

MnDOT Powder Coating Qualification Testing Procedure

The test procedures contained herein describe the process for submittal, testing, and evaluation of powder materials for use in MnDOT powder coating applications. Applied powder materials which meet or exceed the stated performance criteria will be eligible to be listed on the MnDOT Approved Products List (APL). Provide lab test results establishing that the powder coating applicator's system for a particular Powder Product applied over Hot-dipped galvanized or abrasive blasted 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;
- Letter identifying each individual powder coat trade name;
- Powder manufacturer's recommended DFT for each powder used in the tested system;
- Hard copy lab tests proving compliance that the Powder Coating material(s) meet the industry specification AAMA 2604 requirements;
- Product Data Sheets on all components;
- Safety Data Sheets (SDS);
- 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 Federal Standard RAL K5 Classic No. 7031 (blue gray), in semi-matt finish. 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;
- If galvanized, DFT documentation from the Galvanizer which demonstrate compliance to this document;
- Completed test data per table in section 3e.
- Provide written documentation per ASTM D2244 stating the color meets the standard by a $\Delta E \leq 2$, and
- Completed MnDOT Office of Environmental Services Hazardous Evaluation Process Documentation (attached).

3. Performance Testing

Performance testing shall be performed by a laboratory that is acceptable to the Engineer. All associated testing will be at the expense of the submitter.

a) **Steel Panels:** Supply the following:

- All systems: five – 6 in. x 6 in. x ¼ in. steel (MnDOT 3306 steel) test panels [one control, two salt fog, two adhesion];
- For all systems: two – 2⁷/₈ in. x 6 in. x ¼ in. steel (MnDOT 3306 steel) test panels for UV-Con testing.
- Permanently identify each panel by means acceptable to the MnDOT.

b) **For Duplex systems, Hot-dip Galvanize steel panels per MnDOT 3394 and 2402 Special Provision for Ornamental Metal Railing – Powder Coating,**

- Perform SSPC-SP6 blast cleaning prior to galvanizing;
- Use a MnDOT Approved Galvanizer on file at <http://www.dot.state.mn.us/bridge/pdf/approvedsuppliers.pdf>

c) **Powder Coating Material:**

- For testing purposes make the color of the final topcoat conform to Federal Standard RAL K5 Classic No. 7031 (blue gray), in semi-matt finish.
- Provide written documentation per ASTM D2244 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.

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. Contact MnDOT Bridge Office Structural Metals Unit prior to starting abrasive blasting of the test panels.

- Perform the SSPC-SP10 (powder only systems)/SSPC-SP16 (duplex systems) abrasive blast cleaning as applicable, and the powder coating application in the presence of a Structural Metals Unit Inspector at the Powder Coating Facility.
- For each panel, document an average of 3 blast profile readings.
- Apply powder coat system according to manufacturer's recommendation.

Provide the minimum requirements and frequencies in the Quality Control Procedure as shown in this table.

Powder Coating Inspection Requirements		
Requirement	Criteria	Frequency/Extent
Date and time	Each lot of work	Each lot of work
Compressed air test	ASTM D4285	Daily – When abrasive blasting or blow down operations are occurring
Final Dry Film Thickness (DFT)	As submitted by Manufacturer (listed on the MnDOT APL)	SSPC-PA 2
Surface Preparation		

Abrasive blast clean Duplex System (prior to galv.) Duplex System (prior to powder) Powder Only System (prior to powder) Surface cleanliness (all systems)	SSPC-SP 6 SSPC-SP 16/ASTM D7803 SSPC-SP 10 SSPC-PA 1	Each component to be powder coated Each component to be powder coated Each component to be powder coated 100% Visual examination prior to coating
Pre-Bake for Outgassing (Duplex System)		
Surface cleanliness	SSPC-PA 1	100% Visual examination prior to coating
Pre-bake material temperature	Adequate to prevent defects due to outgassing during powder application	Each lot of work
Baking procedure	ASTM D7803	Each lot of work
Prime / Intermediate Coat		
Powder product number	Track for each lot	Each batch of powder
Surface cleanliness inspection	SSPC-PA 1	Visual examination prior to coating (within 1 hr of coating)
Oven temperature	Manufacturer recommendation	Each lot of work
Temperature of component at time of coating	Manufacturer recommendation	Each lot of work
Verification of prime / intermediate coat coverage	100% Coverage of powder	100% Visual Inspection
Top Coat		
Powder product number	Track for each lot	Each batch of powder
Surface cleanliness inspection	SSPC-PA 1	Visual examination prior to coating
Top coat oven temperature	Manufacturer recommendation	Each lot of work
Final cure temperature of component	Manufacturer recommendation	Each lot of work
Curing time	Manufacturer recommendation	Each lot of work
Coating evaluation / repair	Visual Inspection Coating shall be smooth and uniform free of runs, drips, sags, pinholes, blisters, and other deleterious conditions. (Pinhole density shall not be greater than 5 pin holes per sq. ft. in any given area)	100% Visual Inspection (without the aid of magnification)

e) Performance Testing of Coated Test Panels:

MnDOT Powder Coating Performance Requirements		
Criteria	Standard	Requirement
New Panels (initial testing)		
Total Film Thickness	Mils	As submitted by Manufacturer (listed on the MnDOT APL)
Visual Inspection	MnDOT Specification	Coating shall be smooth and uniform, free of runs, drips, sags, blisters, and other deleterious conditions.
Pinholes	MnDOT Specification	Pinholes density shall not be greater than 5 pin holes per sq. ft. in any given area.

Pencil Hardness	ASTM 3363	H-2H
Adhesion	ASTM D 4541- Apparatus Listed in Annex 1-5	Report adhesion values
Color / Gloss	ASTM D 2244 ASTM D523 – Specular Gloss	Color match to standard of $\Delta E < 2.0$ Gloss – report
Aged Panels (post testing)		
UV-Con	ASTM D4587 Cycle 4 (1500 hours)	- Photos - Report change in color from standard (ΔE , 5.0 max) - Gloss – report
Salt Spray (All systems)	ASTM B117 (2000 hours) Blister Resistance ASTM D 714	- Photos - Rust Creep ASTM D 1654 Procedure A Method 1, ≥ 7 - Blister size rating ≥ 7 with a frequency rating of Few

f) Notification:

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

Upon meeting acceptance criteria, the submitted powder products will be placed on MnDOT's Approved Products List www.dot.state.mn.us/products.

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.

New Product ID # _____
 (For MnDOT Use Only)

Revised 7/28/2005

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 ____ Patent pending

Yes _____ No _____ Patent No. _____

2. Local Distributor _____ Phone No. (_____) _____

Address _____ City _____ State _____ Zip _____

3. Recommended Use: _____ Primary

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 (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 (OECD¹ 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>. OECD product test method information can be found at: <http://www.oecd.org/home/> or 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>.

- 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.

¹ 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