Forensic Examination of Paint

Physical and Chemical Properties

Components of Paint

- Made up of 3 primary components
  - Binders
    - Provides support medium for pigments and additives
  - Pigments
    - Impart color and opacity
  - Solvents
    - Suspension of binders and pigments for application
## Where Paint is Encountered in Forensic Science

- Hit-and-run accidents
- Paint transfer
- Fabric impressions
- Burglary cases
- Tool marks
- Fingerprints in wet paint
- Shoe impressions in wet paint
- Tire impressions

## Automotive Paint

- Powder coating colored with dye
- Four step finishing systems gives rise to layered paint
  1. Electrocoat Primer
  2. Primer Surfacer
  3. Basecoat
  4. Clearcoat
### Four Step Finishing System

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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| 1.   | **Electrocoat Primer:**  
|      | - Epoxy-based resin  
|      | - Electrocoated onto the steel body  
|      | - Colors range from black to gray  |
| 2.   | **Primer Surfacer:**  
|      | - Powder  
|      | - Highly pigmented epoxy-modified polyesters or urethanes  
|      | - Helps the color basecoat bind to the primer  |
| 3.   | **Basecoat:**  
|      | - Provides the color  
|      | - Acrylic-based polymer  
|      | - Additional components for varied finishes  
|      |   - Aluminum flakes  
|      |   - Pearl luster  
|      |   - Metal oxides  |
Four Step Finishing System

<table>
<thead>
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<th>4. Clear coat:</th>
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<tbody>
<tr>
<td>• Unpigmented powder</td>
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<td>• Gloss</td>
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<td>• Durability</td>
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<td>• Etch resistance</td>
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<tr>
<td>• Acrylic or polyurethane-based</td>
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<td>• Cross-linking of clear coat and base coat (baked)</td>
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Moral of the Story

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<th>More layers = more unique sample</th>
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<td>• Provides more certainty in the identification of the origin or source</td>
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<td>• Each manufacturer will have a different recipe due to varying finishes and other additives contributing to uniqueness of paint chip.</td>
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<td>• Chemical analysis</td>
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## Importance of Automotive Paint to Forensic Science

- Color
- Manufacturer
- Model
- Model year
- Limited to factory-applied, original automotive paint
- Paint Data Query (PDQ)

## Paint Data Query (PDQ)

- Worldwide, searchable database of chemical and color information of original automotive paints
  - Make, model, year, and assembly plant for many vehicles
- 30 years of accumulated information provided by automotive companies and forensic laboratories or police
- Information can lead to a possible suspect vehicle
Physical Examination of Paint

- Color assessment
  - Especially the hue
  - Human eye and Munsell color system
- Number, sequence and thickness of layers
- Surface texture of the paint
- Match physical irregularities
  - Scratches, contours that are continuous with the known and unknown
  - Physical fit of two paint chips

FIGURE 8–17 Paint chip 1 was recovered from the scene of a hit-and-run. Paint chip 2 was obtained from the suspect vehicle. Courtesy New Jersey State Police.
Chemical Examination of Paint

- Solubility
  - Different samples may show different solubility in various solvents
  - Acetone
  - Methanol
  - Chloroform
  - Hydrochloric acid
  - Potassium hydroxide

Chemical Examination of Paint

- Fourier Transform Infrared Spectroscopy (FT-IR)
- Classification of organic and inorganic chemicals
- Infrared light causes bonds to stretch, contract, bend
- Sample absorbs different wavelengths of IR light
- Absorption spectrum for each layer of paint scanned
FT-IR Comparison

References

- http://www.nuance.northwestern.edu/KeckI/ftir1.asp