

MnDOT Powder Coating Verification Testing Procedure

The test procedures contained herein describe the process for submittal, testing, and verification of a Powder Applicator's process for use in MnDOT powder coating applications. The verification procedure is used to verify the procedures and processes for application of previously approved Powder already listed on the MnDOT Approved Products List (APL). A supplier is required to submit a Quality Manual (QM) for review and acceptance and meet the performance criteria listed below before being eligible to be on the Approved Suppliers list (ASL) for powder coating (using APL powder).

1. Required Documentation:

- Powder Coating Applicator contact name, address, phone number and email address;
- Letter identifying each individual powder coat trade name;
- 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;
- If galvanized, DFT documentation from the Galvanizer which demonstrate compliance to this document;
- Completed test data per tables listed below;
- Provide written documentation per ASTM D2244 stating the color meets the standard by a $\Delta E \leq 2$.

2. 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 supplier.

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

- Two – 6 in. x 6 in. x ¼ in. steel (MnDOT 3306 steel) test panels for adhesion testing.

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.

- 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. 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)	Same as original qualification test	SSPC-PA 2
Surface Preparation		
Abrasive blast clean	SSPC-SP 6	Each component to be powder coated
Duplex System (prior to galv.)	SSPC-SP 16/ASTM D7803	Each component to be powder coated
Duplex System (prior to powder)	SSPC-SP 10	Each component to be powder coated
Powder Only System (prior to powder)	SSPC-PA 1	100% Visual examination prior to coating
Surface cleanliness (all systems)		
Pre-Bake for Outgassing (Duplex System)		
Surface cleanliness	SSPC-PA 1	100% Visual examination prior to coating
Pre-bake material temperature	Same as original qualification test	Each lot of work
Baking procedure	ASTM D7803, Same as original qualification test	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	Same as original qualification	Each lot of work
Temperature of component at time of coating	Same as original qualification	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	Same as original qualification	Each lot of work
Final cure temperature of component	Same as original qualification	Each lot of work
Curing time	Same as original qualification	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.
Adhesion	ASTM D 4541- Apparatus Listed in Annex 1-5	Report

f) Notification:

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

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.