

NJ I-280 High Performance Thin Overlay

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Thin Hot Mix Asphalt Overlays in NJ

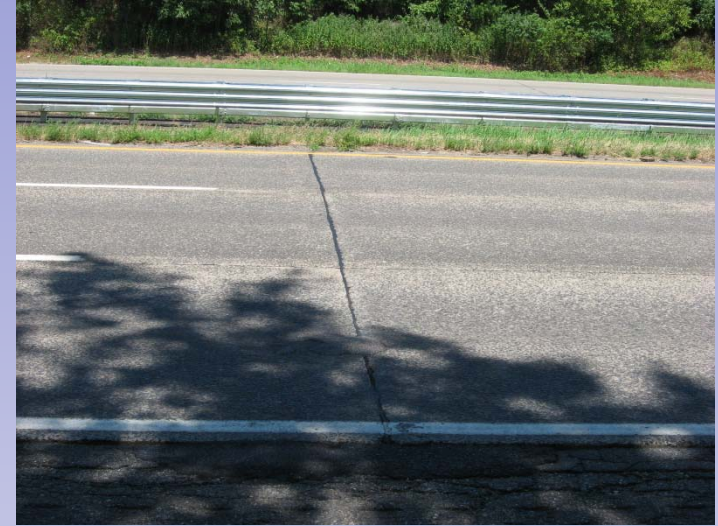
- Thickness 1.5 inches and less
- Functional Overlays
 - ◆ Used to Restore: Ride Quality, Cross Slope, Skid Resistance, Seal the Surface, Marking Contrast, Tire Noise
 - ◆ Minimal addition to pavement structure (i.e. – OGFC & AR-OGFC)
- Structural Overlays
 - ◆ Increased Rutting and Fatigue Resistance utilizing a thin lift
 - ◆ Usually difficult rehabilitation situations (i.e. – bridge decks, deteriorating PCC, profile restrictions)
 - ◆ Associated with performance-based specification
 - ◆ Achieved using high binder mixtures with polymer

NJDOT's View on WMA

- Reduced Emissions and Fumes
- Reduced Oxidation of the Binder
- Improved Workability
- Extending Paving Season
- Compaction Aid & Improved Density

NJ I-280 Conditions

- Deteriorated PCCP: cracks, spalls, patches
- High joint deflections
- Heavy traffic volume
- Water entering subbase/subgrade
- Rutts, Longitudinal & Transverse Faulting



NJ I-280 Resurfacing

- No funding for major rehabilitation (future rubblization will be limited by structures)
- Pavement Design Strategy:
 - ◆ Underseal joints with chemical grout to stabilize vertical deflections and limit water infiltration
 - ◆ Apply High Performance Thin Overlay (HPTO) as leveling course and help seal and insulate the surface
 - ◆ Asphalt Rubber OGFC (AR-OGFC) for noise reduction, (nearby resident complaints) ride and thermal blanket
 - ◆ Total thickness = 1 to 3 inches, limited by barrier curb

NJDOT Success with Similar Overlays

■ Rt. 24 – Short Hills

- ◆ NJDOT MOGFC-1 placed over micro-milled PCCP
- ◆ Project was written into a funding bill “noise reducing HMA pavement”
- ◆ Heavy PG64-22 tack coat
- ◆ Transverse joints reflected within 2 years and sealed
- ◆ Placed 1999; Milled out 2009



NJDOT HPTO Specifications

High Performance Thin-Overlay (HPTO)

Job Mix Formula Requirements	
Sieve Size	Percent Passing
3/8"	100
#4	65 - 85
#8	33 - 55
#16	20 - 35
#30	15 - 30
#50	10 - 20
#100	5 - 15
#200	5 - 8
Min. % Binder	7.0

FAA > 45% (AASHTO T304)

Fine aggregate of stone sand
(no natural sands)

Sand Equivalency > 45%
(AASHTO T176)

Field Density 2% to 7% voids
(AASHTO T-166)

Volumetric Requirements for Design and Control of HPTO					
Requirements	Required Density (% of Max. Sp. Gr.)		Voids in Mineral Aggregate (VMA)	Dust to Binder Ratio	Draindown, AASHTO T305
	Ndes (50 Gyration)	Ndes (100 Gyration)			
Design	96.5	< 99.0	> 18.0%	0.6 - 1.2	< 0.1 %
Control	95.5 - 97.5	< 99.0	> 18.0%	0.6 - 1.2	< 0.1 %

High Performance Thin-Overlay

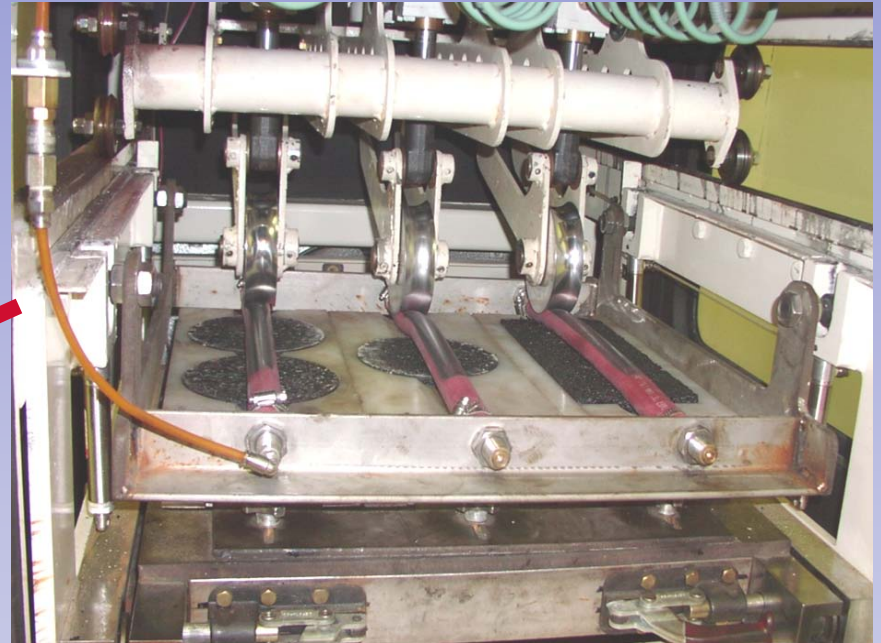
■ Binder

- ◆ PG76-22 (NJDOT Spec)
- ◆ RTFO Elastic Recovery > 65% @ 25°C (AASHTO T301)
- ◆ Separation Test < 4.5°C after 4 hrs (ASTM D5976)

■ Performance Specification

- ◆ Utilize the Asphalt Pavement Analyzer (AASHTO TP 63) for stability check
 - Must supply for mix design verification and control (1st Lot and every other Lot thereafter)

Asphalt Pavement Analyzer



- AASHTO TP 63
- 100 lb wheel load; 100 psi hose pressure
- Tested at 64°C for 8,000 loading cycles
- Samples at 5 +/- 0.5% air voids
- APA Rutting < 4 mm to PASS

So Why WMA for the Thin Lift?

Why WMA for the Thin Lift HMA?

■ Schedule

◆ Corrective action:

- undersealing (lift at PCCP joints – too much urethane grout)
- Partial depth pcc patch failures, replaced with hot syn. resin

◆ Many joints required diamond grinding

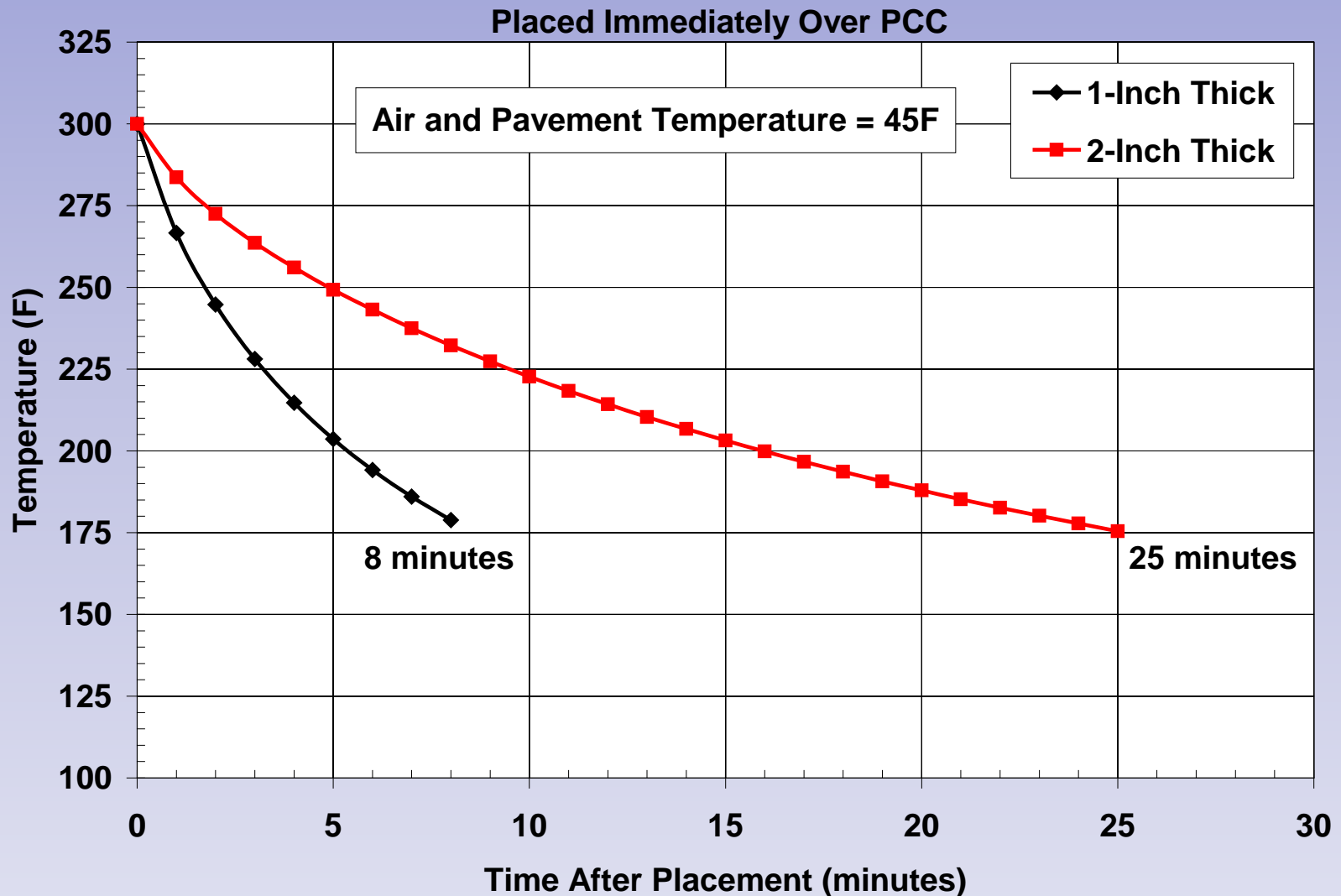
◆ Pushed HPTO paving schedule to start in Nov. 2009

■ PCC Patch Mat'l and Joint Sealant softening

■ Improved Fatigue Resistance

■ Reduced Plant Emissions

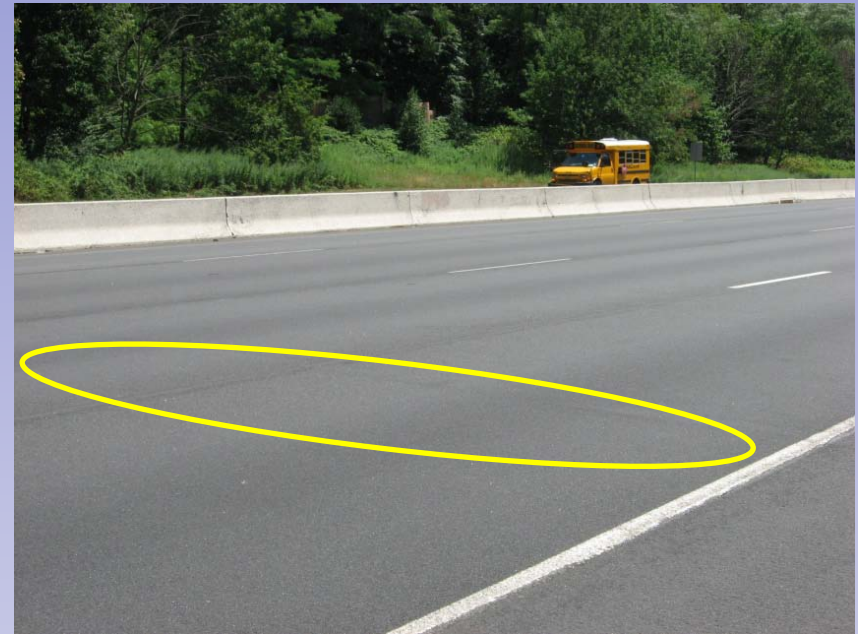
General Thin-Lift HMA Cooling (MultiCool 3.0)



Why WMA for the Thin Lift HMA?

- Schedule
- PCC Patch and Joint Material
 - ◆ Low softening point of synthetic resin PCC patch material (230 F) and joint sealant swell at normal HMA compaction temperatures
- Improved Fatigue Resistance
- Reduced Emissions

Resin Patch Areas on NJ I-280



HPTO left open to traffic from
November 2009 to June 2010

Rt I-280 WB HPTO Patch Bump

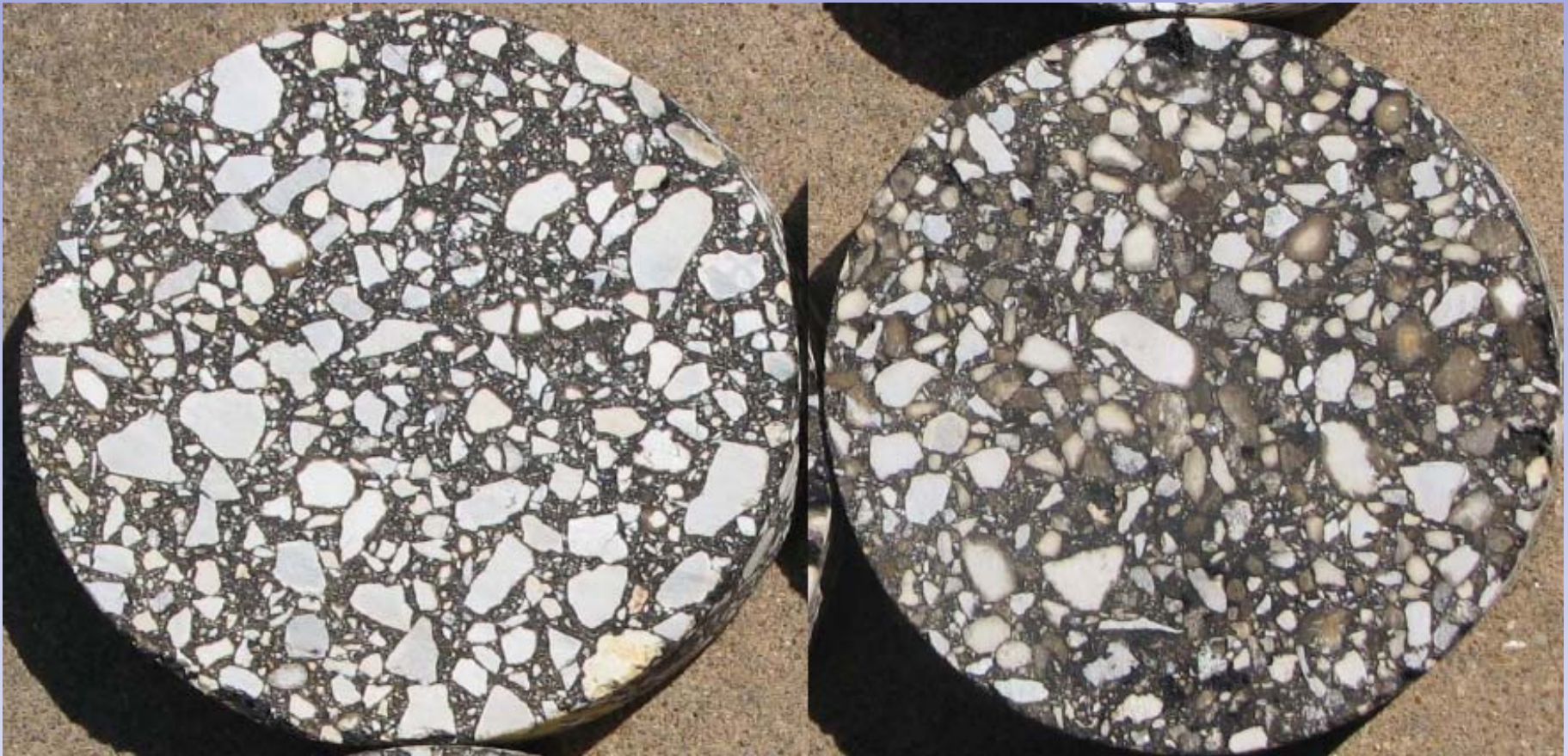


Why WMA for the Thin Lift HMA?

- Schedule more flexible
- PCC Patch and Joint Material
- Improved Fatigue Resistance
 - ◆ Reduces oxidative aging
 - ◆ Reduces polymer degradation from excessive production temperatures
 - ◆ Reduces asphalt absorption in aggregate
- Reduced Emissions

Reduced Asphalt Absorption

Dale Rand, TxDOT

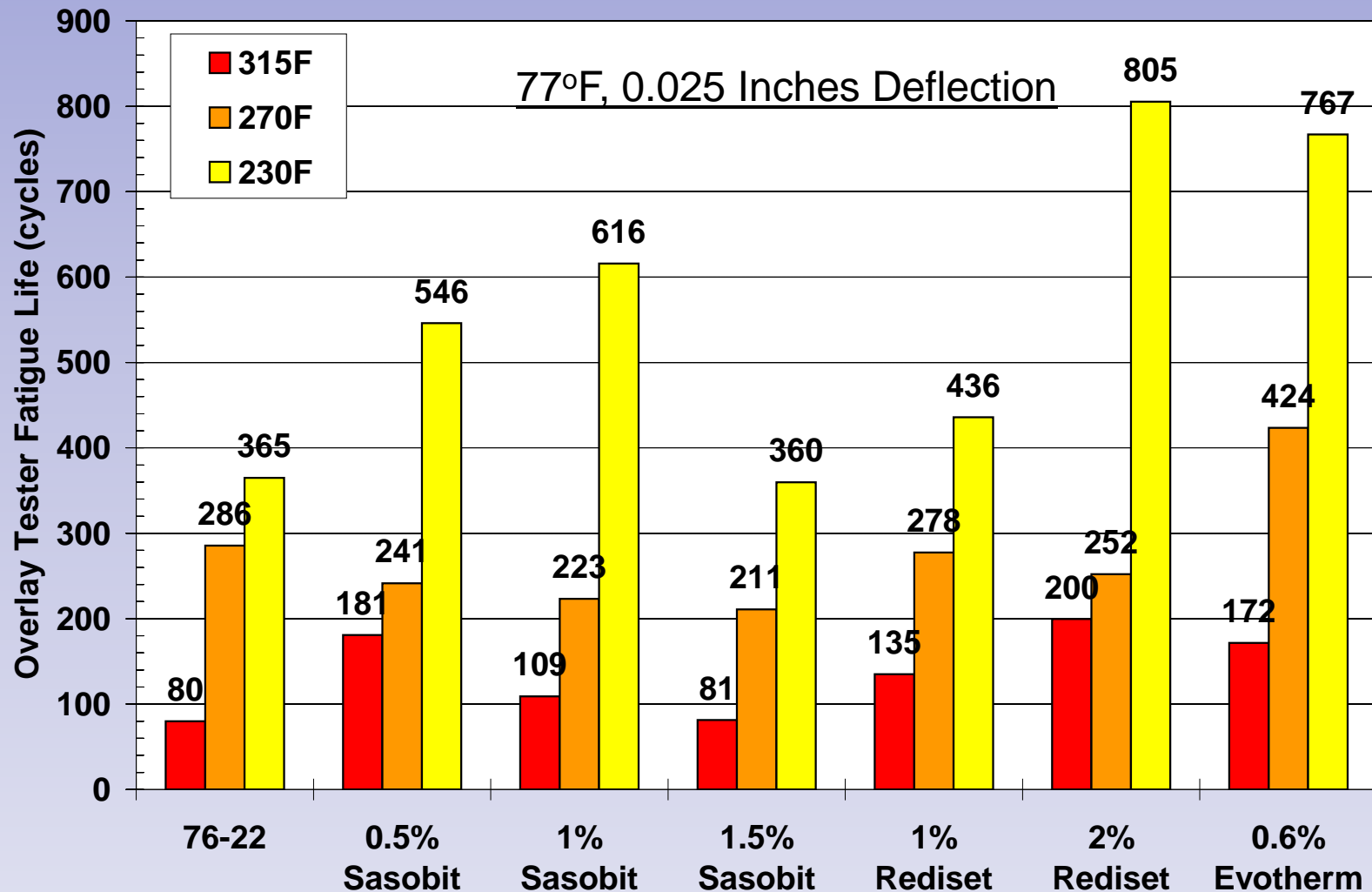


Evotherm

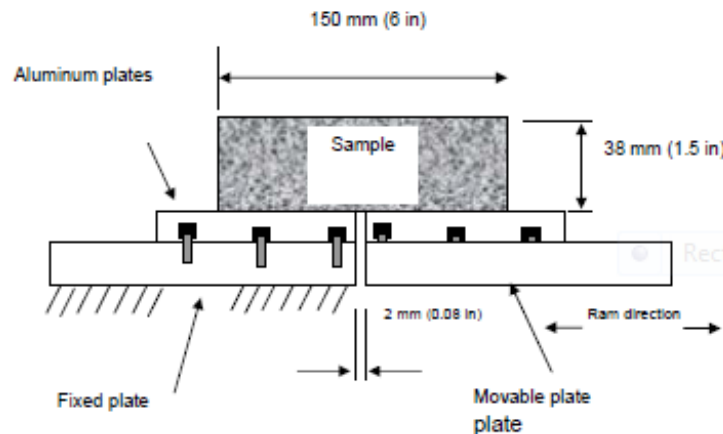
HMA

TTI Overlay Results at Different Mixing Temperatures

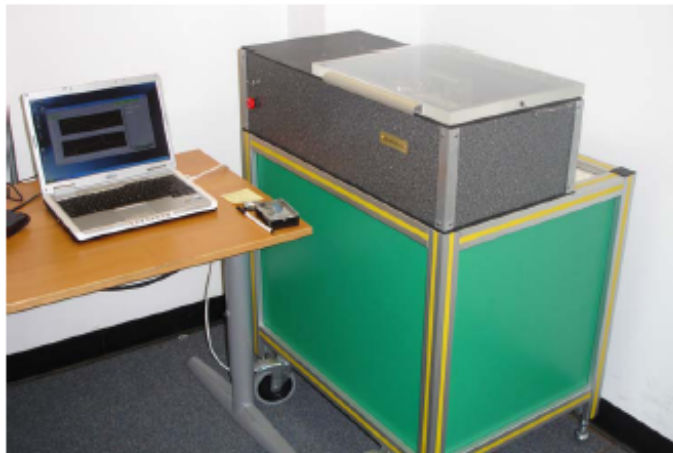
Lab Produced 12.5mm Superpave Mixture with PG76-22



TTI Overlay Tester, NJDOT B-10



Overlay Tester



- Sample size: 6" long by 3" wide by 1.5" high
- Loading: Continuously triangular displacement 5 sec loading and 5 sec unloading
- Definition of failure
 - Discontinuity in Load vs Displacement curve

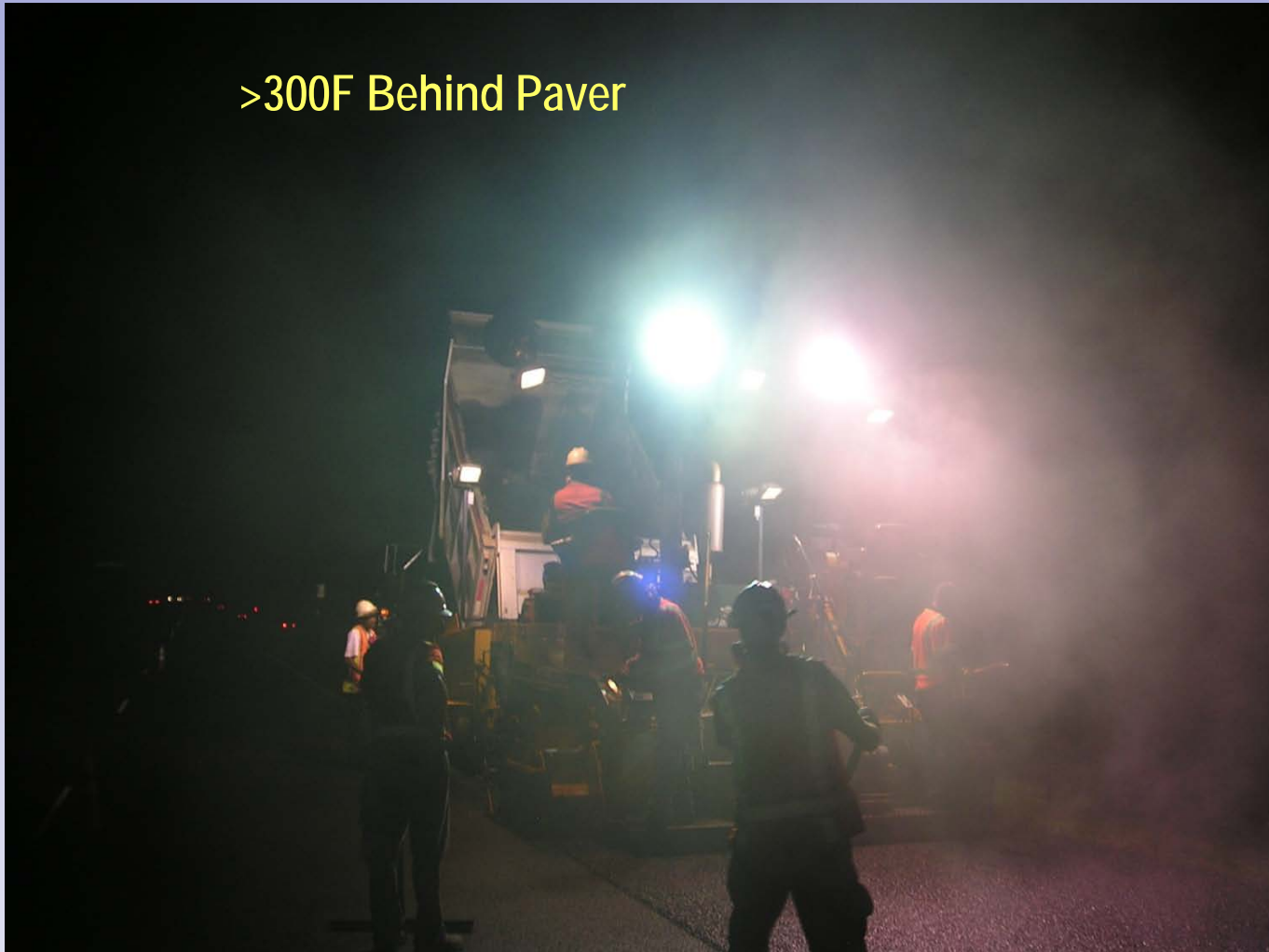
Why WMA for the Thin Lift HMA?

- Schedule
- PCC Patch and Joint Material
- Improved Fatigue Resistance
- Reduced Emissions
 - ◆ Lower production temperatures reduces emissions at plant and paver
 - ◆ Main reason for use in the AR-OGFC
 - Significantly reduces rubber odor

Reduced Emissions/Fumes

- NJ I-78 AR-OGFC (Normal Production Temp.)

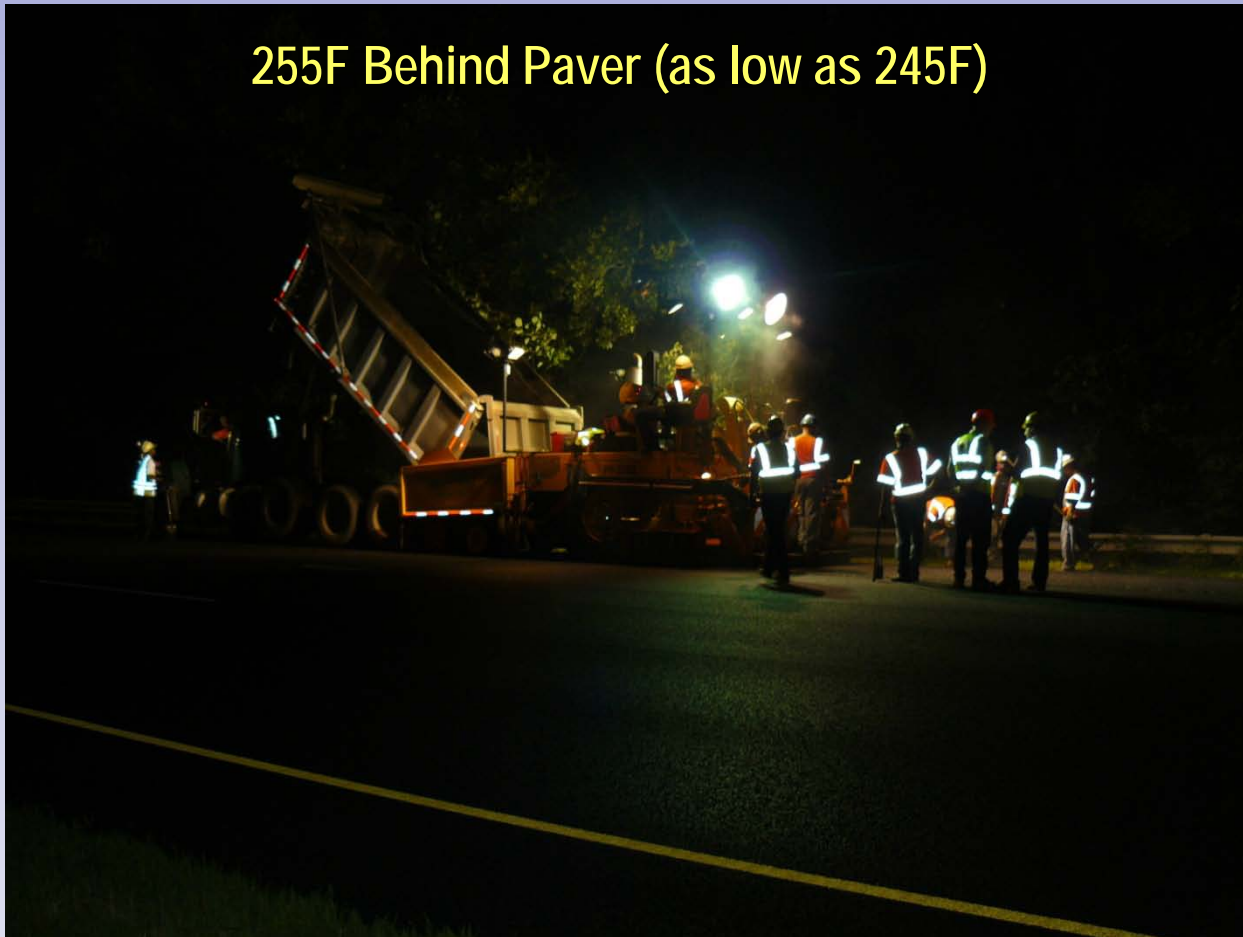
>300F Behind Paver



Reduced Emissions/Fumes

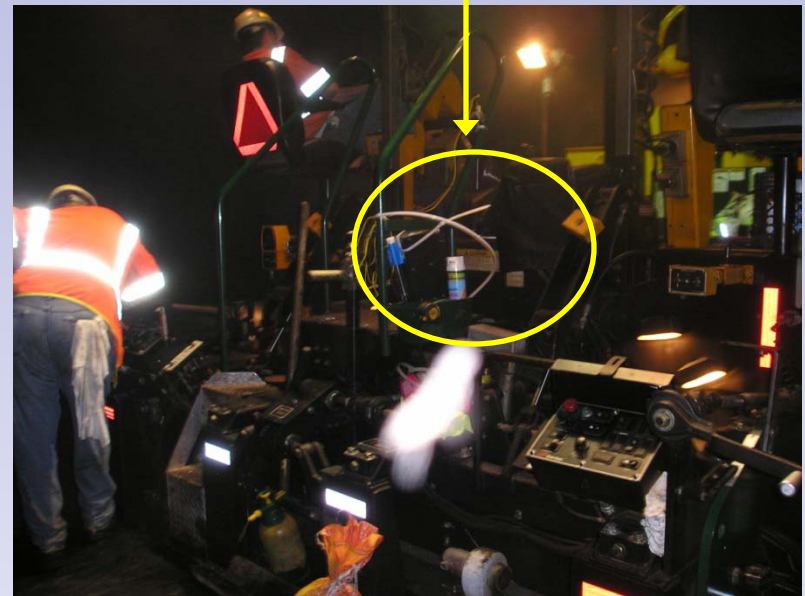
- NJ I-78 AR-OGFC (Reduced Production Temperature with WMA – Evotherm 3G)

255F Behind Paver (as low as 245F)

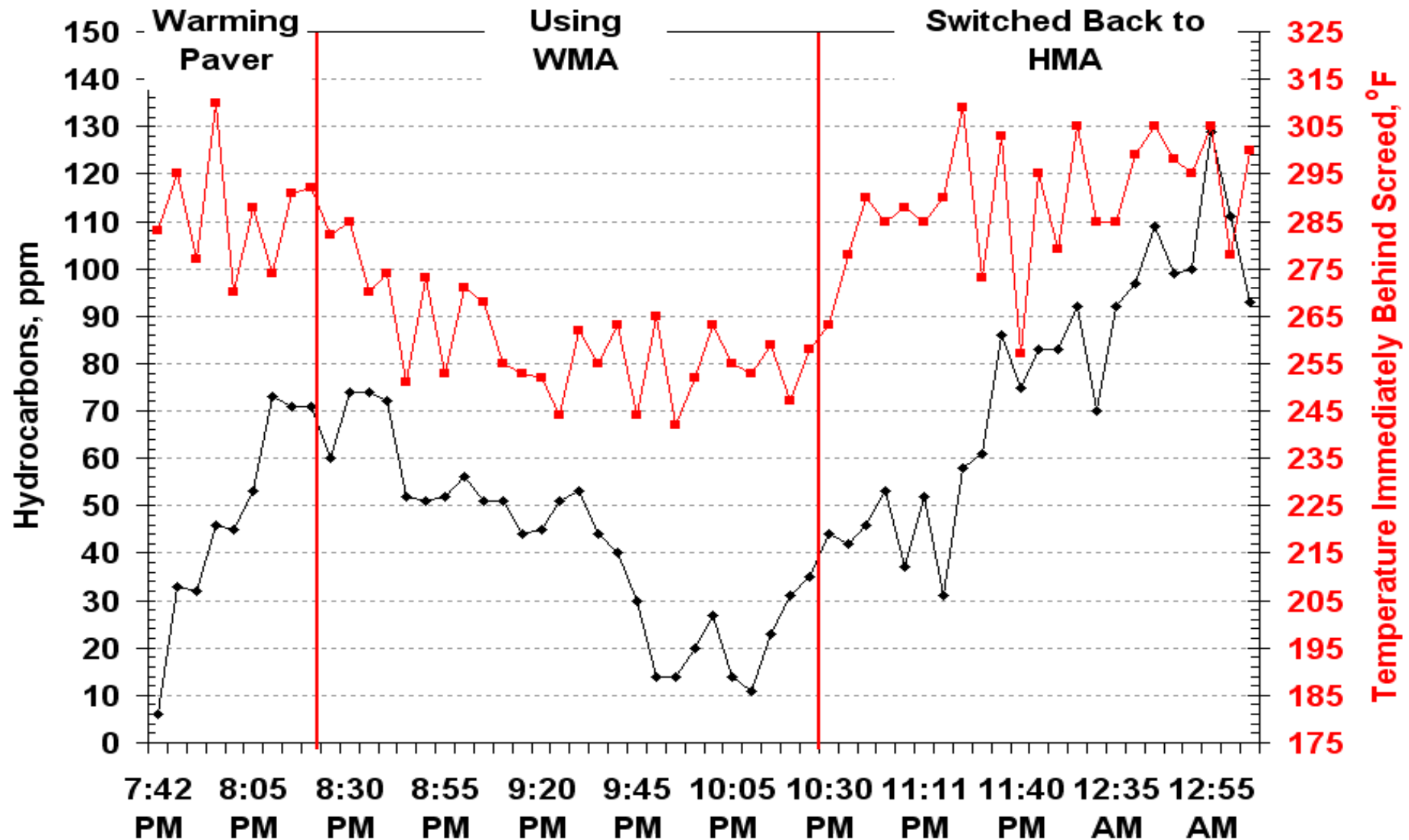


Emissions Testing

- Looked at quantifying emissions reduction at paver with and without WMA
- Used portable emissions tester mounted to railing on back of paver (where workers would stand)



Example of Typical Emissions at Paver (AR-OGFC on I-78)



I-280 – WMA HPTO

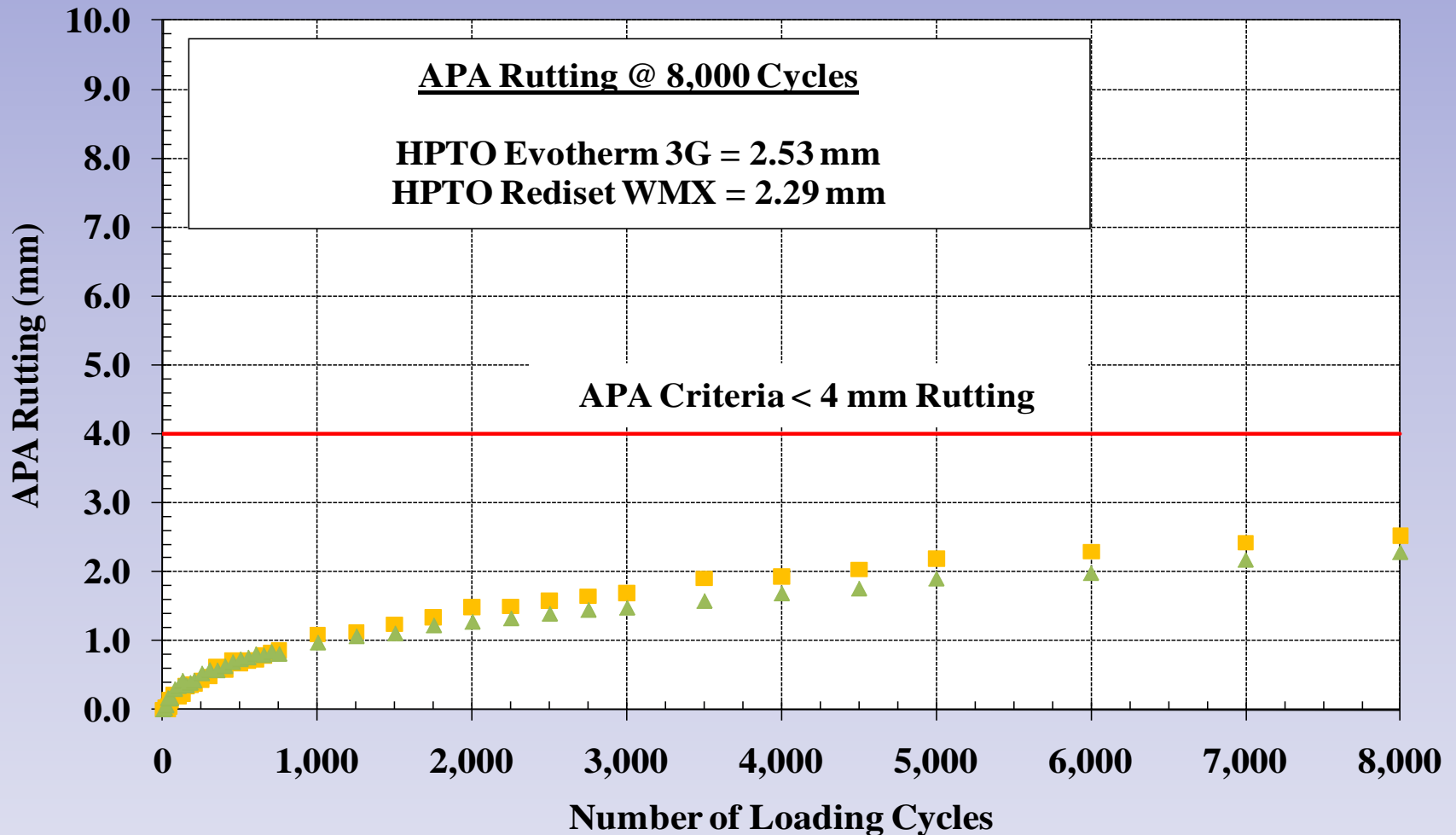
- HPTO paving started November 2009
- Night-time paving
 - ◆ Air and PCC surface temps 40 to 50F
- Use of WMA allowed for a little research
 - ◆ Evotherm 3G
 - ◆ Rediset WMX
- Production temperatures initially at 285F (270F compaction temperature)
 - ◆ Still had issues with some patch softening
 - ◆ Reduced production temperatures to 270F (255F compaction temperatures)

Laboratory Mixture Testing

- Asphalt Pavement Analyzer – rutting
- Flow Number (AMPT) - rutting
- Dynamic Modulus – mix stiffness
- Overlay Tester – fatigue resistance
- TSR – stripping potential

Asphalt Pavement Analyzer

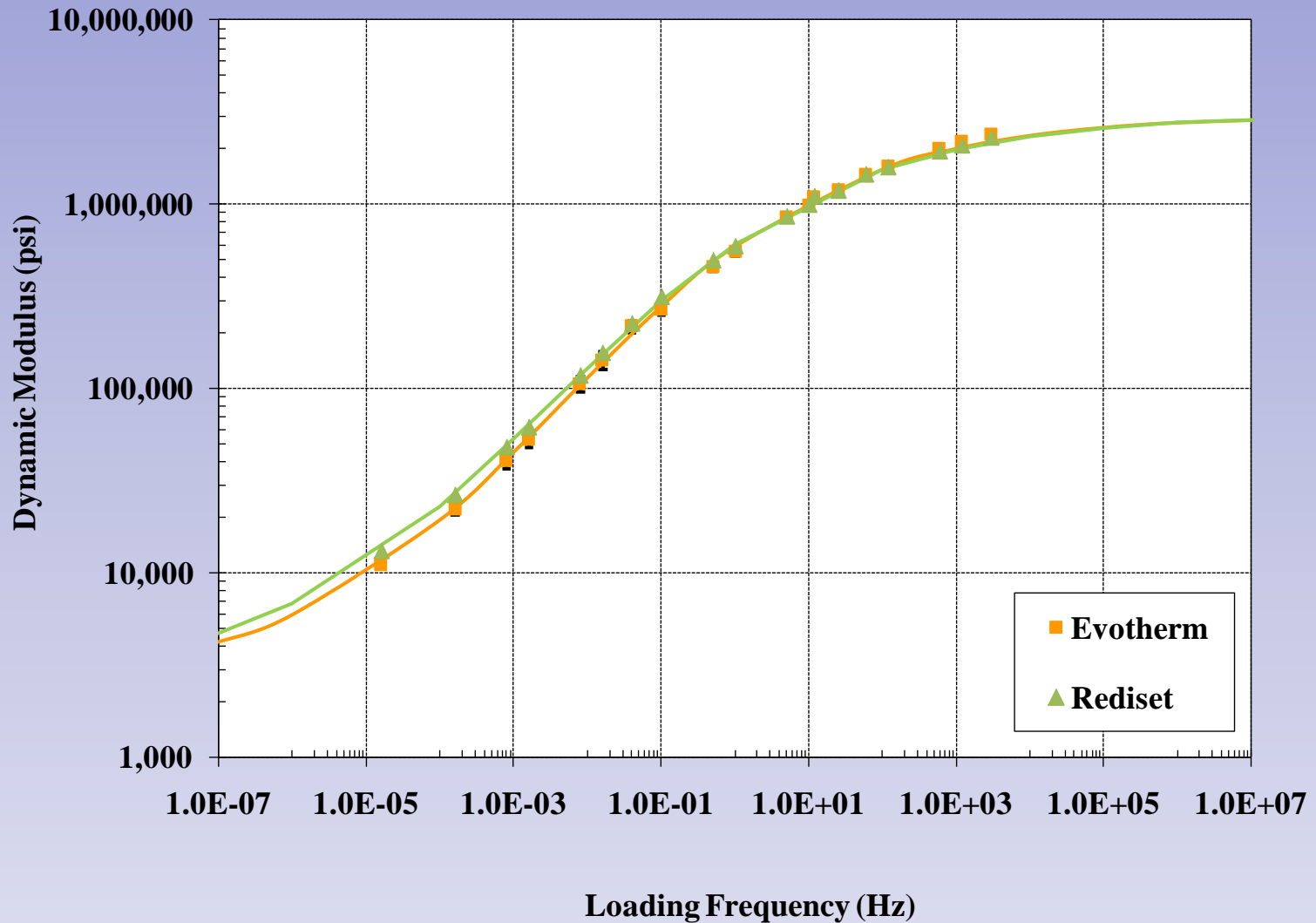
64°C Test Temp.; 100psi Hose Pressure; 100 lb Load Load



Flow Number (AMPT)

Mix Type	Sample ID	Flow Number (cycles)	Cycles to Achieve 5% Strain
Evotherm WMA-HPTO	1	795	1,958
	2	539	1,644
	3	692	2,333
	Average	675	1,978
Rediset WMA-HPTO	1	1,256	3,311
	2	1,453	3,573
	3	1,489	3,859
	Average	1,399	3,581

Dynamic Modulus



TTI Overlay Tester Results

HPTO with Rediset WMX				
Sample ID	Air Voids (%)	Temp (F)	Displacement (inches)	Fatigue Life
# 1	3.91	77 F	0.025"	162
# 2	3.60			112
# 3	3.60			88
# 4	3.60			70
# 5	3.80			169
Average =				120

HPTO with Evothrm 3G				
Sample ID	Air Voids (%)	Temp (F)	Displacement (inches)	Fatigue Life
# 1	3.93	77 F	0.025"	293
# 2	3.81			236
# 3	4.36			289
# 4	3.81			173
# 5	4.20			244
Average =				247

TSR Results

Evotherm 3G HPTO			
Specimen Type	Indirect Tensile Strength		Average TSR (%)
	Dry	Conditioned	
AASHTO T283 Conditioned	161.2	145.8	97.5%
	155.8	160.6	
	158.5	157.2	
	158.5	154.5	
Rediset HPTO			
Specimen Type	Indirect Tensile Strength		Average TSR (%)
	Dry	Conditioned	
AASHTO T283 Conditioned	159.9	157.2	104.4%
	151.7	159.1	
	136.1	151.2	
	149.3	155.8	

NJ I-280 – Completed September, 2010



DATE: 04/28/09

PROJECT: Rt. I-280 Laurel Ave to 8thSt.

HMA	HPTO
Item #	36
Lift	Interm

Note: * Cores for HPTO lot # 15 and lot #17 were not received by the laboratory

HPTO Thin Lift Results

- HPTO design 50 gyrations and 3.5% air voids (low volume road design)
- No rutting after months of exposure to record high summer temperatures
- Final 103% payment (bonus) with a 2%-7% density spec in cool weather
- Polymer Modification necessary

Summary

- HPTO was used in conjunction with AR-OGFC to rehabilitate terminal PCCP
 - ◆ Get 10 more years before reconstruction
- HPTO exposed to very high traffic loading for over 6 high temp. months
 - ◆ Help in resisting reflective cracking and moisture infiltration under PCCP
 - ◆ Protected patches and joint sealant
- Project considered successful by NJDOT and most likely to be used again

Rt I-280 AROGFC



Rt I-280 AROGFC on PCCP



Rt I-280 AROGFC Under Bridge



AROGFC on milled PCCP



AROGFC on Milled PCCP



Rt I-280 Trackless Tack Coat



Rt I-280 Trackless Tack Coat



Rt I-280 Trackless Tack Coat



Rt I-280 Precast Slab Repairs Highways for Life Showcase



Rt I-280 Precast Slab Grouting



Thanks for your time!

Questions?

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