GENERAL SUBJECT:
Quality Assurance Program for High Density Polyethylene (HDPE) and Polypropylene (PP) Pipe

SPECIFIC SUBJECT:
Revise Section 204.26 (h) of the Materials Division Manual of Instructions; Polyethylene and Polypropylene Culvert and Underdrain pipe

SUPERSEDES:

APPROVED:
Charles Babish, PE
State Materials Engineer

This memorandum is effective December 1, 2018.

PURPOSE/NEED/SCOPE/REQUIREMENTS

- Revise Section 204.26 (h) for Polyethylene (PE) and Polypropylene (PP) Culvert and Underdrain Pipe to require participation in a yearly audit under the AASHTO National Testing and Product Evaluation Program (NTPEP) for inclusion on VDOT approved list No. 42 of PE and PP Corrugated Pipe Products Quality Assurance Program.
- Include Polypropylene (PP) Culvert Pipe manufacturers and suppliers on approved list No. 42 once a quality control plan has been submitted and approved.
- Include new tests on recycled PE resins and finished pipe for M 294 HDPE Pipe manufactured with recycled PE and designated M 294 R on pipe.
- Include resin material tests for Polypropylene.
- Revise Section 205 the Table of Minimum Acceptance Sampling Requirements for Material and Test Item 26. Pipe (j) Polyethylene (PE) Corrugated to accept both Polyethylene (PE) Corrugated and Polypropylene (PP) Culvert and Underdrain Pipe visually on the project with the statement, "We certify that these PE or PP pipe and fittings have been tested and conform to the VDOT PE and PP Corrugated Products Quality Assurance Program" on each of the shipping documents and signed by a responsible company representative.
PROCEDURES

204.26 (h) Polyethylene (PE) and Polypropylene (PP) Corrugated Culvert and Underdrain Pipe

Corrugated polyethylene and polypropylene pipe shall be accepted from Approved List No. 42.

For a pipe to be included on the approved list, the manufacturer must be on a VDOT approved quality control/quality assurance program, as outlined below and participate in a yearly audit under the AASHTO National Testing and Product Evaluation Program (NTPEP).

See paragraph (l) for instructions on approval of polyethylene sewer pipe used in municipal sewer lines.

VDOT PE and PP Corrugated Pipe Products Quality Assurance Program

Producers of Polyethylene (PE) corrugated underdrain pipe, PE and PP corrugated culvert pipe and fittings conforming to the applicable VDOT specifications or special designs approved by VDOT can be placed on the Materials Division’s Approved list of PE and PP suppliers by meeting the requirements of the VDOT PE Corrugated Pipe Products Quality Assurance Program or the VDOT PP Corrugated Pipe Products Quality Assurance Program as outlined below.

Quality Control Plan

The producer shall submit for VDOT’s approval a Quality Control Plan. The plan must be site specific. The plan must indicate in detail how the Producer proposes to control the equipment, resins and raw materials, and production methods and finished pipe products to ensure that the specified products are obtained. The plan must list the personnel responsible for production and quality control at the site. The plan must include the following:

- Identification of the physical location of the plant.
- The method of identification of each lot of material during manufacture, testing, storage, and shipment.
- The method of sampling and testing of raw materials and of the finished product, including lot sizes and type of tests performed.
- A plan for dealing with quality control sample failures. This plan must include how the Producer plans to initiate an immediate investigation and how the Producer shall implement corrective action to remedy the cause of the problem.

If a quality control sample indicates the material or pipe does not meet the specification requirements, the Producer shall initiate an investigation to determine the cause of the failure. The investigation shall include a review of the sampling procedures, the equipment used in the production and the testing of the material, and the testing procedures of the technician. If the cause can be attributed to one of the above categories, the Producer shall take corrective action to bring the material equipment, or procedure into compliance. The Producer shall then record the corrective action on the test report form and take another check sample after the corrections have been made.

If a second quality control sample indicates the material or pipe meets the specification requirements, the Producer may resume normal testing procedures.
If a second quality control sample indicates the material or pipe does not meet the specification requirements, the Producer shall notify VDOT and stop the shipment of the affected pipe. The Producer shall continue the investigation into these failures and work with VDOT to determine the cause.

VDOT will review the Producer’s written quality control plan. After approval, an on-site inspection will be scheduled. This on-site inspection using the form in Appendix G will verify that the Producer’s quality control plan has been implemented and is being followed. See Appendix G.

Testing

The producer shall perform the following minimum quality control test procedures on the polyethylene resins and the completed pipe as outlined in AASHTO M294 and AASHTO M252 or polypropylene as outlined in M330. In addition the producer shall follow all Quality Management System requirements and quality control testing outlined in AASHTO NTPEP Work Plan for Evaluation of HDPE (High Density Polyethylene) Thermoplastic Drainage Pipe and the NTPEP Polypropylene Work Plan.

TEST

A. Polyethylene Resin

Table 1 Virgin Polyethylene 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 ASTM D792 or ASTM D4883</td>
<td>One test per lot of resin</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 blend</td>
</tr>
</tbody>
</table>

Table 2 Recycled Polyethylene 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 of NTPEP Work Plan</td>
</tr>
<tr>
<td>Melt index</td>
<td>Recycled HDPE And blends Containing recycled HDPE</td>
<td>ASTM D1238</td>
<td>See Table 3 of NTPEP Work Plan</td>
</tr>
</tbody>
</table>

B. Polypropylene Resin

Table 3 Virgin Polypropylene 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>Base polypropylene resin</td>
<td>ASTM D1505 or ASTM D792</td>
<td>One test per lot of resin</td>
</tr>
<tr>
<td>Melt index</td>
<td>Base polypropylene resin</td>
<td>ASTM D1238</td>
<td>One test per lot of resin</td>
</tr>
</tbody>
</table>
### Table 4 Test Requirements for Finished Product Containing Recycled HDPE

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Test designation</th>
<th>Test Frequency*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>ASTM D4883</td>
<td>One finished product sample shall be collected for every 45,000 lbs. of product produced or every 24 hours, or whenever the material blend ratios are changed by more than 5% or the blended constituents are changed, whichever comes first.</td>
</tr>
<tr>
<td>Melt Index</td>
<td>ASTM D1238</td>
<td>One finished product sample shall be collected for every 45,000 lbs. of product produced or every 24 hours, or whenever the material blend ratios are changed by more than 5% or the blended constituents are changed, whichever comes first.</td>
</tr>
<tr>
<td>Un-notched Constant Ligament-Stress (UCLS)</td>
<td>ASTM F3181</td>
<td>One finished product sample shall be collected for every 45,000 lbs. of product produced or every 24 hours, or whenever the material blend ratios are changed by more than 5% or the blended constituents are changed, whichever comes first.</td>
</tr>
<tr>
<td>Oxidation Induction Time (OIT)</td>
<td>ASTM D3895</td>
<td>One finished product sample shall be collected for every 45,000 lbs. of product produced or every 24 hours, or whenever the material blend ratios are changed by more than 5% or the blended constituents are changed, whichever comes first.</td>
</tr>
</tbody>
</table>

*Note: The above Quality control tests shall be performed as required by the respective AASHTO or ASTM standard.*

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C. PE and PP Pipe/Tubing:

- Tubing Dimensions
- Workmanship
- Perforation Dimensions
- Pipe Stiffness
- Pipe Flattening
- Markings

**Stab Compression**

**Note:** The above Quality control tests shall be performed as required by the respective AASHTO or ASTM standard.
One finished product sample shall be collected for every 45,000 lbs. of product produced or every 24 hours, or whenever the material blend ratios are changed by more than 5% or the blended constituents are changed, whichever comes first.

Note – Test frequency is subject to modifications to NTPEP HDPE Work Plan

D. PE and PP Fitting and Coupling:

Traceability related to marking and labelling

MINIMUM FREQUENCY

For the purpose of this program a lot is considered to be the amount of pipe produced as defined in the current NTPEP Work plan which is typically a day or 24 hours of production.

Test Facilities

Producer's facilities, equipment and testing personnel shall be adequate to conduct the applicable test as outlined in AASHTO M294, AASHTO M252 or AASHTO M330 and will be approved by the Department.

Producers shall maintain current calibration certificates on all analytical equipment used in testing.

Producers may elect to use the services of an independent commercial testing laboratory acceptable to the Department in lieu of conducting their own tests.

Shipments

Products shall be shipped to VDOT projects only when all required testing in the lot has been completed with acceptable results. Invoices with the statement, "We certify that these PE or PP pipe and fittings have been tested and conform to the VDOT PE and PP Corrugated Products Quality Assurance Program" shall be on each of the shipping documents and signed by a responsible company representative.

Records

All testing and inspection documentation shall be maintained at the producing and the shipping facility for at least two (2) years, and shall be made available to Department personnel at their request.

Producer shall maintain a Department-approved quality Control Form(s) for each lot, and as a minimum the form(s) shall contain the following:

- Plant Identification
- QC Technician's Signature
- Lot Identification
- Production Dates
- Tubing/Pipe Dimensions
- Workmanship
- Perforation Dimensions
- Pipe Stiffness
- Pipe Flattening
- Environmental Stress Cracking
- Brittleness
- Markings
Applicable specifications are AASHTO M252, AASHTO M294 AASHTO M 330 and VDOT Road and Bridge Specifications and Standards.

**Inspections/Audits** - VDOT representatives may randomly conduct plant inspections each year with cooperation and assistance of the fabricator to ensure that specifications and quality control requirements are being met. VDOT representatives may take random Independent Assurance Samples during the inspection at the rate of one sample per size in stock or production. Failure to perform all the program requirements may result in a producer being removed from the Approved List. A NTPEP annual audit will be used by the Materials Division Central Office Quality Assurance Section to determine compliance with VDOT's PE and PP Corrugated Products Quality Assurance Program. When the pipe is received on the project, the project inspector shall perform a visual inspection.

**APPENDIX G: Polyethylene and Polypropylene Pipe Plant Inspection Report**

**DATE________________________**

**INSPECTION PERIOD________________________**

**MANUFACTURER________________________**

**LOCATION________________________**

This form is designated to assist those in the review process. A number of questions are provided for this purpose. The applicable specifications contain greater detail than this checklist, and are required to assure that all is in compliance. Use both in this inspection effort.

A. Does the producer have the VDOT Approved QA/QC plan available and is the plan current?

   Yes _____ No _____

   Remarks _______________________________________________________________________

   ______________________________________________________________________________

B. Does the producer maintain a Department approved Quality Control Form for all products produced for VDOT projects? Yes _____ No _____

   Remarks _______________________________________________________________________

   ______________________________________________________________________________

C. Is there written documentation that the following tests are being performed in accordance with AASHTO M252 and M294 for polyethylene or AASHTO M330 for polypropylene?

   1. Workmanship  Yes _____ No _____

   Remarks _______________________________________________________________________

   ______________________________________________________________________________
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2. Tubing Dimensions

- Yes
- No

Remarks

3. Perforation Dimensions

- Yes
- No

Remarks

4. Pipe Stiffness

- Yes
- No

Remarks
5. Pipe Flattening
   Yes _____ No _____
Remarks ________________________________________________________________

6. Environmental Stress Cracking
   Yes _____ No _____
Remarks ________________________________________________________________

7. Britteness
   Yes _____ No _____
Remarks ________________________________________________________________

D. MARKINGS

1. Is the following information clearly marked on each 10 foot (3 m) section of the product?
   A. The name or trademark of the manufacturer?  Yes _____ No _____
   B. Nominal size of the product?  Yes _____ No _____
   C. The specification designation?  Yes _____ No _____
   D. Plant designation code?  Yes _____ No _____
   E. The date of manufacture or an appropriate code?  Yes _____ No _____
Remarks ________________________________________________________________

2. Do shipping tickets/documents contain a statement that the product shipped has been tested, inspected and approved under an approved VDOT PE or PP Pipe QA Acceptance Program?  Yes _____ No _____
Remarks ________________________________________________________________
E. **INSPECTION** SAMPLES

List the VDOT technician **Inspection** Samples taken during this review.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Type of Material</th>
<th>To Be Tested For</th>
<th>Results</th>
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Overall Remarks:

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|                  |                  |                  |
|                  |                  |                  |

SIGNATURE OF PERSON CONDUCTING **INSPECTION** REVIEW

|                  |
|                  |

TITLE

Section 205 Table of Minimum Acceptance Sampling Requirements for Material and Test Item 26 Pipe (j) Polyethylene (PE) Corrugated is revised to read:

<table>
<thead>
<tr>
<th>MATERIAL AND TEST</th>
<th>ROAD AND BRIDGE SPECIFICATION REFERENCE</th>
<th>RATE OF SAMPLING</th>
<th>LOCATION FOR SAMPLING</th>
<th>PROPER CONTAINER AND PACKING</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.Pipe</td>
<td>232</td>
<td>Visually accepted by the project inspector based on VDOT Corrugated (PE) or (PP) Pipe Quality Assurance Program as outlined in Section 204.26</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Notes

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References

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Copy Distribution:

Deputy Chief Engineer  VDOT Resident Engineers
Division Administrators  Federal Highway Administration
District Administrators  Virginia Ready Mix Association
District Location & Design Engineers  Precast Concrete Association of Virginia
District Construction Engineers  Virginia Transportation Construction Alliance
District Maintenance Engineers  Virginia Asphalt Association
District Bridge Engineers  American Concrete Paving Association Mid-Atlantic Chapter
District Traffic Engineers  Old Dominion Highway Contractors Association