

TRANSPORTATION RESEARCH BOARD

Selecting Better Pavement Markings through Field Trials

August 10, 2020

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hour (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Reggie Gillum at RGillum@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.



REGISTERED CONTINUING EDUCATION PROGRAM

#TRBwebinar

Learning Objectives

1. Identify how to use transverse test decks for evaluating pavement marking durability
2. Describe how to install a transverse test deck
3. Identify how to use data to improve paint quality

#TRBwebinar



Introduction to Transverse Test Decks and Correlation to Longitudinal Markings



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Institute

TRB Webinar:
Selecting Better
Pavement Markings
through Field Trials

August 10, 2020

What is a Transverse Test Deck?

- Method to evaluate pavement markings on a roadway
- Markings applied across the lane



Why Use a Transverse Test Deck?

- Direct comparisons of marking retroreflectivity and durability
- Same pavement, weather, and traffic conditions
- Can compare many markings in a small area
- Cost efficient
- Accelerated wear in wheel path areas

Potential Limitations of Transverse Test Decks

- Installation methods
- Correlation to long line retroreflectivity and durability

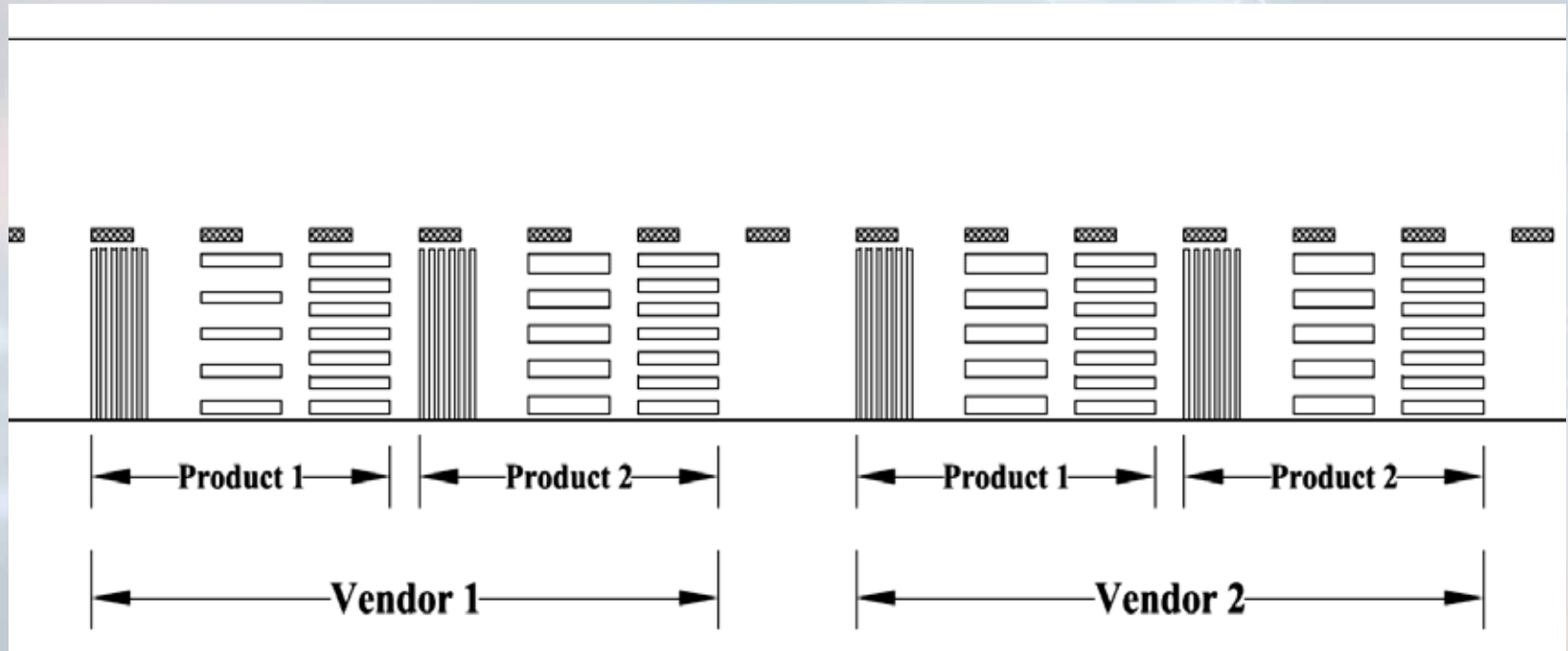


Evaluation of Long Line vs Transverse

- Original Study: TxDOT 0-5548, *Development of Field Performance Evaluation Tools and Program for Pavement Marking Materials*
- Additional Data Collection: TxDOT 9-1001-2, *Evaluation of Traffic Control Devices, Year 3*
- TRR 2258 : *Comparison of Designs of Field Test Decks for Pavement Marking Materials*
- TRB Annual Meeting Paper #15-1108, *Predicting Pavement Marking Service Life Using Transverse Test Deck Data*

Test Deck Setup

- PCC, HMA, seal coat pavement surfaces



Test Deck Layout (Transverse Lines)



Test Deck Layout (5 Lines)



Test Deck Layout (7 Lines)



Marking Materials Evaluated

- Spray thermoplastic
- Extruded thermoplastic
- Methyl methacrylate (MMA)
- Preformed tape
- Modified urethane
- Epoxy
- Polyurea
- High build paint
- Waterborne paint
- Evaluated a variety of bead types and drop rates

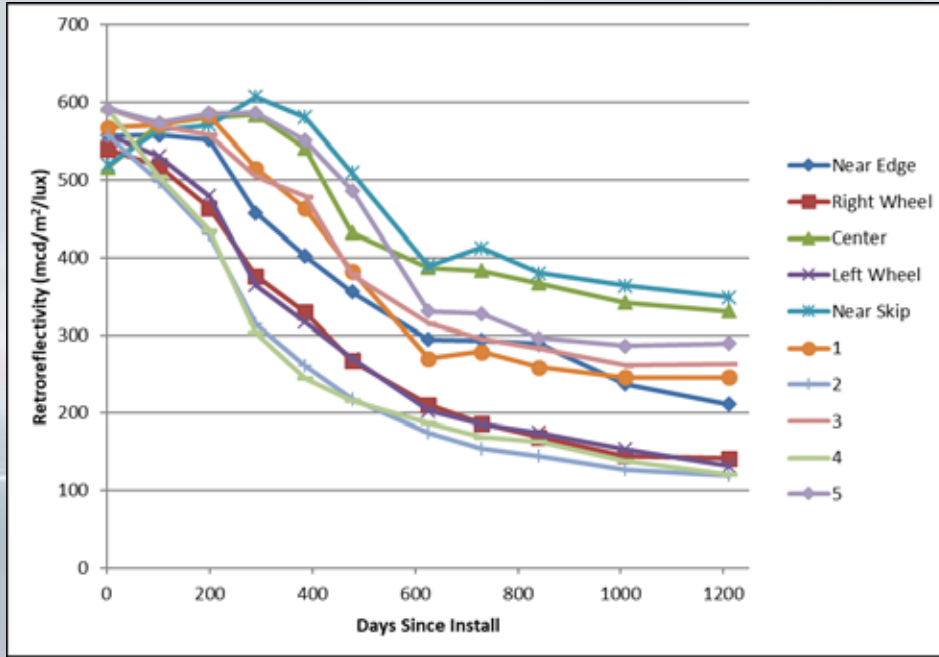
Data Collection

- 33 pavement markings evaluated, each marking had:
 - 5 transverse lines
 - A 5-line longitudinal section
 - A 7-line longitudinal section
- Retroreflectivity readings
 - Initial
 - Every 3-months for 3 years
 - Measured 5 locations on each transverse marking
 - Measured 10 times on each longitudinal marking
- Evaluated color and presence

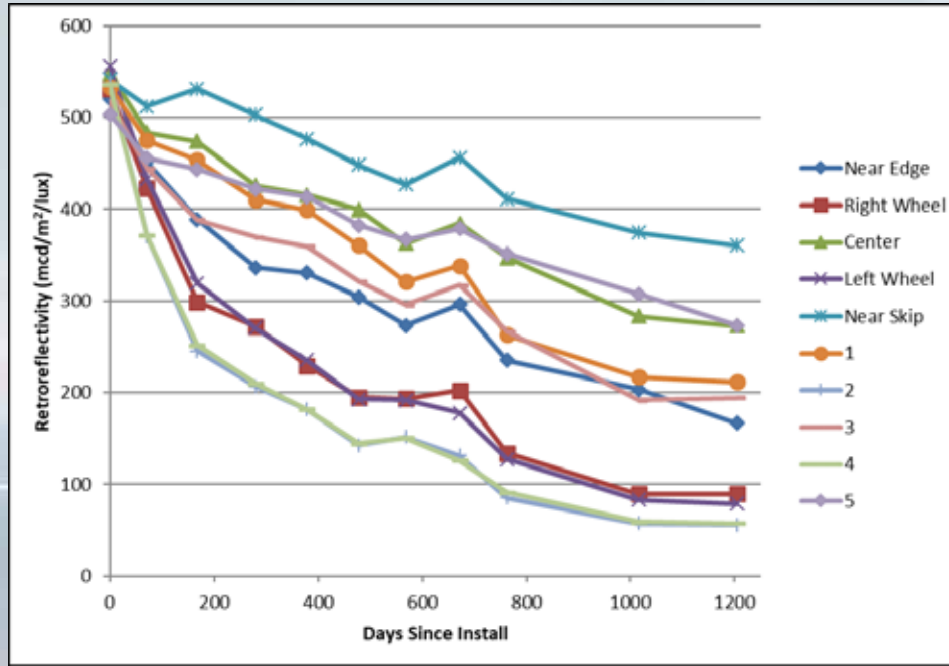
Results

- Plotted degradation curves of the marking retroreflectivity for each measurement position
- Calculated correlation coefficients for the transverse vs longitudinal measurements
- Developed a method to estimate long line retroreflectivity based on transverse marking data (see TRB paper)

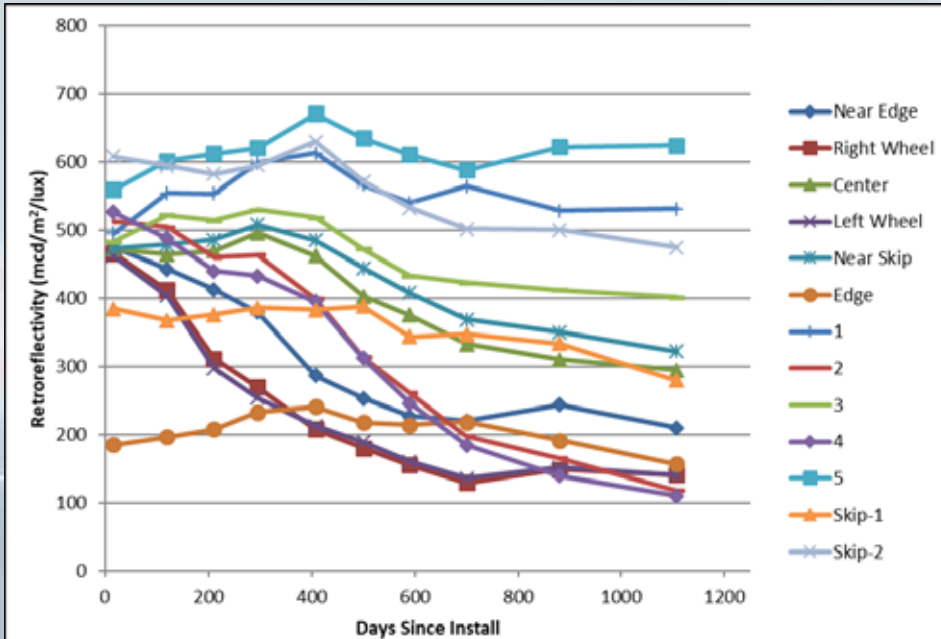
PCC Surface		5 Longitudinal Lines					7 Longitudinal Lines						
		1	2	3	4	5	1	2	3	4	5	6	7
Transverse Lines	Near Edge	0.98	0.97	0.98	0.95	0.93	0.97	0.97	0.99	0.97	0.98	0.99	0.91
	Right Wheel	0.97	0.99	0.99	0.97	0.92	0.97	0.99	0.99	0.96	0.99	1.00	0.90
	Center	0.96	0.82	0.95	0.78	0.96	0.96	0.84	0.89	0.96	0.86	0.89	0.95
	Left Wheel	0.96	0.99	0.98	0.98	0.91	0.95	1.00	0.99	0.95	1.00	1.00	0.88
	Near Skip	0.92	0.73	0.90	0.68	0.97	0.93	0.75	0.82	0.94	0.77	0.81	0.97



HMA Surface		5 Longitudinal Lines					7 Longitudinal Lines						
		1	2	3	4	5	1	2	3	4	5	6	7
Transverse Lines	Near Edge	0.98	0.96	0.99	0.96	0.98	0.98	0.97	0.99	0.99	0.98	0.99	0.97
	Right Wheel	0.95	0.99	0.97	0.99	0.94	0.95	1.00	1.00	0.97	1.00	1.00	0.94
	Center	0.99	0.92	0.99	0.92	0.99	0.99	0.94	0.96	0.99	0.94	0.96	0.99
	Left Wheel	0.95	0.99	0.97	0.99	0.94	0.95	1.00	1.00	0.97	1.00	1.00	0.95
	Near Skip	0.98	0.84	0.95	0.84	0.98	0.98	0.87	0.90	0.96	0.87	0.90	0.99



Seal Coat Surface	5 Longitudinal Lines							7 Longitudinal Lines								
	Edge Line	1	2	3	4	5	Skip Line	Edge Line	1	2	3	4	5	6	7	Skip Line
Near Edge	0.00	-0.15	0.92	0.75	0.92	-0.44	0.60	-0.13	-0.32	0.93	0.86	0.70	0.90	0.86	-0.70	0.64
Right Wheel	-0.11	-0.27	0.88	0.66	0.89	-0.51	0.53	-0.26	-0.46	0.88	0.80	0.60	0.86	0.81	-0.74	0.57
Center	0.50	0.34	0.97	0.96	0.96	-0.03	0.85	0.38	0.09	0.97	0.98	0.96	0.98	0.98	-0.36	0.88
Left Wheel	-0.11	-0.29	0.87	0.64	0.88	-0.51	0.54	-0.26	-0.48	0.88	0.79	0.59	0.85	0.81	-0.74	0.58
Near Skip	0.58	0.42	0.95	0.97	0.94	0.05	0.89	0.47	0.16	0.94	0.98	0.98	0.96	0.97	-0.29	0.91



Findings

- Drivers did not appear to modify their driving behavior when in the test areas
- Thermoplastic materials on the seal coat deck did not degrade as consistently as the markings at other decks
- Measurements near wheel path have lower retro than other locations for both transverse and longitudinal layouts
- Wide range in performance between the different materials evaluated (shows need for field testing)
- The average transverse test deck performed similarly to the average long line test deck when measurements at the same location were considered (high correlation)
- Individual pavement marking test decks had some variation in correlation (installation quality, material types)

Recommendations

- If a longitudinal deck is used, the 5-line setup should be used
- Transverse deck data is comparable to longitudinal data, making transverse decks preferable
 - High correlation between data
 - Similar magnitude of retroreflectivity values
 - Require less space
- Installation quality and consistency is essential. Quality control and monitoring of installations is highly recommended.

Thank you!

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Associate Research Engineer
Program Manager

TEXAS A&M TRANSPORTATION INSTITUTE

Signs and Markings Program

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Current practices for transverse test decks



Presenter: Jonathan Sirianni, AASHTO

Learning Objective:

Understand practices utilized by AASHTO for installation and evaluation of transverse test decks.

What is NTPEP?

- National Transportation Product Evaluation Program
- AASHTO Technical Service Program
- Perform product evaluations & manufacturing facility audits
- Provide data to State DOTs
- Technical Committees to oversee evaluations & audits

Pavement Marking Materials

- One of 25 NTPEP Technical Committees
- Evaluates around 100-150 products each year
 - Waterborne/solventborne paints
 - Thermoplastics
 - Multiple component products
 - Tapes
- Overseen and maintained by State DOT representatives
 - Work Plan & guiding documents development/editing
 - Evaluation activities
 - Data management



PMM Evaluations



- Laboratory and field testing elements
- Laboratory evaluations
 - Fingerprinting/compositional analysis
 - Basic performance properties
- Field evaluations
 - Live roadway monitoring on assigned test decks
 - Up to three years of data collection
 - Retroreflectivity
 - Color
 - Durability

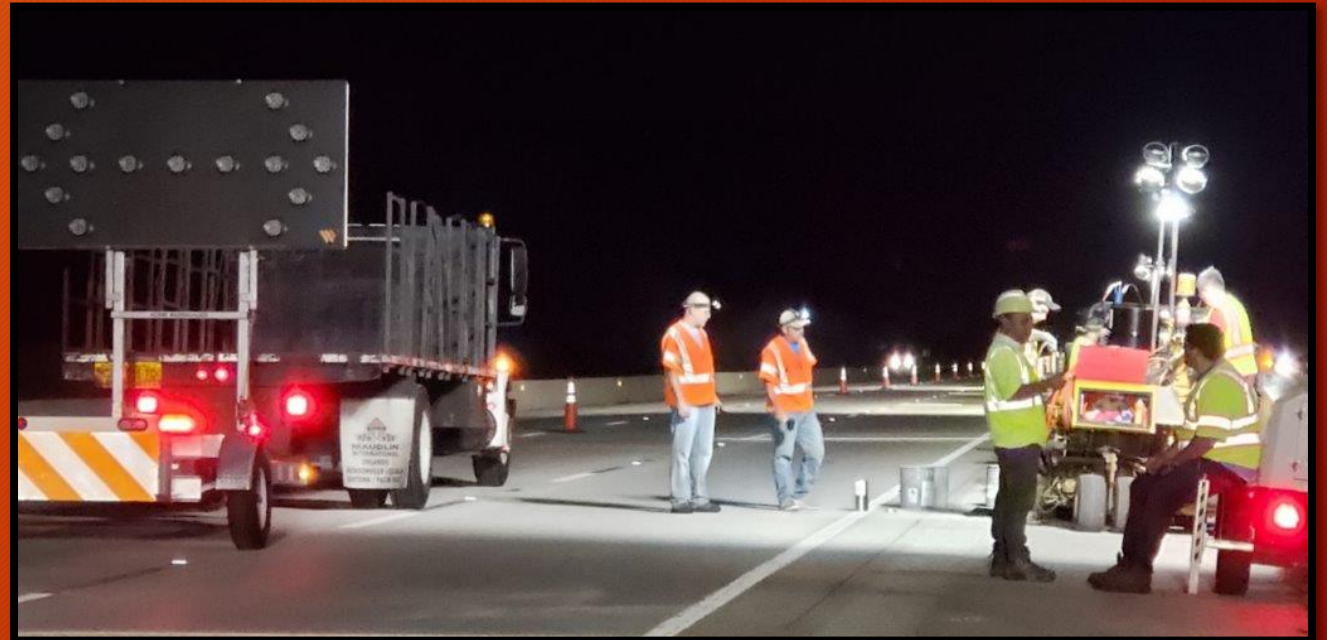
NTPEP PMM Test Decks



- One test deck hosted per year
- Use snowplow and non-snowplow states
- Open to any manufacturer
- Three primary phases
 - Phase 1 - Product installations
 - Phase 2 - Bi-monthly evaluations
 - Phase 3 - Quarterly evaluations

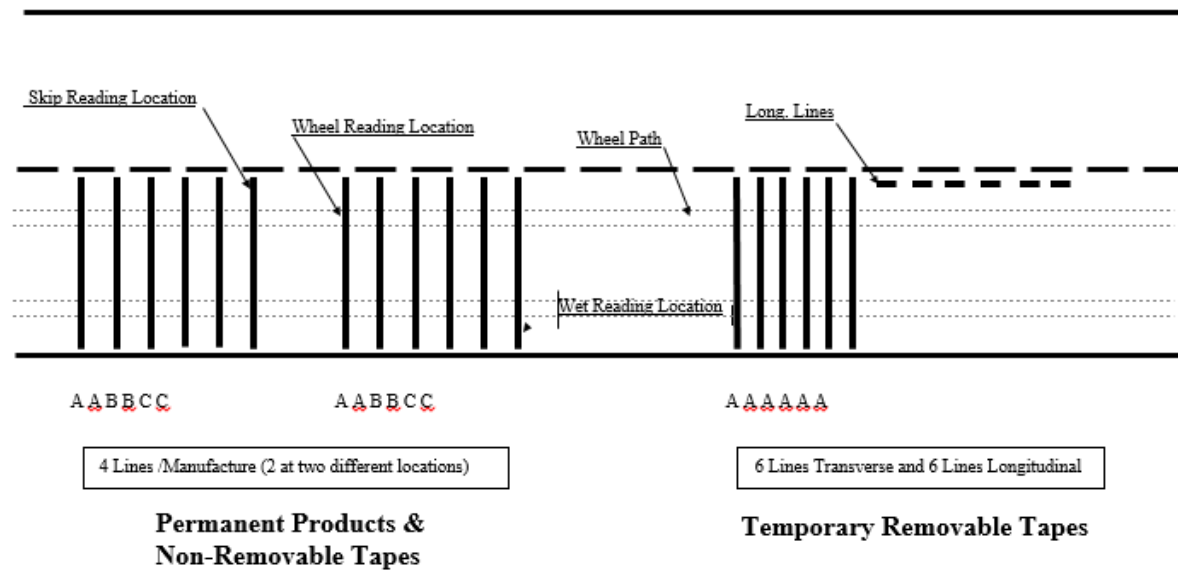
Phase 1 - Product Installation

- Planning
 - Staffing/training needs
 - Selecting location
 - Securing equipment
 - Traffic control
- Scheduling
- Product installations
- Initial evaluations



Phase 1 - Site Selection

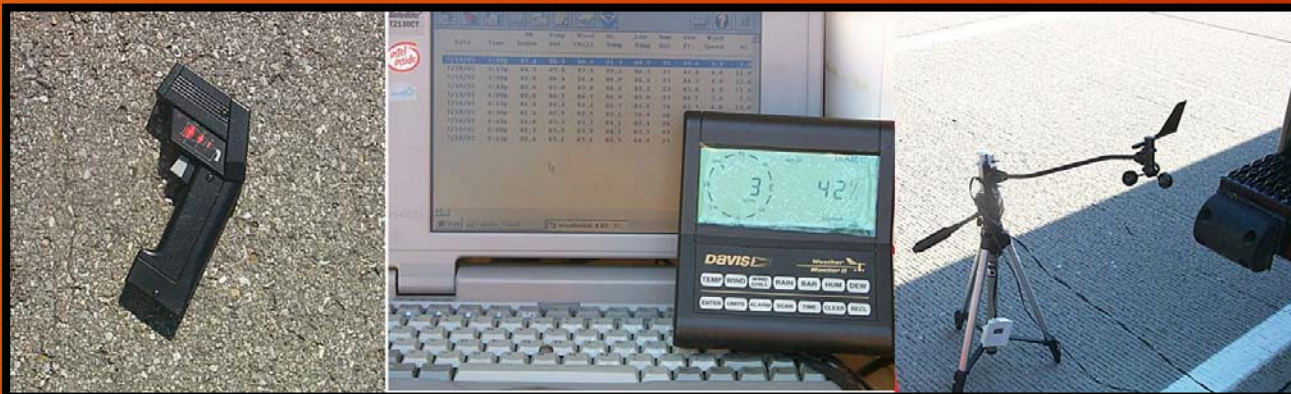
Typical Test Deck Configuration



Phase 1 - Equipment

- General Equipment List:

- ✓ Retroreflectometers
- ✓ Spectrophotometers
- ✓ Film Thickness Gauges
- ✓ Surface Temperature Gauges
- ✓ Weather Station
- ✓ Personal Protective Equipment
- ✓ Computers
- ✓ Generators
- ✓ Balances
- ✓ Weight stations
- ✓ Aluminum panels
- ✓ Vehicles



Phase 1 - Scheduling

Sunday, October 13	Monday, October 14	Tuesday, October 15	Wednesday, October 16	Thursday, October 17
Company 1 Preformed (2)	Company 1 Preformed (2)	Company 1 Preformed (2)	Company 1 Preformed (2)	
Company 2 Paint (6)	Company 2 Paint (6)	Company 2 Paint (6)	Company 2 Paint (6)	
Company 3 Paint (4) Thermo (6) Preformed (2)	Company 3 Paint (4) Thermo (6) Preformed (2)	Company 3 Paint (4) Thermo (6) Preformed (2)	Company 3 Paint (4) Thermo (6) Preformed (2)	
Company 4 Paints (1)	Company 4 Paints (1)	Company 4 Paints (1)	Company 4 Paints (1)	
Company 5 Preformed (4)	Company 5 Preformed (4)	Company 5 Preformed (4)	Company 5 Preformed (4)	
Company 6 Preformed (4)	Company 6 Preformed (4)	Company 6 Preformed (4)	Company 6 Preformed (4)	
(Concrete)	(Concrete)	(Asphalt)	(Asphalt)	(? If needed)



Phase 1 - Preparation



Site Preparation & Equipment Calibrations



Auto-No-Track Time

Phase 1 - Product Installation

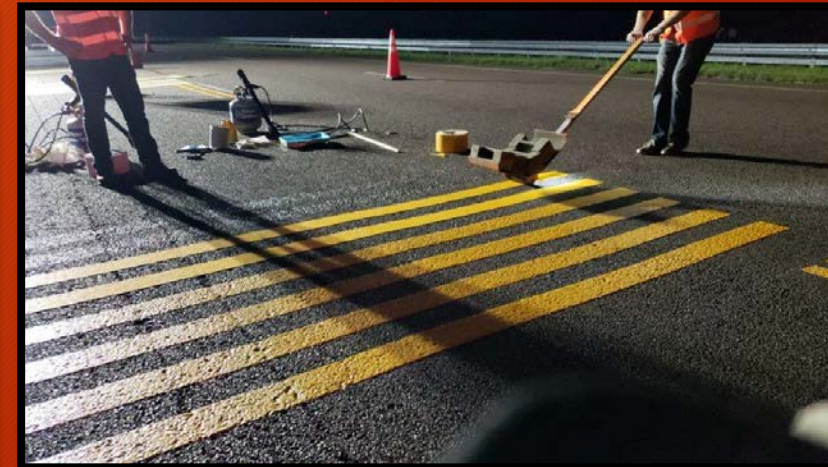
Paint



Thermoplastic



Tape



Phase 2 & 3- Ongoing Field Evaluations

- Phase 2
 - Bi-monthly evaluations
 - Temporary tape - Monthly evaluations (6 months)
- Phase 3
 - Quarterly evaluations
- Winter weather events



Phase 2 & 3- Ongoing Field Evaluations



- Permanent product evaluations
 - Readings taken at skip line and left wheel path
 - Retroreflectivity
 - Wet & dry
 - Durability
 - Color
 - Day & night
 - Photo logging
- Removable temporary tape evaluations
 - Same testing as permanent products
 - Additional testing:
 - Removeability
 - Discernable markings after removal

Data Collection & Distribution




















NTPEP Number	Deck	Sub-Deck	Line	Skip		Wheel		Color (Day)			Color (Night)			Wet/Dry Retro	
				RR	DUR	RR	DUR	Y	x	y	RL	x	y	Dry RR	Wet RR
PMM-2010-01-001	Concrete	1	1												
PMM-2010-01-001	Concrete	1	2												
PMM-2010-01-001	Concrete	1	3												
PMM-2010-01-001	Concrete	1	4												
PMM-2010-01-002	Concrete	1	5												
PMM-2010-01-002	Concrete	1	6												
PMM-2010-01-002	Concrete	1	7												
PMM-2010-01-002	Concrete	1	8												
PMM-2010-01-003	Concrete	1	9												
PMM-2010-01-003	Concrete	1	10												
PMM-2010-01-003	Concrete	1	11												
PMM-2010-01-003	Concrete	1	12												
PMM-2010-01-004	Concrete	2	13												
PMM-2010-01-004	Concrete	2	14												
PMM-2010-01-004	Concrete	2	15												
PMM-2010-01-004	Concrete	2	16												
PMM-2010-01-005	Concrete	2	17												
PMM-2010-01-005	Concrete	2	18												
PMM-2010-01-005	Concrete	3	19												
PMM-2010-01-005	Concrete	3	20												

- NTPEP DataMine 3.0
- Data review
 - Host State
 - Lead State
 - Manufacturer
- Field installation data
- Field inspection data
- Laboratory data
- Option to release/withdraw

Data Collection & Distribution

Interval (Months)	Inspection Date	Retroreflectivity & Durability							
		Asphalt				Concrete			
		Retroreflectivity		Durability		Retroreflectivity		Durability	
Skip	Wheel	Skip	Wheel	Skip	Wheel	Skip	Wheel		
0 (Public)	07/30/2013	350	342	10	10	332	314	10	10
1 (Public)	08/13/2013	373	299	10	10	355	286	10	10
2 (Public)	09/10/2013	377	281	10	10	348	226	10	10
3 (Public)	10/08/2013	341	232	10	10	356	213	10	10
9 (Public)	05/13/2014	120	90	8	10	106	73	5	5
10 (Public)	06/05/2014	132	75	9	10	137	87	4	4
11 (Public)	06/30/2014	135	93	8	10	149	68	4	4
12 (Public)	07/21/2014	149	58	8	10	132	61	4	4
15 (Public)	10/21/2014	95	58	8	9	78	68	4	4
21 (Public)	04/28/2015	64	49	8	10	27	41	0	0
24 (Public)	07/28/2015	62	60	9	9	25	47	0	0
27 (Public)	10/19/2015	69	47	8	9	22	41	0	0
33 (Public)	04/26/2016	58	53	9	9	18	16	0	0
36 (Public)	08/08/2016	70	51	9	9	19	18	0	0

Interval (Months)	Inspection Date	Color Data (Day)				
		Asphalt			Concrete	
		Y	x	y	Y	x
0 (Public)	07/30/2013	35.56	0.4738	0.4394	36.108	0.4731
3 (Public)	10/08/2013	29.474	0.4428	0.4224	29.984	0.4437
9 (Public)	05/13/2014	34.026	0.4588	0.4385	30.13	0.4346
12 (Public)	07/21/2014	30.05	0.4578	0.4316	26.817	0.3848
15 (Public)	10/21/2014	29.837	0.4512	0.4338	24.178	0.3948
21 (Public)	04/28/2015	34.156	0.4528	0.4359	36.634	0.4621
24 (Public)	07/28/2015	33.993	0.4541	0.4338	34.551	0.4563
27 (Public)	10/19/2015	31.938	0.4494	0.4333	31.723	0.4545
33 (Public)	04/26/2016	33.347	0.45	0.4358	33.731	0.4578
36 (Public)	08/08/2016	33.343	0.4559	0.4349	31.984	0.4606

2				
	Sub-Deck: 15 Lines: 61-64	Sub-Deck: 17 Lines: 61-64	Sub-Deck: 13 Lines: 47-49	Sub-Deck: 14 Lines: 24-27
3				
	Sub-Deck: 15 Lines: 61-64		Sub-Deck: 13 Lines: 47-50	Sub-Deck: 14 Lines: 24-27
4				
	Sub-Deck: 15 Lines: 61-64	Sub-Deck: 17 Lines: 61-64	Sub-Deck: 13 Lines: 47-50	Sub-Deck: 14 Lines: 24-27
5				
	Sub-Deck: 15 Lines: 61-65	Sub-Deck: 17 Lines: 61-64	Sub-Deck: 13 Lines: 47-51	Sub-Deck: 14 Lines: 24-27
11				
	Sub-Deck: 15 Lines: 61-64	Sub-Deck: 17 Lines: 61-64	Sub-Deck: 13 Lines: 47-50	Sub-Deck: 14 Lines: 26-29

State DOT Data Usage

Alabama	Required
Alaska	Allowed in lieu of something else
Arkansas	Required
California	Required
Delaware	Required
District of Columbia	Allowed in lieu of something else
Florida	Allowed in lieu of something else
Georgia	Allowed in lieu of something else
Iowa	Allowed in lieu of something else
Kansas	Allowed in lieu of something else
Kentucky	Required
Louisiana	Required
Maine	Required
Maryland	Required
Massachusetts	Allowed in lieu of something else
Michigan	Required
Minnesota	Required
Mississippi	Allowed in lieu of something else

Missouri	Required
Montana	Required
New Hampshire	Required
New York	Allowed in lieu of something else
North Carolina	Required
North Dakota	Required
Ohio	Allowed in lieu of something else
Oklahoma	Allowed in lieu of something else
Oregon	Allowed in lieu of something else
Pennsylvania	Required
Rhode Island	Required
South Carolina	Required
Tennessee	Allowed in lieu of something else
Texas	Required
Vermont	Required
Virginia	Required
Washington	Allowed in lieu of something else
Wisconsin	Required

Thank You!

Jonathan Sirianni

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Using Test Deck Data to Improve Paint Quality

Eric Greyson , PhD
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egreyson@dow.com
TRB AHD-55 Webinar
August 10, 2020



Agenda

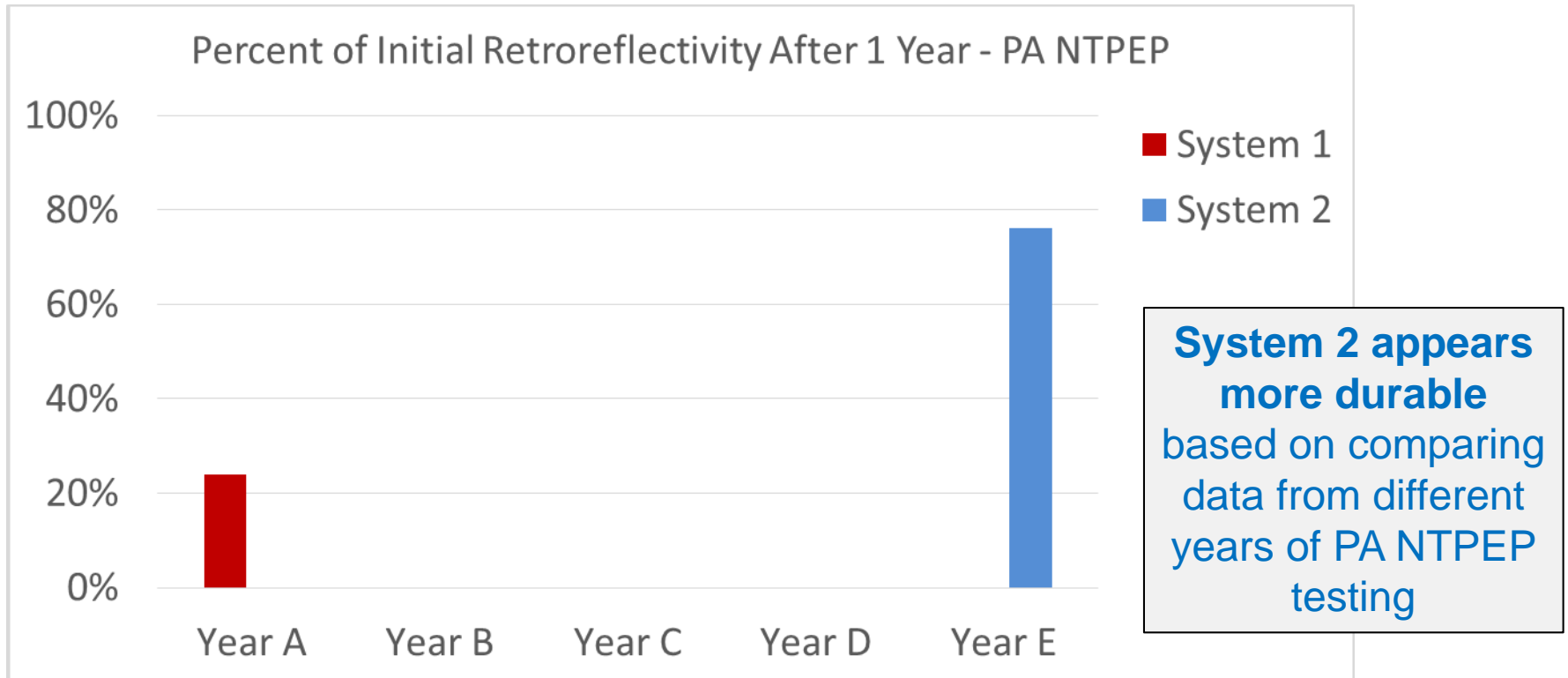
Using Test Deck Data to Improve Marking Quality

Conducting Complementary Field Evaluations

Implementation of Changes

Be Very Careful if you Compare Materials Applied to Different Test Decks

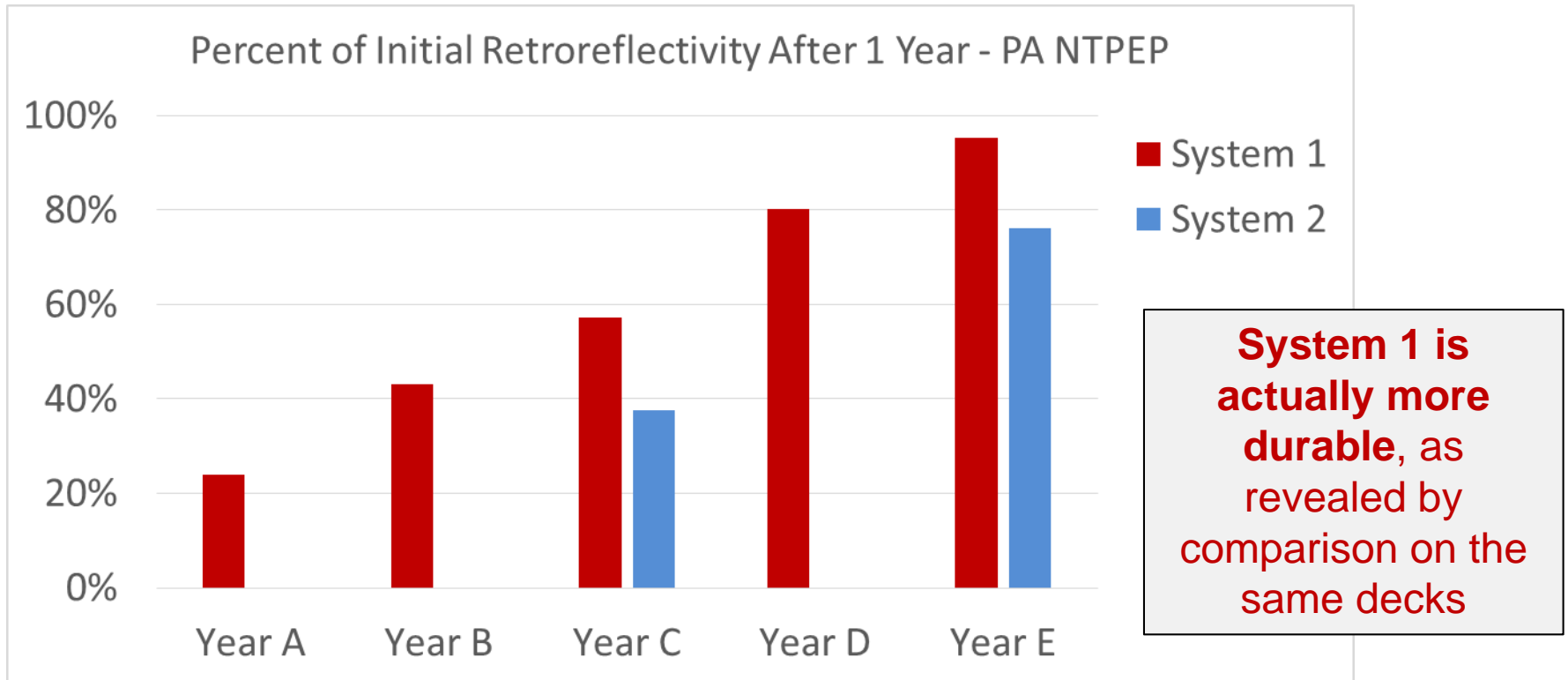
Materials applied to one deck are often compared to materials applied to a different deck. This lacks control



Paint performance can vary from deck to deck

Two paints applied to multiple years of PA NTPEP decks show dramatic year to year variation

Data **comparing materials on the same deck** greatly increases the odds of drawing **valid conclusions**

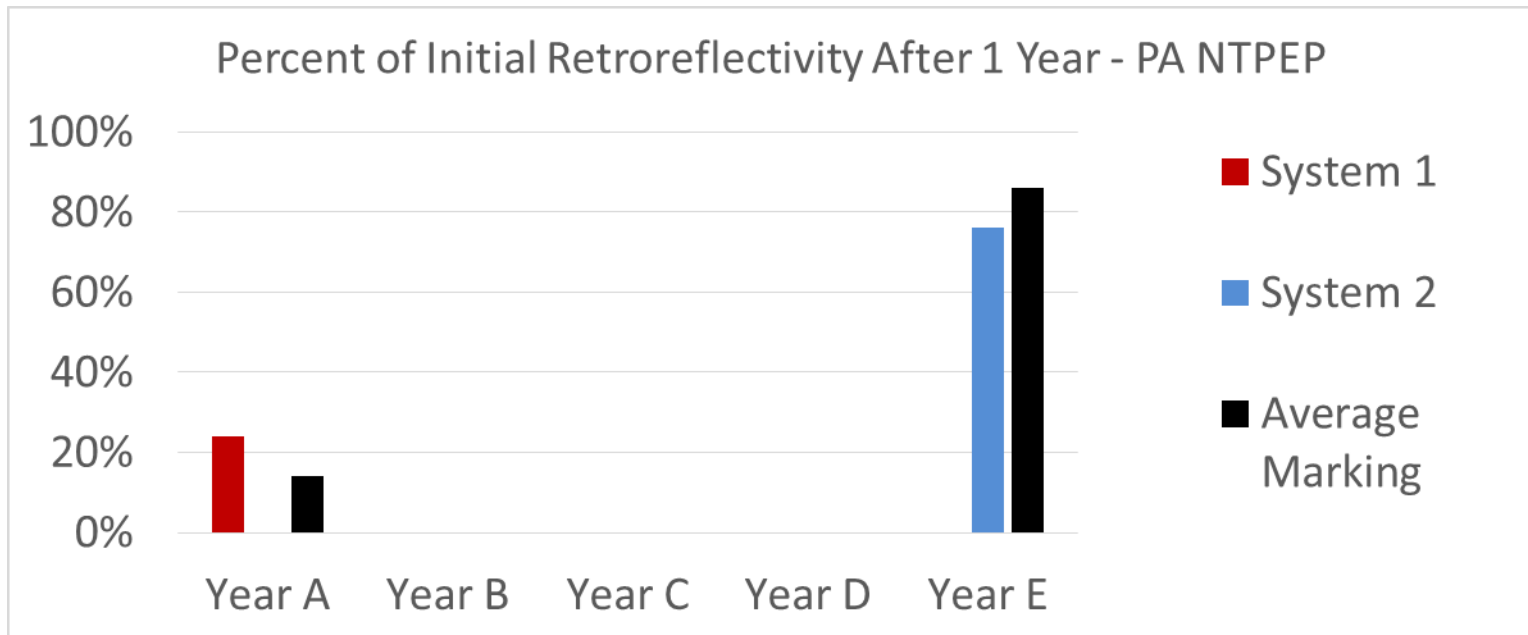


Control Materials or Deck Averages

It is often desirable to compare systems across different trials as not every system can be applied to every deck.

Control paints can help gauge “difficulty” of a trial

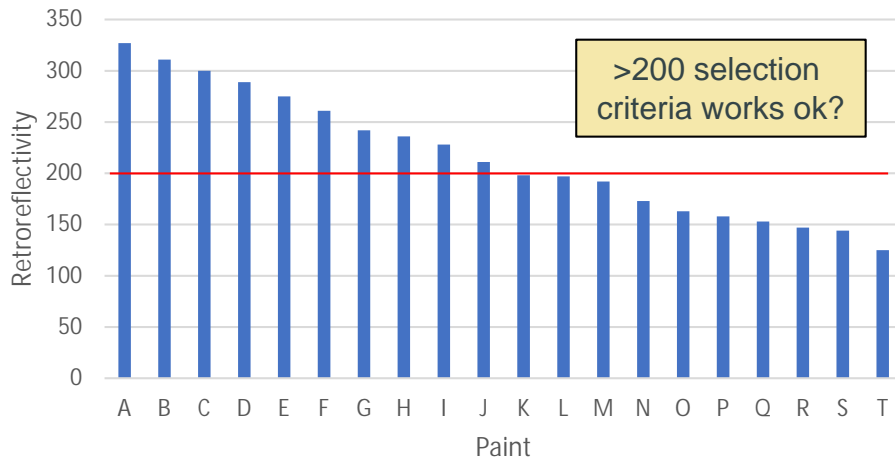
Comparison to Trial Average can also de-risk comparison



Predetermined Performance targets

Predetermined performance targets can work well if you are lucky

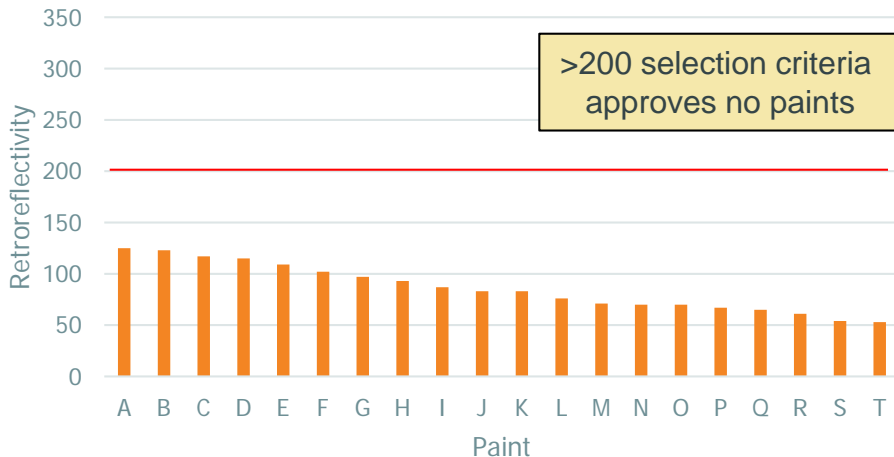
Retroreflectivity after 1 Year



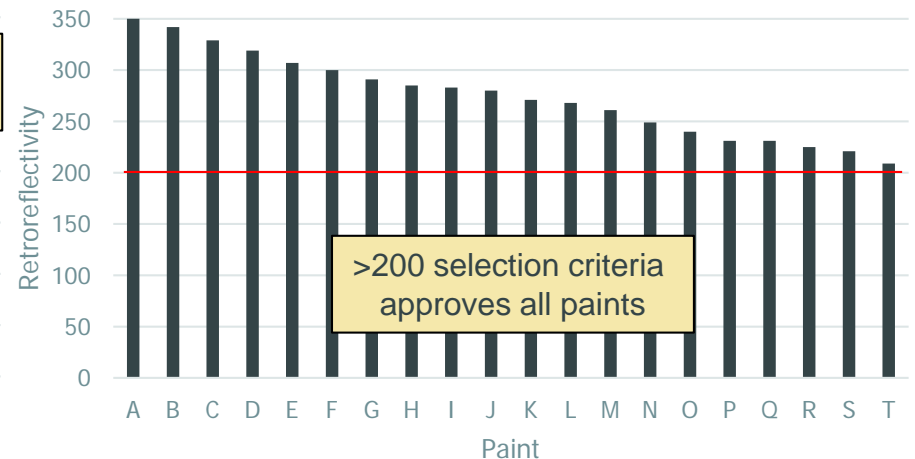
but counting on luck isn't a good plan...

Choosing a cut-off after seeing results can lead to claims of bias except if anonymized paints

Retroreflectivity after 1 Year



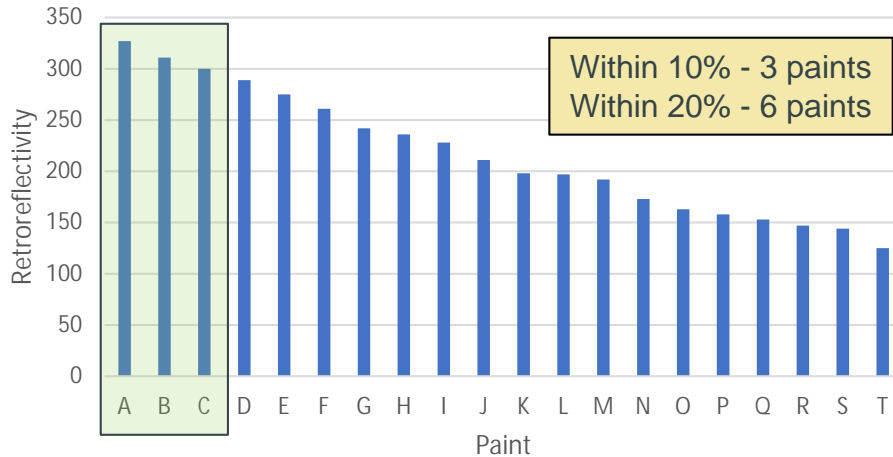
Retroreflectivity after 1 Year



Predefined Selection Rules

Predefined selection rules can avoid bias and yield better results

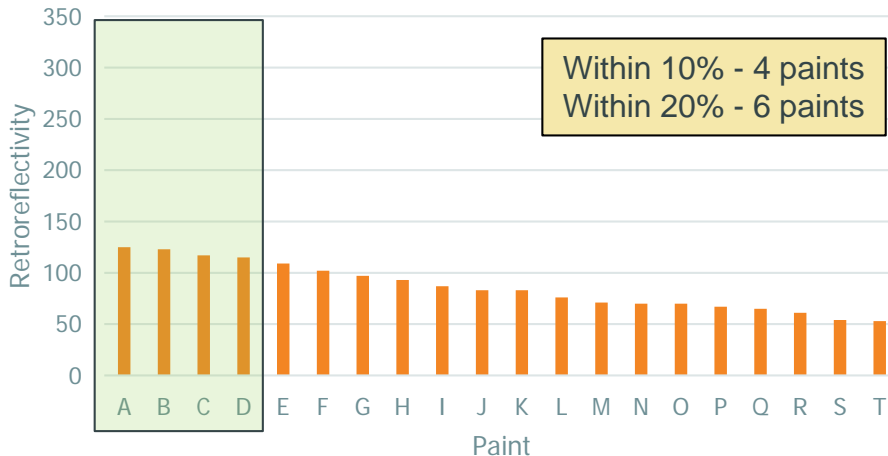
Retroreflectivity after 1 Year



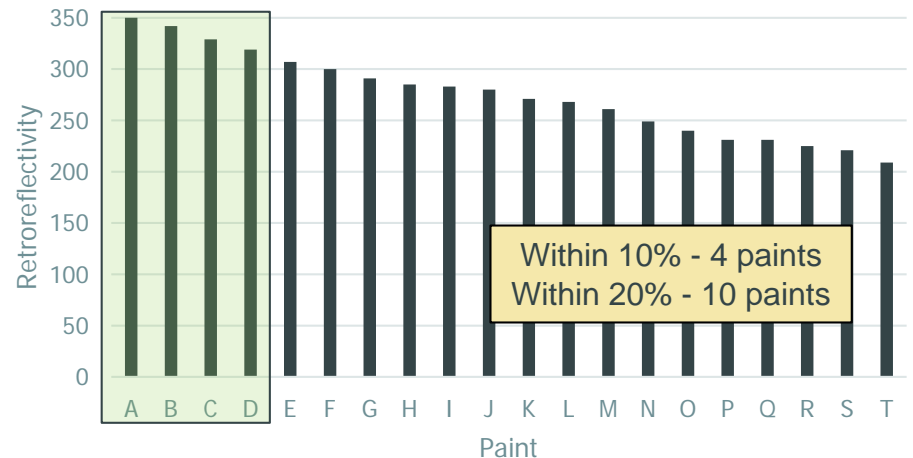
EXAMPLE SELECTION RULE:

approve all paints within 10% of top performing paint on that deck, minimum 2 suppliers

Retroreflectivity after 1 Year



Retroreflectivity after 1 Year



NTPEP: Going Beyond The Numbers

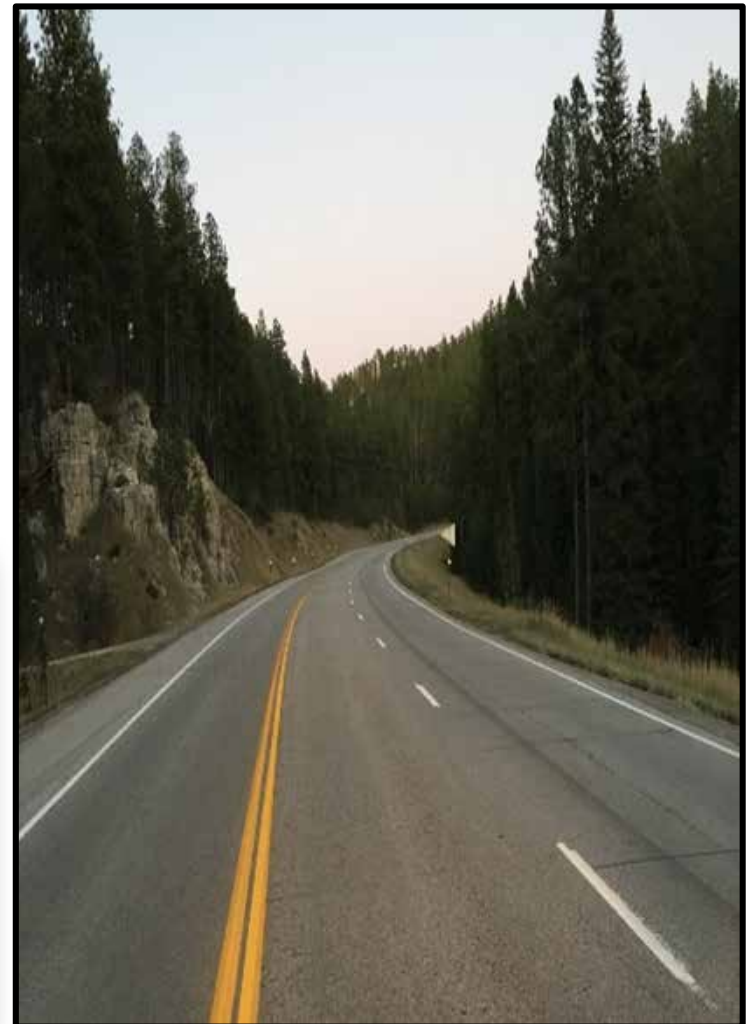
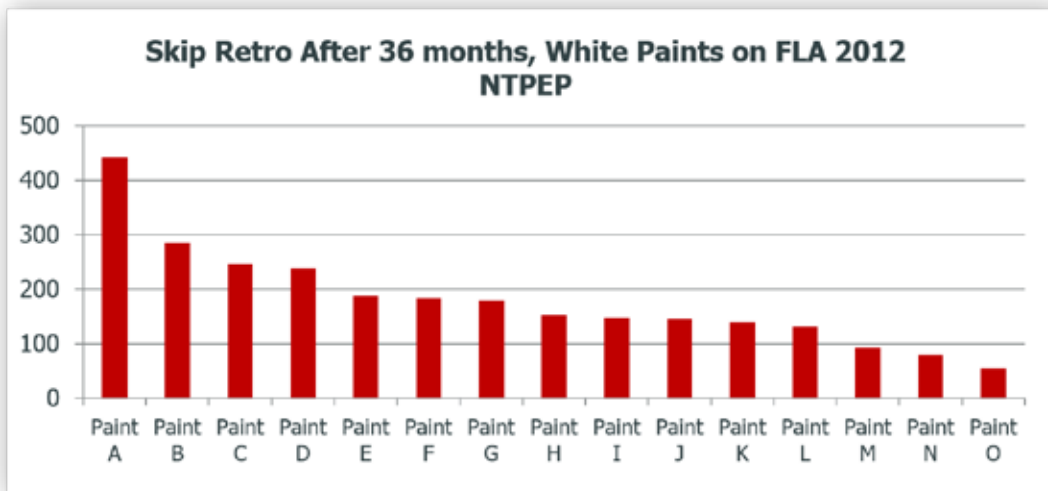
NTPEP decks evaluate **systems**, not beads, not materials

Every product can be applied at any thickness, with any beads/optics

This is great to compare a high build paint with its best optics package vs. a thin film paint with its best optics

Organizations often approve marking materials and beads separately – NOT a systems approach

Care must be taken to ensure you compare apples to apples



Using Additional Data Sources

NTPEP PMM test decks are the largest annual transverse test decks in North America if not the world. They are great sources of data. But you may want more (or different) data

- Different substrate types – e.g. different roughness/porosity, different asphalt mix, chip seal
- Different traffic levels – e.g. lower ADT
- More control – e.g. specific glass bead type, film thickness
- Different climate or season of application
- More / different products –e.g. high cost means not every manufacturer applies to every deck, and manufacturers don't apply all products
- Additional fingerprinting – e.g. polymer type
- Additional control or reference paints – How to compare to your QPL / existing paints?

Running a complementary transverse deck may help you further improve paint quality



Agenda

Using Test Deck Data to Improve Marking Quality

Conducting Complementary Field Evaluations

Implementation of Changes

Running a Complementary Test Deck

Poorly implemented test decks can cost **millions of dollars** and yield no meaningful results

Well implemented test decks can be run for **a few thousand dollars** and provide valuable information

Critical to ensure you have the **right expertise and partners** and that you have **defined the scope and goals** appropriately before you start.

Planning is key

How many materials do you want to evaluate?

Are you trying to identify equivalents or find something new and better?

What are you evaluating? Beads? Marking materials? Systems? Just one technology class or cross-class?

How will the materials be applied?

See **TRB Webinar 1259** (Pike, Honich, Greyson, 2019) for more details
<https://webinar.mytrb.org/Webinars/Details/1259>

British Columbia Test Deck As An Example

- British Columbia Ministry of Transportation and Infrastructure (BC MoTI) Conducted a set of Transverse Test Decks for Waterborne Traffic Paint with the goal of improving paint durability from 2018-2019
- Lafrentz Road Marking was the primary contractor and Dow was asked to help as a consultant
- Extensive laboratory testing was conducted on all supplied paints
- Combination of field data and laboratory testing enabled analysis of what properties or characteristics correlate well to durability

Methods: Paint Solicitation and Anonymization

- BCMoTI solicited paints (max of 2 white and 2 yellow per company) from at least 7 different formulators including all previous bidders as well as bidders for nearby government bids
- Nearby states and provinces were invited to send paints they were using in 2018 and several of those were also tested as well as the primary paint used on BC roads in 2018.
- All Paints were anonymized prior to application such that none of the applicators or administrators of the decks knew the identity of any paint. This was to prevent any claims of intentional or unintentional bias during application or evaluation of lines.
- Paint densities measured to assist in calibration
- All paints were applied 16 wet mils (calibrating by weight on test panel), utilizing AASHTO M247 Type 1 beads (provided by Lafrentz). Paints applied 10 cm wide.



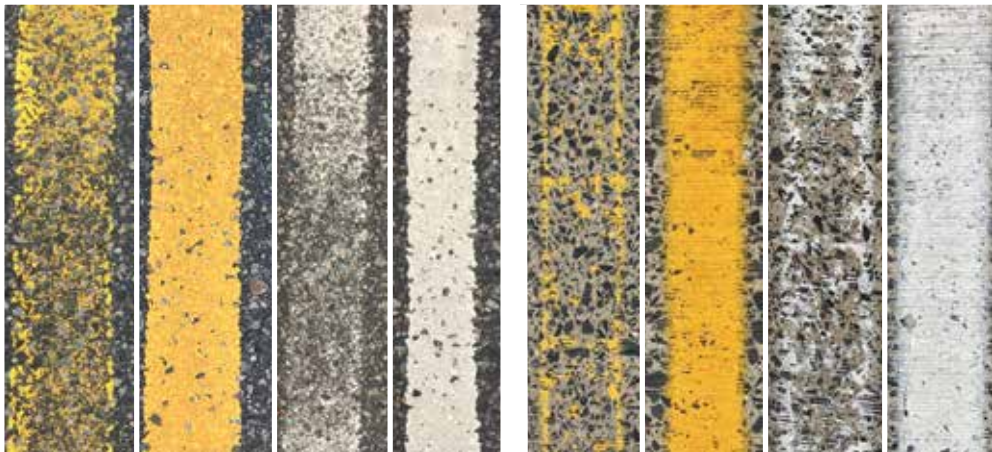
Methods: Geometry and Application of Road Trial

- Decks were applied in both Penticton, BC and Doylestown, PA. Installations done in October with temperature $> 50^{\circ}\text{F}$
- Each paint was applied four times to each location – twice each on two subdecks
- Penticton test deck was applied by Lafrentz under supervision of Dow and BCMOT. Self-propelled airless spray equipment with adjustable speed and gravity drop beads.
- Pennsylvania deck was applied by Dow utilizing a constant-speed, air assisted striper and pressurized beads. This allows greater control and better glass bead embedment
- Installing two test decks should increase signal to noise, providing higher confidence that results will show true durability ranking of paints. Two decks also provide multiple road surfaces and winter weather / maintenance seasons



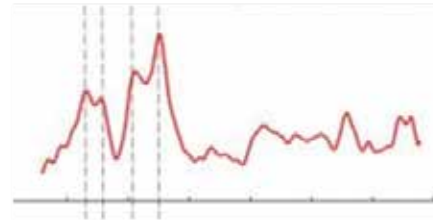
Methods: Evaluations of Test Decks


- Both test decks were evaluated periodically to ensure we did not miss a critical time window – for example if heavy traffic or rough winter wore all lines. Last evaluations 3/22 (BC) and 4/4 (PA)
- Every line was photographed at every reading – photos utilized equipment to ensure uniform distance, lighting, angle. Wide angle photos also taken for cross-reference.
- Retroreflectivity of each line was measured at each reading
 - Lane center and left wheel track in BC; By edge line and right wheel track in PA
- Presence of each line was graded at each reading
 - Each photo was graded by 2 individuals with scores averaged
- Results for each point (4 lines per deck) were averaged at every reading



Methods: Laboratory Testing of Paints

- **Paints had extensive laboratory fingerprint testing**
 - Fingerprinting is critical to ensure paints used match paints tested and approved
- Density
- Viscosity
- Hegman
- Dry to no pickup
- Weight percent solids
- Weight percent pigment
- Opacity
- Y reflectance
- Scrub resistance
- Taber abrasion resistance
- Polymer Type – FTIR & Fluorescence
- *All tests were run in duplicate*



- 
- Broad range of performance in terms of durability was observed across the paints
 - The six most durable paints
 - All contained the same type of polymer
 -

British Columbia Test Deck: Key Lessons

It doesn't have to take a lot of time or money!

- This trial cost <\$10,000 and took 2 days for each deck
- It does require good planning, good equipment and expertise, although some of those may be leveraged

Anonymized paints, plus use of a single applicator, film thickness and bead source can eliminate potential bias and increase comparability

- Bring unmarked pails, labels, and many spray tips

Many properties frequently specified were not found to correlate to paint durability

Polymer type was by far the strongest predictor of paint durability and thus polymer testing is a critical component of fingerprinting

Agenda

Using Test Deck Data to Improve Marking Quality

Conducting Complementary Field Evaluations

Implementation of Changes

■ Reduction to Practice

Given the BC test deck results, *how could one move forward with a specification or qualified/recognized product list*

Specification based on characteristics *proven* to correlate to key properties

Selection of individual products based on test decks

- Anonymize and then cutoff later? Have a rule about at least this many products or must be within X% of or etc..

Selection of quartile or decile of products for test decks

- If you pre-state this, what if you say top 5 paints and there is a huge gap between 4 and 5.. Or almost no gap between 5 and 6?

Performance adjustment factor

Selection of Individual Products

Should select before de-anonymization or define rules (top 5 paints, paints within 10% of best, top 10% of paints, as many paints as it takes to get 3 suppliers)

Advantage: Paints are known to perform

Disadvantage: Freezes QPL. What about new paints invented after this trial?

Paint ID	Durability Score	PA Edge Retro	PA WT Retro	PA WT Presence	Pentiction Center Retro	Pentiction Center Presence	Paint Source	Polymer Type
White A	0.986	314.5	208	86.25	175.75	95.125	F3	4
White E	0.951	247	197	85.625	177.75	93.875	F2	4
White F	0.945	258	214.75	83.75	165	92.625	F5	4
White V	0.925	250.5	169.75	85.625	154.25	93.875	DOT	4
White Q	0.912	253.25	157.25	82.5	159	94.5	F6	4
White P	0.893	272	186.25	85.625	111.75	87.25	F1	4
White Y	0.818	244.5	143.75	65.625	180.75	85.625	DOT	1
White D	0.810	255.75	186.5	81.875	73.25	75.625	F5	1
White C	0.808	278.5	121.75	71.875	142.25	81.875	F3	2
White R	0.696	147.75	74.5	51.25	193.5	84.375	DOT	1
White Z	0.680	225	91.5	58.125	121.5	73.75	DOT	2
White H	0.666	241.25	145.5	56.875	77.25	68.75	F4	1
White T	0.562	164	64.5	52.5	46.5	68.75	F6	3
White G	0.488	99.25	41.5	13.375	139	85.625	DOT	1
White L	0.441	80.75	31.5	28.75	57.5	71.875	DOT	1
White J	0.387	72.5	16.5	6.875	72.25	81.25	F4	1
White X	0.345	62.75	22	5.5	66.25	71.875	DOT	1
White B	0.325	27.5	9	2.125	68.25	75	DOT	1
White N	0.271	78	22.25	11.25	38.25	47.5	F1	1

Paint ID	Durability Score	PA Edge Retro	PA WT Retro	PA WT Presence	Pentiction Center Retro	Pentiction Center Presence	Paint Source	Polymer Type
Yellow D	0.968	194.75	107.75	83.125	66.75	91.625	F5	4
Yellow R	0.943	167	101.25	78.125	71	95.125	F6	4
Yellow X	0.898	129.75	87.75	79.375	81.5	86.875	F1	4
Yellow H	0.880	145.75	86	76.25	59	91.875	F3	4
Yellow Q	0.876	148.5	81.5	75.625	58.5	92.625	F2	4
Yellow W	0.853	129.75	73.25	74.375	64	90.625	F5	4
Yellow E	0.797	151.5	91.25	65	49	82.5	F3	2
Yellow V	0.633	112.5	56.5	54.375	39.5	68.125	F6	3
Yellow B	0.621	100.75	32.25	35	52.75	90.625	F4	1
Yellow Y	0.591	95.5	37.25	41.875	38.5	79.375	DOT	1
Yellow L	0.475	89.25	39.75	20	40.5	70.625	DOT	1
Yellow O	0.458	112.75	40.75	23.125	30.75	61.875	DOT	1
Yellow J	0.445	49.75	15	15.25	40.5	81.25	F1	1
Yellow N	0.432	73.5	27.25	17.5	27.5	72.5	DOT	1
Yellow G	0.355	25.75	10.75	5.25	31.5	75.625	DOT	1
Yellow F	0.348	42.5	19.75	12.5	31.5	60	DOT	1

Specification Based on Test Deck

Develop a specification based on properties found to correlate with high quality paints on test deck

- Minimum values for opacity, reflectance to ensure initial visibility
- Does not contain requirements for scrub, abrasion, lbs TiO₂, or solids

Advantages: Allows for some new paints while attempting to enforce high quality

Disadvantages: Chance of admitting lower quality paint. May need eventual updating.

Property	White Paint	Yellow Paint	Rationale
Viscosity (KU)	70-100	70-100	Storage and application
Hegman	4	4	Sprayability
Dry Time, D711	<20	<20	Road Closure
Polymer Solids	15.0	16.5	Durability Performance
Opacity	.87	.72	Initial Visibility
Reflectance	80	60	Initial Visibility
Polymer Type	Type 4	Type 4	Durability Performance

Performance Adjustment Factor

Advantages:

- Use of a Performance Adjustment Factor (PAF) in a low bid scenario can drive cost down and quality up
- Allows road owner to define how much they would pay for different performance levels

Disadvantages:

- Only as good as the data; can not fairly compare more than one test deck

Pennsylvania PAF

“In order to emphasize quality, the Department will apply a Price Adjustment Factor (PAF) as a multiplier to each paint bid price prior to selecting the “low bid.” The Department’s formula for statewide bids for “white and yellow traffic paint,” i.e., Contract #8010-04, is as follows:

$$\text{PAF: } [1000/((0.85\text{RB} \times \text{DB}) + (0.15\text{RC} \times \text{DC}))]^{0.75}$$

RB and DC are the average skip retroreflectivity on bituminous and Portland cement pavements

DB and DC are the average wheel track durability rating on bituminous and Portland cement pavements

Review

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— Thank
You



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Today's Panelists

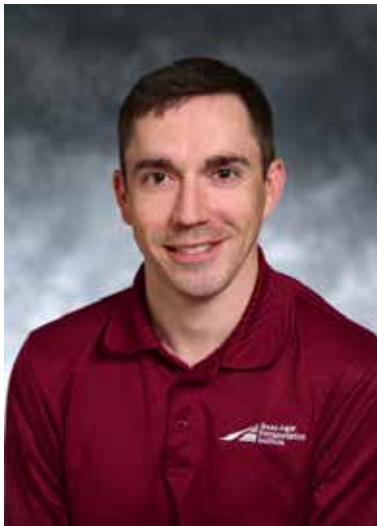
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Moderator: Carmine Dwyer,
Applied Research Associates



Jonathan Sirianni,
AASHTO



Adam Pike



Eric Grayson,
Dow



Get Involved with TRB

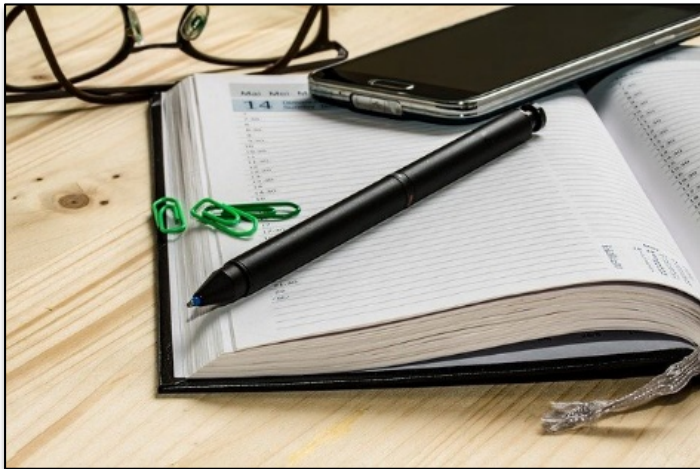
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