced in accordance with AASHTO M 294 and M 252 to review.

5.2.  
Testing of Products – The auditor(s) will select samples of HDPE thermoplastic pipe available at the time of the audit for testing. The auditor(s) may select pipe from the production line or from the yard. All sampling and testing will be in accordance with the applicable AASHTO/ASTM Designation Standard(s). The samples will be for testing at the Manufacturer’s testing facility and the NTPEP Designated Laboratory.

Note 5: If major deficiencies are noted during an on-site audit, a follow-up audit will be required to be completed.

6.  
ANNUAL PRODUCT TESTING

6.1.  
The Auditor will select two sets of test specimens for comparison testing per AASHTO product designation during each annual Manufacturer audit (one set to be tested by the Manufacturer and one set to be tested by the NTPEP Designated Laboratory). This will include samples of pipe made
of recycled resins under M 294R and will be collected separately from pipe made of virgin resins under M 294V. All specimens will be from the same lot of material.

**Note 6:** The manufacturer must have resin available for all AASHTO pipe stored in their yard. The manufacturer must retain the following amounts of resin: a minimum amount of 1.0 lb. for PPI single stream resin, 1.0 lb. for pre-extruded blends, and 4.0 lb. for all dry blends for NTPEP testing purposes.

**Note 7:** For recycled resin, manufacturer can retain a weekly sample of resin provided the manufacturer submits sufficient quality control data to demonstrate with 95% statistical confidence that the finished product density and melt index values meet the M 294 cell class requirements. Density and Melt Index testing on a minimum of 100 consecutive lots of material shall be considered statistically significant to establish this analysis.

6.2. Manufacturer Samples:

6.2.1. **M 252 and M 294 Products** - Once initial product evaluation has been established, a NTPEP Auditor will sample pipe and resin during each annual plant audit. It is the intent to sample all pipe sizes produced by the Manufacturer. At least one pipe and one resin sample for M 252, M294V and M294R product will be taken during each plant audit. The NTPEP or Transportation Agency Auditor will select and label the samples to be tested.

6.2.2. If the pipe Manufacturer does not have the capability to perform the cell class testing as specified in M 252 & M 294, the samples may be tested at a laboratory acceptable to NTPEP, preferably not at the same laboratory testing the NTPEP portion of the sample.

6.3. NTPEP Designated Laboratory Samples:

6.3.1. The NTPEP Auditor will instruct the Manufacturer on the proper labeling of the NTPEP Designated Laboratory samples. These samples will be located adjacent to the previous (Manufacturer) samples and from the same lot(s) and in the same quantities.

6.3.2. Once the NTPEP Manufacturing Auditor posts the results from the NTPEP Designated Laboratory testing, the Manufacturer has the opportunity to provide an explanation of any significant differences between the NTPEP Designated Laboratory and Manufacturer test results, including any corrective actions found necessary in the manufacturing process or testing procedures within 15 business days of receiving the test results.

6.4. Retest Samples:

6.4.1. All NTPEP sampled pipe and resins will contain additional material obtained from the same lot as the Manufacturer samples. The additional material will be used by the NTPEP Designated Laboratory in the verification of any failing test results.

6.4.2. Testing of product performed by an independent laboratory may be witnessed as part of the audit. All testing will be in accordance with this Section.

6.4.3. If during the testing portion of the audit or during NTPEP Designated Laboratory testing at least one tested sample fails to meet specification requirements or when the Manufacturer is found during an audit to have neglected one or more aspects of the governing QMS during manufacturing, the nonconformance(s) will be addressed as outlined in SP01.

6.5. Shipment of Samples:

6.5.1. The Manufacturer is responsible for the shipment of the pipe and compound samples. Proper care (packaging, identification, tracking, etc.) to limit damage or loss of the sample shipment is the responsibility of the Manufacturer. Loss or damage of the samples will require re-sampling and
testing at the Manufacturer’s expense.

6.6. Testing of Samples:

6.6.1. The Manufacturer will complete all in-house testing on the pipe and resin and send test results to AASHTO within 30 days of the completion of their audit.

7. **DELIVERABLES – EVALUATION RESULTS AND DATA**

7.1. Audit results (in the form of an Audit Report, a Comparison Report for the tested samples, and any Corrective Action Reports) will be located in the web-based database – DataMine, as follows:

7.1.1. Once the test data is reported to the Auditor by the NTPEP Designated Laboratory, the Auditor will review the data to ensure completeness. The Comparison Report will be posted to DataMine and will be available to the product manufacturer and the end state user participants for review.

7.1.2. All other audit documents (Audit Report, Manufacturer QMS, and Corrective Action Report – if applicable) will be uploaded by the Auditor, as competed, and made available for review.

7.1.3. Audit results will be made available to all participating states through the AASHTO/NTPEP DataMine website. No judgement as to a product’s acceptability to any state DOT requirement is made in DataMine. End state user participants are responsible for establishing their criteria for product acceptability.

7.2. The DataMine database can be accessed through the AASHTO/NTPEP website link at http://data.ntpep.org/.

8. **KEYWORDS**

8.1. NTPEP; HDPE thermoplastic pipe; Manufacturer
A. PROCEDURE FOR MEASURING INNER LINER THICKNESS

Perform the following steps on a properly conditioned corrugated plastic pipe prior to any stiffness, flattening, or brittleness testing.

1. Isolate the inner liner to ensure that you can measure the center of the liner.
2. Mark 8 equally spaced places on the liner starting at one of the mold seams and marking every 45° around the pipe.

**Note 1: This picture is for informational purposes only**

3. Using a cylindrical or ball anvil tubing micrometer accurate to within ±0.001 in (care should be taken to avoid excessive closure pressure and misalignment when using ball anvil) measure at each of the 8 places marked in step 2 (make sure that the center of the liner is measured).
4. Average all eight of the values and record.
5. Compare the average calculated in step 4 to the minimum requirements in the respective AASHTO pipe specification.

**Note 2: Ultrasonic thickness gauges may be used for the above procedures if the equipment requirements are met and the procedures in Appendix X1 of the NTPEP work plan are followed.**
B. **PROCEDURE FOR LINER NCLS TESTING**

1. Liner NCLS test specimens will be sampled and conditioned as stated below and tested in accordance with ASTM F2136.

2. Specimens will be punched longitudinally from a location 45 degrees from the seam and notched on the outside of the liner; such that the notch is perpendicular to the direction of flow (see Figure F-1, below).

3. Additionally, specimens will be placed in the NCLS tester within one hour of notching.

![Diagram](a) Orientation of the NCLS test specimen taken from the pipe liner

![Diagram](b) Location of the notch with respect to the pipe liner surfaces

*Figure F-1. NCLS test specimens from pipe liner.*
C. **PROCEDURE FOR UNIT WEIGHT OF HDPE PIPE**

1. Unit weight test specimens will be tested under the conditions specified in ASTM D2122; section 6.3.

2. The length of the specimen will be determined according to the procedure specified in ASTM D2122; section 12, averaging a minimum of three equally spaced measurements.

3. The mass of the specimen will be determined using a scale or balance that is accurate to 1% of the applied load.

4. Calculate the unit weight of the pipe as follows:

\[ M = \frac{G}{L} \]

Where:

- \( M \) = unit weight of the pipe
- \( G \) = mass of the pipe
- \( L \) = length of the pipe
X1. APPROVED ALTERNATIVE TESTING PROCEDURE FOR WALL THICKNESS

X1.1. The NTPEP thermoplastic pipe program permits the use of ultrasonic thickness gauges for measuring wall (liner) thickness if the following equipment requirements are met and the procedure below is followed:

X1.1.1. Equipment Requirements:

X1.1.1.1. Each gauge and transducer is identified and calibrated.

X1.1.1.2. Records of all calibration activities, including the person doing the work and the date the calibration activities were performed will be maintained for at least 7 years.

X1.1.1.3. The NTPEP auditor is permitted to witness the calibration of an instrument used and sign the calibration verification form. A copy will be included with the NTPEP audit forms.

X1.1.1.4. When a new transducer is placed in service, it is identified and calibrated with the ultrasonic gauge.

X1.1.1.5. Gauge calibration blocks are maintained at the plants.

X1.1.2. Procedure:

X1.1.2.1. Record two sets of liner thickness readings comprised of at least eight (8) readings per set per work shift.

X1.1.2.2. Take one set of readings using a micrometer in accordance with ASTM D2122 and take the other set of readings using a calibrated ultrasonic gauge transducer.

X1.1.2.3. Indicate which measuring device was used on the calibration record.

X2. NTPEP QA PROGRAM FOR HDPE THERMOPLASTIC PIPE - PARTICIPANT RESPONSIBILITIES

X2.1. Background: This section summarizes the responsibilities for the different parties, which can be found in more detail in the following sections titled, “Operating Procedures” and “Quality Control Requirements for HDPE Thermoplastic Pipe Manufacturers”.

X2.2. Manufacturers’ Responsibilities: Participating Manufacturers will develop and implement a QMS (including a quality management manual) outlining their quality control testing program for production of HDPE Thermoplastic Pipe. In addition, the manual will address the following general program, testing facilities, personnel qualification, and record keeping requirements:

X2.2.1. General Requirements:

X2.2.1.1. Each Manufacturer will be prepared to accommodate Manufacturer and testing facility audits (scheduled and follow-up) by NTPEP representatives when submitting its initial QMS, or updated QMS in the case of the annual re-evaluation, to NTPEP.
X2.2.2. Each Manufacturer’s facility is responsible for ensuring continuous compliance with all NTPEP quality control requirements. Failure to do so may result in revocation of the listing and certificate on the NTPEP website.

X2.2.2. **Testing Facilities:**

X2.2.2.1. The Manufacturer’s quality control manager will be responsible for quality control testing at all facilities and will assure that all sampling and testing is done by qualified technicians.

X2.2.2.2. The testing facilities will maintain current versions of all AASHTO, ASTM, and Manufacturer test procedures for all tests performed and a current version of the Manufacturer’s QMS.

X2.2.2.3. The facilities will adequately house and allow proper operation of all required testing equipment.

X2.2.2.4. The testing equipment will be calibrated/verified/checked in accordance with the Manufacturer’s recommendations at least at the specified intervals (Ref.: SP01, Annex A.1) by personnel customarily involved in such work as documented in the QMS.

X2.2.2.5. The testing facilities will maintain records of all test results and all NTPEP reviews and actions taken to resolve any noted deficiencies.

X2.2.2.6. Records of equipment calibration and verification will be maintained and available to NTPEP and AASHTO transportation agencies upon request.

X2.2.3. **Testing Personnel:**

X2.2.3.1. The Manufacturer’s quality control manager will meet the requirements established by the Manufacturer for the position.

X2.2.3.2. Documentation will show that the technician has been trained in the test procedures to be performed.

X2.2.3.3. Documentation will show that the technician has satisfactorily demonstrated competency to perform the required testing and that this demonstration is repeated annually.

X2.2.3.4. Documentation will show that technician training has been updated when revisions in test methods occur.

X2.2.3.5. Review of reports will show the technician can properly perform test procedure calculations and properly record information.

X2.2.3.6. Technicians-in-training may perform sampling and testing at qualified facilities provided they are working under the direct supervision of a technician fully qualified under NTPEP requirements.

X2.2.3.7. If requested, technicians will perform sampling and testing for NTPEP observers.

X2.2.4. **Testing Documentation**

X2.2.4.1. All quality control test results for HDPE Thermoplastic Pipe will be documented in reports of the same format as the sample forms submitted in the QMS and will be kept for a minimum of seven years.

X2.2.4.2. The reports will document the actions taken in the event of product test failures.
X2.2.4.3. The reports will show the manufacture location, date of manufacture, physical and chemical test results. Identification will be such that the test reports for any product can be located.

X3. AUDIT AGENDA

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