New Structure Space with Balance Chart Analysis

BYK-Gardner GmbH, User Meeting 2010

Uniform Appearance = High Quality

A real challenge

Body vs Add-on parts
Online/off line painting

Various substrates and coating technologies

Stable process to guarantee quality over time
Appearance is influenced by ...

Waviness - Orange Peel

Brilliance - DOI

Appearance Perception

Focus on reflected Image

Focus on Surface

Gloss / Brilliance

Structures / Waves
Visual Perception of Orange Peel

Appearance changes with Observing Distance

One sample

SW: 17
LW: 6

40 cm

3 m
Appearance changes with Observing Distance

Visibility of Structures

Resolution of the human eye
wave-scan: Measurement Principle

Measurement Principle: wave-scan DOI
Wavelength ranges - new separation into 5 ranges

Classical scales: SW LW

Structure - Spectrum

Sample C

Sample D
Appearance is influenced by ...

Waviness + DOI

Contrast Sharpness Distinctness

What is DOI?

Good Poor

Contrast - Sharpness - Distinctness
Influence of structure on DOI

- Light scattering cause a contrast reduction
- Small structures cause a distortion of outlines

Measurement of light scattering (< 0.1 mm)

- Scattering caused by structures < 0.1mm
- Scatter value \( \max \) = dullness
**Dullness**

Independent of paint material

Works on curved surfaces

**Complete Structure Spectrum**

<table>
<thead>
<tr>
<th>dullness</th>
<th>&lt; 0.1</th>
<th>0.1-0.3</th>
<th>0.3-1</th>
<th>1 - 3</th>
<th>3 - 10</th>
<th>10 - 30 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wb</td>
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<tr>
<td>We</td>
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Page 17, BYK-Gardner GmbH, Appearance of Automotive Finishes

Page 18, BYK-Gardner GmbH, Appearance of Automotive Finishes
Distinctness Of Image

![Graph showing distinctness of image](image)

$$DOI = f(du, Wa, Wb)$$

wave-scan - more than just an “Instrument”

- QC tool to document appearance and recognize changes early
- Measurement results help to improve quality

[Diagram showing wave-scan with arrows to Substrate Quality, Paint Materials, and Process Parameters]
Influence of baking position on appearance

Influence of clear coat film build on appearance
Influence of flash-off time on appearance

- Flash-off: 9 min. vs. 3 min.
- Hood and Door
- Longwave
- Shortwave

Influence of steel quality on final appearance

- Topcoat result on rough and smooth steel
- Significant Difference in Short Waves
Topcoat appearance observed at 40cm distance

Topcoat on rough steel:
SW dominates visual

Topcoat on smooth steel
Appears smooth

Improve appearance

Original: High Waviness

1. Step: Optimize CC Application
1. Step: Optimized Clear coat

2. Step: Sanding of primer

Improve appearance

2. Step: Sanding of primer

3. Step: Optimized primer / topcoat application
Well Balanced Structure Spectrums developed by Orange Peel Workgroup

Well balanced ratio of “Wd” and “Wb”

\[ W_{bo} = 6 \sqrt[6]{W_d} + 4 \]

Experimental Result:
- Wb minimum = 10
- Wb – Wd relation = 6 \sqrt[6]{W_d}
- BMW experience with N 1m
- Visual evaluation

\[ B = 10 \times \frac{W_b - W_{bo}}{W_{bo}} \]
Balance Chart - The Easy Way
for comprehensive and clear data visualisation

Balance B

Waviness Wd

less short waves
long waves get dominant

well balanced

more short waves
short waves get dominant
Data Interpretation
How are the balance?

Different paint process
conventional versus short paint process
Prozess Control with Balance Chart
Overview: All colors meet the specs (in average)

How stabil runs silber metallic?
Compare car by car ➔ normal variation
**How stabil runs silver metallic?**
Check uniformity → very uniform within carbody

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<tr>
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<th>Color</th>
<th>Model</th>
<th>Date: 01.01.1992 to 25.01.1992</th>
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</thead>
<tbody>
<tr>
<td>Check Zone</td>
<td>Roof</td>
<td>Door</td>
<td>Head Left (H) Head Right (R)</td>
</tr>
<tr>
<td>UV Light</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Sanding</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Line Stop</td>
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**How stabil runs red solid?**
Compare car by car → significant variation on verticals

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How stabil runs red solid?
Check uniformity ➔ non uniform on verticals

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