Advanced Coil Coating Measurement Solutions for Enhanced Plant Productivity & QA
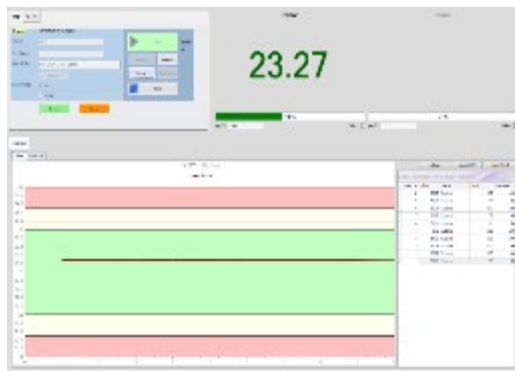

Industry, Technology and Product Overview:

spec METRIX®

Technology by SENSORY ANALYTICS

1

Dedicated coating thickness & process control focus

Sensory is the sole source of SpecMetrix® ROI & EXR technology
  - ❖ Exclusive optical measurement technique for diverse applied coatings
  - ❖ Non-contact coating QA tools exclusively from Sensory Analytics

SpecMetrix is the fastest-growing optical thickness gauge brand
  - ❖ Global sales and regional support teams now cover 50+ countries
  - ❖ Expanding list of OEM partners now offer *SpecMetrix* systems on new lines
  - ❖ Fast-becoming preferred DFT measurement choice of global coil leaders

Specified as new standard for coating thickness measurement

Industrial Applications of SpecMetrix Systems

- **Metal Coils/Containers**
- Rigid Packaging
- Flexible Packaging
- Industrial Coatings/Finishes
- Aerospace & Defense
- Automotive

Next Generation DFT Measurement & Process Control

✓ SpecMetrix® systems help coil coaters reduce QA and production costs, reduce consumption and waste, improve coating process control and streamline plant QA processes

✓ Expanding line *of SpecMetrix In-line* film weight measurement systems accurately measure coatings in-process on metal coils

- ❖ Thin coatings, clear coats and wet pretreatments
- ❖ Laminated metal coils
- ❖ Primers
- ❖ Back coats
- ❖ Top coats, excluding *Plastisol/PVC coatings* > 3 Mils

✓ Exclusive film weight measurement & process control tools:
- ❖ *Metpack Innovation (Gold) Award Winner* - *EU*
- ❖ *AIMCAL Technology of Year Winner* - *USA*
- ❖ *ICE Asia Innovation Award Winner* - *China*

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Opportunity: Real-Time Coating QA & Process Control

Reduced plant production costs
- ❖ Shorter set-up and change-over times
- ❖ Optimized coating consumption
- ❖ Less material waste
- ❖ Increased production throughput

Improved coated product quality
- ❖ Most wet/dry coatings accurately measured
- ❖ Non-contact and immediate thickness results
- ❖ More QA data - with <u>quality record</u> for each coil

Reduced environmental footprint
- ❖ Less solvent usage
- ❖ Less oven use and lower energy costs

5

# SpecMetrix® metal customers include most global leaders:

Metal containers

CROWN — Brand-Building Packaging™ | Ball | SILGAN CONTAINERS | ENVASES UNIVERSALES | B-WAY
ArdaghGroup | ORORA | CP CAN-PACK S.A. | NP Bevcan packaging excellence | MONSTER ENERGY

Material suppliers

SHERWIN-WILLIAMS Coil Coatings | AkzoNobel | Beckers | PPG | INX Ink & Coating Solutions

Coated metal coils

ArcelorMittal | Precoat Metals | Aleris ALUMINUM | TATA STEEL
Ternium | LOGAN ALUMINUM INC. | ADITYA BIRLA NOVELIS | italcoat | steelscape
BAOSTEEL | Constellium | ALCOA | MARCEGAGLIA | Steel Dynamics, Inc.

➤ Proprietary '**ruggedized optical interference**' ROI technology

➤ Absolute thickness measurements

➤ Substrate independent

➤ Measures clear and opaque coatings

➤ Easy to add new coating recipes

➤ Scalable for offline DFT QA testing and in-process coating measurement of primers and back coat

➤ ROI system DFT measurement range:
Transparent: **0.25 to 250 microns**
Pigmented: **1 to 25 microns**
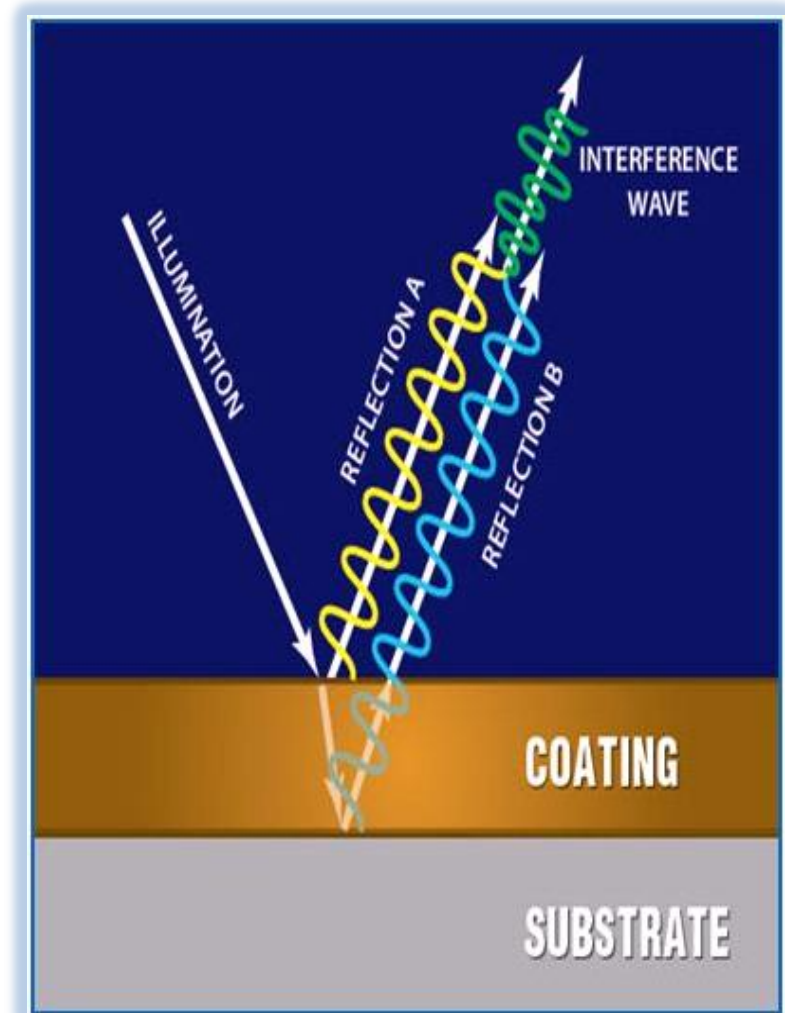
- Proprietary '**ruggedized optical interference**' ROI technology

- Absolute thickness and substrate independent

- Multiple coatings can now be measured with one recipe. Minimal recipes to cover all paints

- Uses non-invasive white light optical source(s)

- Offline and in-line measurement of top coats

- Photon energy of reflected waves used for precise thickness evaluation

- EXR system thickness measurement range:
  Transparent: **0.75 to 350 microns**
  Pigmented : **0.75 to 75 microns**

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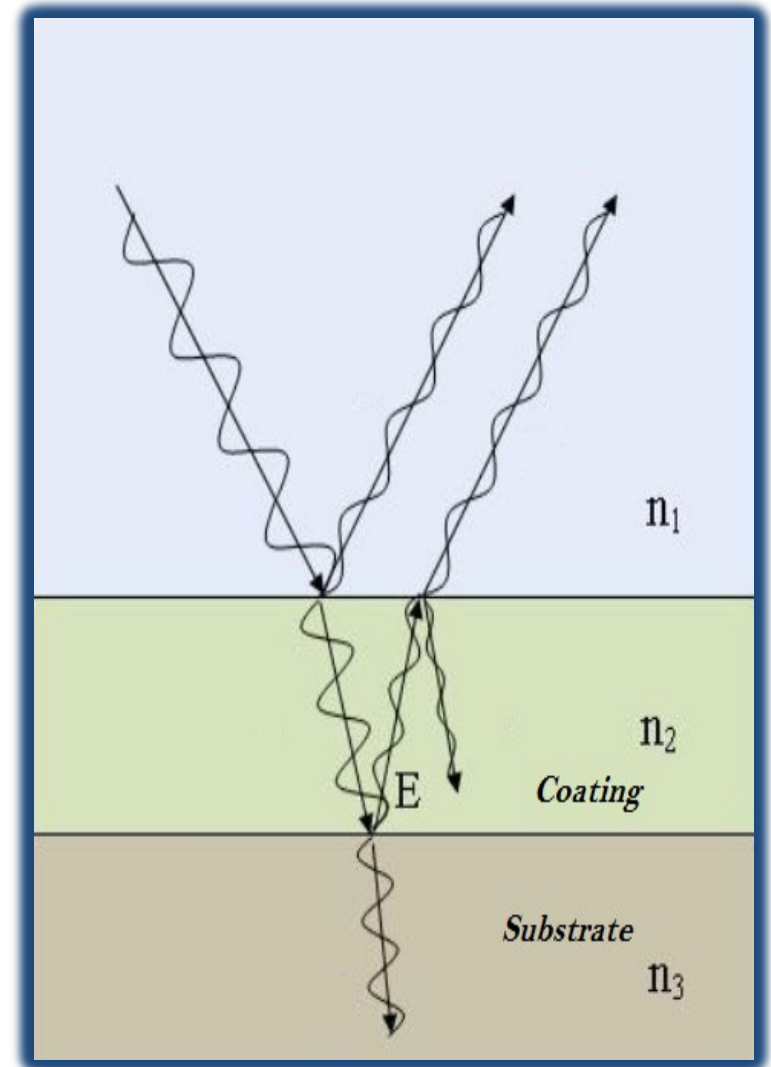
Immediate Film Weight Results – In-Process or Off-Line
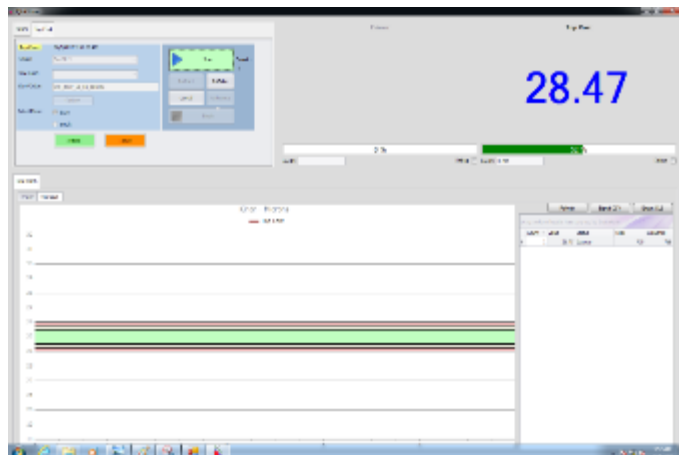
DFT QA user interface

28.47

In-line System user interface

5.73　5.72　5.73

Automatic analysis of interference pattern yields precise thickness measurement data:

System measures in microns and mils with film weight conversion options available:
- ✓ MSI
- ✓ mg/4sq.in.
- ✓ g/m²

Operator quickly sees precise coating thickness measurement results and trends

Production and QA teams benefit from:

More reliable and accurate coating data
Automatic DFT data recording and mapping
No operator manipulation of DFT QA data
Smooth interface to all plant SPC systems

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Expanded SpecMetrix systems offerings for coil coaters

SpecMetrix ROI In-line Systems

- ✓ Primer and other thinner coatings on all surfaces

- ✓ Back coat on all surfaces

- ✓ Pigmented coil coatings - up to **25 microns** total thickness

SpecMetrix EXR In-line & Lab Systems

- ✓ Developed for thicker, highly pigmented top coats.

- ✓ Most coil top coats - up to **75 microns** total thickness

- ✓ Polyester, SMP, Kynar/PVDF, texture, wrinkle, metallic coil coatings

- ✓ PVC/Plastisol coatings - only up to 75 microns

- ✓ Combined DFT QA system measures total primer, backer and top coat DFT

Impact of SpecMetrix EXR and ROI Technologies on Measurement System Accuracy, Reliability and Repeatability

DFT Measurement System Analysis – Gage R&R

Purpose:
- ❖ Determine how much measurement variability is due to the gauge
- ❖ Determine if thickness variability is coming from gauge or from operation
- ❖ Performed with multiple samples, multiple operators and multiple repeat trials
- ❖ <u>If a selected DFT gauge is not repeatable or reproducible, then it is not advisable to make process changes based on data from that gauge</u>

Gage R&R Result	Acceptability
<10%	Excellent
10% < R&R < 20%	Marginally Acceptable
20% < R&R < 30%	Conditionally Acceptable
>30%	Not Acceptable

SpecMetrix Systems - Superior Gage R&R Results

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
Sample	2	1.94300	0.971498	5001.99	0.000
Operator	2	0.00084	0.000421	2.17	0.230
Sample * Operator	4	0.00078	0.000194	4.26	0.013
Repeatability	18	0.00082	0.000046		
Total	26	1.94543			

α to remove interaction term = 0.25

Gage R&R

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	0.000120	0.11
Repeatability	0.000046	0.04
Reproducibility	0.000075	0.07
Operator	0.000025	0.02
Operator*Sample	0.000050	0.05
Part-To-Part	0.107923	99.89
Total Variation	0.108043	100.00

Process tolerance = 0.2

| Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)
Total Gage R&R	0.010967	0.06580	3.34
Repeatability	0.006749	0.04050	2.05
Reproducibility	0.008645	0.05187	2.63
Operator	0.005017	0.03010	1.53
Operator*Sample	0.007040	0.04224	2.14
Part-To-Part	0.328516	1.97110	99.94
Total Variation	0.328699	1.97219	100.00

Number of Distinct Categories = 42

Gage R&R (ANOVA) Report for Measurement

Reported by: VK

Gage name: SpecMetrix DFT QA
Date of study: 03/16/2018
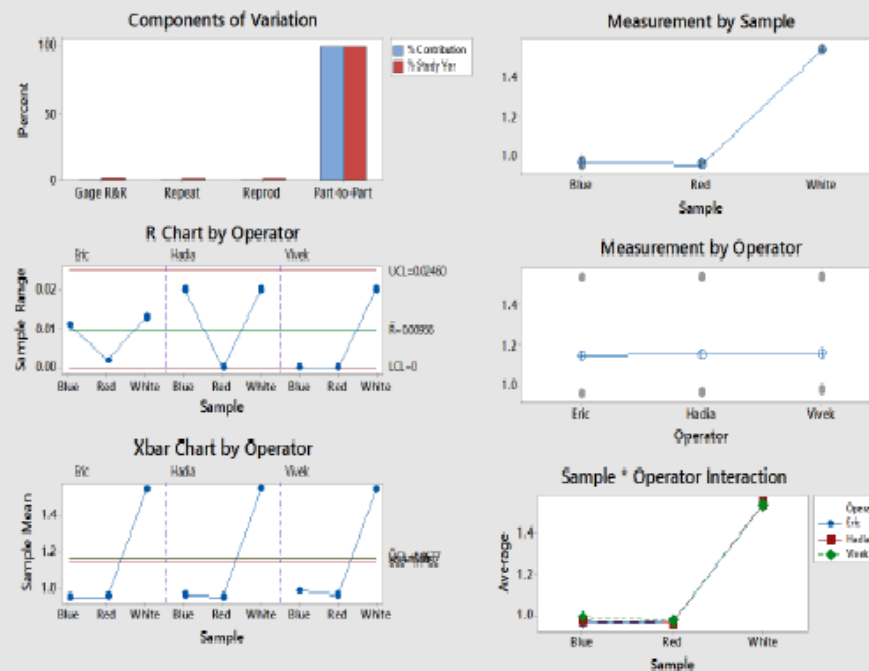
All SpecMetrix systems ship with verified Gage R&R results of <5%

Summary of Recent SpecMetrix System Gage R&R Results

Conclusions:

1) Total Gage R&R Contribution – **3.34% - Excellent**

2) Total % variation from repeatability problems – **0.006% - Excellent**

3) Number of Categories within the process data that the measurement system can discern –**42– Excellent**

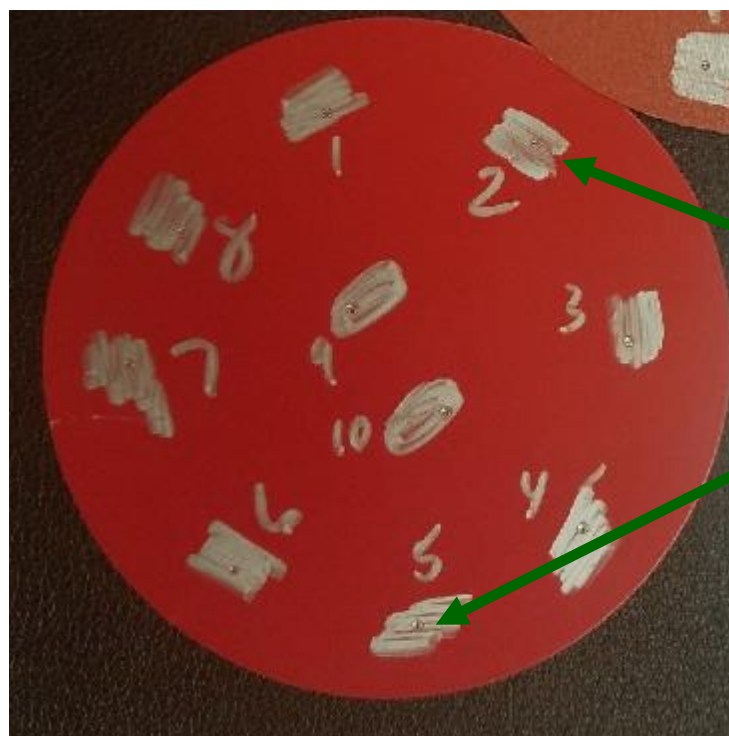**Overall Measurement System Performance: Excellent**
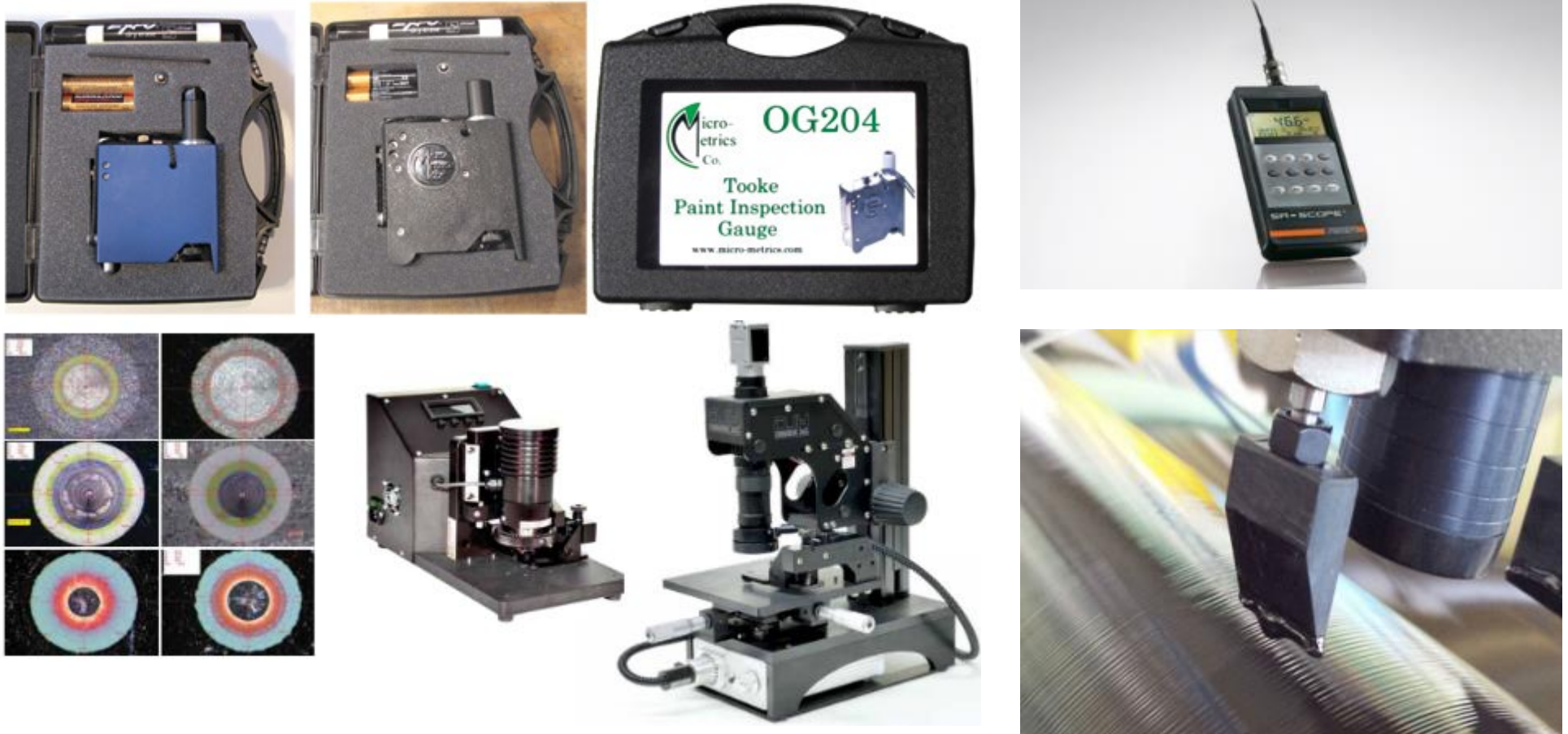
Prior options are contact or destructive gauges that deliver poor Gage R&R performance

DFT Measurements w/Drill Methods

Drill Method	
	Thickness (mils)
1	0.95
2	0.97
3	0.95
4	0.90
5	0.88
6	0.96
7	0.91
8	0.91
9	0.88
10	0.94
Average	**0.925**
Variance	**0.09**

0.97 mil

0.88 mil

0.09 mil

Comparative Measurement Results

Drill Method			
	Sample 1	**Sample 2**	**Sample 3**
1	1.02	0.95	0.81
2	0.96	0.97	0.77
3	1.02	0.95	0.81
4	0.99	0.90	0.81
5	1.01	0.88	0.79
6	1.02	0.96	0.79
7	0.98	0.91	0.83
8	0.97	0.91	0.81
9	1.01	0.88	0.84
10	1.03	0.94	0.85
Average	**1.001**	**0.925**	**0.811**
Variance	**0.070**	**0.090**	**0.082**

| SpecMetrix-EXR			
	Sample 1	**Sample 2**	**Sample 3**
1	1.01	0.92	0.80
2	1.01	0.92	0.80
3	1.01	0.92	0.80
4	1.01	0.92	0.80
5	1.01	0.92	0.80
6	1.00	0.92	0.80
7	1.01	0.92	0.80
8	1.00	0.92	0.80
9	1.00	0.92	0.80
10	1.00	0.91	0.80
Average	**1.005**	**0.918**	**0.803**
Variance	**0.010**	**0.004**	**0.005**

Software and Integration

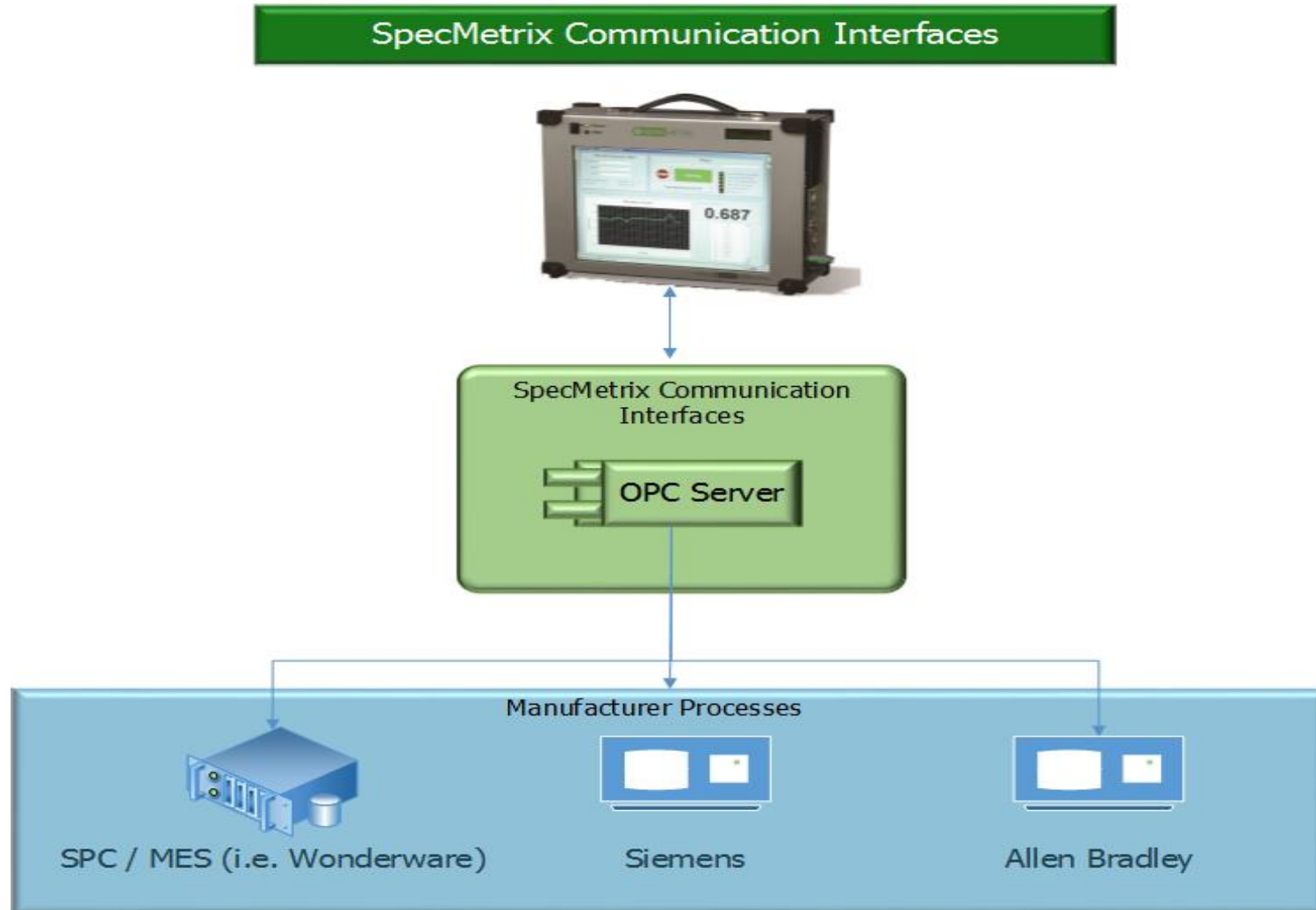# SpecMetrix In-line Systems – Operating Software Features

- User friendly system navigation
- Host country language options
- Easy to use coating Recipe Editor
- Available Recipe Wizard feature
- Secured User/Administrative levels
- Corporate database functionality
- On-line Support and S/W updates
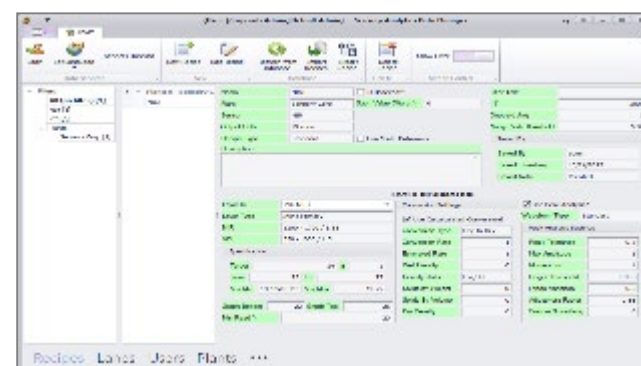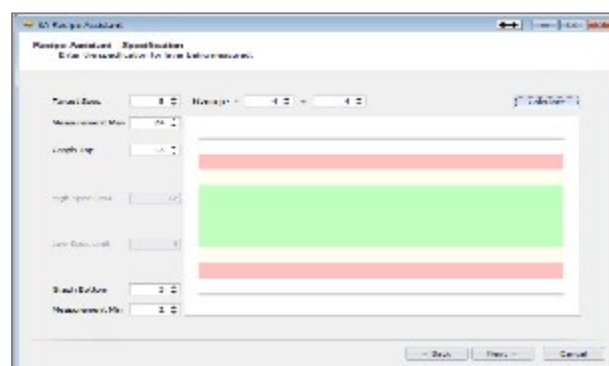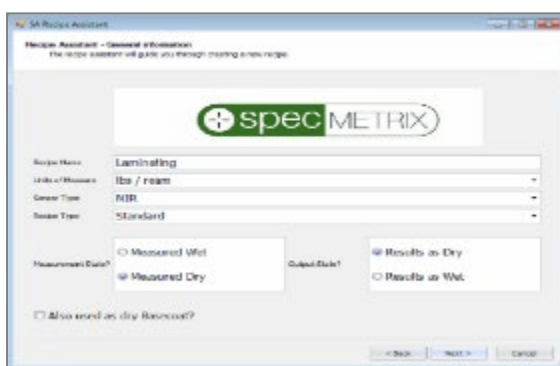
Easy System Interface: Control and data integration

Offline Absolute DFT Thickness Measurement

Results: Primer measurement on metal coils

Sample	Primer on Coils	
	thickness(μ)	mils
1	5.12	0.20
2	5.05	0.20
3	5.26	0.21
4	5.31	0.21
5	5.28	0.21
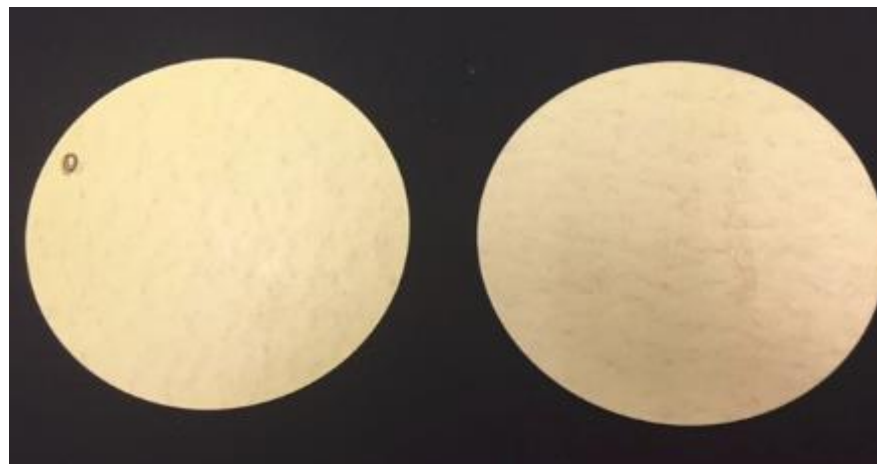
➤ Primer and pigmented coating measurement of coated coils

➤ Both offline and online measurement of different primer coatings

➤ Significantly less time needed for off-line measurement compared to weigh strip weigh & destructive sample test methods

➤ Accurate primer measurement prevents overapplication of top coat

Offline Top Coat DFT Measurement Data

SpecMetrix-EXR				
Polyester	**Fluoropon**	**Texture**	**Metallic**	**Decorative**
1	1.16	1.08	1.99	1.52	1.09
2	1.17	1.08	1.99	1.52	1.09
3	1.17	1.08	1.99	1.53	1.10
4	1.16	1.08	1.99	1.52	1.09
5	1.17	1.08	1.99	1.52	1.09
Average	**1.166**	**1.08**	**1.99**	**1.52**	**1.09**

Measurement of multiple types of top coats at varied thicknesses:

- ✓ Polyester/Silicon Polyester
- ✓ Fluoropon
- ✓ Metallic
- ✓ Texture
- ✓ Decorative

DFT Comparison: SpecMetrix EXR vs Accurate WSW
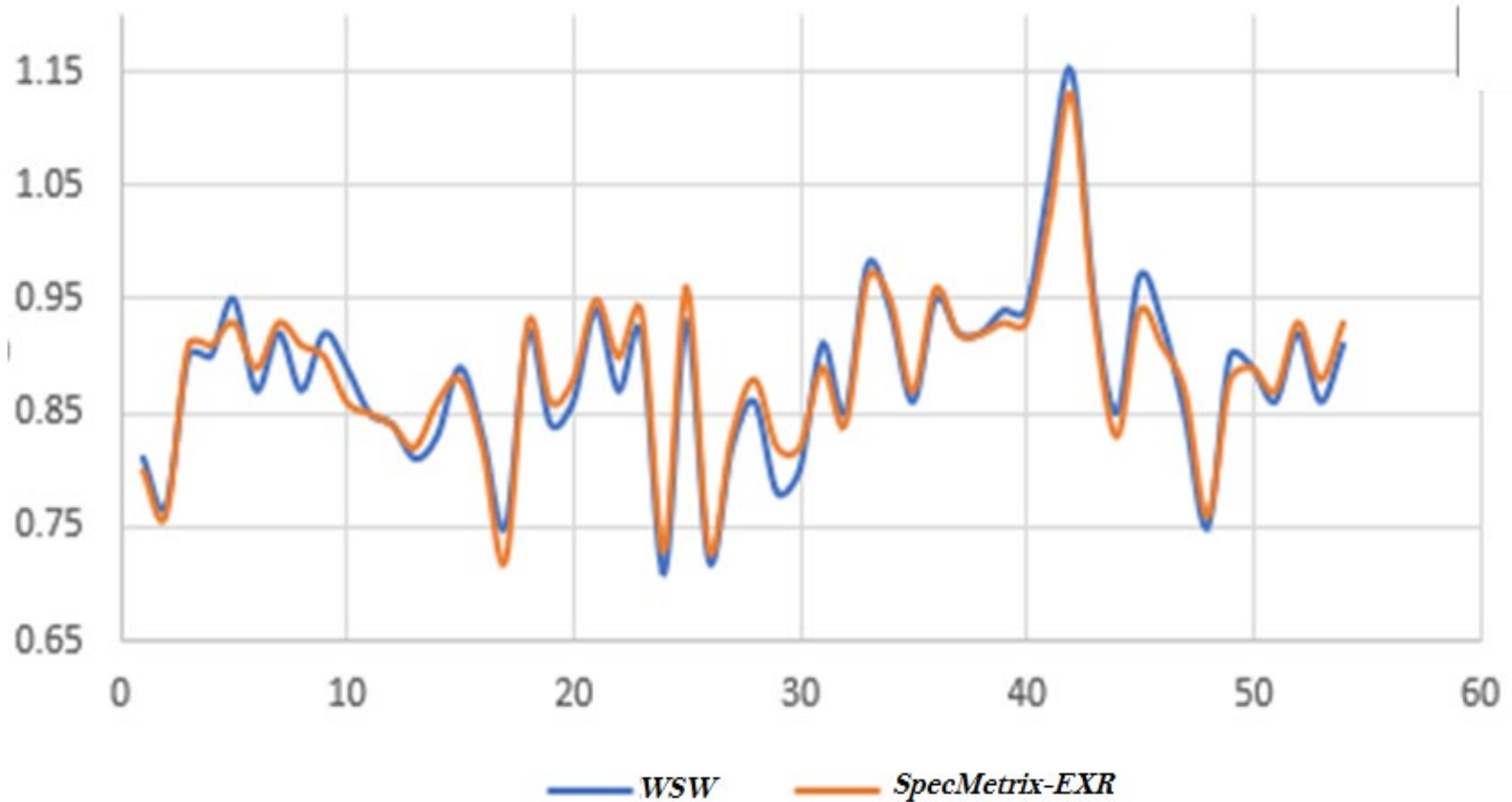
DFT Comparison: SpecMetrix EXR vs WSW vs Tooke

Accurate on Fluoropon / Kynar coatings

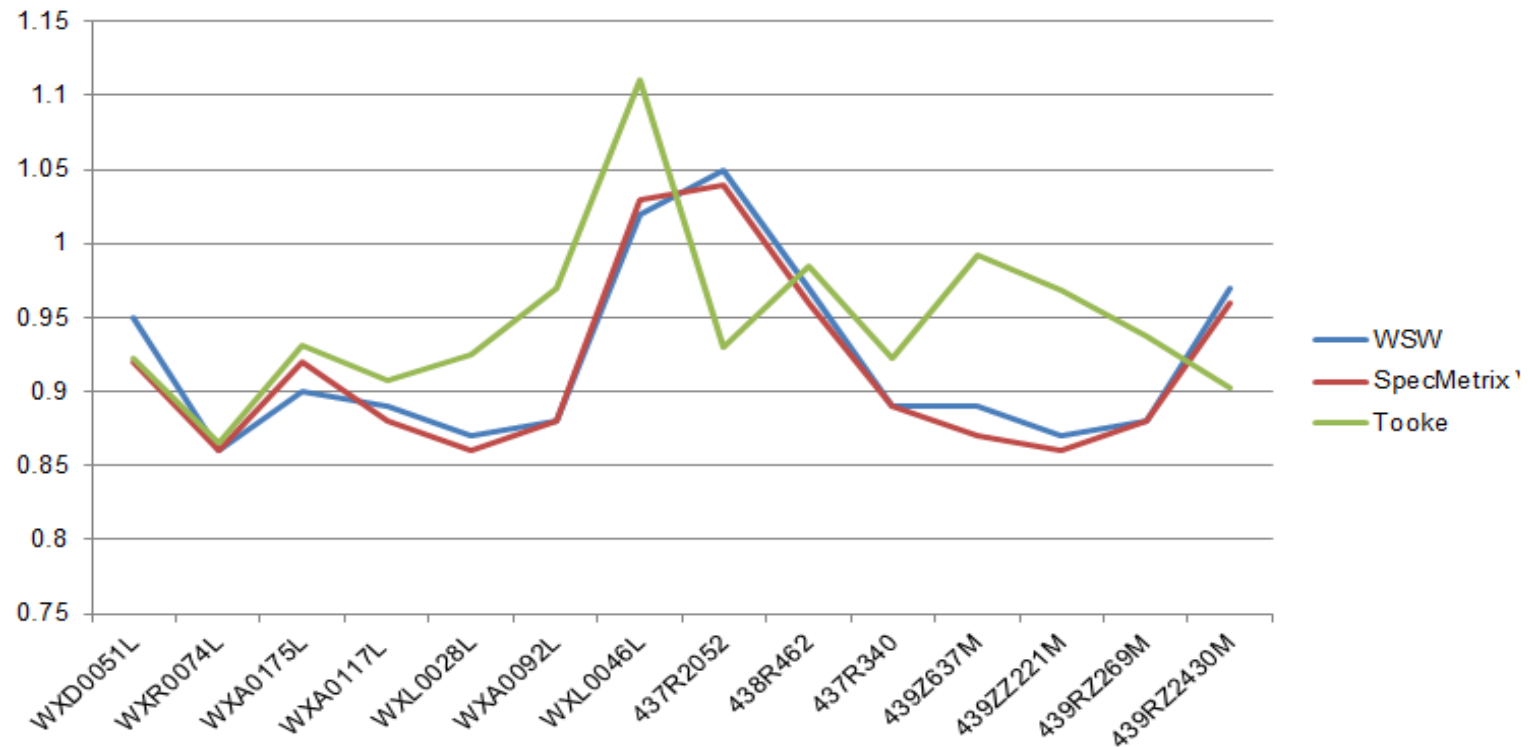| Coating	Color	TopCoat Type	TOPCOAT DFT	PRIMER DFT	TOTAL DFT WSW	EXR	Difference
XXX	BEIGE, OP-1	FLPO	0.56	0.25	0.81	0.80	0.01
	BEIGE, DR-1	FLPO	0.52	0.25	0.77	0.76	0.01
437R813	BLACK, OP-1	FLPO	0.65	0.25	0.90	0.91	0.01
	BLACK, DR-1	FLPO	0.65	0.25	0.90	0.91	0.01
435RZ268	GREEN, OP-1	FLPO	0.7	0.25	0.95	0.93	0.02
	GREEN, DR-1	FLPO	0.62	0.25	0.87	0.89	0.02
434A986	RED, OP-1	FLPO	0.67	0.25	0.92	0.93	0.01
	RED, DR-1	FLPO	0.62	0.25	0.87	0.91	0.04
432B198	DARK BEIGE, OP-1	FLPO	0.67	0.25	0.92	0.90	0.02
	DARK BEIGE, DR-1	FLPO	0.64	0.25	0.89	0.86	0.03
431A866	WHITE, DR-1	FLPO	0.62	0.23	0.85	0.85	0.00
	WHITE, DR-2	FLPO	0.62	0.22	0.84	0.84	0.00
434R808	RED, DR-1	FLPO	0.56	0.25	0.81	0.82	0.01
	RED, OP-1	FLPO	0.59	0.24	0.83	0.86	0.03
434RZ254	BRONZE, OP-1	FLPO	0.63	0.26	0.89	0.88	0.01
437R339	TAN/BEIGE, OP-1	FLPO	0.58	0.25	0.83	0.82	0.01
433B315	GRAY, OP-1	FLPO	0.51	0.24	0.75	0.72	0.03
432R1452	GREEN, OP-1	SPLY	0.67	0.25	0.92	0.93	0.01
XG1Y44633	BROWN, OP-1	SPLY	0.59	0.25	0.84	0.86	0.02
XN3Y44658	GREEN, OP-1	SPLY	0.61	0.25	0.86	0.88	0.02
XG3Y62022	IVORY/CREAM, OP-1	SPLY	0.69	0.25	0.94	0.95	0.01

Accurate on Silicon Polyester

Coating	Color	TopCoat Type	TOPCOAT DFT	PRIMER DFT	TOTAL DFT WSW	EXR	Difference
432R1452	GREEN, OP-1	SPLY	0.67	0.25	0.92	0.93	0.01
XG1Y44633	BROWN, OP-1	SPLY	0.59	0.25	0.84	0.86	0.02
XN3Y44658	GREEN, OP-1	SPLY	0.61	0.25	0.86	0.88	0.02
XG3Y62022	IVORY/CREAM, OP-1	SPLY	0.69	0.25	0.94	0.95	0.01
XH3Y49083	WHITE, OP-1	SPLY	0.63	0.24	0.87	0.9	0.03
WXW0051L	BLACK, OP-1	SPLY	0.68	0.24	0.92	0.94	0.02
WXA0117L	TAN/BEIGE, OP-1	SPLY	0.46	0.25	0.71	0.73	0.02
WXD0071	BROWN, OP-1	SPLY	0.67	0.26	0.93	0.96	0.03
WXB1007L	WHITE, OP-1	SPLY	0.48	0.24	0.72	0.73	0.01
WXW0099	GRAY, OP-1	SPLY	0.53	0.29	0.82	0.83	0.01
WXA0090L	GRAY, OP-2	SPLY	0.6	0.26	0.86	0.88	0.02
WXA0160L	BRONZE, OP-1	SPLY	0.54	0.24	0.78	0.82	0.04
WXB1022L	WHITE, OP-1	FLPO	0.54	0.26	0.8	0.82	0.02
431A811	BLACK, OP-1	FLPO	0.66	0.25	0.91	0.89	0.02
437R994	GRAY, OP-1	FLPO	0.62	0.23	0.85	0.84	0.01
432B045	BEIGE, OP-1	SPLY	0.63	0.35	0.98	0.97	0.01
WXD0038L	GREEN, OP-1	SPLY	0.61	0.33	0.94	0.95	0.01
WXG0026L	BROWN, OP-1	SPLY	0.53	0.33	0.86	0.87	0.01
WXB1009L	GRAY, OP-1	SPLY	0.63	0.32	0.95	0.96	0.01
WXD0047L	RED, OP-1	SPLY	0.58	0.34	0.92	0.92	0.00
WXR0084	BLACK, OP-1	SPLY	0.57	0.35	0.92	0.92	0.00

In-line Absolute DFT Thickness Measurement

Impacts of SpecMetrix In-Process Coating Thickness Measurement & Control

✓ Monitored, assured and <u>documented</u> coated coil quality

✓ Coating process improvement and control

✓ Better coating application with reduced consumption

✓ Less spoilage and reduction of HFI Inventory

✓ Proven thickness data records reduce customer claims

✓ Significant changeover/ setup time reduction

✓ Return on investment within <u>6</u> months after installation

In-line Primer Measurement Benefits

- ✓ Primer coating application can be continuously controlled within +/- 0.01 mils using *SpecMetrix In-line* measurement systems

- ✓ Proper application of primer helps plant team minimize any over application of more expensive topcoats

- ✓ Primer application can be controlled across the width of the coil

- ✓ Quality record for each coil showing proper primer application across the full length of the coil helps to reduce claims created by under or over application of primer.

- ✓ Significant set-up time reductions from immediate primer coating DFT following start-up or changeover

- ✓ Continuous in-line measurement data enables immediate coating application changes

Continuous top and bottom coating measurements for clear coil coating applications

Sample	Top	Bottom
	msi	msi
1	8.91	2.12
2	8.85	2.25
3	8.86	2.15
4	8.84	2.18
5	8.92	2.21

➢ In-line measurement of top and bottom on aluminum coils
➢ Colored coatings for tabs can be easily measured

Results: Non-contact In-line primer measurement

Sample	Primer on Coils	
	thickness(μ)	mils
1	6.65	0.26
2	6.61	0.26
3	6.35	0.25
4	6.25	0.25
5	6.54	0.26

➢ In-line real-time measurement of primer on aluminum or steel coils
➢ Cost savings from minimizing QA time and over application of top coats
➢ Avoiding under or over-application of primer coatings

32

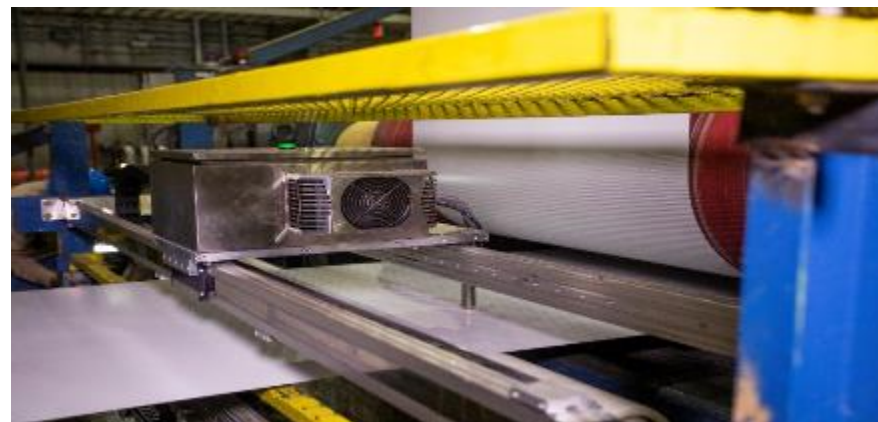# Results: In-line Polyester top coat measurement

Sample	TopCoat + Primer on Coils	
	thickness(μ)	mils
1	22.95	0.90
2	23.15	0.91
3	22.75	0.90
4	23.05	0.91
5	22.98	0.90

22.94

➢ In-line measurement of polyester topcoat on aluminum or steel coils
➢ Cost savings from minimizing over application of top coat and process control
➢ Quicker changeover times and higher throughput

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# Results: In-line HDP top coat measurement

Sample	TopCoat + Primer on Coils	
	thickness(μ)	mils
1	23.87	0.94
2	23.9	0.94
3	23.84	0.94
4	23.71	0.93
5	23.98	0.94

➤ In-line measurement of HDP top coat on aluminum or steel coils
➤ Cost savings from minimizing over application
➤ Quick changeover times

Results: In-line back coat measurement

Sample	BackCoat + Primer on Coils	
	thickness(μ)	mils
1	11.5	0.45
2	11.35	0.45
3	11.29	0.44
4	11.45	0.45
5	11.51	0.45
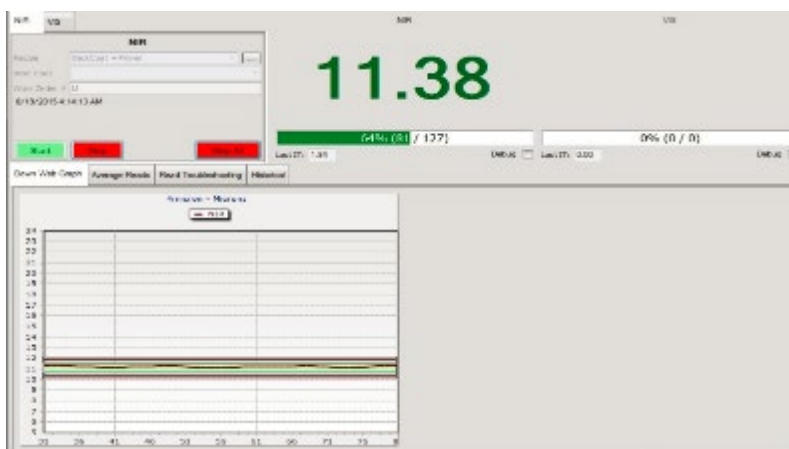
➢ In-line measurement of primer and back coat on metal coils
➢ Cost savings from minimizing over application and process control

Product Configurations for Coil Manufacturers

Range of Use: Coil QA and production applications

Corporate Teams

➤ QA Labs and sample testing
➤ Technical and R&D centers
➤ Pilot lines
➤ Coating supplier tech centers
➤ Film weight forensics/ Claim review

Manufacturing Plants

➤ Incoming coil inspection
➤ Coating and print lines
➤ Coil and component suppliers
➤ In-process coating measurements

23.18
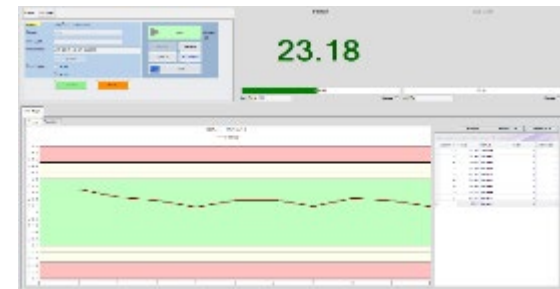
SpecMetrix® Off-line Systems for DFT QA Use

DFT QA Station
(Primer and Total top coat measurement)

21.66

➢ Non-Contact and non-destructive coil coating QA and sample analysis

➢ Preferred lab 'forensic tool' for determining coating or layer thickness defects

➢ Combined Lab system with dedicated clear/primer and top coat probes

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SpecMetrix Fixed In-line DFT Measurement Systems

Regularly used for in-process coating measurement on top and bottom of coils

SpecMetrix Traversing In-line DFT Measurement Systems

For further information, please contact us at any time:

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greg.frisby@specmetrix.com
Tel: +1-336-315-6090
Fax: +1-336-315-6030

Global Sales and Support teams:

Currently covering 50+ countries

Free sample DFT testing
In-plant system demonstrations
SpecMetrix Certified support
On-line technical support – 24/7

See all of these spec METRIX systems firsthand at www.specmetrix.com

White papers	Gage R&R reports	Product videos