DUPONT®

Teflon®

Nonstick & Industrial Coatings

Teflon® 532-13054 Powder, High-Build, Ruby Red, Permeation-Resistant Coating

Description

Teflon® 532-13054 is a new filled version of PFA powder coating, specifically formulated to reduce permeation. It is an analog of *Teflon*® 858-916 liquid, high-build, Ruby Red coating and an improved version of *Teflon*® 532-5700. The basic properties are those of *Teflon*® PFA. This product should be considered whenever permeation is thought to be a considerable risk to the performance of normal fluoropolymer coatings.

The improvement in this coating over *Teflon*® 532-5700 is the microscopic powder composition. The red mica is encapsulated in *Teflon*® 532-13054. The powder components do not separate during powder application. There are several advantages of this technological advance. The powder is easier to reclaim and recycle because the composition of the overspray does not change. The coating composition is also constant; it is not affected by application technique. The red pigment in *Teflon*® 532-5700 tends to separate in the powder cloud, with less pigment hitting the substrate than intended.

This new filled coating can be applied over a broad range of thicknesses. However, a coating thickness of 200–300 µm (8–12 mil) is recommended. Coatings of this thickness have been shown to be more effective than coatings over 500 µm (20 mil) of standard PFA in Atlas cell tests.

FDA Status

Teflon® 532-13054 does **not** conform to FDA regulations governing components of coatings for direct food contact.

Table 1
***Teflon*® 532-13054 Powder Coating**
Typical Properties

Color	Ruby Red
Coverage, m^2/kg/25 µm (f^2/lb/mil)	18.6 (88)
Density, g/cm^3	2.2
Particle Size	
Average, µm	60
Range, µm with 85% between 5 and 125 µm	2–175
Maximum use temperature	
Continuous, °C (°F)	260 (500°)

Application

Metal Surface Preparation

Aluminum, stainless steel, and carbon steel are acceptable substrates with the use of the proper primer. Best adhesion is obtained by thoroughly cleaning and then roughening the substrate. Cleaning is preferably done using a commercially available hot alkaline solution. Commercial solvent degreasing and steam cleaning are an acceptable alternate. Roughening is preferably done by grit blasting with aluminum oxide. The grit blast profile should be to an Ra of 2.5–3 µm (100–125 µin) maximum. This can be achieved with coarse grit (30–40 grit) using 90–100 psi air pressure. Prime and dry the substrate as soon after blasting as possible to reduce oxidation.

Primer

Teflon® 420-703 (solvent based) is the only recommended primer for this product. Filter the primer through 40-mesh (approximately 400 µm [16 mil]) stainless steel or nylon. Take care that the primer covers the substrate completely to avoid rusting of the substrate. The primer should be applied over the freshly cleaned and blasted surface with a dry film thickness just enough to cover the substrate (10–15 µm [0.4–0.6 mil]).

Optional Drying of Primer

The powder coating should be applied directly over wet primer when possible. However, if the substrate is not going to be powder coated right away, bake the part for 20–30 min at 121–150°C (250–300°F) metal temperature. The oven temperature should not exceed 150°C (300°F).

Application Procedures

A standard corona or tribo charging powder gun is recommended. For the first coat, apply powder (which has been filtered through a 60-mesh screen) onto the wet primer and cold substrate using a spray voltage of 15–30 kV. The part must be well grounded. The suggested system pressure is 6 bar (90 psi). Conveying pressure should be 1.5–2.5 bar (20–35 psi). Coating thicknesses per layer (coat) of up to 90 µm (3.5 mil) can be expected.

Baking of the First Coat

Bake for 10–20 min at 400–413°C (750–775°F) as measured by a thermocouple on the substrate being coated. Avoid oven set point temperatures higher than 415°C (780°F). This high bake is important to optimize the adhesion between the primer and powder coat.

Baking Multiple Coats

Several layers (coats) should be applied; however, testing to date indicates coating thicknesses of over 300 µm (12 mil) are not needed to provide good substrate protection.

Apply powder to either a cold part as described for the first coat or hot flock. Higher film builds per coat can be expected by hot flocking depending on the part thickness and application conditions. The bake for the second and subsequent coats should be lowered to 360–377°C (680–710°F) metal temperature for 20 min. The last coat can be baked for 2–4 hr with metal temperature of 340–365°C (645-660°F) for optimum flow out of *Teflon*® 532-13054 (oven temperature not to exceed 360°C [680°F]).

Topcoat

A topcoat is recommended for a smooth and glossy appearance. Apply a mistcoat of *Teflon*® 857-210 to about 40 µm (1.6 mil) dry film. (A small amount of isopropanol can be added to *Teflon*® 857-210 to improve wetting of the *Teflon*® 532-13054 coating). The long bake described in the preceding paragraph is done after the application of *Teflon*® 857-210. A topcoat of *Teflon*® 532-5010 can also be applied after the long bake of the last powder coat, but cure must then be very well controlled because of the bubbling risk.

Spark Testing

A coating of 500 µm (20 mil), which is properly applied and baked, should easily pass a 4–5 kV porosity test.

Performance Testing

The most important performance test for this product is the Atlas cell exposure test.

Atlas Cell Testing

Atlas cell is a test that allows the estimation of the resistance of a coating in contact with a chemical at a given temperature. Refer to **Figure 1**. The coating is applied on the inside of the panels, which close the glass pipe. A thermometer and a heating element control the temperature. The coating is exposed to both a liquid and a vapor phase. Visual inspection is done every week. After 720 hr (±1 month), the test is stopped and adhesion is tested.

To date this coating has only been tested in water, but it is expected to perform similarly to its aqueous analog, *Teflon*® 858-916. Those results are included in **Table 2**.

Two panels and microscopic pictures are shown in **Figure 2**. Significant improvement in performance of the *Teflon*® 532-13054 coating system is evident over a standard, high-build, pure PFA coating applied at a thickness similar to that for the *Teflon*® 532-13054 Ruby Red. **Note**: Under some extreme exposure conditons (high temperature H_2S for instance), the red pigment in the ruby red products can change color to black. Iron oxides are known to change color without a large structural change, so the color change has not affected any of the performance characteristics of the coating system.

Figure 1. Atlas Cell Testing

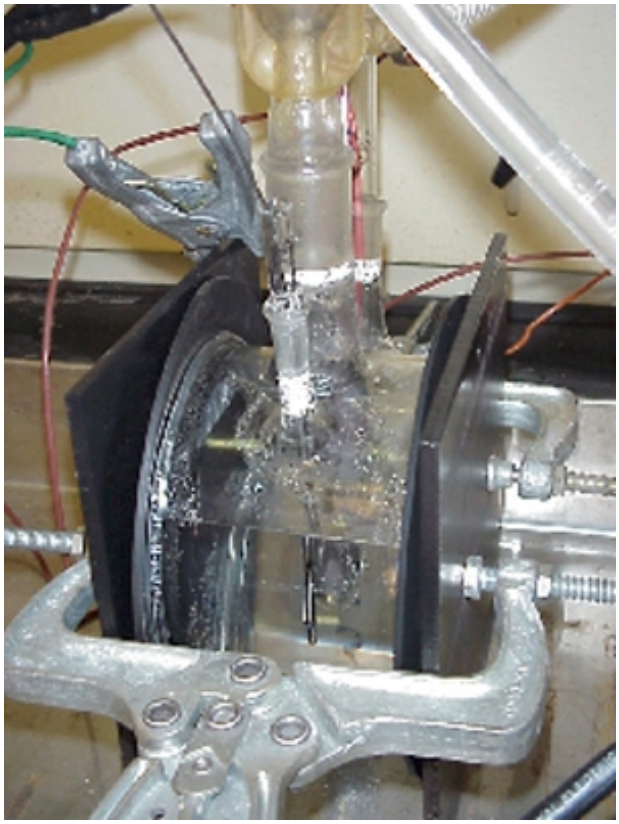
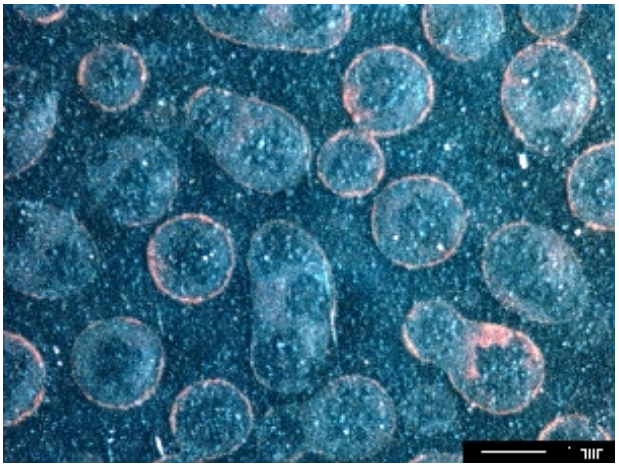


Figure 2. Standard PFA Coating vs. *Teflon*® 532-13054

~10 mil pure PFA powder on primer badly blistered

~12 mil *Teflon*® 532-13054 over primer unaffected except for slight color shft



Microscopic view of the blistering of the Atlas cell panel of standard PFA system

Microscopic view of the lack of blistering of the Atlas cell panel of *Teflon*® 532-13054 system

Table 2
Atlas Cell Test Results

Medium	Temperature, °C (°F)	DFT, µm (mil)	Time of Exposure, hr	Blisters	Adhesion
HCl 0.05 N	100 (212)	>111 (4.4) (1 layer)	720	None	OK
HCl 0.6 N	100 (212)	125 (5) (2 layers)	>744	None	OK
HCl 37%	50 (122)	186 (7.4) (2 layers)	<120	Yes	NOK
H_2SO_4 20%	90 (194)	172 (7) (2 layers)	<240	Yes	NOK
H_2SO_4 20%	90 (194)	552 (22) (5 layers)	>240	None	OK
H_2SO_4 95%	50 (122)	191 (7.6) (2 layers)	>696	None	OK
H_3PO_4 85%	50 (122)	184 (7.4) (2 layers)	>648	None	OK
HNO_3 65%	50 (122)	183 (7.4) (2 layers)	>120	Yes	NOK
Water	100 (212)	250 (12) (3 layers)	>240	None	OK

Safety

Follow normal industrial safety practices for handling and applying *Teflon*® products. Industrial experience has clearly shown *Teflon*® materials can be processed and used at elevated temperatures without hazard providing adequate ventilation is used. Ventilation should be available at baking temperatures of 275°C (525°F) and above. Before using *Teflon*®, read the Material Safety Data Sheet (MSDS) and the detailed information in the "Guide to the Safe Handling of Fluoropolymer Resins," latest edition, published by the Fluoropolymers Division of The Society of the Plastics Industry.

When grit-blasting *Teflon*® finishes off aluminum or magnesium surfaces, the possibility of explosion exists if the fines are allowed to heat up. Good housekeeping practices, keeping the residue wet, and keeping the ventilation and dust collection systems in good working order reduces this risk.

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