Introduction

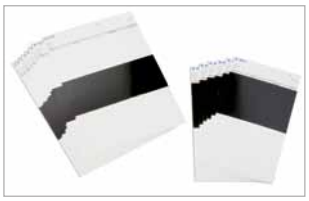
Wet Film Preparation

An accurate and uniform film thickness is essential for achieving uniform color, appearance and specific physical properties such as scrub resistance, chip resistance, flexibility etc. Therefore, international specifications as well as company internal testing methods specify not only a minimum film thickness, but also require controlling the film thickness within a defined range.

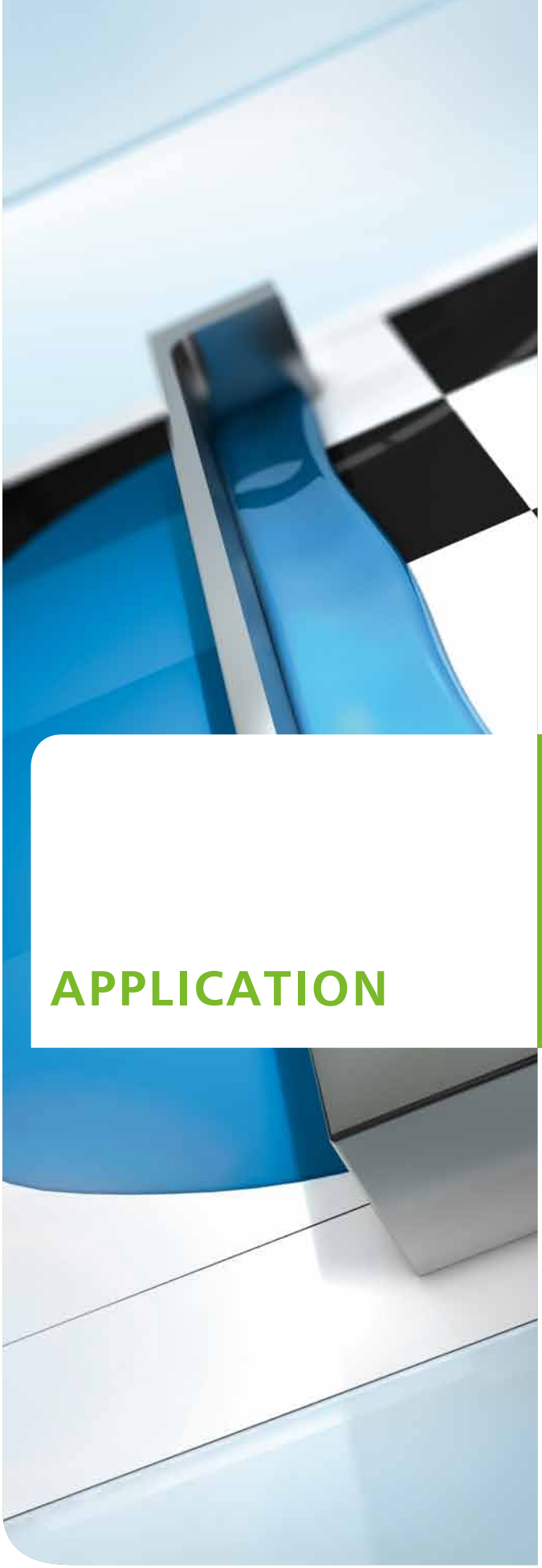
The most common method of applying a liquid finish in the laboratory is with a drawdown bar or often referred to as a "doctor blade". This type of film applicator can lay down wet films of almost any desired thickness from a few µm up to 1000 µm (0.1 mil up to 40 mils).

A typical blade type applicator consists of a metal bar containing a gap of known clearance on one or more faces. It is placed near one end of a flat panel or drawdown chart . A sufficient volume of sample is placed in front of the applicator. The applicator is then "drawn down" the panel/chart, either automatically or manually, leaving a uniform film. The automatic method is more repeatable and will result in a more uniform film thickness over the entire range, as operator deviations are minimized.

Stainless steel, aluminum, or plated steel are the preferred materials of construction, due to their resistance to corrosion. Plated and stainless steel types are harder and will withstand more rigorous use. Regardless of the material of construction, corrosion can damage the region of the drawdown bar controlling thickness of the applied film, therefore affecting the repeatability of the instrument. Good lab practices dictate immediate cleaning of the instrument after each use to eliminate potential corrosion or residue which could affect future results.



Drawdown Charts see pages 145 - 152.



APPLICATION

It is recommended that all units be periodically checked for accuracy by using a feeler gauge, as normal use and cleaning will, after time, render any applicator inaccurate. Should an applicator be dropped or the blade become nicked, it needs to be replaced as the applied film will no longer be equally distributed over the applicator's film width. Numerous types of applicators have evolved over the years and can be divided into two types: adjustable and fixed gap clearance. Applicators may also have single or multiple gaps. Most applicators have shoulders or side arms that hold the pool of sample in front of the gap, while the device is drawn down. The gap on most applicators has a flat shearing edge which yields a wet film to gap ratio of approximately 1 to 2, although this ratio varies with several factors, such as application technique and coating composition. Fixed models are easier to clean and maintain; adjustable models should be disassembled and cleaned after every use.

The quality of the draw down is governed by three main factors:

– Viscosity of the paint
– Speed and uniformity of the application
– Flatness of the surface

A variety of viscometers can be used to control viscosity.

Viscosity Cups
see pages 264 - 252.

Rotational Viscometers
see pages 253 - 259.

BYK-Gardner also offers an automated film applicator which controls the rate of application and planeness of the applicator, assuring a uniform film thickness.

The wet film to gap ratio is a result not only of the shape of the shearing edge, but the fluid's viscosity, the speed of the applicator and other factors. The exact wet or dry film thickness can be determined only by measuring the wet or dry film with a film thickness gauge.

Automatic Film Applicator
see pages 166 - 168.

Wet film thickness measurement
see pages 187 - 189.

Dry film thickness measurement
see pages 190 - 194.

For very thin films, the use of wire-wound rods is recommended. These applicators are drawn across the surface in the same manner as the blade type, but the coating flows through the grooves between the wires and produces a thin, uniform drawdown.

Wire-wound rods see page 158.

Due to liquid evaporation, dry film thickness will always be less than the wet film thickness of a particular coating. Likewise, because of physical properties, wet film thickness will always be less than the gap of the applicator. An operator will learn through experience the approximate wet film thickness that will be obtained with a specific combination of coating, applicator, and application method. Likewise, knowledge of the composition of the coating will tell the operator what dry film thickness to expect. A good rule of thumb for a beginning estimate of dry film thickness is as follows:

$$\textbf{Dry film thickness} = \frac{\textbf{wet film thickness x Vol. \% solids}}{\textbf{100}}$$

The following table helps to estimate the relationship between the gap depth of the applicator and wet film thickness:

Gap Depth		Approximate Wet Film Thickness
mils	**microns**	
1-4	15 - 100	50% of gap depth
5-12	101-300	60% of gap depth
13-20	301-500	80% of gap depth
>20	>500	90% of gap depth