



RESPONDING TO CHALLENGES IN TESTING WOOD COATINGS AND FINISHED WOOD SUBSTRATES

8th Wood Coatings and Substrates Conference

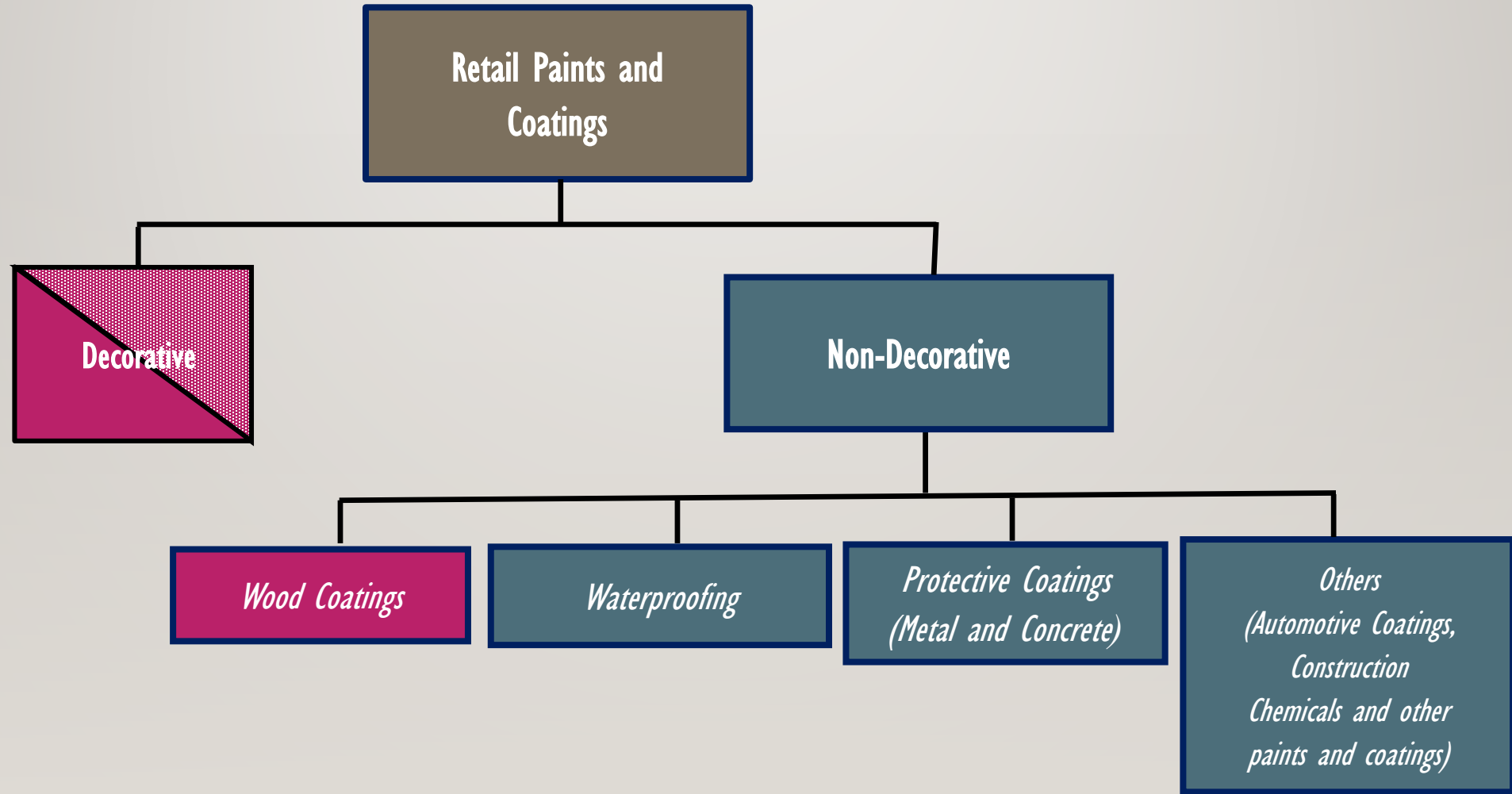
Greensboro, North Carolina

September 20-21, 2018

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WOOD 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:

- Anistropic 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

<u>Properties</u>	<u>Wood</u>	<u>Coating</u>	<u>Wood/Coating</u>
Coating film thickness			D5235 (6132)
Extractives staining	NA	NA	D6686
Water permeability	NA	D1653	D5795
Water absorption/resistance	D1037; D7433; D4442	D4585; D870; D2247 and others	D5401
Water repellency	D4446; D2921		D6763; D4446
Tensile of film		D2370	

ASTM STANDARDS USEFUL IN TESTING WOOD COATINGS

<u>Properties</u>	<u>Wood</u>	<u>Coating</u>	<u>Wood/Coating</u>
Accelerated biological activity: Interior/exterior	D1413	D5590	D3273; D3274; D3456
Variability of properties and surface features			D7787
Accelerated weathering exterior			D4587; D6695; STPI615S; D1014
Finished flooring			D2394
Furniture coating		D333	D25712
Resistance to stains and reagents			D3023

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

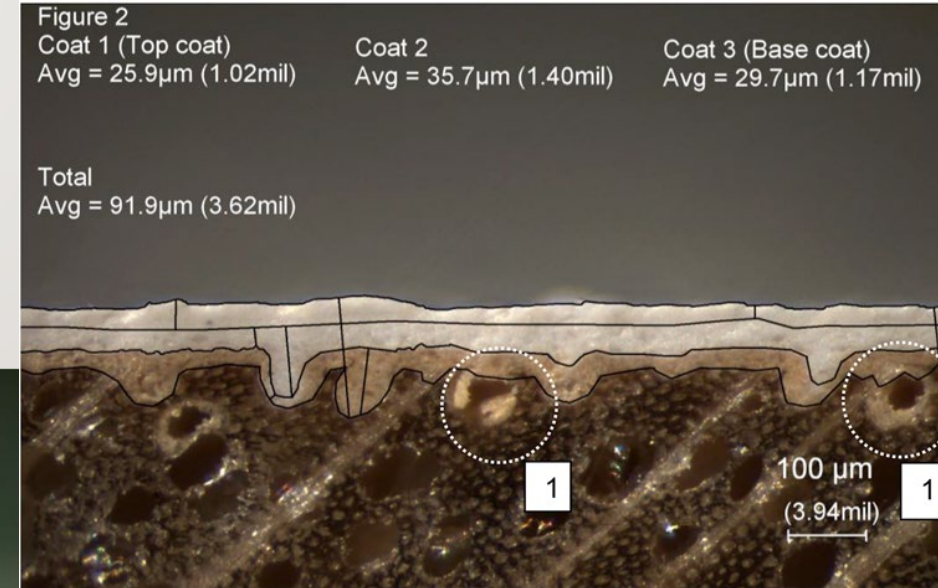
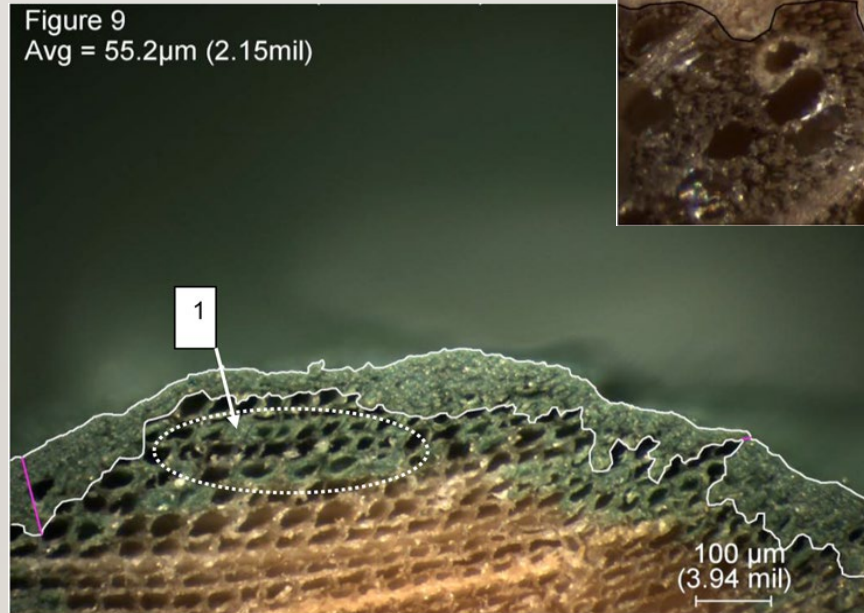


Figure 9
Avg = 55.2 μ m (2.15mil)



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



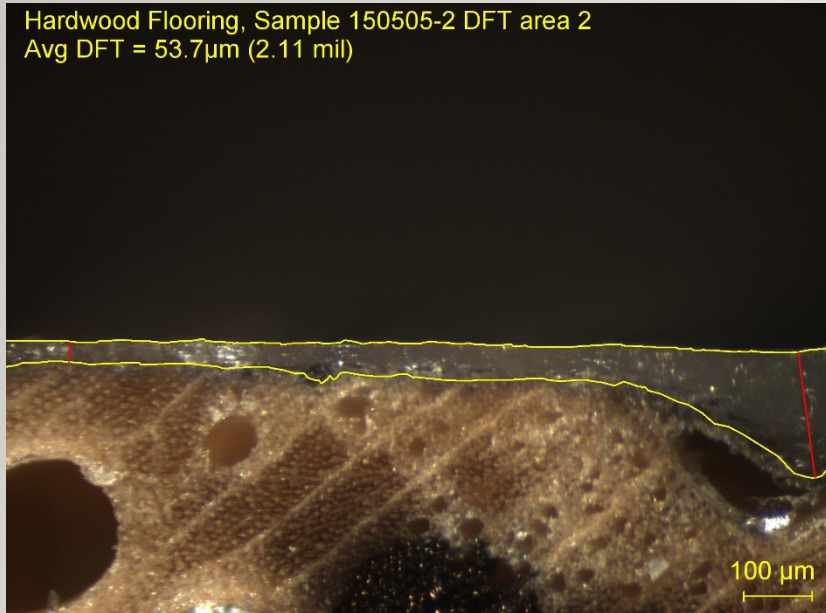
3. Spruce siding board with two coat exterior finish



CHALLENGES IN TESTING WOOD COATINGS – D5235

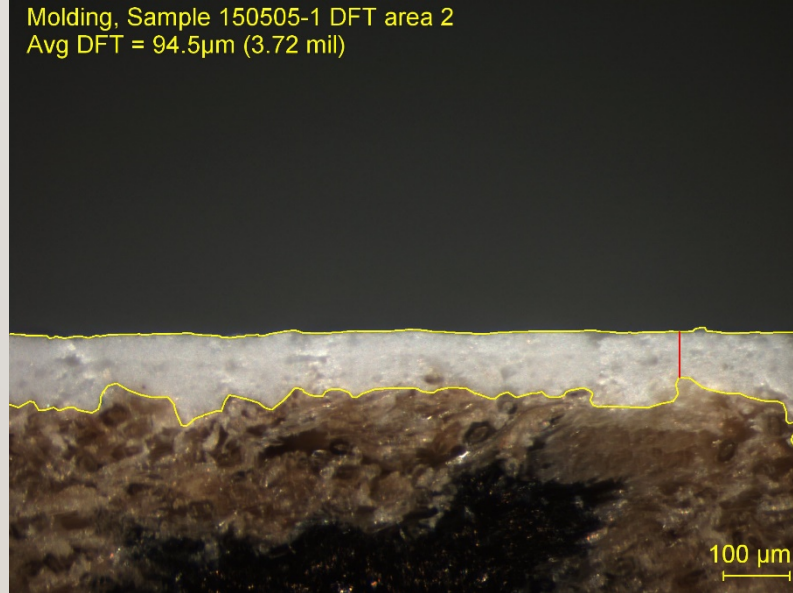
ASTM ILS 1184 (interlaboratory study)

Hardwood Flooring, Sample 150505-2 DFT area 2
Avg DFT = 53.7 μ m (2.11 mil)



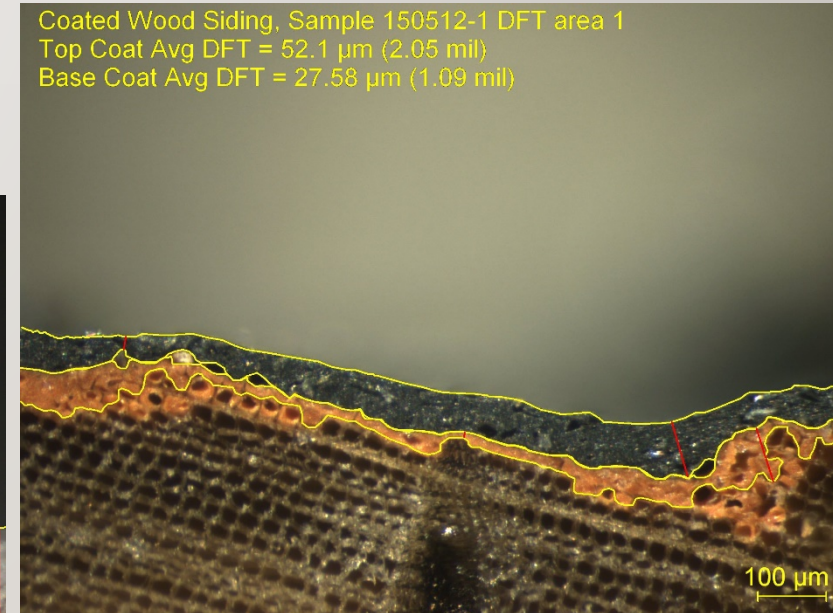
1. Engineered wood flooring
coating cross-section

Molding, Sample 150505-1 DFT area 2
Avg DFT = 94.5 μ m (3.72 mil)



2. MDF moulding primer
cross-section

Coated Wood Siding, Sample 150512-1 DFT area 1
Top Coat Avg DFT = 52.1 μ m (2.05 mil)
Base Coat Avg DFT = 27.58 μ m (1.09 mil)



3. Spruce siding board two coat
exterior finish cross-section





CHALLENGES IN TESTING WOOD COATINGS – D5235

ASTM ILS 1184 (interlaboratory study)

	Average	Repeatability Standard Deviation	Reproducibility Standard Deviation	Repeatability Limit*	Reproducibility Limit
	\bar{X}	S_r	S_R	r	R
Engineered Flooring	49.24	0.58	9.29	1.62	26.01
MDF Molding	85.04	0.25	3.50	0.71	9.80
Siding board 1 st coat (base coat)	65.26	0.66	20.95	1.83	58.66
Siding board 2 nd coat (top coat)	56.12	0.22	2.50	0.61	7.01
Siding Board, 1 st coat and 2 nd coat (combined)	121.37	0.53	23.04	1.48	64.52

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:

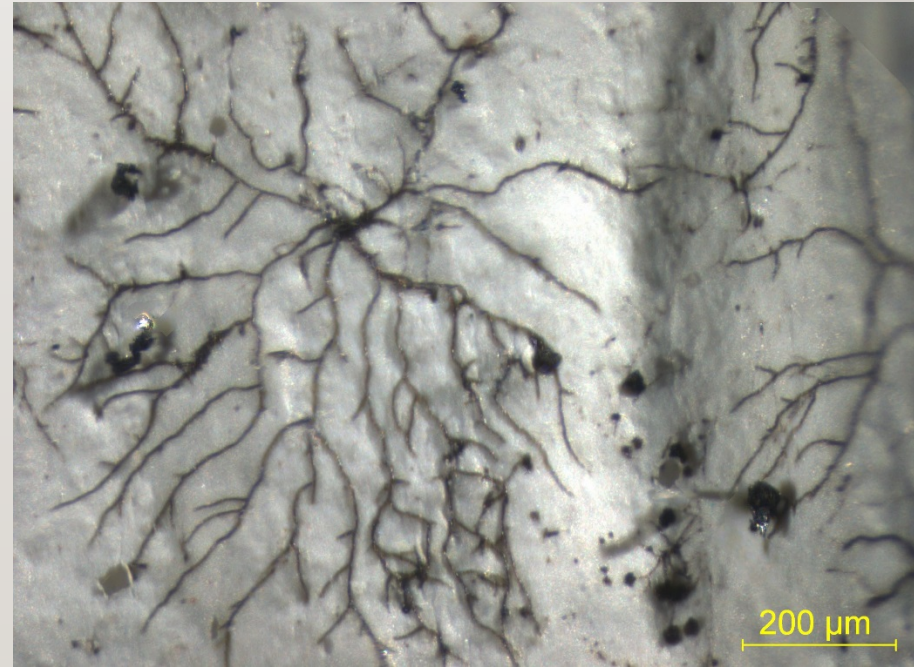
- Large reproducibility limit between laboratories mainly due to different identification of wood/coating interface
- Microscopic area method delivered mean values slightly higher than ISO 2808
- Ultrasonic method resulted in mean values higher with no reduction in variability.



CHALLENGES IN TESTING WOOD COATINGS – D5590

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 DEFACEMENT BY ACCELERATED FOUR-WEEK AGAR PLATE ASSAY

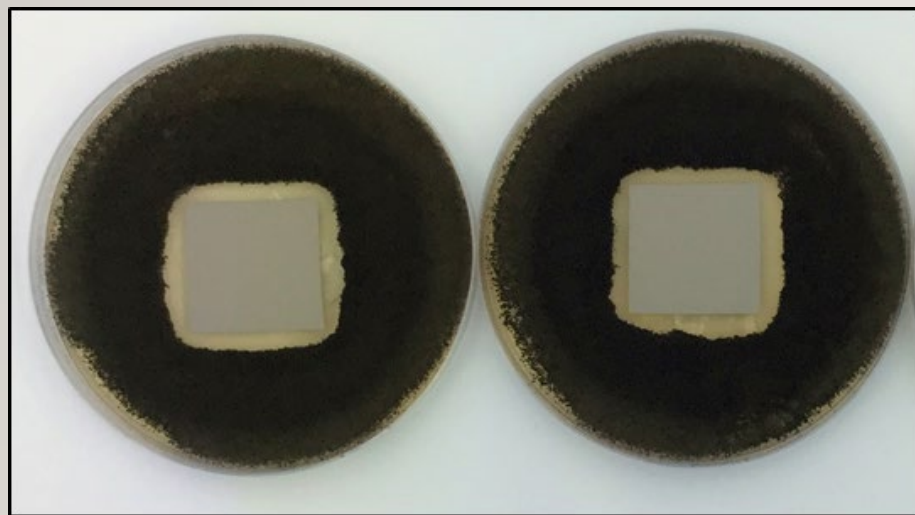
- Method is intended for the comparison of paint films, not painted wood
- Accelerated weathering included in a note in D5590-00 version
- Accelerated weathering added as an option in D5590-17 version
- Question: Is this the correct method for testing wood coatings?



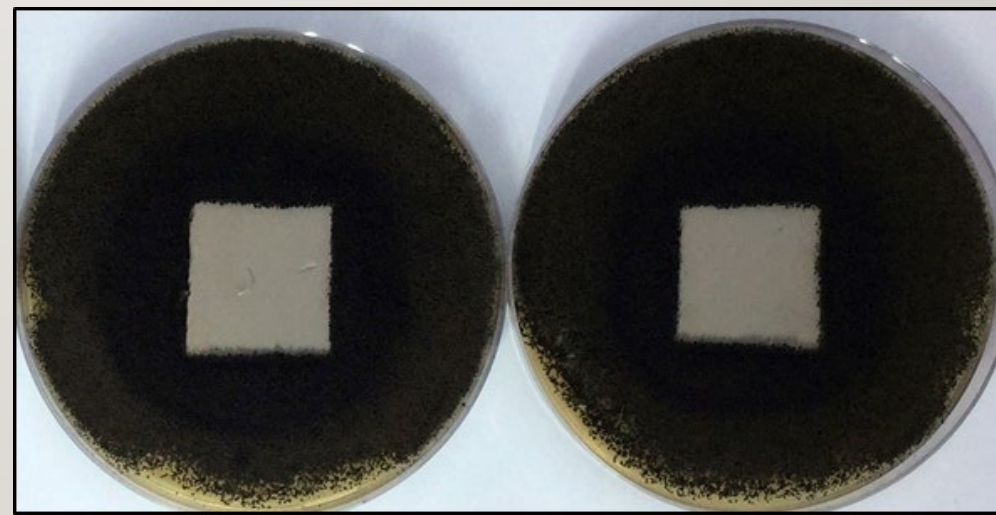
CHALLENGES IN TESTING WOOD COATINGS

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

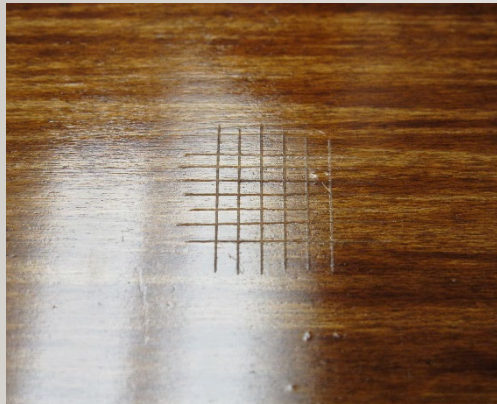


Dried 70°C; Leached 24h; QUV 500h

CHALLENGES IN TESTING WOOD COATINGS – ADHESION

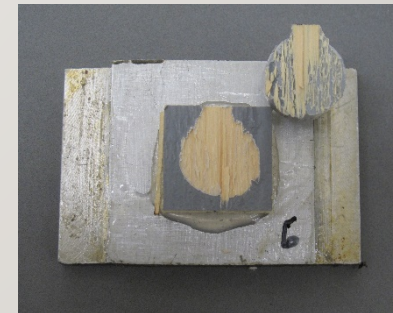
D3359 testing challenges

D5179 testing challenges



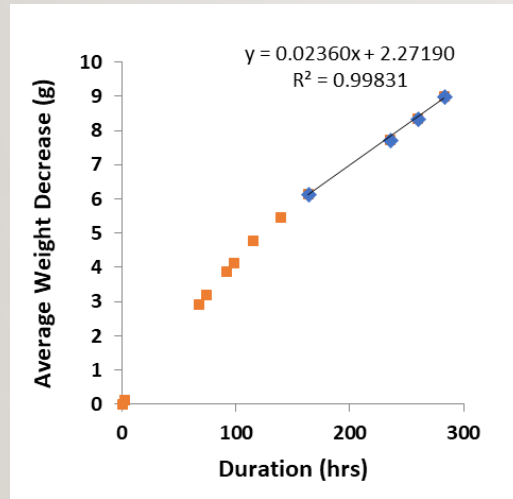
- Lack of important test details
- Grains and features of wood
- Roughness of surface
- Variability in moisture content

- 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



DI653

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:

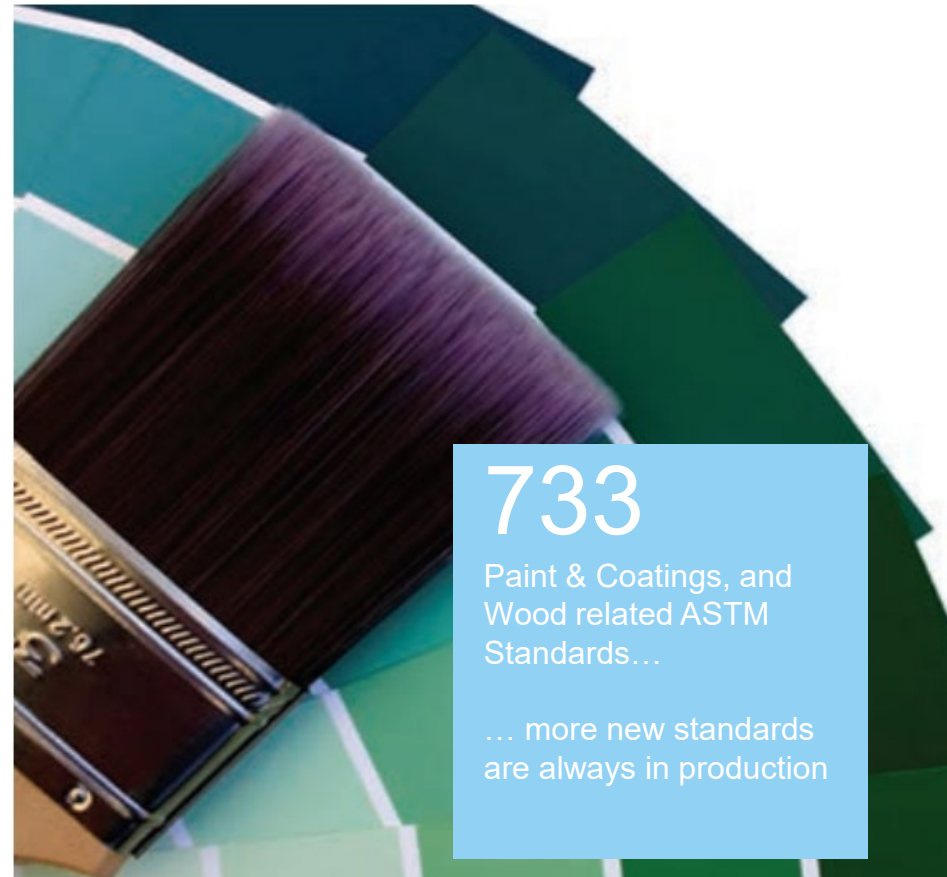


D01 Committee on Paint and Related Coatings Materials and Applications:

- 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:
 - Oct 2018: Wash., D.C.; April 2019: Denver, CO



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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