NTPEP Committee Work Plan for

Evaluation of Corrugated Metal Drainage Pipe

NTPEP Designation: [CMP-18-01]
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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 Corrugated Metal Drainage 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 Corrugated Metal Drainage 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 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 standard practice 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 standard practice 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 36 Standard Specification for Corrugated Steel Pipe, Metallic Coated, for Sewers and Storm Drains
- AASHTO M 190 Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
- AASHTO M 196 Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
- AASHTO M 197 Standard Specification for Aluminum Alloy Sheet for Corrugated Aluminum Pipe
• AASHTO M 218 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized), for Corrugated Steel Pipe
• AASHTO M 245 Standard Specification for Corrugated Steel Pipe, Polymer-Precoated, for Sewers and Storm Drains
• AASHTO M 246 Standard Specification for Steel Sheet, Metallic-Coated and Polymer-Precoated, for Corrugated Steel Pipe
• AASHTO M 274 Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe
• AASHTO M 289 Standard Specification for Aluminum-Zinc Alloy Coated Sheet Steel for Corrugated Steel Pipe
• AASHTO T 241 Standard Method of Test for Helical Continuously Welded Seam Corrugated Steel Pipe
• AASHTO T 249 Standard Method of Test for Helical Lock Seam Corrugated Pipe
• ASTM A90 Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
• ASTM A370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
• ASTM A760 Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
• ASTM A792 Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
• ASTM A796 Standard Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications
• ASTM A849 Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
• ASTM A924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
• ASTM A929 Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
• ASTM A978 Standard Specification for Composite Ribbed Steel Pipe, Precoated and Polyethylene Lined for Gravity Flow Sanitary Sewers, Storm Sewers, and Other Special Applications
• ASTM A1073 Standard Practice for Using Hand Micrometers to Measure the Thickness of Uncoated Steel Sheet and Nonmetallic and Metallic-Coated Steel Sheet
• ASTM E376 Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods

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 member department co-auditor that wishes to participate.

3.4 Coil Change – The process of exchanging a new coil or adding to an existing coil for a continuous run of pipe.
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.

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

Manufacturer – Defined in this Work Plan as, an individual fabricator/producer of corrugated metal drainage pipe. The corporate name (actual location) will be included in the NTPEP program.

NTPEP Designated Laboratory – A laboratory qualified by NTPEP to perform the specific tests as outlined in the Work Plan and has an on-site qualified technician(s) and equipment necessary to perform the tests per the applicable AASHTO/ASTM Designation Standard(s).

NTPEP Corrugated Metal Drainage Pipe Technical Committee – The NTPEP Technical Committee that includes member departments 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.

Quality Management System (QMS) – The documented process used by the Manufacturer for quality control/quality assurance.

Pipe Run – Amount of pipe produced of a certain diameter, corrugation profile and gage on a specific fabrication machine during a defined work shift.

Repair – A condition where the product cannot be returned to applicable standards; however a subsequent operation can be performed to return the product to a condition that will meet fit, form, and function. Cosmetic appearance typically will not meet engineering requirements.

Tooling Change – The process of exchanging production equipment to produce a different corrugated metal pipe product.

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

4. QUALITY MANAGEMENT SYSTEM (QMS) REQUIREMENTS

4.1 The QMS will include a written procedure for documenting traceability of steel and iron materials to comply with “Buy America” requirements.

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 state transportation agency to whom the manufacturer provides product.

4.1.1 The procedure will list the individual(s) responsible for implementing and monitoring this process.

4.1.2 Describe how the steel items are identified and tracked through each manufacturing step.

4.1.3 Describe separately how foreign steel products (if used) are identified, tracked and documented for the manufacturing steps performed by the manufacturer.

4.1.4 Additionally, the procedure will include a description of the processes and examples of the documentation used to prove compliance with “Buy America” requirements of the furnished products.
4.2 **Handling Raw Materials and Finished Product** - The QMS will include a written procedure for handling raw materials and finished product.

4.2.1 **Metal** – Coil and hardware delivered to the corrugated metal drainage pipe manufacturer’s facility must be marked in accordance with the referenced specification. The identity of the metal must be traceable throughout the manufacturing process. The manufacturer must maintain mill test reports and documentation for all metal.

4.2.2 **Finished Pipe Product** - As a minimum, the QMS will describe the Manufacturer’s inspection process to conduct visual inspections of the pipe’s lock seams, rerolled ends and other workmanship items described in AASHTO M 36 during production (Ref. Table 1). The Manufacturer must retain for a period of five years all test reports and documentation for all finished pipe products.

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workmanship (AASHTO M 36)</td>
<td>Record a minimum of once per pipe run</td>
</tr>
<tr>
<td>Lock Seam (AASHTO T 249)</td>
<td>Record a minimum of once per pipe run and at each tooling change – whichever is greater</td>
</tr>
<tr>
<td>Marking</td>
<td>Record a minimum of once per pipe run and at each coil change – whichever is greater</td>
</tr>
</tbody>
</table>

Table 1: Inspection Requirements

4.3 **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 all Manufacturer procedures used.

4.3.1 The QMS will require the Manufacturer to perform at least the following items of inspections during production, and to record the results of such inspections at the minimum frequency indicated on each production run of each pipe diameter, type and machine (Ref Table 2).

<table>
<thead>
<tr>
<th>Measurement/Test</th>
<th>Frequency: Minimum once per pipe run or at frequency listed below – whichever is greater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape</td>
<td>one per pipe run</td>
</tr>
<tr>
<td>Metal Thickness</td>
<td>once per coil change</td>
</tr>
<tr>
<td>Inside Diameter</td>
<td>one per pipe run</td>
</tr>
<tr>
<td>Pipe Length</td>
<td>one per pipe run</td>
</tr>
<tr>
<td>Corrugation Measurement (annular or helical)</td>
<td>one per tooling change</td>
</tr>
<tr>
<td>Rivets (spacing and placement)</td>
<td>one per pipe run</td>
</tr>
<tr>
<td>Resistance Spot Welds</td>
<td>one per pipe run</td>
</tr>
<tr>
<td>Coating Thickness (polymer)</td>
<td>one per coil change</td>
</tr>
<tr>
<td>Coating Weight/Thickness (galvanizing)</td>
<td>one per coil change</td>
</tr>
<tr>
<td>Coating Weight/Thickness (aluminized)</td>
<td>one per coil change</td>
</tr>
<tr>
<td>Coating Thickness (bituminous)</td>
<td>one per pipe run</td>
</tr>
<tr>
<td>End Finish</td>
<td>one per pipe run</td>
</tr>
<tr>
<td>Lock Seam</td>
<td>one per tooling change</td>
</tr>
<tr>
<td>Welded Seams</td>
<td>one per pipe run</td>
</tr>
<tr>
<td>Perforations</td>
<td>one per pipe run</td>
</tr>
</tbody>
</table>
4.4 Repair - The QMS will include a written procedure describing how finished product is repaired due to: coating damage/loss of coating; indications of cracks, skips, or deficient welds; and damage either during fabrication or in shipping.

4.5 Labeling and Storage of Finished Product - The QMS will include a written procedure describing how finished product is labeled, packaged and stored. It will also include an explanation of the markings used for the pipe, as required by the governing AASHTO/ASTM product specification.

4.6 Shipment Documentation - The QMS will include a written procedure describing the typical handling, shipping, and installation procedures for round and non-round pipe.

5. NTPEP ON-SITE AUDITS

5.1 Quality Control Testing Evaluation - Each Manufacturer will be asked to demonstrate the production quality control inspections/tests they perform as stated in their QMS. While performing each inspection/test, the most current AASHTO or ASTM test methods will be referenced. The equipment used for each inspection/test will be examined and applicable records will be reviewed.

5.2 Production Record Review of Products – The auditor will select random lots of pipe for review of raw material traceability and production records. In addition, three random weeks (within the previous 12 months) of pipe production test reports (on raw materials and finished pipe) will be reviewed.

5.3 Inspection of Products - The auditor will select random lots of pipe for the demonstration of specification compliance by the Manufacturer. The Manufacturer will perform the necessary inspections to verify the product in the storage area meets the specification requirements.

5.4 Testing of Products – The auditor(s) will select samples of pipe materials available at the time of the audit for testing in accordance with SP01, Section 8, “Annual Product Conformance Testing”. The auditor(s) will select test samples from the coiled metal production lots and coatings available during the audit. All testing will be in accordance with the applicable AASHTO/ASTM Designation Standard(s). Samples will be taken for testing at the NTPEP Designated Laboratory.

Note 1 - If major deficiencies are noted during an on-site audit, a follow-up audit will be required.

6. ANNUAL PRODUCT TESTING

6.1 The NTPEP Auditor will select samples during each annual Manufacturer audit from the various pipe product specifications produced by the Manufacturer since the last audit.

6.1.1 Product conformance tests to be conducted are shown in Table 3.

<table>
<thead>
<tr>
<th>Metal Test Property</th>
<th>Product Specification</th>
<th>Material Specification</th>
<th>Test Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile/Yield/Elongation</td>
<td>AASHTO M 36, M 190, M 196, M 245</td>
<td>AASHTO M 197, M 218, M 246, M 274, M 289, ASTM A929</td>
<td>ASTM A370</td>
</tr>
<tr>
<td>Metal Thickness</td>
<td>AASHTO M 36, M 196</td>
<td>AASHTO M 197, M 218, M 246, M 274</td>
<td>ASTM A1073</td>
</tr>
</tbody>
</table>
### Finished Pipe Test Property

<table>
<thead>
<tr>
<th>Property</th>
<th>Product Specification</th>
<th>Material Specification</th>
<th>Test Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength (Helical Lock Seam)</td>
<td>AASHTO M 36, M 196</td>
<td>M 197, M 218, M 246, M 274, M 289.</td>
<td>AASHTO T 249</td>
</tr>
<tr>
<td>Cup Test (Helical Continuous Welded Seam)</td>
<td>AASHTO M 36</td>
<td>ASTM A796</td>
<td>AASHTO T 241</td>
</tr>
</tbody>
</table>

### Coating Test Property

<table>
<thead>
<tr>
<th>Property</th>
<th>Product Specification</th>
<th>Material Specification</th>
<th>Test Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc-Coated</td>
<td>AASHTO M 36</td>
<td>AASHTO M 218</td>
<td>ASTM A90</td>
</tr>
<tr>
<td>Aluminum-Coated</td>
<td>AASHTO M 36</td>
<td>AASHTO M 274</td>
<td>ASTM E376</td>
</tr>
<tr>
<td>55 Percent Aluminum-Zinc Alloy-Coated</td>
<td>AASHTO M 36</td>
<td>AASHTO M 289</td>
<td>ASTM A792, ASTM E376</td>
</tr>
<tr>
<td>Zinc-5 Percent Aluminum-Mischmetal Alloy-Coated</td>
<td>AASHTO M36</td>
<td>AASHTO M 289</td>
<td>ASTM A924</td>
</tr>
<tr>
<td>Polymer</td>
<td>AASHTO M 245</td>
<td>AASHTO M 245</td>
<td>ASTM A849</td>
</tr>
</tbody>
</table>

6.2 NTPEP Designated Laboratory Samples:

6.2.1 The NTPEP Auditor will instruct the Manufacturer on the proper labeling of the NTPEP Designated Laboratory samples. The Manufacturer will send (freight paid by the Manufacturer) the samples to the NTPEP Designated Laboratory for testing. All samples will be required to be shipped within 2 working days after sampling and by a traceable courier.

6.2.2 The Manufacturer is responsible for the shipment of the pipe and coating 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.

6.2.3 Once the NTPEP Manufacturing Auditor posts the results from the NTPEP Designated Laboratory testing, the Manufacturer will be contacted. If a failure occurs, the manufacturer will respond with a corrective action to comply with specifications as outlined in SP01.

6.2.4 Samples will be of a suitable size for initial testing and capable to provide additional test specimens for failure verification if required. If a sample fails to meet specification requirements, or the Manufacturer is found negligent during an audit in one or more aspects of the governing QMS manufacturing process, the nonconformance will be addressed as outlined in SP01. If major deficiencies are noted during an on-site audit, a follow-up audit will be required.

6.3 The NTPEP Auditor will verify documentation associated with selected hardware and operations during each annual Manufacturer audit. Product conformance documentation will be verified for items listed in Table 4.

### Table 4: Hardware / Operations Verification

<table>
<thead>
<tr>
<th>Hardware/Operation</th>
<th>Verification Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivets</td>
<td>Review manufacturer’s supplier(s) certifications</td>
</tr>
<tr>
<td>Component</td>
<td>Review</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>Bands</td>
<td>Review manufacturer’s supplier(s) certifications</td>
</tr>
<tr>
<td>Gaskets</td>
<td>Review manufacturer’s supplier(s) certifications</td>
</tr>
<tr>
<td>Bolts</td>
<td>Review manufacturer’s supplier(s) certifications</td>
</tr>
<tr>
<td>Nuts</td>
<td>Review manufacturer’s supplier(s) certifications</td>
</tr>
<tr>
<td>Lock Seams</td>
<td>Review manufacturer’s documentation of inspection &amp; testing</td>
</tr>
<tr>
<td>Riveted Seams</td>
<td>Review manufacturer’s documentation of inspection</td>
</tr>
<tr>
<td>Spot Welded Seams</td>
<td>Review manufacturer’s documentation of resistance spot welding machine’s and operation’s qualification tests (initial and verification). Review manufacturer’s documentation of welding equipment qualification before use, and verification before each work shift and when changing sheet thickness.</td>
</tr>
</tbody>
</table>

7. **FINISHED PRODUCT DOCUMENTATION**

7.1 Documentation used to prove compliance with “Buy America” shall be included with the finished products as required by the specifying DOT.

7.2 Handling, installation procedures and assembly drawings shall be included with the finished product for use in assembling pipe in the correct order for all round and non-round pipe.

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

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

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

8.1.2 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.

8.1.3 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.

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

9. **KEYWORDS**

9.1 NTPEP; Corrugated Metal Drainage Pipe; Manufacturer
ANNEX (MANDATORY INFORMATION)

X1. NTPEP QA PROGRAM FOR CORRUGATED METAL DRAINAGE PIPE - PARTICIPANT RESPONSIBILITIES

X1.1. **Background:** This section summarizes the responsibilities for the different parties.

X1.2. **Manufacturers’ Responsibilities:** Participating Manufacturers will develop and implement a Quality Management System (QMS) outlining their quality control testing program for production of corrugated metal drainage pipe. In addition, the manual will address the following general program, testing facilities, personnel qualification, and record keeping requirements:

X1.2.1. **General Requirements:**

X1.2.1.1. 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.

X1.2.1.2. 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.

X1.2.2. **Testing Facilities:**

X1.2.2.1. 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.

X1.2.2.2. 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.

X1.2.2.3. The facilities will adequately house and allow proper operation of all required testing equipment.

X1.2.2.4. The testing equipment will be calibrated/verified/checked in accordance with the Manufacturer’s recommendations at least to the specified intervals (Ref.: SP01, Annex A.1) by personnel customarily involved in such work as documented in the QMS.

X1.2.2.5. The testing facilities will maintain records of all test results and all NTPEP reviews and actions taken to resolve any noted deficiencies.

X1.2.2.6. Records of equipment calibration and verification will be maintained and available to NTPEP and AASHTO member departments upon request.

X1.2.3. **Testing Personnel**

X1.2.3.1. The Manufacturer’s quality control manager will meet the requirements established by the Manufacturer for the position.

X1.2.3.2. Documentation will show that the technician has been trained in the test procedures to be performed.

X1.2.3.3. Documentation will show that the technician has satisfactorily demonstrated competency to perform the required testing and that this demonstration is repeated annually.
X1.2.3.4. Documentation will show that technician training has been updated when revisions in test methods occur.

X1.2.3.5. Review of reports will show the technician can properly perform test procedure calculations and properly record information.

X1.2.3.6. 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.

X1.2.3.7. If requested, technicians will perform sampling and testing for NTPEP observers.

X1.2.4. Testing Documentation

X1.2.4.1. All quality control test results for corrugated metal drainage 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 five years.

X1.2.4.2. The reports will document the actions taken in the event of product test failures.

X1.2.4.3. The reports will show the manufacture location, date of manufacture, and test results. Identification will be such that the test reports for any product can be located.
X2. **AUDIT AGENDA**

On-Site Audit

**Opening Meeting**
- Introductions
- Address Any Safety or Security Concerns
- Address Confidentiality
- Questions, Comments, or Concerns?

**Summary of Desktop Review (5-Year Cycle)**
- Unresolved Findings
- Date of next Review

**Manufacturing Line Walk Through**
- Review Fabrication Processes
- Review Plant Inspection Processes
- Collect Corrugated Metal Drainage Pipe Samples for Testing of Products

**Yard Walk Through**
- Review of Corrugated Metal Pipe in Storage
- Record Product Information for Traceability Purposes
- Witness Inspection of Selected Yard Samples
- Record and Report Measurements from Inspection and Document Workmanship and Condition of Finish Product.

**Review of Documentation**
- Most Current Quality Manual
- AASHTO and ASTM Standards
- Training and Competency Evaluations
- Internal Audits/Management Reviews
- Equipment Records
- Certificates, MTRs, Reports, etc.

**Quality Control Testing**
- Demonstration of In-House Inspection/Testing Methods
- Inspection of Equipment

**Audit Summary Close-Out Meeting**
- Review of Audit Findings
- Questions/Concerns?
- Closing Remarks