

Drawdowns – Minimizing Variables is Crucial in Achieving Reliable Test Results



When performing any physical testing of liquid coatings, minimizing variables is an important prerequisite for achieving accurate, reliable and repeatable test results, whether you are evaluating color, gloss, film thickness, adhesion or some other property. This is especially true when making drawdowns, a first step in many test procedures.

Drawdowns typically require:

- A standardized substrate (chart or card)
- A level, rigid support surface for the standardized substrate
- A device (applicator) to ensure consistency of coating application at a controlled film thickness

Standardized Substrates and Important Chart Characteristics

Although a variety of materials, such as plastic, metal and wood can be used, a sealed paper drawdown chart or card, commonly with various black and white patterns, is usually the substrate of choice. To achieve the goal of minimizing variables, it is important that certain characteristics are considered when selecting a chart. These include:

- **Color uniformity:** Consistency of color and reflectance over the white and black areas are particularly important when working with semi-transparent or clear coatings because show-through of the substrate can affect color measurements of the applied coating.
- **Imperviousness/Solvent resistance:** The chart's surface needs to be sealed with a clear topcoat which acts as a strong barrier to prevent water molecules from penetrating its surface and solvents from attacking it, thereby ensuring that smooth, uniform drawdowns are produced. If you see such failures as tiny bumps or eruptions, "crazing" or cracking in the applied coating, it is clear evidence that the chart is inadequately sealed.

- **Wettability:** The chart's surface needs to be compatible with most water and solvent based coatings. If the clear topcoat is not formulated with this requirement in mind, then applied coatings may "crawl", show "fish eyes" or other characteristics of poor wetting.
- **Surface smoothness:** The smoother and the less bumpy the chart surface is, the better the appearance of your drawdown. If the chart has a bumpy surface, the uneven texture may be telegraphed through the drawdown, resulting in a distinct orange-peel appearance.
- **Curl resistance:** The chart should be flexible yet sufficiently sturdy so that it will lie flat both before and after application of your coating. Lower quality charts may curl due to moisture in the air or water vapor transmission occurring during applications of water-based paints.
- **Non-fluorescence (no optical brighteners):** The chart should be free of optical brighteners. The presence of optical brighteners can cause misleading results when making instrumental or visual color evaluations.

Support Surface

The surface which supports the drawdown chart is also critical. A desk or table top should not be presumed to be flat as it may have wear or distortion which may result in coating thickness variations. The optimal surface for supporting drawdown charts is a glass plate because of its superior planarity (see Leneta Item GDP-1 Glass Drawdown Plate). In addition to glass drawdown plates, vacuum plates are frequently used to ensure that the chart is held flat (see Leneta VP-0912 Vacuum Plate).

Applicator

Straight bar or blade type applicators are the most frequently used devices for drawing down paints and related coatings (see Bird Applicators). Wire wound rods (see Wire-Cators) are also popular due to their much lower cost as well as their ability to apply edge-to-edge drawdowns while producing films with good consistency.

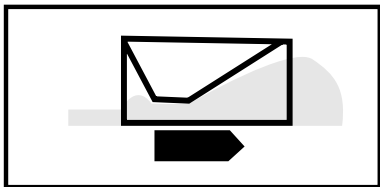
Wet Film Thickness Determinants

A number of factors can influence the wet film thickness applied by a film applicator. When using a straight bar type, the geometry of the applicator can have significant influence. For example, the width of that portion of the blade which contacts the paint can affect the amount of shear applied, thus potentially changing the viscosity and, therefore, the applied film thickness. In addition, the rheological properties of the material being tested can affect the thickness being applied.

The accepted, broadly accurate guide when drawing down coatings with good flow properties, using a straight bar applicator, is that the wet film thickness equals approximately half of the gap clearance, the “gap” being the distance from the bottom of the applicator blade to the top of the surface being coated. If a low viscosity fluid, like water or solvent, with significantly more flow than a formulated coating is applied, a wet film of considerably less than half the gap will be produced.

Highly viscous materials, like peanut butter or a mastic coating, will be extruded through the gap clearance, producing a wet film equal, or nearly so, to the height of the gap. If applying a non-Newtonian coating, care should be taken to prepare the sample by applying a shear similar to that encountered in the field prior to doing the drawdown. This can be accomplished by stirring, shaking or whatever preparation method is recommended to pre-shear the coating. The speed at which the drawdown is made may also affect the resulting film thickness.

The following diagram schematically indicates the flow that occurs during a drawdown with a Bird Applicator[®]. The liquid level drops after passing between



the applicator blade and the substrate. It is in this area that rheology plays a significant role. The liquid is subjected to shear as it passes under the blade so a highly shear-thinning material could produce a thinner than expected film. When the sample

is non-Newtonian, drawing down at different speeds can apply different shear rates to the liquid, potentially resulting in different wet film thicknesses being applied. ASTM D823 recommends a drawdown speed of about 250 to 300 mm/s. A different speed may be more appropriate for your coating.

Confirmation of Film Thickness

ASTM D823 specifies that the wet film thickness be measured immediately after the drawdown is made. Practically, it may be more effective to wait until the film has dried and then measure the dry film thickness.

Conclusion

To maintain consistency of drawdowns, thereby helping to ensure accuracy of test results, it is important to minimize variables as much as possible. We have seen that the three essential elements for making drawdowns – substrate, supporting surface and applicator – need to be selected and used with as much care as possible. Of these elements, it is the drawdown chart which is the most critical for making uniform, consistent drawdowns. To ensure that test results are accurate and reliable, the drawdown chart needs to have good color uniformity, imperviousness, wettability, surface smoothness, curl resistance as well as being free of optical brighteners. Leneta charts meet all these criteria.



To speak with an expert, you can call us at **201-847-9300** or email us at [**sales@leneta.com**](mailto:sales@leneta.com). You can also visit our contact page on our website [**www.Leneta.com**](http://www.Leneta.com) and fill out the inquiry form. We will get back to you as soon as possible.

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