BYK-mac with smart-chart
The QC Solution for Effect Coatings

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Surface quality

Gloss
Distinctness of Image

Color
Effect

Orange Peel
Effect Coatings
80% of today's automotive finishes are effect coatings

- Metallic coatings accentuate the curved profile: Light – Dark Flop

- Pearlescent coatings result in a more spectacular color effect: Color Flop

- Effect finishes with special glitter effect (Xirallics™)

Photo: Courtesy of MERCK
Multi-angle Measurement Geometries
Aspecular viewing angles
Color changes with Viewing Angles

Traditional 5-angle

New: -15°

Photos: Courtesy of
Surface quality

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Orange Peel
Appearance of effect finishes depends on illumination conditions:

**Sunny sky: Direct illumination**
- Color starts to sparkle

**Cloudy sky: Diffused illumination**
- Fine versus grainy pattern
Visual Appearance of Effect Finishes under diffused lighting

Graininess:
Texture – Structure – Coarseness – Salt & Pepper

Viewing conditions:
• Diffused light
• Close observation distance
• Observation angle not important

Potential causes of graininess:
• Flake type – flake size
• Disorientation of flakes
• Agglomeration of particles
Visual Appearance of Effect Finishes under direct illumination

Sparkle: Micro brightness – Glints – Diamonds

**Viewing conditions:**
- Spotlight ~ direct sun light conditions
- Observation angle critical: Sparkle impression changes with illumination angle

**Sparkle is generated by e.g.:**
- Reflectivity of the individual effect pigment (alu flakes, mica, Xirallics®)
- Amount of effect pigments
- Size of the aluminum flakes
- Flake orientation → Sparkle 75°
Flake Characterization
Evaluation of the optical properties of effect particles

• Camera Analysis:
The spatial resolution of the CCD chip correlates to the spatial resolution of the human eye.

• Camera pictures are taken under different light conditions to simulate sunny sky and cloudy sky.

• The sparkling impression is evaluated under 3-illumination angles: 15° - 45° - 75°
Camera pictures characterize Sparkle and Graininess
Calculation of Sparkle and Grainingness values

Analysis of the histograms

Count

Lightness
Grades

Sparkle 15°  Sparkle 45°  Sparkle 75°  Grainingness
Flake Characterization

Analysis of Sparkle Effect:

- **Sparkling area** is detected → Not size of the individual effect pigment

- **Sparkling intensity** is measured: How strong is the light flash of the effect pigment

- Total **Sparkle Grade** is determined as a function of Sparkle area and Sparkle intensity
Analysis of Sparkle Effect

Sparkle Parameters Absolute:
• 1-dimensional:
  Sparkle Grade
• 2-dimensional system:
  Sparkle area – Sparkle intensity

Sparkle Grade = f (Sa; Si)
Analysis of Sparkle Effect

Sparkle Parameters Differences:
• 2-dimensional:
  \( \Delta \) Sparkle area – \( \Delta \) Sparkle intensity

\[ \Delta = \text{Sample} - \text{Standard} \]

What are visually acceptable tolerances for Sparkle differences?
Sparkle Tolerance Model

Tolerance for Grade: \( \text{Tol}_{\text{Gr}} = +/- 1 \)

Visually the samples look very different within the marked tolerance range.

Tolerance within Grade:
\( \text{Tol}_{\text{GF}} \times \text{Tol}_{\text{Gr}} \)
Sparkle Tolerance Model

Tolerance within Grade > Tol. Grade to Grade

\[ \Delta S = \text{Total Sparkle Difference} \]

\[ \Delta S = \left[ \left( \frac{\Delta S_a}{f(Tol\_Gr)} \right)^2 + \left( \frac{\Delta S_i}{f(Tol\_GF \times Tol\_Gr)} \right)^2 \right]^{1/2} \]

- 2 - dimensional distance to standard
- Weighted with length of ellipse axis

\[ Tol\_GF \times Tol\_Gr = 2 \times 1 \]

\[ Tol\_S \text{ sets tolerance:} \]

\[ \Delta \text{Sparkle} < Tol\_S \quad \text{PASS} \]
\[ \Delta \text{Sparkle} > Tol\_S \quad \text{FAIL} \]
Sparkle Tolerance Model

Tol_Grade = 1
Tol_GF = 2
Tol_S = 1

\( \Delta S = 1.07 \)
\( \Delta S = 0.66 \)

Tol_Grade = 1
Tol_GF = 2
Tol_S = 2

\( \Delta S = 1.07 \)
\( \Delta S = 0.66 \)

Tol_Grade = 1
Tol_GF = 3
Tol_S = 1

\( \Delta S = 0.72 \)
\( \Delta S = 0.63 \)
Flake Characterization

Analysis of Graininess Effect:

• Uniformity of light/dark areas is evaluated and summarized in a **Graininess** value

• 1-dimensional scale: relative dimension

• Solid color (very uniform) → **Graininess = 0**
NEW smart-chart Software for BYK-mac, wave-scan Family, cloud-runner

- **Standard Management**
  Define standard settings and tolerances

- **Organizer**
  Define sample identification and measurement procedure

- **Data Analysis**
  Display single test series and process control charts

- **Instrument Management**
  Send Organizer / Standards / Date and Delete Data

- **Data Transfer**
  Download measurement data / standards from instrument and save in database

- **Configuration**
  Define database settings, instruments and language
smart-chart Software: Standard Management

Set Color difference method: \( dE_c - dE_p \)

Set measurement geometries

Define color families with common settings: \( \Delta E \) equation, geometry, statistic

Define tolerances and limits
smart-chart Software: Standard Management

Define effect tolerances / limits

Set effect geometries
NEW smart-chart Software for BYK-mac, wave-scan Family, cloud-runner
smart-chart Software: Organizer

Clear sample identification:
Par 1: Models
Par 2: Colors
Par 3: Paint Booths
smart-chart Software: Organizer for BYK-mac

Menu guided operation:
Car schematics help to define sampling procedure
smart-chart Software: Organizer for BYK-mac

Example: Color Harmony test procedure

- Checkzone creation
- Curvature per checkzone
- Number of readings per checkzone
- Definition of “Panel Matches”
NEW smart-chart Software for BYK-mac, wave-scan Family, cloud-runner
smart-chart Software: Data Analysis for BYK-mac

- Filter database by: Status – Date – Model – Color – Paintline – Instrument
- Click on “Refresh”
  → List of all measured vehicles which “failed”
- Click on individual vehicle for detailed report
smart-chart Software: Data Analysis for BYK-mac
Single Car Analysis

• Car schematic with traffic light symbols
• Panel match with Pass/ Fail analysis
• Match to standard with Pass/Fail