

Materials Management & Handling



Adam Hand, PhD, PE

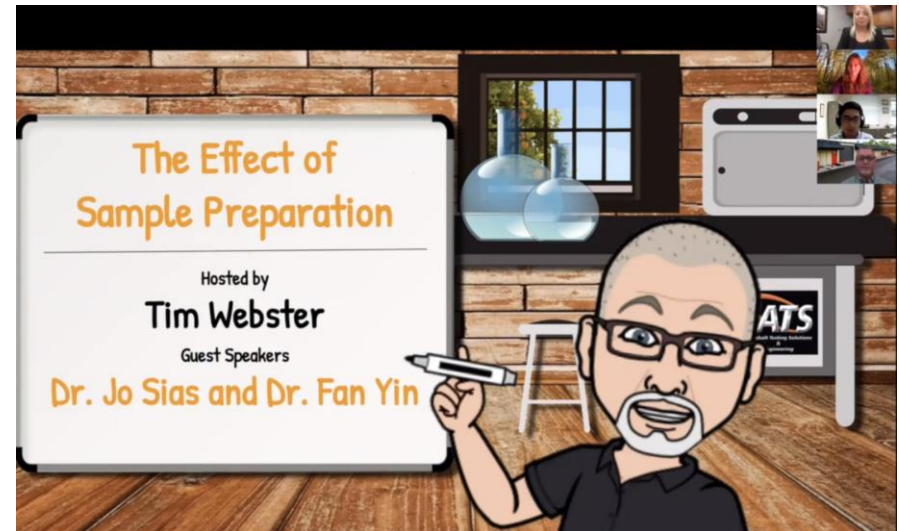
University of Nevada, Reno

ATS Webinar Series

January 14, 2021

Materials Management & Handling

- Planning
- Sampling
- Managing Samples
- Sample Integrity
- Traceability
- Impacts on Materials & Results



<https://youtu.be/aPWHeILbUM4>

NCHRP
SYNTHESIS 552

Practices for Fabricating
Asphalt Specimens for
Performance Testing
in Laboratories



A Synthesis of Highway Practice

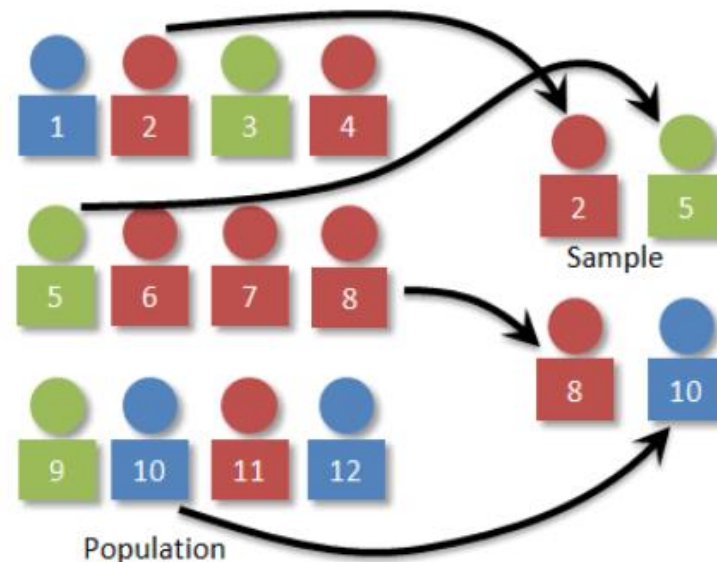
The National Academies of
SCIENCES • ENGINEERING • MEDICINE
DEVELOP
TRANSPORTATION RESEARCH BOARD

NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM

100 YEARS 1918-2018

Materials Sampling

- Plan
 - Material
 - Purpose
 - Location
 - Size
 - Process/Method
 - Random
 - Representative
 - Splitting
 - Labeling
 - Storage/Integrity



ITP: HMA Aggregate Production Example

- What, where, when, how
- Simple, clear expectations, easily communicated
- Check and hold points

HMA Aggregates																
Product	Sieve Analysis (CTM 202)		Sand Equivalent (CTM 217)		Durability Index (CTM 229)		Specific Gravity.Absorp Coarse Aggregates (CTM 206)		Specific Gravity.Absorp Fine Aggregates (CTM 207)		Specific Gravity.Absorp Fine Aggregates (CTM 208)		Fractured Faces (CTM 205)		LA Abrasion (CTM 211)	Sodium Soundness (CTM 214)
	Stockpile	Loadout	Stockpile	Loadout	Stockpile	Loadout	Stockpile	Loadout	Stockpile	Loadout	Stockpile	Loadout	Stockpile	Loadout	Stockpile	Stockpile
19.0mm PMA	12/day	1/week	N/A	N/A	N/A	N/A	2/month	1/3 months					1/month	1/6 months	1/6 months	1/6 months
12.5mm PMA	3/day	1/week	N/A	N/A	N/A	N/A	2/month	1/3 months					1/month	1/6 months	1/6 months	1/6 months
9.5mm PMA	3/day	1/week	N/A	N/A	N/A	N/A	2/month	1/3 months					1/month	1/6 months	1/6 months	1/6 months
Dust	3/day	1/week	1/day	1/week	1/day	1/week			2/month	1/3 months	2/month	1/3 months				1/6 months

Don't Underestimate Value of Inspection

Tack Coat Core Sampling Plan, Instructions, and Sample ID

Clear Direction

The experimental plan shown in Table 1 is for the performance evaluation of SuperTack. In summary, cores will be taken from 2 locations per test section per tack coat material and evaluated for bond strength, and tank or distributor samples of tack coat material will be taken for binder bond strength (BBS) testing. All testing will be conducted at 25°C. The DOT will

Table 2. Core Sample Identifications and Related Information.

Core ID	Tack Coat	Sample Location	Project	Route	Direction	Milepost	Lane	Offset	Core	Picture
UC-1-1	SS-1	1							1	
UC-1-2	SS-1	1							2	
UC-1-3	SS-1	1							3	
UC-1-4	SS-1	1							4	
UC-1-5	SS-1	1							5	
UC-1-6	SS-1	1							6	
UC-1-7	SS-1	1							7	
UC-1-8	SS-1	1							8	
UC-2-1	SS-1	2							1	
UC-2-2	SS-1	2							2	
UC-2-3	SS-1	2							3	
UC-2-4	SS-1	2							4	
UC-2-5	SS-1	2							5	
UC-2-6	SS-1	2							6	
UC-2-7	SS-1	2							7	
UC-2-8	SS-1	2							8	
UNT-1-1	SuperTack	1							1	
UNT-1-2	SuperTack	1							2	
UNT-1-3	SuperTack	1							3	
UNT-1-4	SuperTack	1							4	
UNT-1-5	SuperTack	1							5	
UNT-1-6	SuperTack	1							6	
UNT-1-7	SuperTack	1							7	
UNT-1-8	SuperTack	1							8	
UNT-2-1	SuperTack	2							1	
UNT-2-2	SuperTack	2							2	
UNT-2-3	SuperTack	2							3	
UNT-2-4	SuperTack	2							4	
UNT-2-5	SuperTack	2							5	
UNT-2-6	SuperTack	2							6	
UNT-2-7	SuperTack	2							7	
UNT-2-8	SuperTack	2							8	

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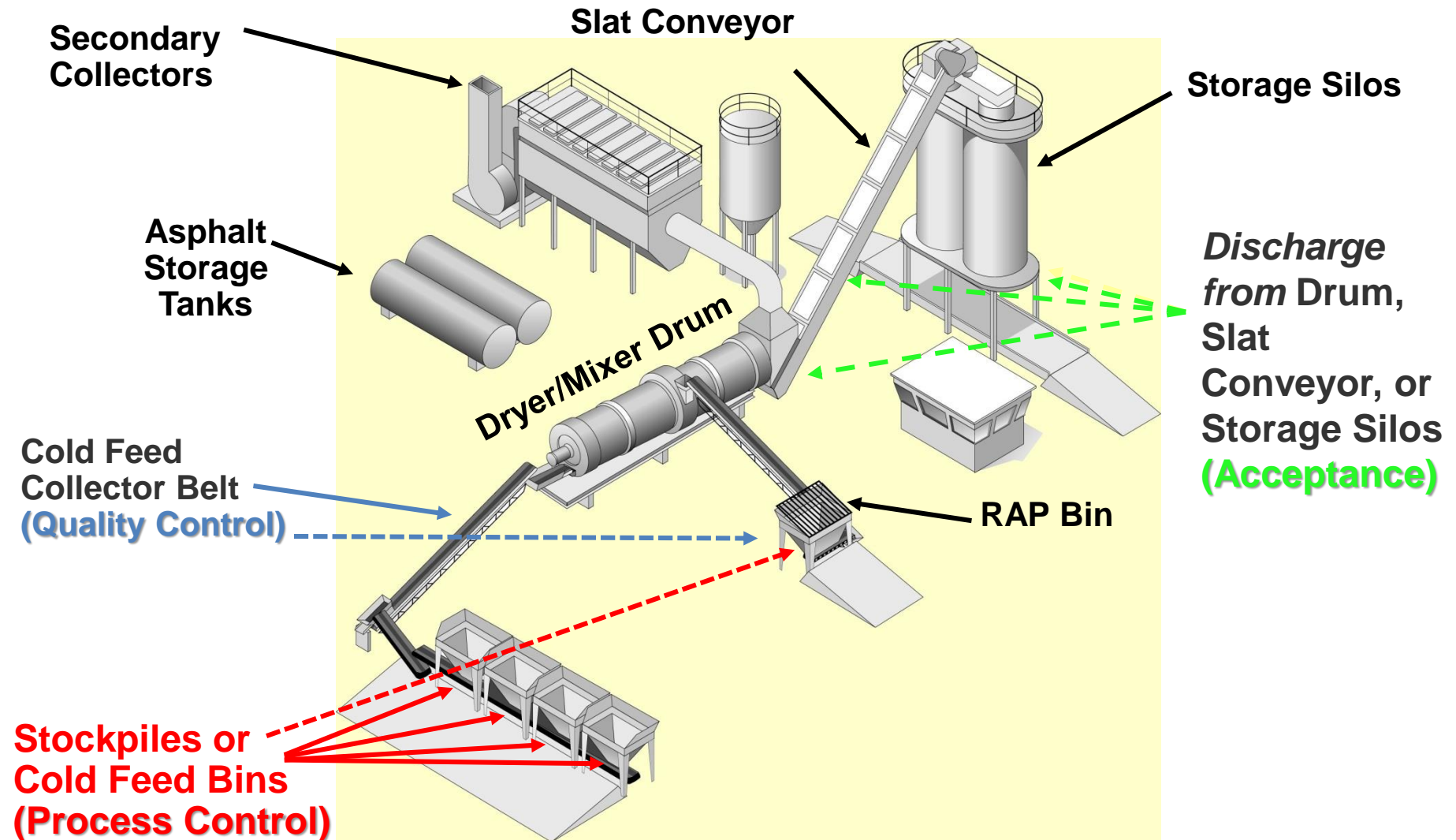
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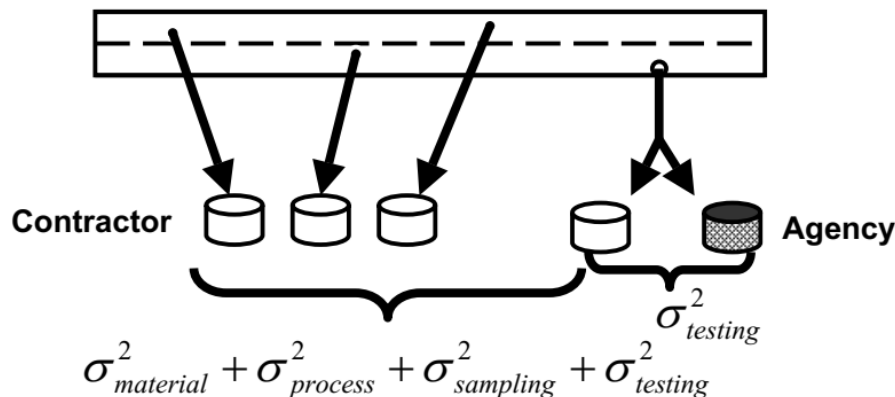
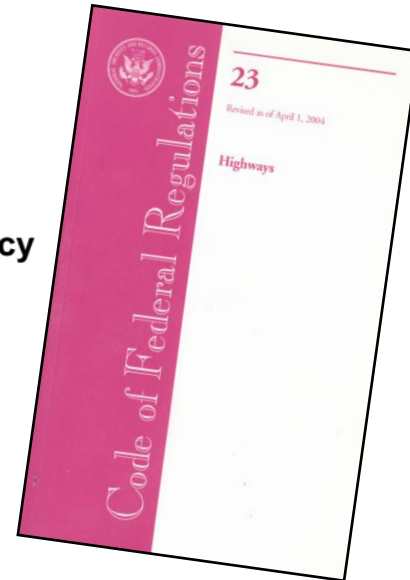
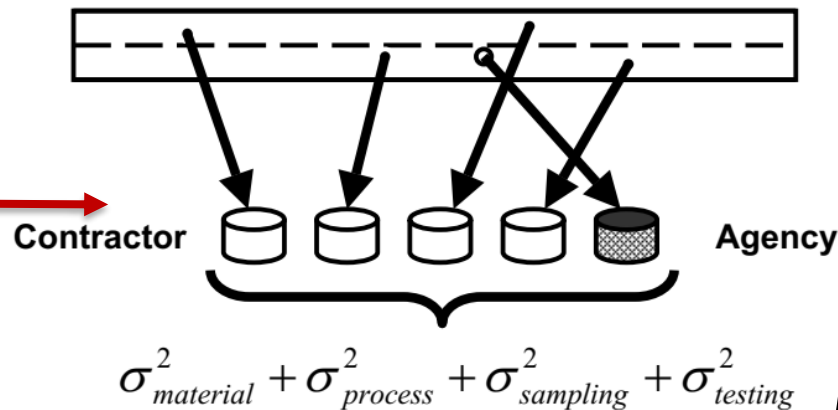
Know Sample Purpose/Type/Use/Requirements



Purpose/Use – Understanding Risk

Independent vs. **Split Samples**

Independent Samples
(process verification)

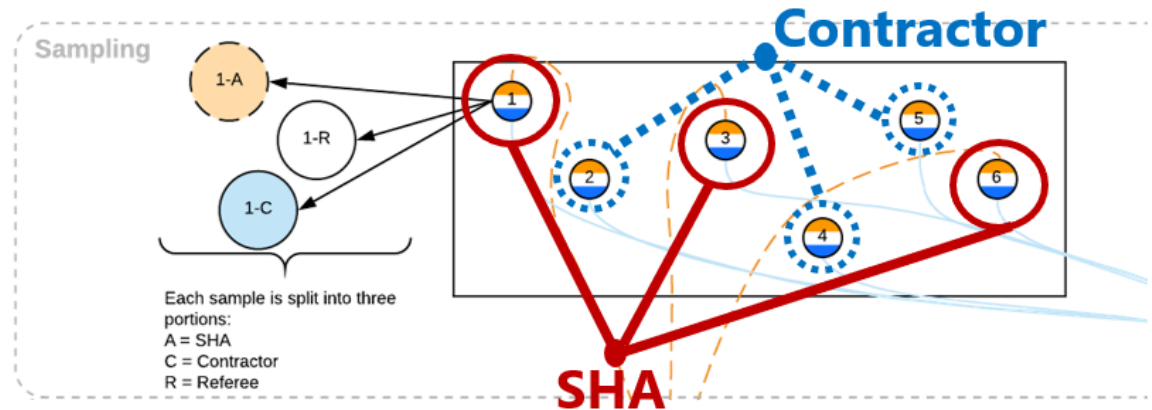


Split Samples
(test method verification)

Figure 9. Components of Variance for Split Samples

Sampling

- Representative
- Random
- Purpose or Use
 - Mix Design
 - PC
 - QC
 - Acceptance
 - Research
- *What Might be Different based on Use?*



Appropriate Sample Containers

- Clean / Dry
- Labeled
- Delivered



Safety Moment!

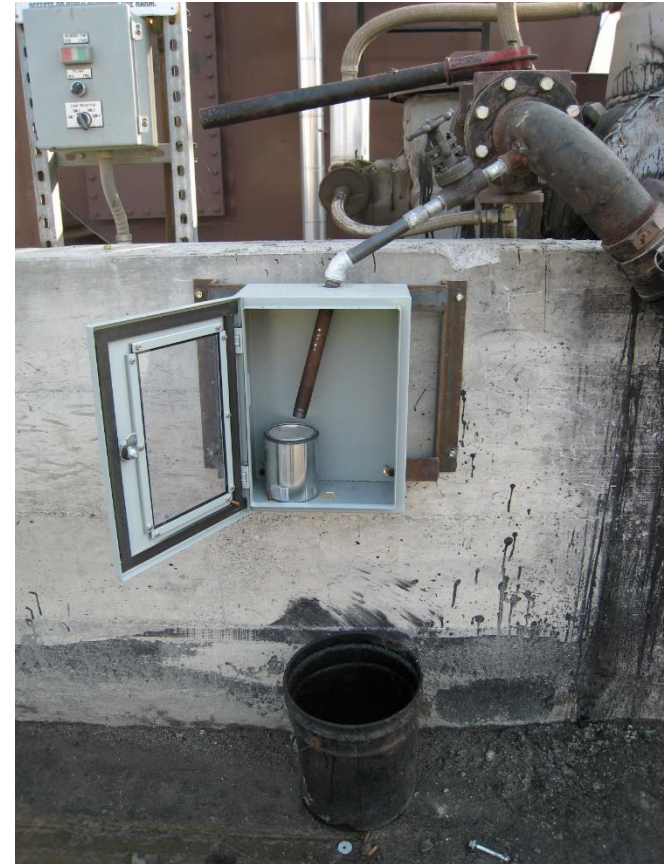


Risk Assessment: Binder Sampling

- Safety – What Matters
 - Proper PPE
 - Right Equipment
 - Fastest \neq Safest
- People's H&S Matters



Safer Sampling



Risk Assessment: Stockpiles



Safer Sampling



Risk Assessment: Truck Sampling



Safer Sampling



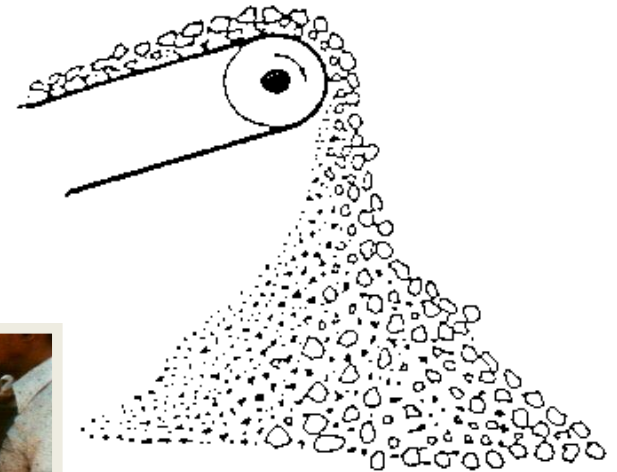
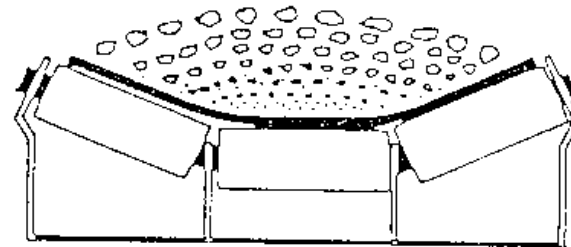
Risk Assessment: Coring



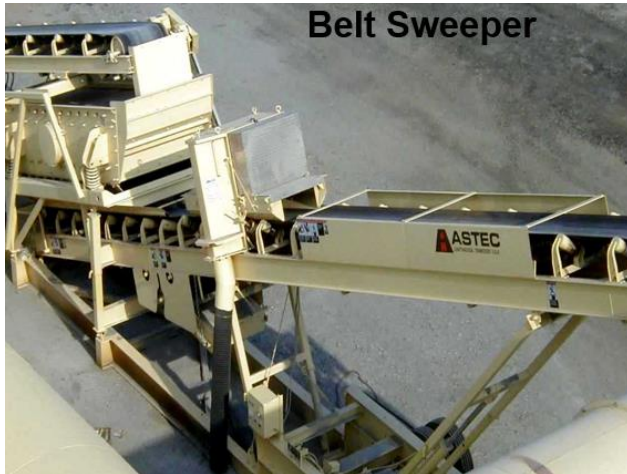
Safer Sampling



Aggregate Sampling - Conveyers

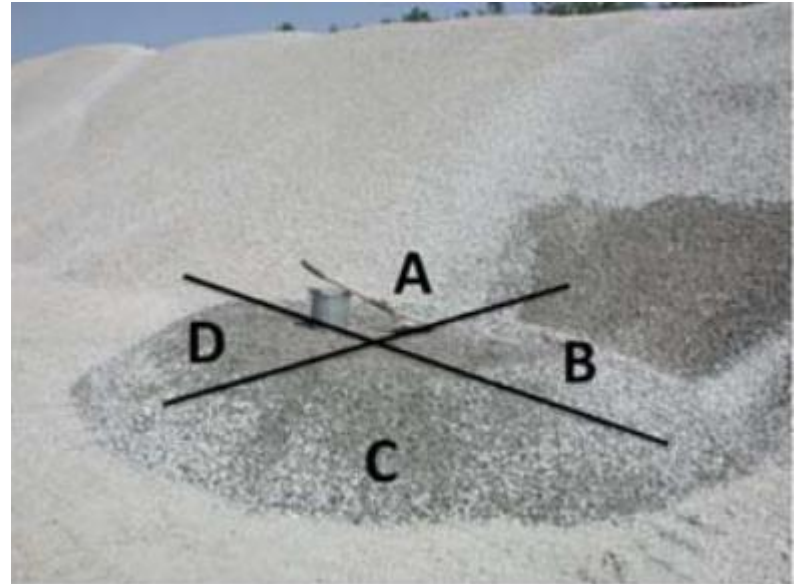


Belt Sweeper

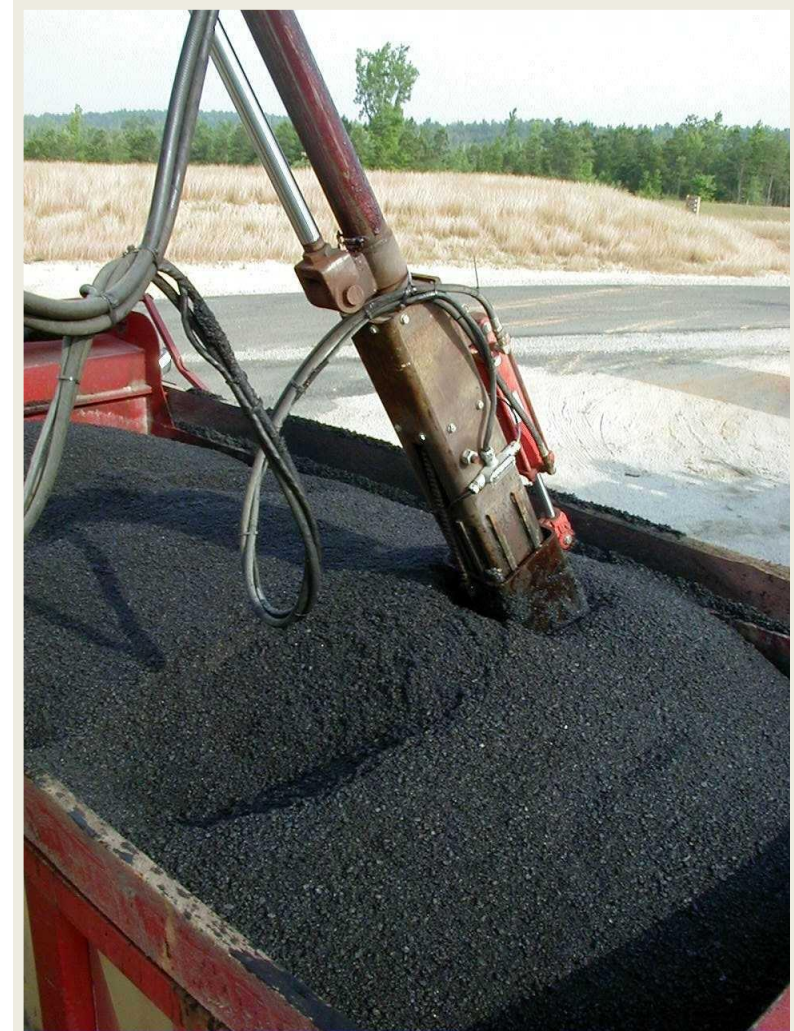


Stockpile Sampling

- Fine
- Coarse
- RAP
- RAS



Loose HMA Sampling



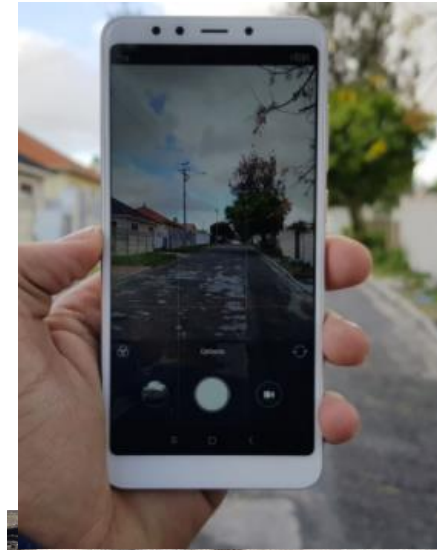
Loose HMA Sampling



Core Sampling



Records...*what, where, when, who, how...*



Associated Observations

New Work Item

PlacedQty: 2

Units: TN

Location: NB lane

Randy Stewart

Station: 0

Offset: 0

Location: 47.6139, -122.3421

88% Density

49° F

Mostly Cloudy

Tags: Location 5, Acme Road Construction, 022 - Pavement, HMA (CL 1/2 IN)

Weather: 49° F, Mostly Cloudy

Tags: Location 5, Acme Road Construction, 022 - Pavement, HMA (CL 1/2 IN)

Sample Splitting



Components of Variability

Variability = variability + variability + variability

(total)

(sampling)

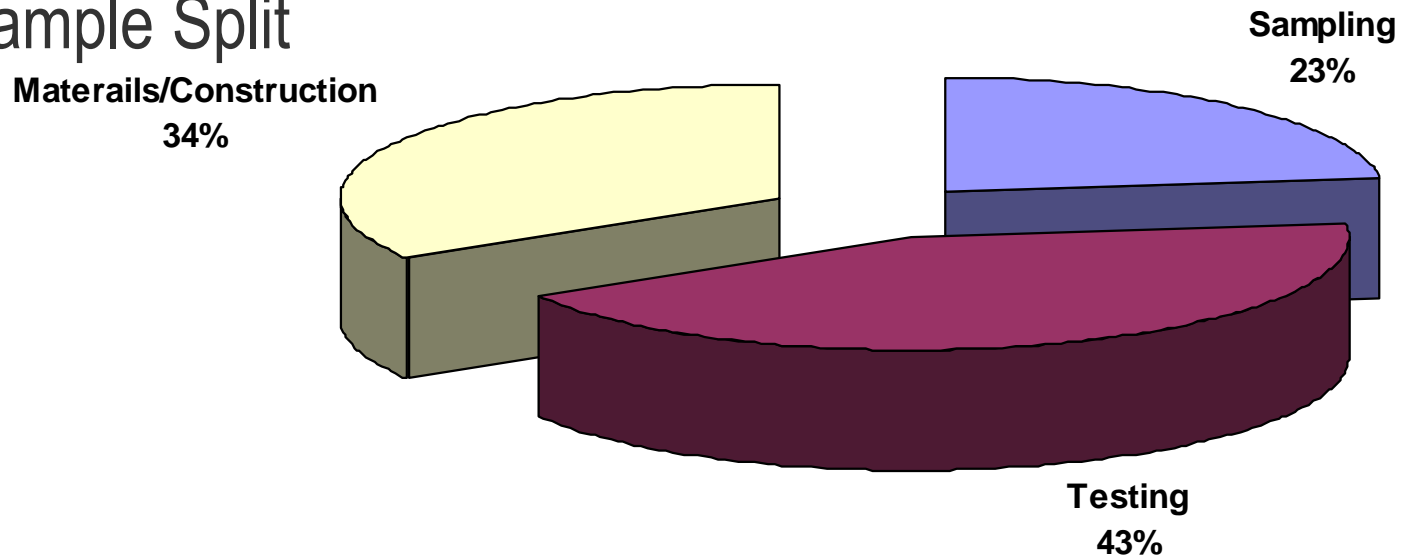
(test method)

(mat./const.)

$$\sigma^2_{\text{total}} = \sigma^2_s + \sigma^2_t + \sigma^2_{m/c}$$

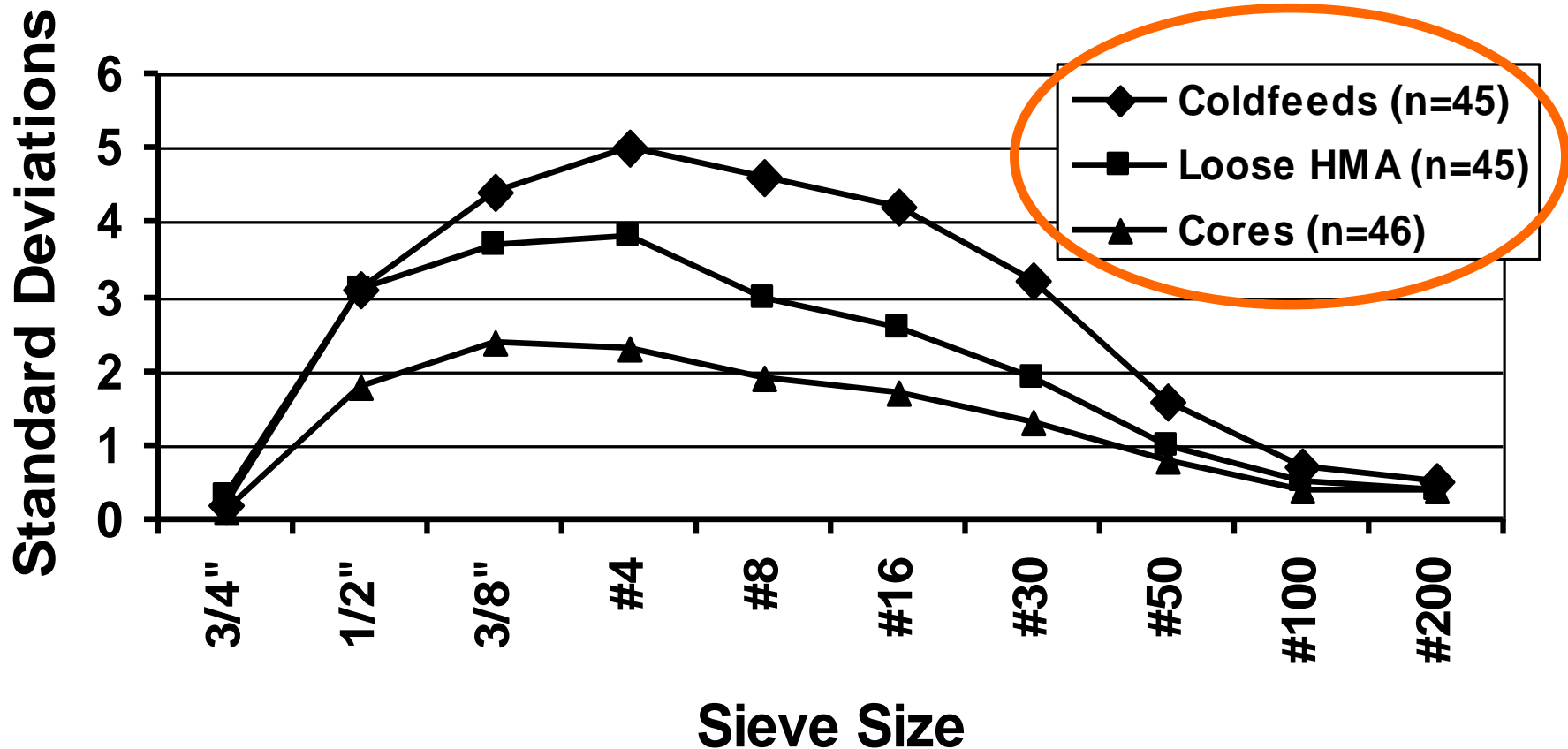
Sampling Variability (σ^2_s)

- 10-30% of Total Variability
 - Sample Location
 - Sample Method
 - Sample Size
 - Sample Split



Effect of Sampling Location on HMA Gradation Variability

(Superpave 3/4" Mix with MTV)



Reduce Sampling and Testing Variability

- Technician Training
- Technician Certification (Qualified Workforce)
- Laboratory Accreditation
- Regionalize/Standardize Test Methods
- Regionalize/Standardize Test Method Options
- Proficiency Sample Programs (Round Robins)
- Partnering Before Issue



Label Every Sample Well



Good



Bad



Ugly

Acceptance Sample Integrity



TR Circular E-C249: Key Elements of Construction Quality Assurance for Implementation



FIGURE 10 Security tape used for asphalt mix samples.



FIGURE 12 Tamper resistant security seal for asphalt pavement core sample cases.

Storage: Time and Temperature

- Asphalt Binder - Humm
- Emulsion – Eeks!
- Aggregates – No Biggy
- HMA - Eeks!
 - Test: immediately vs. cool & re-heat vs. minimum time vs. ... on site lab vs. 4hr drive vs. overnight
 - *This is a big issue with volumetrics*
- *How do you Minimize Differences?*
- *Does Silo Time Matter? Does Re-heat Time/Temp Matter?*

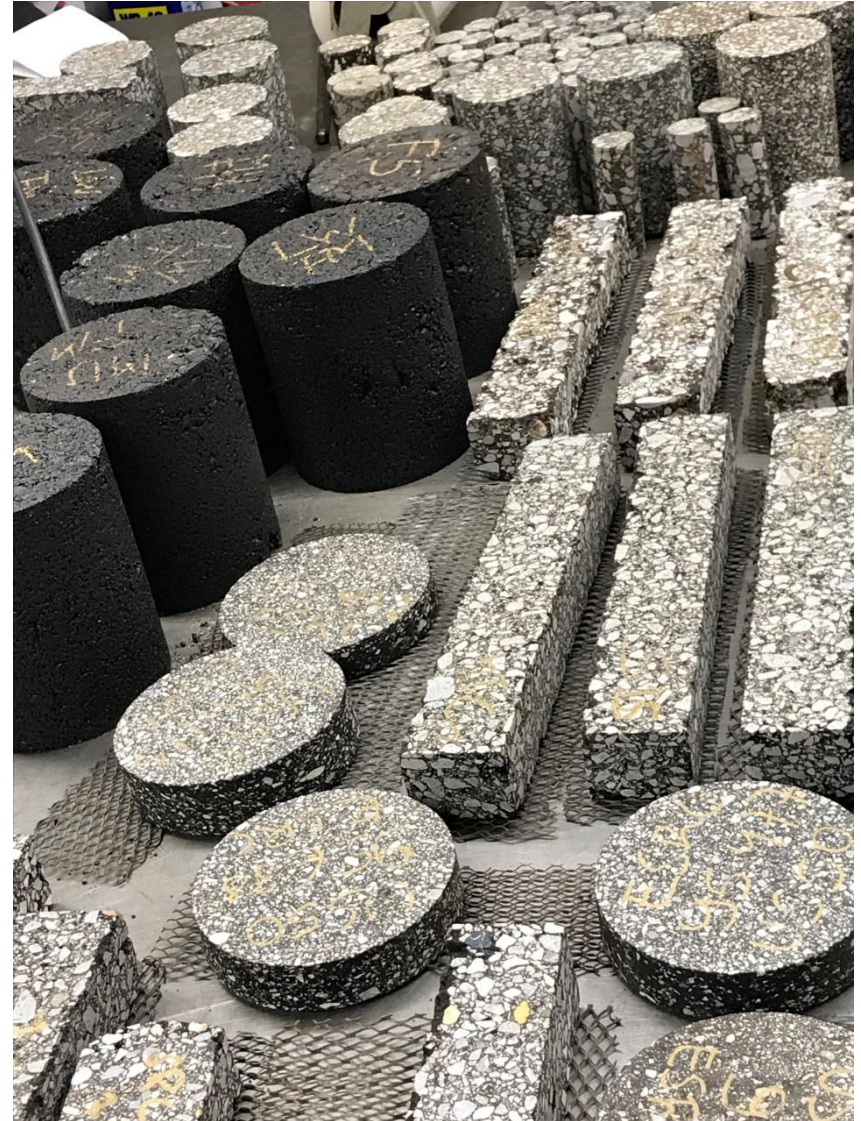
Volumetric & Performance Test Specimen Preparation

- Time & Dollars
 - Integrity
 - Storage
 - Staging



Performance Test Specimen Preparation

- **Thixotropy**-the property of asphalt binder whereby it “sets” when unagitated. Thixotropy is thought to result from hydrophilic suspended particles that form a lattice structure throughout the asphalt binder. This causes an increase in viscosity and thus, hardening. Thixotropic effects can be somewhat reversed by heat and agitation. Exxon Company, (1997), *Petroleum Encyclopedia for the Users of Petroleum Products*. <http://www.exxondist.com>
- Stage Sample Prep so ALL sample “rest” the same amount of time
- Properly Supports Samples



Volumetric & Performance Test Specimen Preparation

- Lab Mixed Lab Compacted
 - Batching Method
 - Aging Time & Temperature
- Plant Mixed Lab Compacted
 - Re-heat, Time & Temperature Inconsistency
- Plant Mixed Field Construction (Cores)
 - Skewed Cores

Follow Standard Procedures

- *This Topic Deserves a Webinar of its Own*

<https://youtu.be/aPWHeILbUM4>

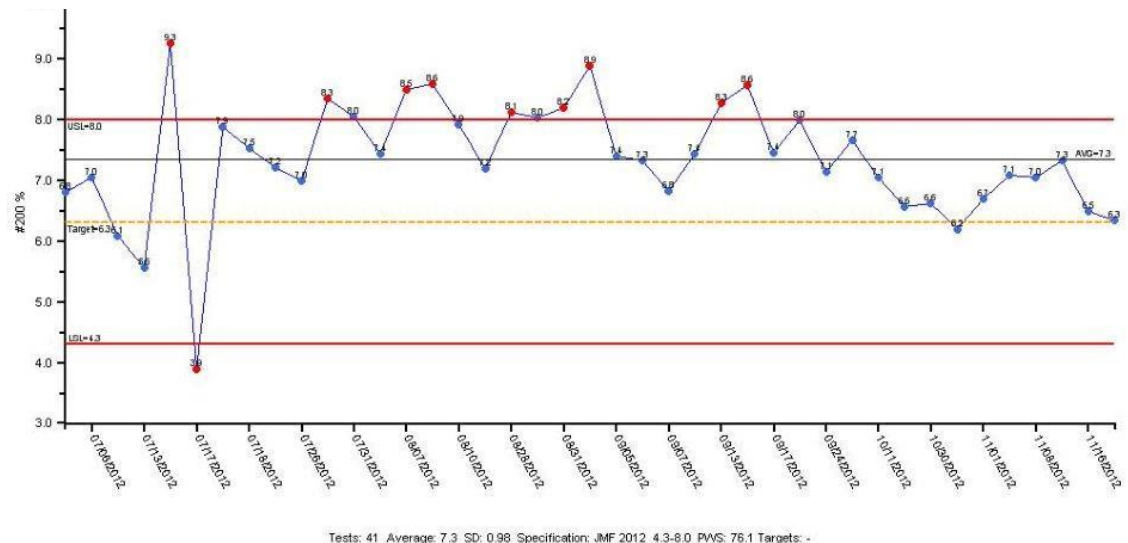
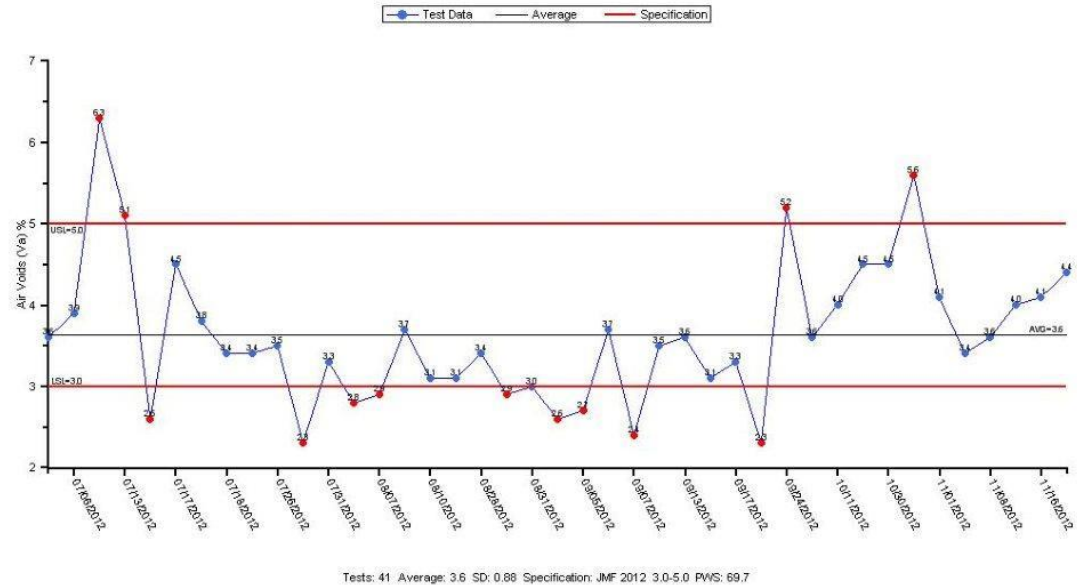


Best Practices (BPs) Control Charts

Look at Multiple Charts

- Priceless
- Time Series
- Individual or Moving Average
- Correlation of Properties
- Can't Hide from Data

Air Voids (Va) %
Run Chart 07/05/2012 - 11/19/2012 Loadout
100184-Sparks HMA Plant 1154-1/2"HMA64-22 4V50BR150L



Volumetrics BP - Use Charts

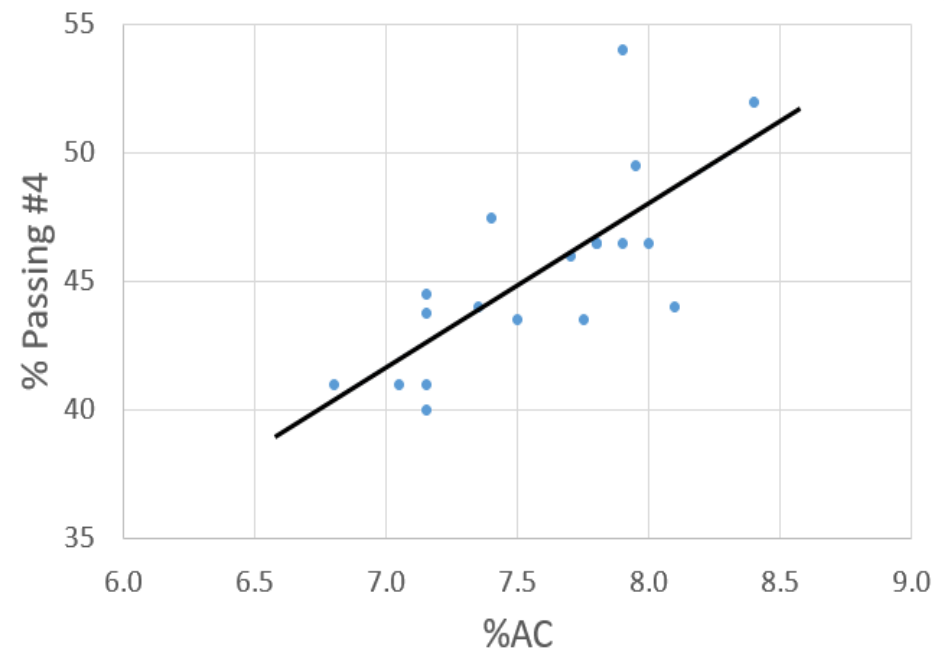
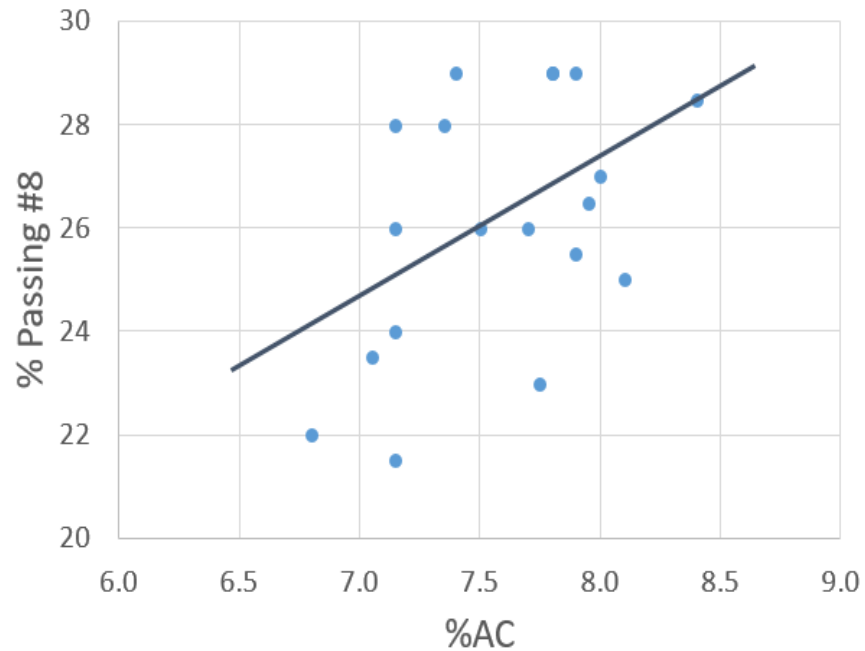
- My Favorite Asphalt Mix Properties to Monitor
 - %AC, p200, G_{mm} , G_{se} , %AV – Together (Control Charts)
 - #4 or #8 vs. %AC – *What does it tell you?*
 - G_{mm} vs. %AC or #4 or #8
 - G_{se} vs. P_{be}
- *Do You use Control Charts?*
 - *Required to or Voluntary?*
- *Do You use Control Chart Rules?*
- *Do You use Relationship Plots?*



Shewhart

BP - Relationship Charts

- Segregation Detector



BP Self-Inspection: Effective Process Control

- Visual Inspection when Sampling
- Does a Test Need to be Run?
 - **NO!!!**
- Inspect More, Test Less



Inspection

- Mine Face/Primary Feed – Uniformity, Surge
- Walk Your Stockpiles –ID, Color, Tracking, Seg, ...
- HP Controls – JMF, Right Loadout, Amps, Gas Temp
- Bins – JMF ID, Flowing of Fines, RAP/RAS Accglom
- Slat – Coating, Temp, Amps
- Silos – Moisture, Seg, NMAS
- Trucks – Coating, Seg, Temp
- Paving Spread – Seg, Uniform Coverage, Core Corr, ...
- *Don't Need Tests to Identify All Issues*
 - Talk with Rock/Hot Plant Operators, Loader Operator, Foremen, Operators, Screed man, Lute man, and if you must...STOP!

BP - Traceability

A graphic of a warning sign. It features a black rectangular border with rounded corners. Inside the border is a yellow diamond-shaped sign with a black border. The word "WARNING" is written in large, bold, black capital letters across the center of the yellow diamond.

WARNING

**PET PEEVES
AHEAD**

Traceability – What is it & Why does it Matter?

- **What is it?**
 - **Traceability** is the ability to verify the history, location, or application of an item by means of documented recorded identification.
 - **Traceability** is the ability to discover information about where and how a product was made.
- **Why does it Matter?**
 - Proof of product for customer
 - Did you or your supplier deliver what the customer specified and can you prove it if challenged?

Example: Asphalt Binder Traceability

When You are Buying

- Specification
- Purchase Order (PO)
- Bill of Lading (BOL)
- Certificate of Compliance (COC)
- Submittals

When in Your Possession

- Traceability in Possession
 - Labeling/Tagging
 - Chain of Custody Forms
 - Quality Control Testing
 - Assurance Inspection and Testing
- Plant Inventory Reports
- Plant Production Records
- Truck Tickets
- Mix Designs

Purchase Order

- **Purchase order (PO)** - a commercial document and first official offer issued by a buyer to a seller, indicating types, quantities, and agreed prices for products or services. It is used to control the **purchasing** of products and services from external suppliers.
- ALWAYS reference a Specification when issuing a PO

Specification

- **39-2.01B(3) Asphalt Binder**
- Asphalt binder shall comply with **Section 92...**

2015

Thru 05-06-2016

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Purchase Order

PURCHASE ORDER

[Your Company Name]

[Your Company Slogan]

P.O. # [100]

DATE: OCTOBER 25, 2011

[Street Address], [City, ST ZIP Code]
Phone [000.000.0000] Fax [000.000.0000]
[e-mail]

VENDOR [Name]
[Company Name]
[Street Address]
[City, ST ZIP Code]
[Phone]
Customer ID [ABC12345]

SHIP TO [Name]
[Company Name]
[Street Address]
[City, ST ZIP Code]
[Phone]
Customer ID [ABC12345]

SHIPPING METHOD	SHIPPING TERMS	DELIVERY DATE

QTY	ITEM #	DESCRIPTION	JOB	UNIT PRICE	LINE TOTAL

1. Please send two copies of your invoice.

2. Enter this order in accordance with the prices, terms, delivery method, and specifications listed above.

3. Please notify us immediately if you are unable to ship as specified.

4. Send all correspondence to:
[Name]
[Street Address]
[City, ST ZIP Code]
Phone [000.000.0000] Fax [000.000.0000]

SUBTOTAL	
SALES TAX	
TOTAL	

Authorized by

Date

Bill of Lading (BOL)

- Supplier to Customer
- Receipt Signature Required



Paramount Nevada Asphalt Company

425 S Logan Lane
Fernley, NV 89408
(775) 835-6366

77 8

Bill of Lading

Warning: Detectable amounts of substances known to the state of California to cause Cancer, Birth Defects, or other reproductive harm may be found in the products sold under this Bill of Lading. (California Health and Safety Code 25249.6)

Note - this is a consolidated form used for purposes of expediting the handling of all shipments from the supplier company's plants.

Condition of Carriage - Carrier (the word "carrier" being understood as including any person or corporation in possession of the property) has received from Shipper the property described on the face hereof in apparent good order, and that Carrier agrees to abide by all terms and conditions contained within "Terms and Conditions of Access to the Refinery" or "Terms and Conditions of Access to the Terminal" and to fulfill all obligations contained therein.

PARAMOUNT PETROLEUM CORPORATION WEIGHMASTER

BY (DEPUTY TARE WEIGHT):

BY (DEPUTY GROSS WEIGHT):

MANUAL CHANGES ON THIS BILL OF LADING ARE HEREBY
ACKNOWLEDGED AND AGREED TO BY (DRIVER'S NAME)

CARRIER COMPANY

DATE

WEIGHMASTER CERTIFICATE: THIS IS TO CERTIFY that the following described commodity was weighed, measured or counted by a weighmaster whose signature is on this certificate, who is a recognized authority of accuracy, as prescribed by Chapter 7 (commencing with Section 12700 of Division 5 of the California Business and Professions Code administered by the Division of Measurement Standards of the California Department of Food and Agriculture).

Important - do not unload truck until sample of contents has been checked with stock specified on this order. Check all valves and lines so that correct ones will be used.

The carrier certifies that the cargo tank supplied for this shipment is a proper container for the transportation of the commodity as described by the shipper.

THIS PRODUCT CONTAINS "OIL" AS DEFINED BY DOT UNDER 49 CFR 130.5. CARRIER CERTIFIES IT HAS AN OIL SPILL PREVENTION AND RESPONSE PLAN AS REQUIRED BY DOT UNDER 49 CFR PART 130

BOL NUMBER	BOL TYPE	IN DATE	OUT DATE	PO NUMBER	LOAD TICKET
5679820009	LOAD	10/10/2016 04:05	10/10/2016 04:56	224529	5583800009

SHIPPER

SHIP TO

BILL TO

0009
Paramount Nevada Asphalt Company
425 South Logan Lane
Fernley, NV 89408

10010249N
GRANITE CONSTRUCTION CO.
USA Parkway SE Connector
Lockwood, NV

10010249N
GRANITE CONSTRUCTION CO.
USA Parkway SE Connector
Lockwood, NV

DESTINATION

CARRIER
NV-013 - Granite Construction Co

TRUCK
41060

TRAILER 1
03453

TRAILER 2
03979

DRIVER
N10102 - Granite - David Miller

TRUCK LICENSE

TRAILER 1 LICENSE

TRAILER 2 LICENSE

COMMENTS

CODE

PRODUCT DESCRIPTION

UN 3257, Elevated temperature liquid, n.o.s., (Asphalt) 9, PG III T&T ERG 128
N13125 PG 64-28 NV

TARE LBS	GROSS LBS	NET LBS	NET TONS	NET MTONS	NET BBLs	NET GAL	NET LTR	LBS / GAL	SPEC GRAV	API GRAV
37180	118860	81680	40.84	37.05	228.40	9593	36310	8.51480	1.022	6.900

Shipper's receipt of the commodities under this Bill of Lading shall signify acceptance of each of the provisions contained in the Refinery Access Agreement as executed by an authorized employee or owner of Shipper.

☐ Hazardous
Placards Offered

Loaded by

Driver Receiving

Received at Destination by

Shipper's Name
PARAMOUNT PETROLEUM CORPORATION

Agent
PARAMOUNT PETROLEUM CORPORATION

FOR CHEMICAL EMERGENCY -

Spill, Leak, Fire, Exposure or Accident
CALL CHEMTREC - DAY OR NIGHT

- 800-424-9300

100194

Certificate of Compliance (COC)

- Illustrates Supplier Compliance
- Does Not Eliminate Need for QC or Assurance Testing



"Trust but Verify."

- Ronald Wilson Reagan



**PARAMOUNT-NEVADA
ASPHALT COMPANY, LLC**

Product: PG64-28NV Asphalt Cement
Code: N13125
Date: 10-1-16
Tank# 4

Paramount - Nevada Asphalt Co. LLC
425 Logan Lane
Fernley, NV 89408

Purchaser: Granite
Destination: Lockwood
Transporter: GCCO
Truck No: 41060
Bill of Lading No: 567987
Contract No: 10010249N
Purchase Order No: USA Parkway

MEETS SPECIFICATIONS: Nevada 703,03.05 NDOT

CERTIFICATE OF COMPLIANCE / ANALYSIS

TESTS	NEV#	AASHTO #	SPEC	RESULT
Test on Original Asphalt:				
Viscosity, 135°C (275°F), Pa.s		T316	3.00 Max	0.637
DSR, G*/sind, 64°C @ 10 rad/s, kPa		T315	1.00 min	1.30
Flash Point, C.O.C., °F	T716	T48	450 min	550+
Ductility, 4°C (39.2°F), 5cm/min, cm	T746		50 min	70.75
Toughness, inch-lbs	T745		110 min	190
Tenacity, inch-lbs	T745		75 min	177
Specific Gravity, 77/77°F		T228	----	1.0175
Specific Gravity, 60/60°F		T228	----	1.0236
API Gravity, 60°F		T228	----	6.74
Sieve Test, Particles Retained	T730		0	0
Test on Residue from Rolling Thin Film Oven:				
DSR, G*/sind, 64°C @ 10 rad/s, kPa	T728	T240	----	
Ductility, 4°C (39.2°F), 5cm/min, cm	T746	T315	2.20 min	2.63
Mass Loss, wt. %		T51	25 min	37.25
		T240	1.0 max	-0.634
Tests on Residue from Pressure Aging Vessel @100°C				
DSR, G*/sind, 22°C @ 10 rad/s, kPa		T315	5000 max	1690
Creep Stiffness, S, -18°C @ 60s, Mpa		T313	300 max	124
Creep Stiffness, m-value, -18°C @ 60s, Mpa		T313	0.300 min	0.336
Direct Tension, Failure Strain, @ -18°C @ 1.0 mm/min, %		T314	1.00 min	N/A

We hereby certify that the above material was sampled, tested and complies with all applicable standards and specifications.

This certification is valid for up to 30 days from the day of issued

Signature: [Signature]
Printed: Brent Skovly
Title: Lab Technician II



2012 & 2013 Award Winner of W/CTG
Superiority in Testing of Performance
Graded Asphalt Binders



100194

Labeling & Storage



Appear Traceable?



Appear Traceable?



Traceability

- Logging Samples
- Labelling Consistent with Logging ID

Home Analysis Output Database Setup

Login / Logout Exit Home Up New Save Delete Restore Edit Documents Copy Find Record Copy Cut Paste Standard Advanced Product Plant Job Contents About

Access Navigation Records Clipboard Query Tool Help

Data Queue << >>

Saturday, September 10, 2016

- Fountain Springs Aggregate
- Granite Falls Pit D217-1000
- Hidden Canyon-100185
- Indio Aggregate Plant-10039
- Indio HMA Plant-100388
- Indio Recycle Plant-100383
- Lockwood Aggregate Plant-1
 - 2119-FAA P209 Base-1
 - 2928-2947 - Structural B
 - Lockwood HMA Plant-10019
 - 1015-1/2" RAP-07:15-In
 - 1901-Paramount PG 64-**
 - 1901-Paramount PG 64-
 - 2121-3/4"HMA64-28NV
 - 2121-3/4"HMA64-28NV
 - 2121 (CF)-2121 Cold
 - XX-Orange Book RA
 - 3634-1/2"HMA64-22 4V
 - 3634 (CF)-3634 Cold
 - XX-Orange Book RA
 - 3634-1/2"HMA64-22 4V
- Martin HMA Plant-100038
- Nevada Portables-216855
- Pre-Bld - Western Washingt
- Rosemary's Mountain Aggre
- Rosemary's Mountain HMA
- Singer Aggregate Plant-100
- Singer HMA Plant-100018
- Smith Island HMA Plant-100
- Sparks HMA Plant-100184
- Vancouver HMA Plant-1000
 - 09/10/2016
 - 1859-Grindings-03:32-Pr
 - HMA-Mix #25 - 1/2" HR_
 - HMA-Mix #20 - 3/8in HR
 - HMA-Mix #19c-1/2" Co
 - HMA-Mix #25 - 1/2" HR_
 - Western WA Aggregate Sou

Sample

Long Gradation

Test Results

Worksheets

Process Variables

Certification

Customers

Documents

Sample No 1730729153

Plant Lockwood HMA Plant-100194

Product Paramount PG 64-28NV-1901

Date Collected 09/10/2016 12:00

Sampled By Plant Personell ""

Sample Type QC

Sample Method Truck

Sample Location

Process

Ledge

Tested By Plant Personell ""

Completed ☒ 09/13/2016 15:10

General Location Split / Resample

Other

Weather

Temp

Sample Note #566024

Chart Note

Procedure

Unit g Moist Mass Dry Mass Wash Mass Moisture % Wash Loss % Grad Loss % FM

Sieve	Individual Mass	Cumulative Mass	Individual % Retained	Percent Retained	Percent Passing	Targets	Specification	Comment
PAN								

☒ Individual Mass
☐ Cumulative Mass
☐ Reverse Sieves
 Specification

CHAIN OF CUSTODY FORM

[Agency Name] Case #:	
-----------------------	--

[illegible]

Sample Storage and Integrity

- Traceable



Recent Relevant Reads

- NCHRP Report 818
- NCHRP Synthesis 552

NCHRP SYNTHESIS 552

Practices for Fabricating
Asphalt Specimens for
Performance Testing
in Laboratories



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Comparing the Volumetric
and Mechanical Properties of
Laboratory and Field Specimens
of Asphalt Concrete

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Summary

- Plan
- Know Purpose/Use/Type for Best Outcomes
- Use Safe Proper Sampling
- Keep Good Records - Traceability
- Sample Preparation: Batching, Oven Time & Temp, Thixotropy
- Minimize Volumetric & Performance Test Sample Variability
- Appropriate Handling & Storage
 - Time & Temperature, Support, ...
- Do Your Part to Minimize Variability & Questions.



Thank You!



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