

## POSITION PAPER ON ASTM D3363-74 (REAPPROVED 1989) – STANDARD TEST METHOD FOR FILM HARDNESS BY PENCIL TEST

The Standard Test Method for Film Hardness by Pencil Test, ASTM D3363 (R1989) is used by a wide variety of producers and users of coatings. This is also true for coil coaters and paint manufacturers for the coil coating industry. After many years of using this ASTM standard (since 1974, and subsequent revision in 1989 of sections 2 and 3), the National Coil Coating Association believes it is important that information be disseminated to clarify issues related to the subjectivity of this test method. ASTM D3363 method provides a very inexpensive and rapid means of determining the film hardness and adhesion of an organic coating on aluminum or steel; however, there are many issues regarding the method about which interested parties should be aware, as follows:

### 1.) Lack of standardization of the abrasive paper

Grit No. 400” is specified to prepare the pencil or lead cutting edge. (NOTE: Throughout this document, the term “lead” is used to describe the graphite pencil lead used in conjunction with a mechanical holder. The term “pencil” refers to a wooden pencil that encases the graphite pencil lead.) A recent check in the marketplace found that there was no uniform method of grading abrasive paper, and methods differ from one manufacturer to another. Differences that exist among the No. 400 grit paper provided by various suppliers have an effect on the sharpened edge of the lead. Lead from the same pencil, applied to an identical sample of organic coating and substrate, will in some cases cut, and in other cases not cut, the sample, depending on the No. 400 grit paper that was used to prepare the lead. No specific manufacturer of the abrasive paper is recommended in the specification.

### 2.) Mechanical Holders

According to note 3 of the standard, “Turquoise No. 10 is preferred holder. However, any holder adequately constructed to eliminate lead slippage may be used”. This note is an indication to the tester that it is difficult but essential to find a holder that does not allow the lead to slip during this test method. Experience has shown that it is very difficult to find a good holder, and sometimes, the performance of a holder that appears to hold well initially will degrade over time, with slippage occurring after a few tests. In conversations with manufacturers and retailers, it is apparent that the holders are not made to take the abuse of the pencil test. One solution to the “holder issue” is to use wooden pencils; however, this creates another problem: finding a pencil sharpener that will remove the wood around the lead 3/16 to 1/4 inch without making a point on the lead. The specification notes, “Dexter Super 10 Draftman Type A10D Cutter Assembly, manufactured by Apsco Products, Inc. or equivalent. In practice, a regular pencil sharpener is sometimes modified to obtain the desired configuration of the pencil lead.

### 3.) Operator Variability

This method is fraught with operator variability. Extreme care must be taken to:

- a) Hold the pencil at a 90 degree angle when sharpening
- b) Maintain the proper pencil lead exposure length of 3/16 to 1/4 inch

- c) Maintain the proper 45 degree angle to perform the actual test -- too low of an angle will allow the lead to cut the paint at a lower hardness, and too high of an angle will allow a harder lead not to cut the paint.

#### 4.) Standardized Pencil Leads

This test utilizes *drawing pencils*. These pencils are constructed and calibrated by the darkness of a mark that they make on paper. This type of control is valuable and suitable for artists and draftsmen, but has no relationship to the use of these pencils in the coatings industry. These pencils are *never* tested by the manufacturer for their ability to “cut” or “gouge” a paint film. It is often found that an “F” pencil will actually cut into a paint film when an “H” (one pencil harder) pencil will not. When comparing from one pencil lead manufacturer to another, this hardness system can be completely unreliable. We are aware of instances in which one manufacturer’s leads were certified, but they didn’t cut any paint films and were equivalent to another lead manufacturer’s B or HB leads. In addition, there is some indication that leads may age over time and gain or decrease hardness relative to their initial rating. Some users of this test method believe that the wood pencils are more consistent in maintaining their original hardness rating.

The specification tips the reader off in paragraph 3.1 with several subjective comments, as follows:

1. “It should be recognized that the results obtained may vary between different operators and laboratories.”
2. The use of this method as a “basis for a purchase agreement” is not recommended.

### Conclusion

NCCA recommends that the ASTM D3363 pencil test not be used as a pass/fail test method, but rather as an additional test along with the MEK resistance test, impact test, and color tests, among others, that are used to determine the overall suitability of a paint coming off a coil coat paint line.

If a value is insisted upon by a customer, a four pencil range is recommended. For example, if a customer thinks that he wants an “F-H” hardness, the specified pencil range should be stated as “HB-2H.”