

# COATING WORLD®

SPECIAL REPORT ON NONSTICK COATINGS AND HOUSEWARES FOR RETAILERS

## Testing Nonstick Coatings: Which Test Reveals What, And How To Make The Most Of The Test Results

In past issues of RCW we have provided details on our testing methods, how to perform them, what they reveal and even on which product category each test should be conducted. So what happens when you get the test results back from the lab? What do all those numbers and cycles mean to you and your product?

More important, how do you use the results to your best advantage?

(Of course, if you are a member of Whitford's Quality Cooperative Program [QCP], the test results are interpreted for you and any issue that may arise is presented with a solution and promptly addressed with your vendor.)

### Making the most of test results

In this issue we want to discuss what results you can expect from each test, what they mean, when you need to be concerned, how to address them and why.

A frequently-asked question is: Do test results translate directly into warranties?

Many retailers ask if there are tests which can help determine the length of a warranty. But warranties have more marketing than science behind them. While test results (in combination with an understanding of the nonstick coating used and where it falls in the brand hierarchy) can give you a guide to help establish your warranty strategy, warranties ultimately must be determined based on each company's standards and policies.

### The three key tests

An important note to keep in mind is that failure of a nonstick coating, or a coating not meeting its established specifications, can be dependent on a combination of factors, including the particular specs of the product itself. In some cases, one test not meeting its expected results may not mean the product will not perform properly. If other factors are in line, the product may still perform as expected, can be shipped, and can be corrected as a running change.

The key is to know what to look for. If you are ever in doubt, please call us, and we can assist in the interpretation of your test results.

The following are standard test methods for conventional and internally-reinforced coatings.

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#### 1. Whitford Test Method (WTM) 132C & 132D, Adhesion test.

Both 132C & 132D are used to confirm that the coating has properly adhered to the substrate, a crucial element in the performance of the coating. 132D adds an additional dimension by exposing the test area to boiling water, which is important since it



*The ultimate test takes place in the consumer's kitchen. Intelligent testing programs properly managed help assure that your products will pass the ultimate test with flying colors.*

adds an element of actual cookware use. Both are recommended for cookware and bakeware, and both tests will provide a simple PASS or FAIL result.

In the case of failure, the substrate preparation is evaluated as well as the thickness of the coating applied. This is an excellent yet simple procedure that can be conducted by the manufacturer.

#### 2. WTM 114A, Dry Film Thickness (DFT).

The second crucial factor is that the coating be applied at the proper thickness. So conducting this test is important, and it should be conducted on all product categories. The results are reported in mils (microns). A general guideline for proper film thickness is:

- One-coat nonstick coating: 0.7 to 0.8 mils (18 to 20 $\mu$ ).
- Two-coat nonstick coating: 1.0

to 1.2 mils (25 to 30µ).

- Three-coat nonstick coating: 1.2 to 1.4 mils (30 to 36µ).

Each Whitford brand has detailed product specs by formula, and should be confirmed with your Whitford rep prior to evaluating test results. Here is an overview of Whitford-brand DFT specs:

- Xylan®: 0.7 to 1.2 mils (18 to 30 µ).
- Quantum2®: 0.9 to 1.2 mils (23 to 30µ).
- QuanTanium®: 1.0 to 1.3 mils (25 to 33µ).
- Eclipse®: 1.2 to 1.5 mils (30 to 38µ).

If a coating is too thin, it will wear more quickly and shorten product life. If a coating is too thick, it may cause blisters, mud cracking, sagging, and will be more likely to peel or chip.

If results are outside the required specs, they should be discussed with the coating manufacturer promptly.

### 3. WTM 115A: Completeness of Cure.

Confirming whether the coating has been properly cured is the third and final crucial factor in testing the application of the coating. As we have mentioned before, the type of coating systems used can vary widely depending on the end use. Coatings used for bakeware are usually very different from those used for cookware, and different tests must be used to evaluate them. Completeness of cure is a case in point.

For cookware, the nonstick coatings used tend to be more sophisticated multicoat systems. A problem with cure will usually show up in one of the tests used to evaluate adhesion to the substrate or one or more layers will pull off. This is a warning that more investigation must be done to determine the cause (which is fre-

quently improper cure). It is important to involve your coating supplier at this stage to help resolve the problem.

For bakeware, simpler coating systems are the rule and the results will be either PASS or FAIL with WTM 115A.

If a coating is improperly cured (too fast, too slow, too hot, etc.) it can result in numerous problems, including blisters, bubbles, pinholes and premature product failure.

In the case of failure, the application process must be reviewed and corrected quickly to meet product specifications. Note: With bakeware coatings, this test can be performed easily right on the production line. And a failed piece can often be salvaged simply by recuring.

### Additional tests: Performance Abuse\*

#### 1. WTM 135C: Reciprocating Abrasion Test (RAT).

The RAT is an abuse test used to measure the resistance of coatings to abrasion. The pan is placed on a machine on which a Scotch-Brite™ pad is dragged back and forth across the coating under a weighted, sliding arm. The results are reported in num-

ber of cycles. This test can be conducted on both cookware and bakeware items.

A general guideline of RAT results for Whitford brands is:

#### Cookware

- Xylan: 2,000 to 3,000 cycles.
- Quantum2: Approx. 5,000 cycles.
- QuanTanium: 10,000 to 20,000 cycles.
- Eclipse: 150,000 to 300,000 cycles.

#### Bakeware

- Xylan: 400 to 500 cycles.
- Quantum2: 1,500 to 2,000 cycles.
- QuanTanium: 10,000 to 15,000 cycles.
- Eclipse: 150,000 to 200,000 cycles.

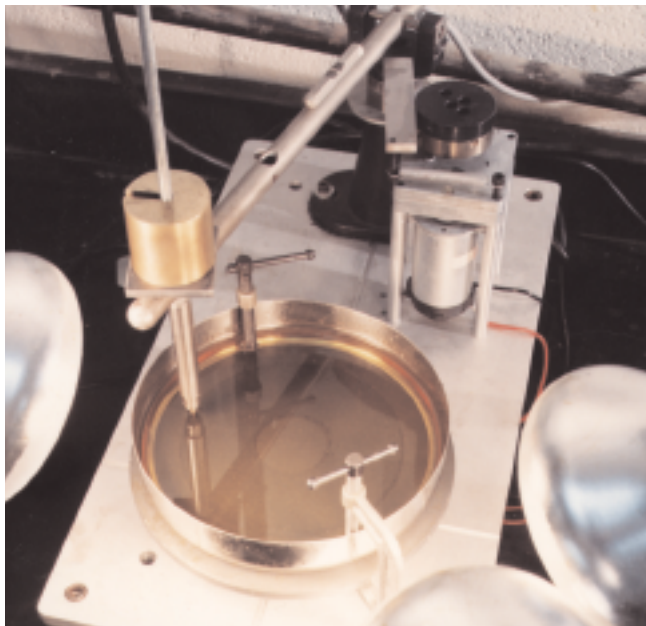
It is important to contact your coating manufacturer for the exact specs for the formula you are using.

If the results you receive are below the expected range, abrasion and wear resistance are not up to spec. You should discuss it with the coating manufacturer promptly.

Interpreting Results of Whitford's Gyrograph Test		
Rating	Description	Details
10	No effect	Light scratching of the surface. No breakthrough at any place in the scratch pattern.
8	Slight	Light scratching of the surface. Inner circle of pattern shows slight cut-through to basecoat and possibly to substrate. Outer circle not cut through.
6	Moderate	Moderate scratching between inner and outer circle. Both cut through to basecoat and possibly substrate (inner usually worse than outer circle).
4	Considerable	Less than 25% loss of coating between inner and outer circles (estimate and record amount). Considerable cut-through and fraying at the inner and outer circles.
2	Severe	Between 25-50% loss of coating between inner and outer circles. Severe loss of coating at inner and outer circles. Metal substrate shows through.
0	Total failure	Greater than 50% loss of adhesion and coating surface.

## 2. WTM 137C: Mechanical Scratch (Gyrograph) Test

The Mechanical Scratch Test is used to measure the potential damage to a coating from scratching and cutting by metal utensils. The coated pan is placed on a revolving turntable. Then a weighted ball-point-pen tip, affixed to a balance arm, is placed on the coated surface. The balance arm oscillates from side to side while the turntable is rotating. The speed and weight are controlled, and the test is



Whitford's unique Gyrograph provides a highly sensitive measure of adhesion of nonsticks, especially of inter-coat adhesion (a common source of failure among improperly-applied multicoat systems).

run for the same amount of time for all coatings.

This is another test which is not appropriate for bakeware.

The performance level is rated using the scale shown on page 2.

A general guideline of Gyrograph test results for Whitford brands, all run for the same period of time, shows:

### Cookware

- Xylan . . . . . 4
- Quantum2 . . . . . 6
- QuanTanium . . . . . 8

- Eclipse/Excalibur . . 10

While cost usually precludes the use of multicoats on bakeware, these are the performance levels you could expect.

### Bakeware

- Xylan . . . . . 4
- Quantum2 . . . . . 6
- QuanTanium . . . . . 8
- Eclipse/Excalibur . . 10

It's important to consider the type

of coating used as well as the specs of the product itself. Generally, the best three-coat reinforced coatings will achieve a rating of 8 or 10, while a two-coat non-reinforced coating may only see a rating of 4 or 6 (run for the same amount of time).

If any test results in a rating of 2 or below, notify your vendor immediately and consult your coating manufacturer for solution recommendations.

\*Note: These performance-abuse tests are not part of Whitford's standard QCP testing program. They are best carried out during the development phase of a new product line.

### **End-use tests\***

The last series of tests to discuss is those that simulate "in use" conditions and ensure that the coating will withstand the elements to which it can be exposed — salt, acid, heat, etc. All the tests listed below are for cookware only (except 150A, which can also be used for bakeware).

## 1. WTM 150A: Detergent resistance Test

This test measures the resistance of a coating to prolonged exposure to detergents. A detergent solution is prepared and heated to a specific temperature. The parts to be tested are placed in the solution and left there for a set amount of time. Then the parts are removed, dried and evaluated for blisters, adhesion loss (via fingernail or knife-scratch tests), softening and loss of gloss or color.

## 2. WTM 165A: Salt water immersion corrosion test

## 3. WTM 165B: Acidic corrosion test

## 4. WTM 165C: Boiling salt water test

## 5. WTM 165D: Salt water and starch corrosion test






All these procedures evaluate the susceptibility of various coating/substrate-preparation combinations to attack by corrosive foods.

In each test, the pan is filled with a prepared solution and heated for a specific amount of time. It is then removed from the heat and let to stand for a specified time at a specified temperature. Whitford evaluates the utensil at specified intervals for corrosion spots or blisters.

## 6. WTM 199A: Cooking test

This procedure evaluates (a) the stain resistance and (b) the retention of release properties for cookware coatings. Various foodstuffs are introduced at various stages to simulate the conditions a fry pan may typically encounter.

The intention is to accelerate these conditions and to rate the effect of the conditions on critical properties of the coatings. The degree of release (5, best, to 1, poor) and staining (none, slight, moderate or severe) are evaluated, and the surface is evaluated for blisters.

Standards for Whitford coatings		
Brand	Recip. Abrasion Test	Gyrograph Test
	★★	★★
	★★★	★★★
	★★★★	★★★★
	★★★★★	★★★★★
	★★★★★	★★★★★

For all of the above, if any of the negative factors described is found at any stage of the evaluation of any test, it is a sign the coating may not have been applied properly or was not applied to the proper specifications. You should notify the vendor immediately and contact your coating manufacturer to identify the correct course of action to address it.

\*Note: These end-use tests are not part of Whitford's standard QCP testing program, and are best carried out during the development phase of a new product line.

### Not as easy as it looks

Interpreting test results for non-stick coating housewares products is more complicated than it might seem. So many factors impact the performance of the coating that it is important to involve your coating manufacturer, to understand the results you receive and how to respond to them.

Over-reacting to what appear to be bad results can be as costly as not taking the time to interpret the results and letting the problems hit the selling floor.

### Take advantage of us

Since Whitford's founding in 1969, we have stated our "slightly different approach to the business" in these terms:

*We are not in the business of selling coatings. We are in the business of solving problems for our customers. Our coatings and related technology are simply the means by which we solve their problems.*

Our focus on doing all we can to make sure quality is high to begin with, then is maintained at the same high level throughout the application process, is designed to help you avoid problems.

If you are not already a member of the Quality Cooperative Program, we invite you to join.

We invite you to visit any of our laboratories (we have laboratories in 8 countries) to learn more about these tests, what they mean and how to use the results to your best advantage.

If you'd like a copy of Whitford's test procedures, please let us know. If you'd like more information on the QCP or Whitford's extensive testing program, please contact Fran Attilio, Retail Marketing Manager, Whitford Corporation, Box 2347, West Chester, PA 19380-0110. Call (610) 296-3200, fax (610) 647-4849 or email her at fattilio@whitfordww.com.

### Frequently Asked Questions

**Question:** "Is there a relationship between the weight of the pan and the life of the nonstick coating?"

**Answer:** A pan's weight can impact the life of the coating, depending on its ability to distribute heat. For example, a pan constructed of thick aluminum, copper, or stainless steel with a thick aluminum encapsulated base, distributes heat better, avoiding hot spots. Since non-

stick coatings are organic, overheating can damage them. So heavier pans, with good heat conductivity, can contribute to prolonging the life of the nonstick coating.

But a thicker substrate increases the cost of the pan. And better pans use better quality nonstick coatings. So a safe rule of thumb is that, the more you pay for cookware with nonstick, which usually means a heavier pan, the better the nonstick coating will be, and the longer it will last.

Send questions with your name, address to: Fran Attilio, Whitford Corp., Box 2347, West Chester, PA 19380-0110, call (718) 967-7967 or email: fattilio@whitfordww.com.

### Coming in future issues:

- Opening price-point products: what you should know.

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