

PWL Specification State Perspective SCDOT

Cliff Selkinghaus
SCDOT Asphalt Materials Manager
SEAUPG - November 2015

SCDOT PWL Specification

- SC-M-400 – SCDOT Quality Acceptance
- Specification revised **7** times since introduced in 2005.

[http://www.scdot.org/doing/technicalPDFs/supTechSpecs/SC-M-400_\(04-15\).pdf](http://www.scdot.org/doing/technicalPDFs/supTechSpecs/SC-M-400_(04-15).pdf)

Consistency, Consistency!!!! Quality Asphalt Mixtures

- Consistency # 1
Production - Plant
- Consistency # 2
Testing - Lab
- Consistency # 3
Placement – Road



We don't have but 30 minutes and Happy Hour is next!

Consistency issues at the plant

- Stockpiles - cleanliness
- Asphalt pump calibration
- Moisture tests accurate
- Aggregate , RAP/RAS bin calibrations
- Scalping screens working properly
- Silo being used correctly – charging - load out
- Mix temperature – minimize start and stops
- Maintenance of plant – mech. breakdown

Consistency - In the Laboratory

QC Plan
Does the contractor have a QC plan and does the contractors personnel follow the established plan?


Job Mix Formula
Approved design?

Has this mix been run prior to SCDOT production?
(Mix Calibration?????)

Field Laboratory
Approved Laboratory – QPL # 76?
Is the equipment operational and calibrated?

Are the technicians certified and proficient in performing the required tests?

Consistency - In the Laboratory

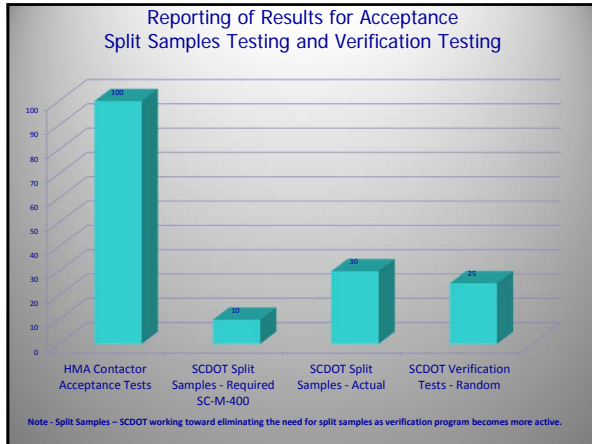


Equipment Calibrations...
Do away with the old saying: "If it ain't broke, don't fix it!"
Perform equipment checks as required by AASHTO R-18 or by SC-M-404 or greater.

Perform **maintenance** on the laboratory equipment as it was your own.

Keep a **clean** work environment: "Your momma still does not need to remind you to clean your room."

Take pride in your work!



Consistency - In the Laboratory Plant QA Tests (SC-M-400) – Split Samples Testing

Test Parameter	Typical Frequency	Sampling Method	Test Method
Individual Aggregate Stockpile Gradation	1 per 10,000 tons (or min. of 1 per month)	SC-T-1, SC-T-2	SC-T-4
Lime Rate and Moisture Verification	2 per LOT	SC-T-71	SC-T-71 or SC-T-78
Mixture Stability (Base C&D, Surface Type E)	1 per LOT	SC-T-101, SC-T-62, SC-T-72 or SC-T-93	SC-T-96
Maximum Specific Gravity (excluding Base Courses, Surface Type E, and OGFC)	1 per 500 ton SUBLOT	SC-T-101, SC-T-62, SC-T-72 or SC-T-93	SC-T-83
Asphalt Binder Content, %	1 per 500 ton SUBLOT	SC-T-101, SC-T-62, SC-T-72 or SC-T-93	SC-T-75
Mixture Gradation (Base Courses, Surface Type E, and OGFC only)	1 per 500 ton SUBLOT	SC-T-101, SC-T-62, and SC-T-72 or SC-T-93	SC-T-102 SC-T-110
Void Analysis Air Voids, % VMA, % (excluding Base Courses, PMTLSC, Surface Type E and OGFC)	1 per 500 ton SUBLOT	SC-T-101, SC-T-62, and SC-T-72 or SC-T-93	SC-T-103 and SC-T-68

Consistency - In the Laboratory QA Test Tolerance (SC-M-400) – Split Sample Testing

Test Parameter	Allowable Difference	
Asphalt Binder Content, %	± 0.40	
Maximum Specific Gravity	± 0.024	
Bulk Specific Gravity of Cores	± 0.017	
Gradation (Base, Shoulder Widening, Surface Type E, PMTLSC, and OGFC only)	½" and greater	± 7.0
	3/8"	± 6.0
	No. 4	± 6.0
	No. 8	± 5.0
	No. 30	± 4.0
No. 100	± 3.0	

Consistency - In the Laboratory

Follow Test Procedures!
They are all available on the SCDOT Website.
http://www.scdot.org/doing/materials_Test.aspx
Communicate!
Keep communications open all QC Personnel and with the control tower, inform them of your test results and suggest or discuss the findings of your plant results...do not wait until the end of the day to tell them we have a problem.

Consistency issues on the road: Testing Frequency

Test Parameter	Required Frequency	Sampling Method	Test Method
In-Place Density (% of Max. Theoretical)	Surface	1 per 2,000 foot SUBLOT	SC-T-101 SC-T-87
	Intermediate	1 per 1,500 foot SUBLOT	
In-Place Density (% of Target Gauge Control Strip Density) Base Courses and Low ADT Surface Courses	10 per LOT	SC-T-101	SC-T-65


* Note: Cores and Gauge Shots witnessed by SCDOT Road Inspector.

Consistency issues on the road: Testing Tolerances

% of Theoretical Maximum Density	INTERMEDIATE COURSES AND SURFACES WITH HIGH ADT			BASE COURSES AND SURFACE MIXTURES WITH LOWER ADT		
	LSL	USL	USL	LSL	Target	USL
* Interstate and US Primary Routes	92.2	94.0	96.0	—	—	—
All Other Paving	91.2	94.0	96.0	—	—	—
% of Control Strip Target Density	—	—	—	98	100	102

* Note – 100% of cores weighed by SCDOT plant inspectors, gauge shot witnessed and documented by the SCDOT road inspector.

Consistency – Accuracy! Verification Testing



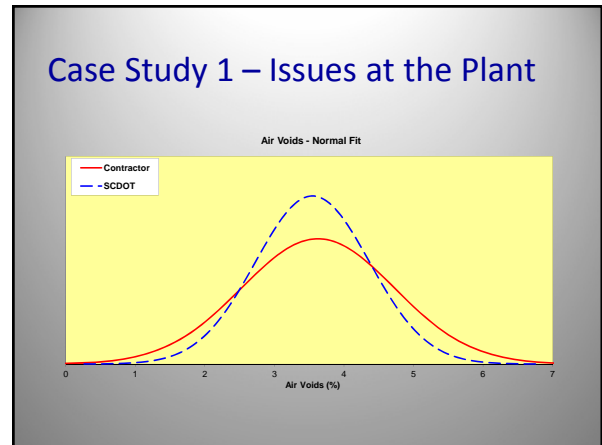
- Random Tests performed by Verification Labs
- Perform Full QC Tests – w/ Volumetrics
- Case Study’s
- Summary of F & t Data Sets

Test Performed by Verification Labs Plant QA Tests (SC-M-400) – Mobile Lab Tests

Test Parameter	Typical Frequency Contractor QA vs Verification	Sampling Method	Test Method
Maximum Specific Gravity (excluding Base Courses, Surface Type E, and OGFC)	1 per 500 ton SUBLOT Verification - Random	SC-T-101, SC-T-62, SC-T-72 or SC-T-93	SC-T-83
Asphalt Binder Content, %	1 per 500 ton SUBLOT Verification - Random	SC-T-101, SC-T-62 and SC-T-72 or SC-T-93	SC-T-75
Mixture Gradation (Base Courses, Surface Type E, and OGFC only)	1 per 500 ton SUBLOT Verification - Random	SC-T-101, SC-T-62, SC-T-110, and SC-T-72 or SC-T-93	SC-T-102
Voids Analysis Air Voids, % VMA, % (excluding Base Courses, PMTLSC, Surface Type E and OGFC)	1 per 500 ton SUBLOT Verification - Random	SC-T-101, SC-T-62, and SC-T-72 or SC-T-93	SC-T-103 and SC-T-68

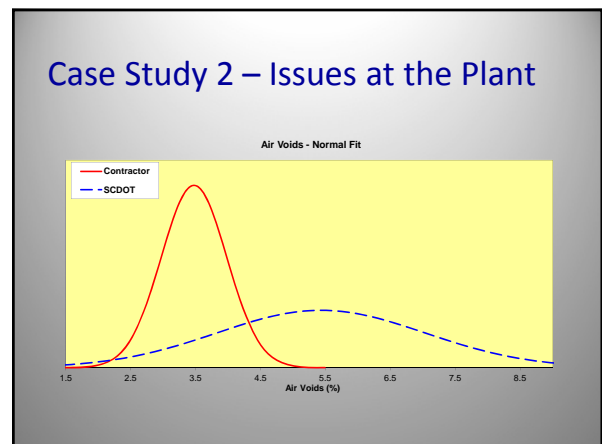
Case Study 1 – Issues at the Plant

- Contractor’s QA results for % AV – 3.38 Optimum
2.50, 1.40, 2.10, 4.43, 4.75, 4.24, 3.98, 4.48, 3.61, 4.51, 2.57, 4.51, 4.06
- Verification Lab results for % AV – 3.38 Optimum
3.44, 1.98, 4.17, 4.35, 3.04, 3.99, 3.85
- Contractor Standard Deviation – 1.102
- Verification Standard Deviation – 0.821
- Contractor Average – 3.626
- Verification Average – 3.546
- Data Set COMPARED Use Contractor’s QA results



Case Study 2 – Issues at the Plant

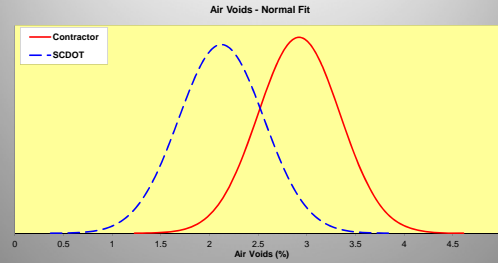
- Contractor’s QA results for % AV – 3.47 Optimum
4.07, 3.66, 4.19, 3.10, 3.35, 2.97, 3.09, 2.61, 3.48, 3.51, 3.42, 4.61, 3.39, 3.24, 3.42
- Verification Lab results for % AV – 3.47 Optimum
4.60, 4.99, 4.20, 5.33, 4.44, 4.51, 6.71, 4.87, 9.22
- Contractor Standard Deviation – 0.505
- Verification Standard Deviation – 1.603
- Contractor Average – 3.47
- Verification Average – 5.43
- Data Set NON-COMPARED Use SCDOT Test results



Case Study 3 – Issues at the Lab

- Contractor's QA results for % AV – 3.45 Optimum
1.91, 2.93, 2.11, 2.83, 3.23, 3.21, 2.50, 2.54, 3.31, 3.03, 3.16, 3.22, 2.35, 3.45, 3.27, 3.67, 2.72, 2.96, 3.00, 2.61, 2.74
- Verification Lab results for % AV – 3.45 Optimum
1.76, 1.92, 2.50, 2.30, 2.74, 1.47, 2.16
- Contractor Standard Deviation – 0.423
- Verification Standard Deviation – 0.439
- Contractor Average – 2.92
- Verification Average – 2.12
- Data Set NON-COMPARED Use SCDOT Test results

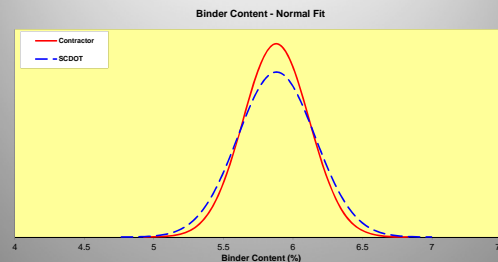
Case Study 3 – Issues at the Lab



Case Study 4 – What we like to SEE

- Contractor's QA results for % AC – 6.00 Optimum
6.52, 6.19, 6.09, 5.81, 5.64, 5.87, 5.86, 5.90, 5.71, 5.55, 5.62, 6.03, 5.92, 5.93, 5.91, 6.00
- Verification Lab results for % AC – 6.00 Optimum
6.32, 5.54, 5.49, 5.97, 5.89, 6.12, 5.95, 5.77
- Contractor Standard Deviation – 0.238
- Verification Standard Deviation – 0.278
- Contractor Average – 5.88
- Verification Average – 5.88
- Data Set COMPARED Use Contractor's QA results

Case Study 4 – What we like to SEE



QC/QA – SC-M-400

Calculate the TPWL and Pay Factor for each Acceptance Characteristic:

$$\bar{X}_a = \frac{\sum_{i=1}^n X_i}{n}$$

$$s = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X}_a)^2}{n-1}}$$

$$Q_L = \frac{X_a - LSL}{s}$$

$$Q_U = \frac{USL - X_a}{s}$$

$$TPWL = (LPWL + UPWL) - 100$$

$$PF = 55 + 0.5(TPWL)$$

If the TPWL is 20 or less for any one acceptance characteristic, or 40 or less for any 2 acceptance characteristics, or 60 or less for any 3 or more acceptance characteristics **remove and replace the mixture representing that LOT.**



Data Sets Evaluated – 2012-2015

- F & t Statistics on 376 Data Sets
(Type Mixes: Base, Intermediate, Surface & OGFC)
- 288 of 376 Data Sets Compared
- 88 of 376 Date Sets Non-Comparison
- 77 % Overall Acceptance Rate

Modified Total Percent Within Limits (TPWL)-2012-2015

- 88 Non-Comparison Data Sets
- 15 (17%) 100 TPWL (No change or Higher)
- 24 (27%) 90 - 99 TPWL
- 17 (19%) 80 - 89 TPWL
- 12 (14%) 70 - 79 TPWL
- 20 (23%) 0 - 69 TPWL

Consistency – Accuracy! Split Samples & Verification

- Consistency # 1
Producing Quality Mix
- Consistency # 2
Obtaining samples
- Consistency # 3
Testing samples
- Accuracy # 4
Reporting results

Questions?
Please feel free to
contact me @

SCDOT
Office and Materials
& Research
1406 Shop Road,
Columbia, SC
(803) 737-6700

Cliff Selkinghaus

