



non-stick coatings

**QUALITY  
CONTROL  
PROCEDURES  
Rev. 2010**



non-stick coatings

## Tests done for coatings that have been sprayed on cookware:

### 1) INSPECTION

- Spray coating, and inspect at 30X magnification for surface flaws.

### 2) BOILING WATER CROSS-HATCH ADHESION TEST

**Purpose:** Check adhesion properties of the non-stick system to a specific type of pretreatment and substrates.

- Submerge coated pan in boiling water for 15 minutes.
- Scribe a 10mm X 10mm cross-hatch on the coating surface with a blade, ensuring that the cross-hatch fully penetrates to substrate.
- Using Glass-Reinforced pressure-sensitive tape, press tape firmly on to the cross-hatched area, Forcefully rip off in one motion.
- Repeat 5 times in various directions (horizontally, vertically, diagonally)

No coating should be removed with the tape in order for the coating to be considered satisfactory.

### 3) DRY EGG RELEASE TEST

**Purpose:** To check initial non-stick properties of the coating system. Egg should show absolutely no sticking.

- Heat the pan to 400°F;
- Break a standard egg in the center of the pan;
- Allow the egg to cook thoroughly (usually 90-120 seconds);
- Attempt to remove the egg with a spatula;
- Check the pan for any sticking or residue remaining on the coated surface.



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#### 4) STAINLESS STEEL SPATULA TEST

**Purpose:** Check adhesion, scratch resistance, and hot hardness of the coating system under cooking conditions.

- Install coated pan and stainless steel spatula on fixture of abrasion test machine;
- Apply 5 pound weight static vertical pressure;
- Heat substrate to 204°C on machine's hot plate;
- Stroke substrate with stainless steel spatula at a 45° angle to surface;
- Run 30,000 cycles for standard 2-coat systems.
- Run 50,000 cycles for standard 3-coat systems.

Check for topcoat scratching, basecoat and/or substrate penetration.

#### 5) SCOTCH BRITE ABRASION / EXTENDED DRY EGG RELEASE TEST

**Purpose:** Check the abrasion resistance and extended release properties of a non-stick coating system.

- Install coated pan on abrasion test machine and new 3M Scotch-Brite 7447 pad to fixture.
- Apply 10 pound weight static vertical pressure.
- Run 30,000 cycles for 2-coat systems.
- Run 50,000 cycles for 3-coat systems.
- For *high performance* systems, run until failure (maximum 250K cycles).
- Every 10,000 cycles, change Scotch-Brite pad.
- Every 10,000 cycles, check dry egg release on unabraded and abraded surface.
- **NOTE: As of 2010, this test is being modified by adding 5% soapy water to the substrate during the test to simulate kitchen use and to accelerate coating failure.**



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Check for superficial scratches and/or intercept/substrate penetration. Egg should be easily removable from wear track. If egg sticks, coating system must be modified.

### 6) PENCIL HARDNESS

**Purpose:** To check the room-temperature hardness of the new coating system

- Hold pencil at an angle approximately  $45^{\circ}$  to coating surface.
- Use pressure, short of breaking lead, to push the pencil forward.
- Any marring of the surface, visible at an oblique angle in strong light indicates that the specific pencil lead is harder than the film.
- The “pencil hardness” rating is expressed as the grade of the next softer pencil.

### 7) TIGER PAW TEST

**Purpose:** Measure hot hardness, scratch resistance and overall durability off a non-stick coating system at cooking temperatures and conditions.

- Use the hand-held “TIGER PAW” testing device;
- Cover bottom of pan with vegetable oil;
- Heat pan to  $400^{\circ}\text{F}$ ;
- Rotate “TIGER PAW” device on surface of pan, changing directions every 100 cycles (clockwise & counter-clockwise)
- Repeat for 2000 cycles, 3000 cycles for high performance systems.

Check for superficial scratches, intercoat/substrate penetration.

### 8) CORROSION TEST

**Purpose:** Check the corrosion resistance of a non-stick system on a specific type of pretreatment and substrate.

- Prepare a solution of 5% Sodium Chloride solution.



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- Fill pan being tested to the rim.
- Bring the water to a 170°F and cover.
- Run for 48 hours covered at a constant temperature of 170°F.
- Empty the pan and wash with mild soap and water.

No surface defects (i.e blistering or corrosion) should appear on surface of coating.

### **STANDARD TESTS FOR “WET” BATCHES IN PROCESS**

#### **1. FINENESS OF GRIND**

**Purpose :** To ensure that pigment dispersion is adequate to obtain desired appearance of final coating.

- Use of Hegman grind gauge ( as specified in ASTM D1210)
- Put a small amount of paint at the deep end of the groove and draw down towards and of gauge with device.
- The dispersion rating of the product is the point on the scale at which pigment particles first begin to appear above the surface.
- Reading should be taken within 10 seconds after completion of drawdown especially for grinds of 7 or better.
- Make two or three more drawdowns using fresh material each time.
- Grind should be at the rating specified on QC card in Laboratory.

#### **2. WEIGHT PER GALLON**

**Purpose :** To ensure that the density of the batch is in accordance with specifications.

- Weigh empty “weight per gallon” cup and cover.



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- Fill cup almost to the rim with the material being tested.
- Carefully place cover on the cup and wipe off excess material that exudes through hole in cover and along the rim. Record weight measured.
- $(\text{Grams of Paint in cup}/10) = \text{weight per gallon}$

### 3. VISCOSITY

There are various devices which can be used to measure viscosity of a coating. GMM uses Iwata#2 standard viscosity cup unless otherwise specified by customer.

- Bring temperature of paint to 77°F/25°C.
- Dip specified Iwata#2 cup in to sample. When cup is filled, remove from sample. Starting stopwatch when rim of cup breaks through surface.
- Stop the watch when flow from cup breaks through surface.
- Take reading in seconds
- Viscosity of batch must match with standard viscosity of product within  $\pm$  3-5 seconds.

### 4. % NON-VOLATILE MATTER. (WEIGHT SOLIDS)

**Purpose:** To ensure weigh solids of coatings match product specification per ASTM.

- Weigh two samples of approximately 1-2 grams of coating in tared aluminum foil dishes.
- Spread coating to cover entire surface area of dish.
- For solvent based coating material add 1 ml of toluene and shake to mix.



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- Bake for 1 hour at 220°F and then cool down at RT and weigh.
- Residue in dish is Non-volatile matter

$$\frac{(\text{Wt. of Aluminum dish+residue}) - \text{Wt. of aluminum dish} \times 100}{\text{Wt. of aluminum dish} + \text{wet coating}} = \% \text{ NVM}$$

### 5. pH TEST - Checked for all Water based coatings

**Purpose :** To ensure that pH of batch matches QC standard of the particular product.

- Standardize pH meter with appropriate buffer solution
- Make sure electrode is cleaned properly
- Immerse electrode into sample ( which has been stabilized at 77°F
- Take pH reading

### **STANDARD TESTS FOR “DRY FILM” OF BATCHES IN PROCESS.**

After checking wet coating properties the batch is sprayed on customer specified substrates to ensure that appearance and physical properties of dry film are in accordance with standards.

#### 1. DRY FILM THICKNESS

**Purpose :** To ensure that the appearance and properties of coating are achieved at the specific dry film thickness recommended by GMM

##### A. FERROUS SUBSTRATES

- Using Fischer Film thickness gauge, place the probe tip on the top of the coated panel
- The force required to detach the probe tip is inversely proportional to the thickness of the coating.



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- The scale reading on the barrel calibration is taken as the coating thickness in microns.

### **B. NON-FERROUS SUBSTRATES.**

- Use Fischer Film thickness gauge.
- Zero the gauge by pressing probe tip on the surface of the uncoated substrate.
- Take 2-3 readings and average. Reading are given in microns.

## **2. ADHESION TESTS**

**Purpose:** To ensure adhesion of coating system on specified pretreatment and substrates.

\*Zero coating should be removed by tape pull in any of the following adhesion tests.

### **A) CROSS-HATCH TEST**

- Using a razor blade, scribe a 10mm×10mm cross-hatch on the coating surface;
- Insure that it penetrates the coating all the way to the substrate;
- Using glass-reinforced pressure-sensitive tape, press tape firmly onto cross-hatched area;
- Pull tape off in one abrupt motion and check for paint adhesion failure.

### **B) BOILING WATER TEST**

- Spray coating over appropriate substrate and cure per specification.
- Immerse panel in boiling water for 15 minutes.
- Check cross-hatch adhesion again.

### **C) RECOATABILITY (IF SPECIFIED)**

- Spray coating over appropriate substrate and cure per specification;
- Cool panel to room temperature;
- Spray material again over ½ of the coated panel and cure again;
- Perform cross-hatch test again.





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### **3. GLOSS**

**Purpose:** To ensure that the gloss of hatch matches product standard.

- Use Byk-Chemie Glossmeter;
- Standardize accordingly either at 20 degrees or 60 degrees (high or low gloss)
- Take reading given by digital indicator and check QC specification.

### **4. COLOR**

**Purpose:** To ensure that the color of batch matches product standard

- Use Hunter color machine;
- Place the coated panel on the machine;
- Based on the delta reading of the panel, add necessary shading pigments to coating.

### **5) SOLVENT RESISTANCE (Double MEK Rub Test)**

**Purpose:** To check that the new batch cures at the required temperature.  
QC card

Will indicate number of Double MEK rubs batch should pass.

- Soak a clean rag or cheese cloth in MEK solvent;
- Rub cloth on small surface of the film;
- Rubbing the MEK-soaked rag up and down the film constitutes 1“Double MEK”
- For highly chemical resistant film, test only up to 100 Double rubs
- Chemical resistance as >100 Double MEK rubs.

### **6) PENCIL HARDNESS**

**Purpose:** To ensure that the hardness of the cured film meets standard specification.

- Hold pencil at an angle approximately 45<sup>0</sup> to coating surface;
- Use pressure, short of breaking lead, to push the pencil forward;
- Any marring of the surface visible at an oblique angle in strong light indicates that the specific pencil lead is harder than the film.



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- The “Pencil hardness” rating is expressed as the grade of the next softer pencil.

### **7) FLEXIBILITY. For coil-coated , roll-coated, or postformable products.**

#### **A) T-BEND TEST**

- Bend coated panels using a panel bending machine;
- Complete the bending using a Carver Laboratory Press;
- T-bend is expressed as the number of bends, with the first one being 0-1
- Check for adhesion failure, peeling or cracking of coating.

#### **B) IMPACT RESISTANCE (ASTM D2794-69)**

- Place coated panel face down over hole on base plate of Gardner Impact Tester;
- Lift the impact rod along the seale, Let rod fail;
- Mark the height at which it is lifted;
- Multiply height by the weight of the rod;
- This figure is the foot-lb of impact.