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
The visual perception of motting 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 motting is very subjective, as it depends on the illumination conditions, the observing distance and the viewing angle.

**Simulation of visual perception**

In order to objectively evaluate motting, 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 motting meter is rolled across the surface for a defined distance of 10 to 100 cm and measures the lightness variations point by point.

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 motting 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.

<table>
<thead>
<tr>
<th>Mottle Size</th>
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<tbody>
<tr>
<td>Md</td>
<td>6 - 13 mm</td>
</tr>
<tr>
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<td>Mf</td>
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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.
cloud-runner

Control and guarantee a uniform finish – no more mottling!

Mottling disturbs the overall color harmony of effect finishes. These irregular lightness variations can now be objectively measured with BYK-Gardner’s newest innovation: the cloud-runner simulates visual evaluation under different observing angles and characterizes clouds / mottles by their size and visibility.

Objective and reliable values for QC and trouble shooting

- Small to large mottles are measured under three observing angles
- Scan length can be varied from 10 to 100 cm
- Objective measurement results independent of color and curvature

Ideal tool for the production line

- Small and light weight – easy to handle
- For flat and curved areas, radius > 50 cm
- Easy, menu guided operation via scroll wheel and large, multilingual display
- Full statistics with ability to save in selectable memories
- Large memory for 1000 readings
- USB port for data transfer to PC
- auto-chart software:
  - Organizer files for sample id
  - Data management with Access DB
  - Standard QC Report in Excel®

Always ready

The mottle meter is operated with a rechargeable battery pack (Li-Ion). The docking station automatically charges the battery pack and transfers the measured data to the PC.
Comes complete with:
- Mottling meter with protective cover
- Reference tile with certificate
- Auto-chart software on CD
- Docking station with USB-able
- 2 rechargeable Li-Ion battery packs
- Operating manual
- Carrying case
- Training

Free 1x preventive maintenance service during warranty period

Hardware Requirements:
- Operating system: Windows® 2000 or higher
- Excel® version: 2002 or higher, incl. VBA
- Memory: min. 256 MB RAM (recommended 512 MB)
- Hard-disk space: min. 100 MB
- Monitor resolution: XGA (1024 x 768) or higher
- Disk drive: CD-ROM or DVD
- Interface: USB port

Technical Specifications

<table>
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| Repeatability¹ | 5% or > 0.5 |
| Reproducibility¹ | 8% or > 0.8 |
| Object Curvature | radius > 500 mm |
| Scan Length | 10 to 100 cm, selectable in 1 cm steps |
| Resolution | 25 points/cm |
| Measuring Time | < 4 sec. |
| Memory | 1000 readings |
| Interface | USB 1.1 |
| Languages | English, French, German, Italian, Japanese, Portuguese, Spanish |
| Light Source | White Power LED |
| Dimensions | 150 x 110 x 55 mm (5.9 x 4.3 x 2.2 in.) |
| Weight | 650 g (1.5 lbs) |
| Power Supply | Rechargeable battery pack, approx. 1500 readings |
| Temperature Range | Operation: +10°C to 40°C (+150°F to 104°F), Storage: 0°C to 60°C (+32°F to 140°F) |
| Rel. Humidity | Up to 85% at 35°C (95°F), non-condensing |

¹Standard deviation
Training for cloud-runner
BYK-Gardner offers you more than just an instrument. We assist you in operating the cloud-runner system and understanding your mottle readings. As a result you will be able to use the mottling meter to save time and money and at the same time improve your quality. Therefore, the instrument comes with a one day training course including:

1. Mottling Theory
   ■ Visual perception and instrumental measurement of Mottling / Cloudiness
   ■ Data interpretation: How can the readings be used to optimize process and material parameters

2. Operation and Software Training
   ■ Set-up of an “Organizer” to create a routine measurement procedure
   ■ Programming of the instrument with “organizer” and measurement of several samples
   ■ Direct data transfer to Excel for documentation of individual readings
   ■ Data transfer to auto-chart software and saving in a database for routine QC
   ■ Data analysis

The training can be performed in one day or two half days. It is recommended to split the training into two half days:

Day 1: Theory and basic operation (set-up organizer, taking readings and saving data in a database)
Day 2: 3-4 weeks later to ensure readings were taken and saved in a database. Data analysis and standard QC reports can be explained using customer specific data.

Ordering Information

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<tr>
<td>6353</td>
<td>Reference Tile</td>
</tr>
<tr>
<td>6351</td>
<td>Docking Station</td>
</tr>
<tr>
<td>6349</td>
<td>Battery Pack</td>
</tr>
<tr>
<td>4809</td>
<td>auto-chart</td>
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Accessories

To check performance of the mottling meter, with certificate
Incl. USB interface cable and recharger 100 – 240 V self adapting
Rechargeable battery for automatic charge in docking station
Software for analysis and professional documentation in Excel®

For Certification Services and Preventive Maintenance see pages 268 – 270.
Efficient Data Analysis
with auto-chart Software

Substrate + Coating Material + Application: Numerous production parameters influence the appearance of the coating. Therefore, a representative process control requires structured analysis. The auto-chart software allows for systematic planning and efficient handling of large data sets.

Definition of Test Procedure

The individual object identification and control sequences are defined in the auto-chart software to create so-called "Organizer" files. These Organizer files are then transferred to the instrument and this information is shown on the display of the instrument. This procedure guarantees that every user always measures in the correct sequence – without operator errors.

1. Clear Object Identification
Your parameters for object identification can be model – color – line; the system is open for your specific needs.

2. Definition of Measurement Sequence
In the Organizer file the control zones for each model can be defined.

3. Send Organizer file to the instrument

Measuring: Easy and Quick

Clear object identification without notepad or annoying typing: Just select on the display model, color and line no. and start measuring.

Easy and fast measuring at the production line with model specific operator guidance.

Transfer Data and Save

The measurements are saved in the instrument, transferred to the PC, and displayed in a well structured menu. The measured data can be saved in the integrated Access® database. Thus, large data sets can be easily managed and analyzed.
Professional Analysis and Documentation

auto-chart combines the efficient data management of Access® with the proven Excel® functionality. Standardized reports allow for easy and fast analysis of large data sets with graphics. The results of individual car bodies or comprehensive analysis of various production lines over time can be performed.

Data Selection and Analysis in Excel
Clearly structured queries allow analyzing your data according to your criteria. The filtered data can be analyzed using pre-prepared standard reports or can be directly transferred to Excel®.

Trend Graph

Summary by lines
Shows at one glance how various colors are running at the different paint lines.
Zoneprofile
This standard report compares the values of an actual car body with the results of the previous period—deviations of the required uniformity are quickly detected.

xR-graph: The voice of the process
A typical Statistical Process Control chart for daily process control. The average and range values for defined blocks (e.g., horizontals or verticals) per car are calculated and displayed in a graph. In addition, upper and lower control limits are calculated. Thus, trend can be easily recognized.

Structure spectrum
The structure spectrum is shown for each control zone to support trouble shooting. The example shows the structure spectrum of a silver metallic automobile. Very noticeable is the higher waviness on the fuel door in the range of 1 to 10 mm wavelength (Wc, Wd) which is perceived as higher Orange Peel compared to the body. The flexible reporting possibilities of Excel® allow for professional documentation according to your individual needs.

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Comes complete with: Software on CD-ROM

Note: auto-chart licence fee for more than two installations is quantity dependent. Please contact your local BYK-Gardner representative.

### Technical Specifications

Software for analysis and documentation. For wave-scan dual, wave-scan II, micro-wave-scan, wave-scan DOI and wave-scan ROBOTIC

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- Monitor resolution: XGA (1024 x 768) or higher
- Disk drive: CD-ROM or DVD
- Interface: serial or USB port

Prices are subject to change without notice.