

# Introduction

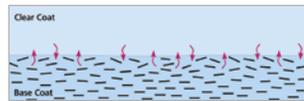
## Mottling

Mottling is an undesirable defect which can occur with effect coatings – it is most obvious on light metallic finishes. The total color impression shows irregular areas of lightness variations. These "patches" are usually visually evaluated, described as a mottling effect. Some also feel that it reminds them of clouds. This effect is especially noticeable on large body panels. It can be caused by the coating formulation, as well as variations in the application process. For example, disorientation of the metallic flakes or film thickness variations of the basecoat can lead to various mottle sizes resulting in a non-uniform appearance.

### Orientation Clouds

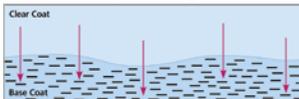


Disorientation influenced by wetting behaviour, rheology additive or application

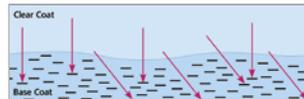


Strike in effect: disorientation by interaction between clear coat and basecoat

### Thickness / Hiding Clouds

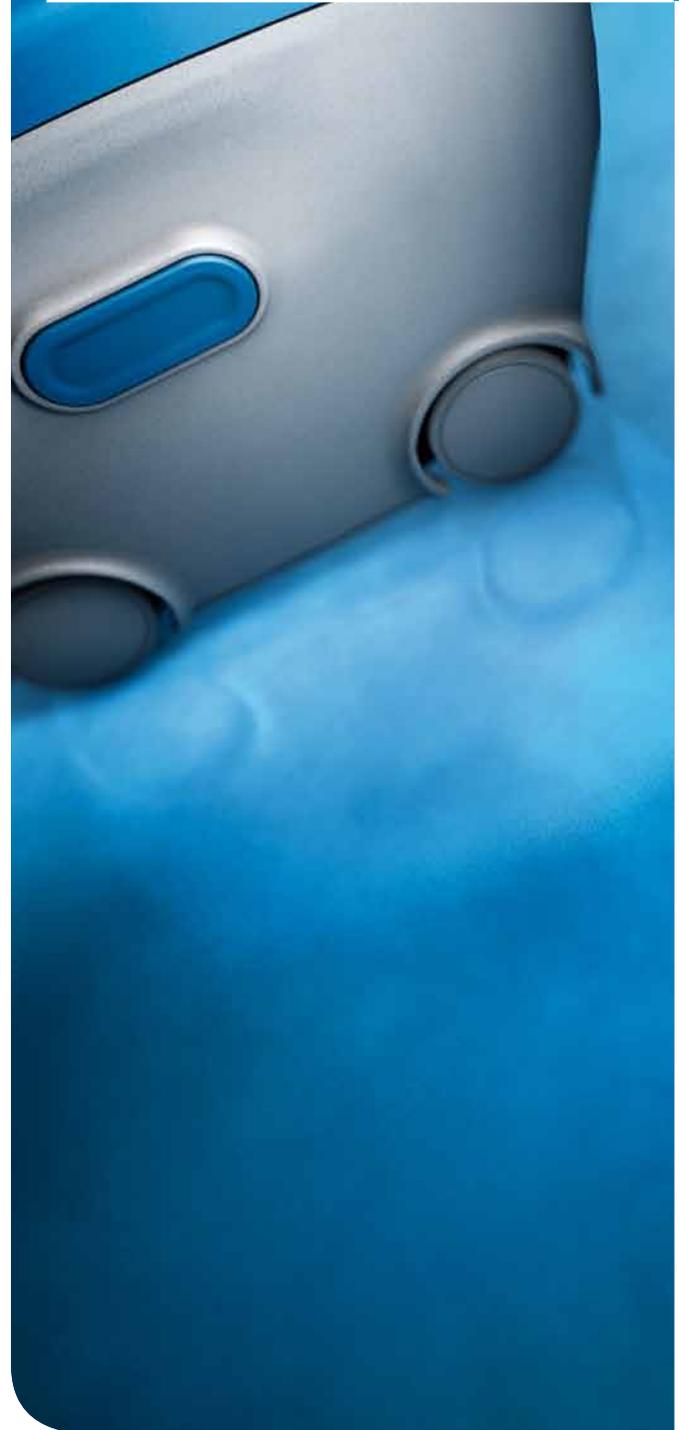


Thickness variations result in poor hiding

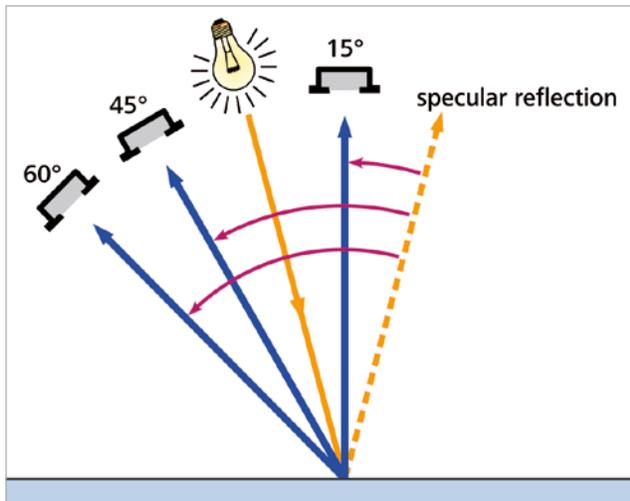
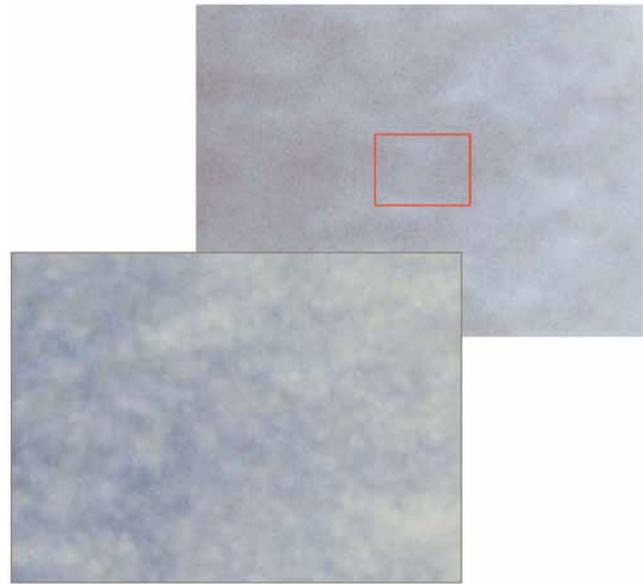


Thickness variations result in partial hiding at a grazing angle

## MOTTLING



The visual perception of mottling is dependent on the viewing distance: Large mottles can be seen in far distance evaluation, while small mottles are more noticeable in close up evaluation. The visual evaluation of mottling is very subjective, as it depends on the illumination conditions, the observing distance and the viewing angle.



cloud-runner: measurement principle

## Simulation of visual perception

In order to objectively evaluate mottling, it is necessary to measure lightness variations over a large sample area and under different detection angles.

The cloud-runner optically scans the surface and measures the lightness variations. The specimen is illuminated with a white light LED at a 15° angle and the lightness is detected under three viewing angles to simulate visual evaluation under different observing conditions: 15°, 45° and 60° measured from the specular reflection.

The mottling meter is rolled across the surface for a defined distance of 10 to 100 cm and measures the lightness variations point by point.



### Mottle Size

Md	6 -13 mm
Me	11 -24 mm
Mf	19 - 42 mm
Mg	33 - 72 mm
Mh	57 - 126 mm
Mi	100 - 200 mm

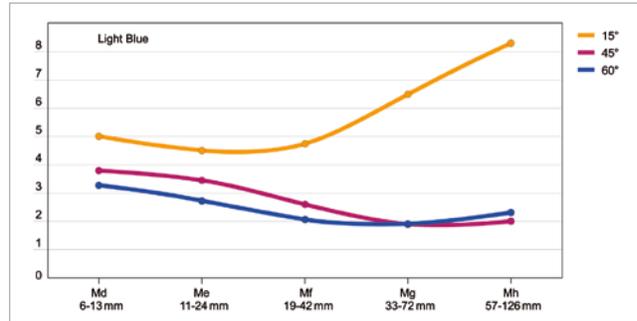
The measurement signal is divided via mathematical filter functions into 6 different size ranges and a rating value is calculated for each angle and mottle size. The higher the value is, the more visible the mottling effect.

The measured values are displayed in a graph showing the mottle size on the X-axis and the rating value on the Y-axis. Thus, target values for small and large mottle sizes can be established for paint batch approval as well as process control.

# Interpretation of measurement data

## Example: Light Blue Metallic

In this example the influence of the observing angle is quite significant. Visually medium to large size mottles are most obvious at a head-on viewing when the sample appears lighter, while at flatter angles the mottling is no longer visible.



## Example: Silver Metallic

Horizontal and vertical parts were visually evaluated and measured. The horizontal areas showed a high amount of medium size mottles, while the vertical areas were visually acceptable. The cloud-runner measured high Mg-values at all three angles on the horizontal areas and considerably lower readings on the vertical areas.

