APL Powder Testing Procedure for MnDOT Powder Coating Applications

The test procedures contained herein describes the process for submittal, testing, and evaluation of powder materials for use in MnDOT powder coating applications on duplex coated items. Applied powder materials which meet or exceed the stated performance criteria will be eligible to be listed on the MnDOT APL (Approved Products List). Provide independent lab test results proving that the powder coating applicator’s system of their particular Powder Product applied over the Hot-dipped galvanized steel works as a system, as defined below.

1. Send a submittal package to:

   Allen Gallistel
   Chemical Laboratory Director
   MnDOT Office of Materials
   1400 Gervais Ave.
   Maplewood, Mn  55109
   651-366-5545
   allen.gallistel@state.mn.us

2. Include the following in the submittal package:

   • Completed New Products Application Form (attached),
   • Powder Coating Applicator contact name, address, phone number and email address,
   • Submittal letter naming intermediate and finish coat trade names,
   • Provide hard copy independent lab tests proving compliance that the Powder Coating material(s) meet the industry specification AAMA 2604 requirements,
   • Product Data Sheets on all components,
   • Material Safety Data Sheets,
   • Certification from the powder manufacturer that products meet Minnesota Statute 115A.9651 requirements for heavy metals,
   • One pound of each component for Infrared Spectrum matching RAL standard color No. 7031. Any un-approved change to system formulation will result in removal from the Approved Products List. Infrared Scans will be used as references for Quality Assurance Testing for future awarded jobs,
   • Galvanizing DFT documentation from the Galvanizer which demonstrate compliance to this document,
   • Completed test data per tables listed below,
   • Provide written documentation per ASTM D 2244 stating the color meets the standard by a ΔE ≤ 2.
   • Completed MnDOT Office of Environmental Services Hazardous Evaluation Process Documentation (attached).
   • Documented references from other public agencies that have used the submitted system (optional).
3. Performance Testing

Performance testing shall be performed by an independent third party laboratory accredited by the American Association of Laboratory Accreditation (A2LA), or an alternative that is acceptable to the Engineer. The supplier must contact MnDOT Structural Metals Unit prior to SP6 abrasive blasting of the test panels. All associated testing will be at the expense of the supplier.

a) **Steel Panels:** Supply the following:
   - five – 6 in. x 6 in. x ¼ in. steel (MnDOT 3306 steel) test panels [one control, two salt fog, two adhesion];
   - two – 2 7/8 in. x 6 in. x ¼ in. steel (MnDOT 3306 steel) test panels for UV-Con testing.

b) **Hot-dip Galvanize steel panels per MnDOT 3394 and 2402 Special Provision for Ornamental Metal Railing – Powder Coating,**
   - Use a MnDOT Approved Galvanizer on file at [http://www.dot.state.mn.us/bridge/pdf/approvedsuppliers.pdf](http://www.dot.state.mn.us/bridge/pdf/approvedsuppliers.pdf)
   - Permanently identify each panel utilizing welding or other means acceptable to the engineer, measure blast profile and report average for each panel.

c) **Powder Coating Material:**
   - For testing purposes make the color of the final topcoat conform to RAL Standard Color 7031. Provide written documentation per ASTM D 2244 stating the color meets the standard by a \( \Delta E \leq 2 \) prior to testing the plates and \( \Delta E \leq 5 \) after UV-Con testing is completed.
   - Submit all required test information in hard copy form with this submittal package.

d) **Application of Powder:**

This portion of the qualification process has the Powder Coating Applicator document specific criteria that powder coated components must conform to in order to meet the quality and intent of the finished product. You must contact MnDOT Bridge Office Structural Metals Unit prior to SP 16 abrasive blasting of the test panels.

   - Perform the SP16 abrasive blast cleaning and the powder coating application in the presence of a Structural Metals Unit Inspector at the Powder Coating Facility.
   - Apply powder coat system according to manufacturer’s recommendation with a 4 mil minimum combined thickness of primer and topcoat. Any evidence of the intermediate coat bleeding through the topcoat shall be cause for rejection.
e) **Performance Testing of Duplex Coated Test Panels:**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Standard</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Panels (initial testing)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Film Thickness</td>
<td>Mils</td>
<td>4.0 mils [100 μm] minimum</td>
</tr>
<tr>
<td>Visual Inspection</td>
<td>MnDOT Specification</td>
<td>Coating shall be smooth and uniform, free of runs, drips, sags, blisters, and other deleterious conditions.</td>
</tr>
<tr>
<td>Pinholes</td>
<td>MnDOT Specification</td>
<td>Pinholes density shall not be greater than 5 pin holes per sq. ft. in any given area</td>
</tr>
<tr>
<td>Adhesion</td>
<td>ASTM D 4541-Type IV or V</td>
<td>Report</td>
</tr>
<tr>
<td>Color / Gloss</td>
<td>ASTM D 2244 ASTM D 523 - 60°</td>
<td>Color match to standard of ΔE &lt; 2.0 Gloss – report</td>
</tr>
</tbody>
</table>

| **Aged Panels (post testing)** | | |
| UV-Con | ASTM D 4587 Cycle 4 (1500 hours) ASTM D 4541-Type IV or V | - Photos - Report change in color from standard (ΔE, 5.0 max) - Gloss – report - Adhesion – report |
| Salt Spray of the entire system (hot-dipped) | ASTM B117 (2000 hours) | - Photos - Rust Creep ASTM D 1654 Procedure A Method 1, ≥ 7 |
| Galvanized steel with Powder Coating | ASTM D 4541-Type IV or V | - Blister Resistance ASTM D 714; blister size rating ≥ 7 with a frequency rating of Few - Adhesion - report |

f) **Notification:**

MnDOT will notify the Powder Coating Applicator of the approval status upon completion of the review of submittal package.

Upon meeting acceptance criteria, the submitted powder products will be placed on the MnDOT Approved Products List. ([www.dot.state.mn.us/products/bridge](http://www.dot.state.mn.us/products/bridge))
Commentary:

The phenomenon of pin holing in powders applied over hot dip galvanized surfaces has been identified as a serious problem associated with coating integrity and aesthetics. The presence of pinholes gives chlorides and other corrosives access to the zinc substrate with consequent production of bulky zinc corrosion products which leach out through powder coatings.

Pinholes of concern are identified as small around 1 mm in diameter swelled blister like areas that when bursting form a small hole through the entire thickness of the coating down to the hot-dipped galvanized layer. The formation of these pimply defects in the cured film is unacceptable and should be minimized or eliminated. Powder manufacturers, along with powder coaters, have combined to develop systems and technology that minimizes or eliminates pin holing.

Control pin holing by:
• Pre-heating the work prior to applying powder,
• Use of ‘degassing’ grades of powder that cure slower increasing flash off time,
• Cleaning surfaces prior to powder coating to eliminate hydrophobic organic contaminants that would attract moisture.
State of Minnesota
Department of Transportation
New Product Preliminary Information Form

INSTRUCTIONS: Answer ALL questions. Where a question is not applicable enter "N/A". Attach additional sheet(s) as required with reference to item number.

Date: __________________________

1. Trade Name ____________________________________________________________
   Manufacturer ____________________________________________________________
   Phone No. (_____) __________________
   Address ______________________ City ______________ State __ Zip _____
   Yes ___________ No ______ Patent No. ____________
   Patent pending

2. Local Distributor ________________ Phone No. (_____) __________________
   Address ______________________ City ______________ State ______ Zip ______

3. Recommended Primary Use: _____________________________________________

4. Describe product, material equipment or process:

   ______________________________________________________________________

5. Describe any limitations or use restrictions:

   ______________________________________________________________________
6. Material composition (attach laboratory test results, storage requirement, shelf life, Material Safety Data Sheet and disposal procedure):

7. Outstanding feature or advantage claimed:

8. Date introduced on market. Alternate for what existing product?

9. a. Total Estimated Cost Per Unit Material (including delivery)
   b. Total Estimated Cost Per Unit Furnished and Installed

10. Does product meet requirements of any of the following specifications? (Give specific number.)
    AASHTO    ASTM    Fed. Spec.    MnDOT    Others
    Others (state and attach specifications)

11. Indicate whether this product has been evaluated by a national or regional product evaluation program? (Attach any results.)
    HITEC    NTPEP    Others (specify)

12. Cite use by other agencies and persons to be contacted concerning experience with use, including how many years used, and whether use has been experimental or routine (list names, titles, mailing address and phones):
13. Note here and attach any test results, reports, etc., from the organizations above:

14. Is a documented quality control process available for this product?

15. Who has been contacted within MnDOT about this product?

Has this person been sent a copy of this form?

16. Additional comments:

Name and Title of person completing this form:

Address, State, Zip:

Date: Phone: ( ) 

Email Address: 

Manufacturer Representative
MnDOT Office of Environmental Services
Hazardous Evaluation Process

The MnDOT Office of Environmental Services developed the Hazard Evaluation Process (HEP) as a tool to determine potential environmental impacts that could result from use of a product and consequently, if the product is acceptable for use on MnDOT infrastructure. The following information must be submitted by the vendor in order for MnDOT to complete the HEP:

1. Vendor information
   a. Name of Company
   b. Address
   c. Technical Contact Name and Telephone Number
   d. Application Date
   e. Product Trade Name
   f. Product Chemical Name
   g. Product Data Sheet

2. Provide Material Safety Data Sheets for all chemicals in the product/waste material.

3. Regulatory Approvals & Status:
   a. Licenses
   b. Approval
   c. Permits
   d. TSCA Listing

4. Chemical Status:
   a. Provide Individual Chemical & Physical Properties (OECD\(^1\) Methods 102, 103, 104, 105, 111, 112, 113, 117, 121);
   b. Identify chemicals with molecular weights greater than 1000 Daltons (OECD Methods 118, 120 or equivalent);
   c. Certification that final product would not be considered a hazardous waste under Minnesota Rules Chapter 7045 if disposed of unused;
   d. Names and Chemical Abstract Numbers (CAS numbers) of the reportable substances in the product (40 CFR 302);

   The following product-specific information must be submitted if known. If information for a representative test is unknown it must be stated as such. EPA SW-846 test method information can be found at: [http://www.epa.gov/epaoswer/hazwaste/test/main.htm](http://www.epa.gov/epaoswer/hazwaste/test/main.htm). OECD product test method information can be found at: [http://www.oecd.org/home/](http://www.oecd.org/home/) or [http://www.oecd.org/document/23/0,2340,en_2649_34379_1948503_1_1_1_1,00.html](http://www.oecd.org/document/23/0,2340,en_2649_34379_1948503_1_1_1_1,00.html). U.S. EPA Office of Prevention, Pesticides and Toxic Substances Harmonized Test Guidelines can be found at: [http://www.epa.gov/opptsfrs/home/guidelin.htm](http://www.epa.gov/opptsfrs/home/guidelin.htm).
   a. Leach test results (EPA Method 1311 and OECD Method 312 with subsequent analysis for test substance or equivalent method);
   b. Biodegradation (OECD Method 301C, 301D, 302C, 304A, 307, 309 or equivalent method);
   c. Ecotoxicity to include three trophic levels (OECD Method 201, 207, 208, 210, 211 or equivalent method, OPPTS Method 850.5400, 850.1300, 850.6200, 850.4100, 850.4150, 850.1400 or equivalent method);
   d. Other available test data that provide individual chemical fate, exposure and pathway information.
Organization for Economic Co-operation and Development methodology for product testing is preferred but equivalent methods may be acceptable.

Questions regarding the MnDOT Hazard Evaluation Process can be sent to: Robert.Edstrom@state.mn.us