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# **NTPEP Committee Work Plan for Evaluation of Steel-Reinforced Polyethylene Thermoplastic Pipe Manufacturers**

**NTPEP Designation: SRPE-19-01**



**National Transportation Product Evaluation Program  
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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 steel-reinforced 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 SRPE thermoplastic 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 Standards and follow the minimum quality control provisions of their quality program.
- 1.4 NTPEP validates this program through a review of the Manufacturer’s quality systems manual, testing the Manufacturer’s product(s) to verify compliance with the applicable standard and auditing the Manufacturer’s in-plant quality control facilities and procedures. 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.*

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### 2. REFERENCED DOCUMENTS

- 2.1 AASHTO Standards:
- LRFD Bridge Construction Specifications, Section 26
  - AASHTO M 335 Standard Specification for Steel-Reinforced Polyethylene (PE) Ribbed Pipe, 12- to 60-in. Diameter
  - AASHTO T 341 Determination of Compression Capacity for Profile Wall Plastic Pipe by Stub Compression Loading
- 2.2 ASTM Standards

- ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- ASTM D618 Standard Practice for Conditioning Plastics for Testing
- ASTM D638 Standard Test Method for Tensile Properties of Plastics
- ASTM D883 Standard Terminology Relating to Plastics
- ASTM D2122 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- ASTM D2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- ASTM D2444 Standard Test Method for Determination of Impact Resistance of Thermoplastic Pipe and Fittings by Means of a TUP (Falling Weight)
- ASTM D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- ASTM F412 Standard Terminology Relating to Plastic Piping Systems
- ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Jointing Plastic Pipe
- 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

2.3 NTPEP Documents:

- SP01 Qualification of Highway Product Manufacturers Through the Use of NTPEP Audits

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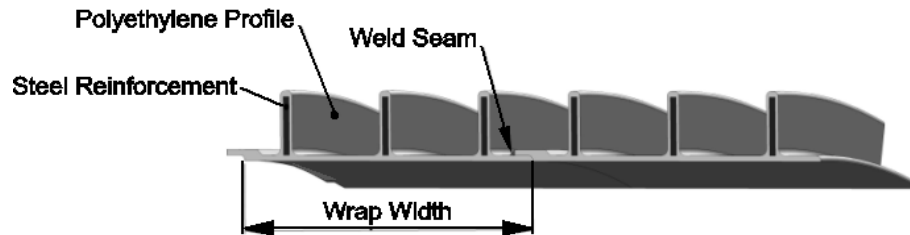
### 3. TERMINOLOGY

- 3.1 *AASHTO/ASTM Designation Standard* – Referenced AASHTO Standard Specification, AASHTO Standard Method of Tests, ASTM Standard Specification, or ASTM Standard Test Method.
- 3.2 *Auditor* – A NTPEP representative who reviews submittals, coordinates auditing and testing, and reports audit findings.
- 3.3 *Audit* – A documented review of a Manufacturer’s plant and associated test facilities by an Auditor assisted by any AASHTO member department co-auditor able to participate.
- 3.4 *Buy America* – Refers to the Federal law and FHWA regulation, 23 CFR 635, governing the domestic manufacturing process of steel and iron products that are permanently incorporated in Federally funded projects.
- 3.5 *Comparison Testing of Products*– As required by the NTPEP Work Plan, random sample(s) selected by an Auditor from the manufacturing line or inventory are tested by the Manufacturer and the NTPEP designated laboratory. The results from both testing locations are reported for comparison.
- 3.6 *Crack* – Any break or split that extends through the wall.
- 3.7 *Crease* – An irrecoverable indentation generally associated with a loss in shape stability.
- 3.8 *Delamination* – A gap extending through the welded lap seam between two adjacent wrap widths.
- 3.9 *Encapsulation Thicknesses* - The thickness of the high density polyethylene (HDPE) covering on both sides of the steel reinforcement as well as the thickness of the closure at the top (outside) of the rib and the thickness of the profile directly under (inside) the reinforcement.

- 3.10 *Gravity Flow* - A condition in which liquid flow through a piping system results from a downward pipeline slope where flow is less than full; except during conditions when the system may become temporarily surcharged, in which case the system is subject to temporary internal hydrostatic pressure that is limited to 74 kPa.
- 3.11 *Independent Laboratory* – An outside laboratory acceptable to NTPEP 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.
- 3.12 *Initial Audit*- The first audit conducted at a Manufacturer by NTPEP.
- 3.13 *Manufacturer*- An individual producer of SRPE thermoplastic pipe. The corporate name (actual location) will be included in the NTPEP program.
- 3.14 *Mill Test Report (MTR)* – Document provided by the Manufacturer certifying the steel’s chemical and physical properties.
- 3.15 *NTPEP*- The entity responsible for overseeing all areas of the program are being run according to what is noted in this work plan.
- 3.16 *NTPEP Designated Laboratory* – A laboratory qualified by NTPEP to perform the specific tests as outlined in the work plan with on-site qualified technicians and equipment necessary to perform the tests per the applicable AASHTO/ASTM Designation Standard(s).
- 3.17 *NTPEP Follow-Up Audit*- An audit of a Manufacturer’s location and associated laboratory included in the program. These audits are conducted by NTPEP and/or an AASHTO member department to determine compliance with the program requirements. These audits may be performed due to: an incomplete initial/annual audit where nonconformance is found, reports of noncompliant product from an AASHTO member department, or any other reason deemed significant to NTPEP.
- 3.18 *NTPEP SRPE Thermoplastic Pipe Technical Committee* – The NTPEP Technical Committee comprised of AASHTO member departments and Industry. The members are volunteers who are interested in the advancement of the product. The Technical Committee appoints a Chair and a Vice-Chair.
- 3.19 *Polyethylene (PE) Plastics* – Plastics based on polymers made with ethylene as essentially the sole monomer (ASTM D 883).
- 3.20 *QMS Desktop Audit* – A complete review of a Manufacturer’s Quality Management System (QMS) and the corresponding documentation by NTPEP or its designee.
- 3.21 *Quality Management System (QMS)* – A Manufacturer’s comprehensive, documented processes used for their quality control/quality assurance.
- 3.22 *Recycled Plastic* – Post-consumer or post-industrial HDPE other than from the Manufacturer’s production line that may be used to produce only non-AASHTO pipe.
- 3.23 *Resin Lot* – A railcar, truckload with hopper, or truckload of boxes of resin.
- 3.24 *Resin Blend* – Two or more virgin resins. A resin blend may include carbon black pellets and reworked material in accordance with the provisions of AASHTO M 335.

3.25 *Reworked Material* – A plastic from a Manufacturer’s own production that has been reground, pelletized, or solvated after having been previously processed by molding, extrusion, etc. (ASTM D 883).

3.26 *Seam* – The portion of the helically wrapped strip that overlaps and is fused to adjacent helically wrapped strips (Figure 1).



**Figure 1** – Cross Section of Profile

3.27 *Shape Stability* – A general measure of a pipe’s ability to maintain geometric and structural stability while deflected and carrying a load equal to or greater than 75 percent of its peak load carrying capability. Peak load carrying capability is identified as the maximum load in the load/deflection curve as measured during the flattening test described in AASHTO M 335.

3.28 *Single-Stream Resin* – A single stream resin is a feed of one virgin resin. A single stream resin may include carbon black pellets and reworked material in accordance with the provisions of AASHTO M 335.

3.29 *Comparison Sample* – A comparison sample consists of pipe taken directly from the manufacturing line or in the yard during an on-site audit. The resin used to produce the pipe is also sampled during the audit. The pipe is cut into specified lengths. Half of the pipe samples are sent (along with the resin) to a NTPEP designated laboratory for testing. The other half of the pipe and resin samples are tested internally by the plant’s lab personnel.

3.30 *Steel-Reinforced Polyethylene (SRPE) Thermoplastic Pipe* – Ribbed/Corrugated thermoplastic pipe with steel reinforcing strips encapsulated within the ribs (Figure 1).

3.31 *Surveillance Audit*- An audit by an AASHTO member department of any Manufacturer’s plant and associated laboratory included in the program to determine compliance with the program requirements.

3.32 *Virgin Polyethylene Material* – A plastic material in the form of pellets, granules, powder, floc, or liquid that has not been subjected to processing other than required for initial manufacture.

3.33 *Wrap-Width* – The width the helically wrapped strip covers when measured across the strip, perpendicular to the ribs (Figure 1).

3.34 Additional terminology can be found in applicable AASHTO/ASTM Designation Standards, especially in ASTM D883 and ASTM F412, as well as NTPEP SP01.

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#### **4. ADDITIONAL QUALITY MANAGEMENT SYSTEM (QMS) REQUIREMENTS**

NTPEP audits will be based on the Manufacturer following an established quality control program that provides assurance the products meet the requirements of the AASHTO/ASTM materials

specifications and that these products and the documented Quality Management System (QMS) conform to NTPEP SP01.

- 4.1 *Contract Review* – The QMS will include a procedure for processing SRPE thermoplastic pipe orders per AASHTO M 335 and the review of contracts for producing SRPE thermoplastic pipe. This procedure will ensure that:
- The requirements are adequately defined, documented and understood;
  - Records of contract reviews are maintained; and
  - The client will be informed of any deviation from the contract.

- 4.2 *Handling Raw Materials and Finished Product for DOT Products* - The QMS will include a written procedure for handling resins, steel, and finished product. The QMS shall include a documented procedure for traceability of steel and iron materials to comply with “Buy America” requirements. This procedure will indicate the responsible individuals and how the steel (either foreign or domestic) is identified and traced through each manufacturing step, including the MTR. The “Buy America” requirement for steel begins with the melting process through the finished product.

*Note 1- Buy America requirements may vary from state to state and it is the responsibility of the Manufacturer to comply with the requirements for each AASHTO member department to whom the Manufacturer provides product.*

- 4.2.1 Polyethylene Resins - The Manufacturer will test the polyethylene resins as specified in AASHTO M 335, or have it tested at an independent laboratory acceptable to NTPEP, as specified in Table 1. For every lot of resin, the Manufacturer will maintain, for a minimum period of 5 years, resin test reports and the resin supplier’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 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: Resin Test Requirements**

Test Property	Test Performed On	Test Designation	Test Frequency
Density	virgin resins and blends	ASTM D 3350	one test per lot of resin
Melt Index	virgin resins and blends	ASTM D 3350	one test per lot of resin
Notched Constant Ligament-Stress (NCLS)	AASHTO M 335 product, resin blends only	AASHTO M 335 & ASTM F2136	once on initial use of a resin blend and then quarterly with continued use of the blend

- 4.2.1.1 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.

- 4.2.1.2 Resin Blend - If reworked material is added to a 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.

- 4.2.1.3 Additional Resin Requirements for AASHTO M 335 Products:

- If produced from a single stream resin there will be a C of A indicating the virgin resin meets the melt index and density requirements of AASHTO M 335. The resin may be used before testing, but the Manufacturer will verify the melt index and density for each lot by subsequent testing.

- If produced from a resin blend, the Manufacturer will test the melt index and density of each component resins. The 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 ( $\pm 1.5\%$ ). The final blend must meet AASHTO M 335 cell class requirements.
- When Plastics Pipe Institute (PPI) 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 Auditor so that it can be verified it is an approved blend being used to produce the AASHTO M 335 product.

4.2.2 Fittings and Coupling Resin Requirements:

4.2.2.1 The QMS will document where fittings and couplings are manufactured, the source of the components, and the fabrication process used.

4.2.2.2 All fittings will include indelible markings with the designation number of the specification, AASHTO M 335, and with the manufacturer’s identification symbol per AASHTO M 335. This procedure will also be included in the QMS.

4.2.2.3 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 335, including those components purchased from another party.

4.2.3 Stub Compression Test – Profile compression capacity in any specimen in the stub compression test shall not be less than 50 percent of the gross cross section of the steel reinforcing area times the minimum specified yield strength of the steel when tested in accordance with AASHTO M 335. The stub compression test (AASHTO T 341) shall be a material and wall design qualification test conducted twice a year or whenever there are changes in wall design or material distribution. Computing the minimum capacity requires determining the cross-sectional area of the pipe wall. This can be accomplished conveniently by optically scanning the profile and determining the section properties using a computer drafting program.

4.2.4 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 335 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 in Table 2:

**Table 2: Finished Product Inspection**

<b>Inspection</b>	<b>Procedure</b>	<b>Frequency</b>
Workmanship	AASHTO M 335	continuous, recorded at least once per shift
Markings	AASHTO M 335	one per shift

4.2.5 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 2: The Manufacturer's procedures are subject to approval. The Manufacturer's test procedures which pertain to the tests providing useful information to evaluate the product are included in this requirement.*

4.2.5.1 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 in Table 3 on each production run of each pipe diameter, type and machine:

**Table 3: Quality Control Testing Frequencies**

Measurements and Tests	Frequency
Unit Weight	Two per work shift
Wall Thickness: types S and SP (see Appendix X1) **	one per work shift with a minimum of two per week conditioned ***
Carbon Black Content (per ASTM D 3350)	One per day
Inside Diameter	one per work shift with a minimum of two per week conditioned ***
Pipe Length	One per work shift
Perforation Locations and Dimensions	One per work shift
Water Inlet Area	One per work shift
Pipe Stiffness	Two per week ***
Pipe Flattening	Two per week ***
Brittleness	Two per week ***
Joint Integrity	One per week
Encapsulation Thickness	One per work shift
Delamination	One per work shift
Tensile Strength of Seam	One per work shift
NCLS, Finished Product	Semi-annually*
Stub Compression Capacity (AASHTO T 341)	Semi-annually*

\* per plant, per size produced during that half of the year

\*\* when a panametrics unit is used, at a minimum and prior to each shift, a calibrated ball micrometer and the panametrics unit shall be compared by checking at least eight locations of a destructive sample.

\*\*\* this is understood to represent 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 NTPEP SP01 for the procedure to follow if a design change occurs.

4.2.5.2 The QMS will ensure that:

- Each sample selected for quality control inspection and testing is designated with a sample control number for record keeping and traceability;
- The test report for each sample identifies the plant, date, shift of manufacture, production line, and lot designation for the polyethylene resin; and
- Quality control test reports (not samples) are maintained and available for review for 5 years.

4.2.5.3 The Manufacturer's QC manager will be responsible for QC testing at all facilities and assure that all sampling and testing is done by technicians meeting the requirements of the Manufacturer's



technician qualification program. In the event the Manufacturer utilizes an independent laboratory for testing, the independent laboratory will be NTPEP compliant.

- 4.2.6 *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 335;
  - A detailed explanation of any coding used to mark the pipe and/or steel; and
  - The procedures used to ensure that product handling, storage, and shipping processes will not adversely affect the material composition, characteristics, or product quality.

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## 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 335 to review.
- 5.2 Comparison Samples for Testing – The Auditor will select samples of pipe available at the time of the audit for testing in accordance with NTPEP SP01. The Auditor may select pipe from the production line or from inventory. All sampling and testing will be in accordance with the appropriate AASHTO/ASTM specifications. The comparison samples will be for testing at the Manufacturer's testing facility and NTPEP's designated laboratory.

*Note 3: If major deficiencies are noted during an on-site audit, a follow-up audit will be required to be completed.*

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## 6. ANNUAL PRODUCT CONFORMANCE TESTING

- 6.1 The NTPEP program requires that pipe and resin samples be tested to determine conformance with the appropriate AASHTO/ASTM Materials Specifications.
- 6.2 The Auditor will select two sets of samples, per NTPEP SP01, during each annual Manufacturer audit (one set to be tested by the Manufacturer and one set to be tested by the NTPEP designated laboratory). All samples will be from the same lot of material.
- 6.3 Once the initial product evaluation has been established, an Auditor will sample pipe and resin during each annual plant audit. Samples of two random pipe diameters and corresponding resins will be taken annually at the time of the audit. Subsequent annual pipe samples should not duplicate previously tested diameters or formulations until all diameters and formulations produced at the plant have been tested.

*Note 4: The Manufacturer must have resin available for all AASHTO pipe stored in their yard.*

*Note 5: It is the responsibility of the Manufacturer to have these samples of pipe and resin sent to the NTPEP designated laboratory.*

- 6.4 Manufacturer Samples:
- 6.4.1 If the Manufacturer does not have capability to perform the cell class and NCLS testing as specified in M 335, the resin comparison samples may be tested at an independent laboratory that is not the same as the laboratory testing the NTPEP portion of the comparison sample. If requested, an AASHTO member department testing facility can be included in the comparison sampling process.

6.4.2 The Manufacturer will report the results from their testing using the standard format provided by NTPEP within 15 days of their on-site audit being completed.

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**7. KEYWORDS**

7.1 NTPEP; SRPE thermoplastic pipe; Manufacturer

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## ANNEX (MANDATORY INFORMATION)

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### A. PROCEDURE FOR MEASURING INNER LINER THICKNESS

Perform the following steps on a properly conditioned pipe sample.

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.



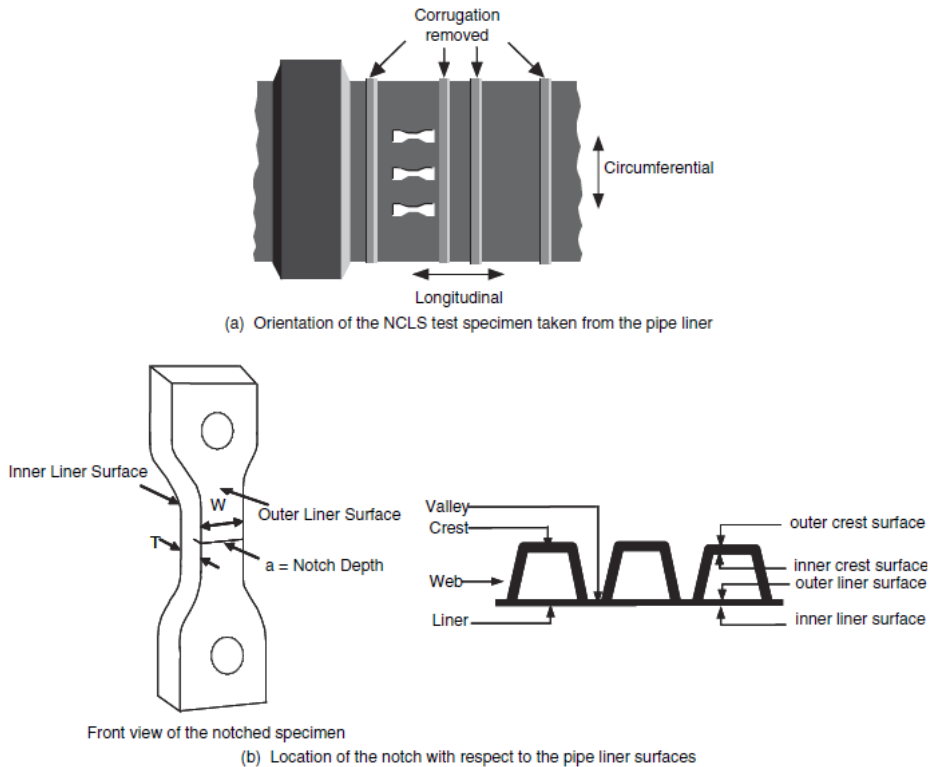
**Note 1: An example of 8 equally spaced locations for measurement.**

3. Using a cylindrical or ball anvil tubing micrometer or ultrasonic gauge accurate to within  $\pm 0.001$  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 and record each reading.
4. Average all eight of the values and record the average.
5. Report minimum reading and the average.
6. Compare the minimum reading in step 3 to the minimum requirements in the respective AASHTO pipe specification.

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## B. PROCEDURE FOR LINER NCLS TESTING

- B.1.1 Liner NCLS test specimens will be sampled and conditioned as stated below and tested in accordance with ASTM F2136.
- B.1.2 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).
- B.1.3 Additionally, specimens will be placed in the NCLS tester within one hour of notching.



**Figure F-1. NCLS test specimens from pipe liner.**