RESPONDING TO CHALLENGES IN TESTING WOOD COATINGS AND FINISHED WOOD SUBSTRATES

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WOOD COATINGS

Retail Paints and Coatings

Decorative

Wood Coatings

Non-Decorative

Waterproofing

Protective Coatings (Metal and Concrete)

Others (Automotive Coatings, Construction Chemicals and other paints and coatings)
TESTING OF WOOD COATINGS

Testing accompanies

- Academic research and R&D of new products
- Evaluation of coating, wood and coated wood properties
- Assessment of long and short term durability
- Selection of a coating for specific wood species and service conditions
- Quality Control in manufacturing (raw materials and finished products)
- Failure Analysis
TESTING OF WOOD COATINGS

Testing Requirements

• Well reflects tested properties
• Good reproducibility
• Good repeatability
• Inexpensive
• Simplicity
• Wide acceptance
CHALLENGES IN WOOD COATINGS

Wood creates specific challenges for coating finishes due to its:

- Anisotropic shrinkage/swelling
- Porosity
- Water absorption
- Variable surface structure and texture
- Specific features
- Presence of extractives
- High variability of properties
- Sensitivity to weather elements
- Support of biological activity

These challenges are reflected in specific testing requirements.
# ASTM STANDARDS USEFUL IN TESTING WOOD COATINGS

<table>
<thead>
<tr>
<th>Properties</th>
<th>Wood</th>
<th>Coating</th>
<th>Wood/Coating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating film thickness</td>
<td></td>
<td></td>
<td>D5235 (6132)</td>
</tr>
<tr>
<td>Extractives staining</td>
<td>NA</td>
<td>NA</td>
<td>D6686</td>
</tr>
<tr>
<td>Water permeability</td>
<td>NA</td>
<td>D1653</td>
<td>D5795</td>
</tr>
<tr>
<td>Water absorption/resistance</td>
<td>D1037; D7433;</td>
<td>D4585; D870;</td>
<td>D5401</td>
</tr>
<tr>
<td></td>
<td>D4442</td>
<td>D2247 and others</td>
<td></td>
</tr>
<tr>
<td>Water repellency</td>
<td>D4446; D2921</td>
<td></td>
<td>D6763; D4446</td>
</tr>
<tr>
<td>Tensile of film</td>
<td></td>
<td>D2370</td>
<td></td>
</tr>
</tbody>
</table>
**ASTM STANDARDS USEFUL IN TESTING WOOD COATINGS**

<table>
<thead>
<tr>
<th>Properties</th>
<th>Wood</th>
<th>Coating</th>
<th>Wood/Coating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerated biological activity: Interior/exterior</td>
<td>D1413</td>
<td>D5590</td>
<td>D3273; D3274; D3456</td>
</tr>
<tr>
<td>Variability of properties and surface features</td>
<td></td>
<td></td>
<td>D7787</td>
</tr>
<tr>
<td>Accelerated weathering exterior</td>
<td></td>
<td></td>
<td>D4587; D6695; STP1615S; D1014</td>
</tr>
<tr>
<td>Finished flooring</td>
<td></td>
<td></td>
<td>D2394</td>
</tr>
<tr>
<td>Furniture coating</td>
<td></td>
<td>D333</td>
<td>D25712</td>
</tr>
<tr>
<td>Resistance to stains and reagents</td>
<td></td>
<td></td>
<td>D3023</td>
</tr>
</tbody>
</table>
CHALLENGES IN TESTING WOOD COATINGS - D5235

Challenges in Dry Film Thickness (DFT) Measurement

- Variable DFT due to wood surface roughness (peaks and valleys)
- Lumens
- Coating “soaking in”

Responding to Challenges

- Use of photomicrographs
- Computerized image analysis
- Criteria to define wood/coating interface

The coating filling the open vessels of wood are included in the dry film thickness measurement. The partially filled vessels (1) are excluded.
CHALLENGES IN TESTING WOOD COATINGS – D5235
ASTM ILS 1184
(interlaboratory study)

1. Engineered wood flooring with clear coat

2. MDF moulding with white primer

3. Spruce siding board with two coat exterior finish
CHALLENGES IN TESTING WOOD COATINGS – D5235

ASTM ILS 1184 (interlaboratory study)

1. Engineered wood flooring coating cross-section

2. MDF moulding primer cross-section

3. Spruce siding board two coat exterior finish cross-section
### CHALLENGES IN TESTING WOOD COATINGS – D5235

#### ASTM ILS 1184 (interlaboratory study)

<table>
<thead>
<tr>
<th>Material Description</th>
<th>Average</th>
<th>Repeatability Standard Deviation</th>
<th>Reproducibility Standard Deviation</th>
<th>Repeatability Limit*</th>
<th>Reproducibility Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineered Flooring</td>
<td>49.24</td>
<td>0.58</td>
<td>9.29</td>
<td>1.62</td>
<td>26.01</td>
</tr>
<tr>
<td>MDF Molding</td>
<td>85.04</td>
<td>0.25</td>
<td>3.50</td>
<td>0.71</td>
<td>9.80</td>
</tr>
<tr>
<td>Siding board 1st coat (base coat)</td>
<td>65.26</td>
<td>0.66</td>
<td>20.95</td>
<td>1.83</td>
<td>58.66</td>
</tr>
<tr>
<td>Siding board 2nd coat (top coat)</td>
<td>56.12</td>
<td>0.22</td>
<td>2.50</td>
<td>0.61</td>
<td>7.01</td>
</tr>
<tr>
<td>Siding Board, 1st coat and 2nd coat (combined)</td>
<td>121.37</td>
<td>0.53</td>
<td>23.04</td>
<td>1.48</td>
<td>64.52</td>
</tr>
</tbody>
</table>

Six laboratories participated in this study
CHALLENGES IN TESTING WOOD COATINGS

Report Holzforschung: “Measurement of Dry Film Thickness of Coating on Wood”

1. Three species of wood: spruce, beech, meranti.

2. Three white pigmented coatings with different thicknesses.

3. Three different DFT measurement methods:
   a) microscopic measurement (EN ISO 2808-07) - 10 laboratories
   b) microscopic area method (similar to ASTM D5235) - 4 laboratories
   c) ultrasonic measurement (similar to ASTM D6132) - 3 laboratories
CHALLENGES IN TESTING WOOD COATINGS

Report Holzforschung: “Measurement of Dry Film Thickness of Coating on Wood”

Conclusions:

• Large reproducibility limit between laboratories mainly due to different identification of wood/coating interface

• Microscopic area method delivered mean values slightly higher than ISO 2808

• Ultrasonic method resulted in mean values higher with no reduction in variability.
Fungal defacement challenges

1. Microbiological test variability
2. Simulation of environmental impact.
3. Correlation between laboratory and field performance
4. Impact of migration wood extractives

Aureobasidium pullulans growing on wood coating
CHALLENGES IN TESTING WOOD COATINGS
D5590 - STANDARD TEST METHOD FOR DETERMINING THE RESISTANCE OF PAINT FILMS AND RELATED COATINGS TO FUNGAL DEFAECMENT BY ACCELERATED FOUR-WEEK AGAR PLATE ASSAY

• Method is intended for the comparison of paint films, not painted wood
• Accelerated weathering included in a note in D5590-00 version
• Accelerated weathering added as an option in D5590-17 version
• Question: Is this the correct method for testing wood coatings?
CHALLENGES IN TESTING WOOD COATINGS
D5590 - STANDARD TEST METHOD FOR DETERMINING THE RESISTANCE OF PAINT FILMS AND RELATED COATINGS TO FUNGAL DEFACEMENT BY ACCELERATED FOUR-WEEK AGAR PLATE ASSAY

- ILS 1441 from 2017 – accelerated weathering of samples

Control – not weathered
RT dry – 7 days @50% RH

Dried 70°C; Leached 24h; QUV 500h
CHALLENGES IN TESTING WOOD COATINGS – ADHESION

**D3359 testing challenges**

- Lack of important test details
- Grains and features of wood
- Roughness of surface
- Variability in moisture content

**D5179 testing challenges**

- Grains and features of wood
- Roughness of surface
- Variability of moisture content
- Complex specimens preparation
- Expensive equipment
- Test not suitable for field inspection
- Destructive
CHALLENGES IN TESTING WOOD COATINGS

Liquid and Water Vapour Permeability

\[
\begin{align*}
\text{Average Weight Decrease (g)} & \quad y = 0.02360x + 2.27390 \\
R^2 & = 0.99831
\end{align*}
\]

Duration (hrs)

D1653 D5795
CHALLENGES IN TESTING WOOD COATINGS

Standards revisions

ASTM requires periodic revision of each standard

- Respond to challenges
- Update procedure
- Address technological advances

Existing standard revisions and preparation of new standards require qualified technical personnel with a wide range of expertise.
ASTM Standards Development Activity Stats:

D01 Committee on Paint and Related Coatings Materials and Applications:
- 641 Standards
- 35 Technical Subcommittees
- 620 Members
- Established in 1902
- Meets twice a year in January and June:
  - Jan 2019: Houston, TX; June 2019: Denver, CO

D07 Committee on Wood:
- 91 Standards
- 10 Technical Subcommittees
- 270 Members
- Established in 1904
- Meets twice a year in April and October:

Paint & Coatings, and Wood related ASTM Standards…
… more new standards are always in production
Some Standard Fundamentals…

What is a Standard?

− Types of Standards:
  − Specification / Test Method / Practice / Guide / Terminology
  − Company Std / Consortium Std / Industry Std / Government Std

How are Standards Made?

− Written by a group of experts, who are committee members, who volunteer their time in draft-development sessions
− A standard is published after it has been approved by the committee via a consensus process
− The consensus will consist of ALL stakeholders with an interest in its use, it will include trade associations / government agencies / professional societies / manufacturers / users / consumer groups

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