

Understanding Testing Variability

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Understanding Testing Variability

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Understanding Testing Variability


Introduction

- Many factors can affect test results; equipments, Manufacturer, Human, Lab management, Test procedure, etc
- Statistical analysis is used to verify acceptable test variations
- It is also used to indicate the probability that an error has occurred



Repeatability / Reproducibility Standards

ASTM Standards for Measures of Test Precision

- Single Operator Precision
 - Multi-Batch Precision
 - Single-operator-apparatus
 - Multi-day precision; or multi-operator
 - Single-day apparatus precision
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Repeatability / Reproducibility Standards

ASTM Standards for Measures of Test Precision

- Repeatability/Single Operator Precision: greatest acceptable difference between results of two tests conducted on same material by the same operator
- If two determinations or test results by the same operator differ by more than 2 standard deviations, there is a high probability that an error has occurred and retests should be made

Repeatability / Reproducibility Standards

ASTM Standards for Measures of Test Precision

- Multilaboratory Precision/Reproducibility: greatest acceptable difference between results of two tests conducted on same material by two different operators at two different laboratories on material that is as close as possible to being the same
- If two determinations or test results differ by more than 2 standard deviations, there is a high probability that one or both labs are in error or that a difference in the characteristics of the test specimens used for the tests

Repeatability / Reproducibility Factors Affecting Test Results


Human Factors affecting test results (not in order)

- Number of technicians performing the test – one or more
- Following out-of-date procedure
- Following improper testing practice
- Making short cuts
- Technicians follow what they've taught (Vs. instructions in test procedure)
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Repeatability / Reproducibility Factors Affecting Test Results


Lab Management factors affecting test results (not in order)

- Shortage of lab staff
 - Lack of quality system or lack of following it
 - Lack of trained/certified technicians in the lab
 - Lack of technician training programs
 - High turnover of staff
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Repeatability / Reproducibility Factors Affecting Test Results

Other Factors (not in any order)

- Equipment maintenance and calibrations
 - Use of scheduled equipment checks to ensure specification/tolerance requirements
 - Equipment manufacturer
 - Test procedure vagueness in areas
 - Samples techniques/Non-representative sample
 - Regular use of control samples
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Lab Certification – How It Relates to Testing Variability

Regular lab inspections and annual proficiency testing significantly reduce test variability; It ensures:

- Equipments are Calibrated and maintained
- Uniform and Up-to-date test procedure are used
- Testing is done by qualified staff
- Encourage Technician certification/training
- Reduces test variations and potential for job interruptions and/or contract disputes

CCIL Certification Program Make-up Asphalt and Aggregate Materials

	<u>CCIL</u>	<u>Canadian Mix Exchange</u>	<u>ISO 17025</u>	<u>AASHTO/ AMRL</u>
Interlab Correlation	√	√	-	√
Correlation Follow up	√	-	-	?
Lab Audits	√	-	√	√
Quality System	√	-	√	√
Technician Certificate	√	-	-	√

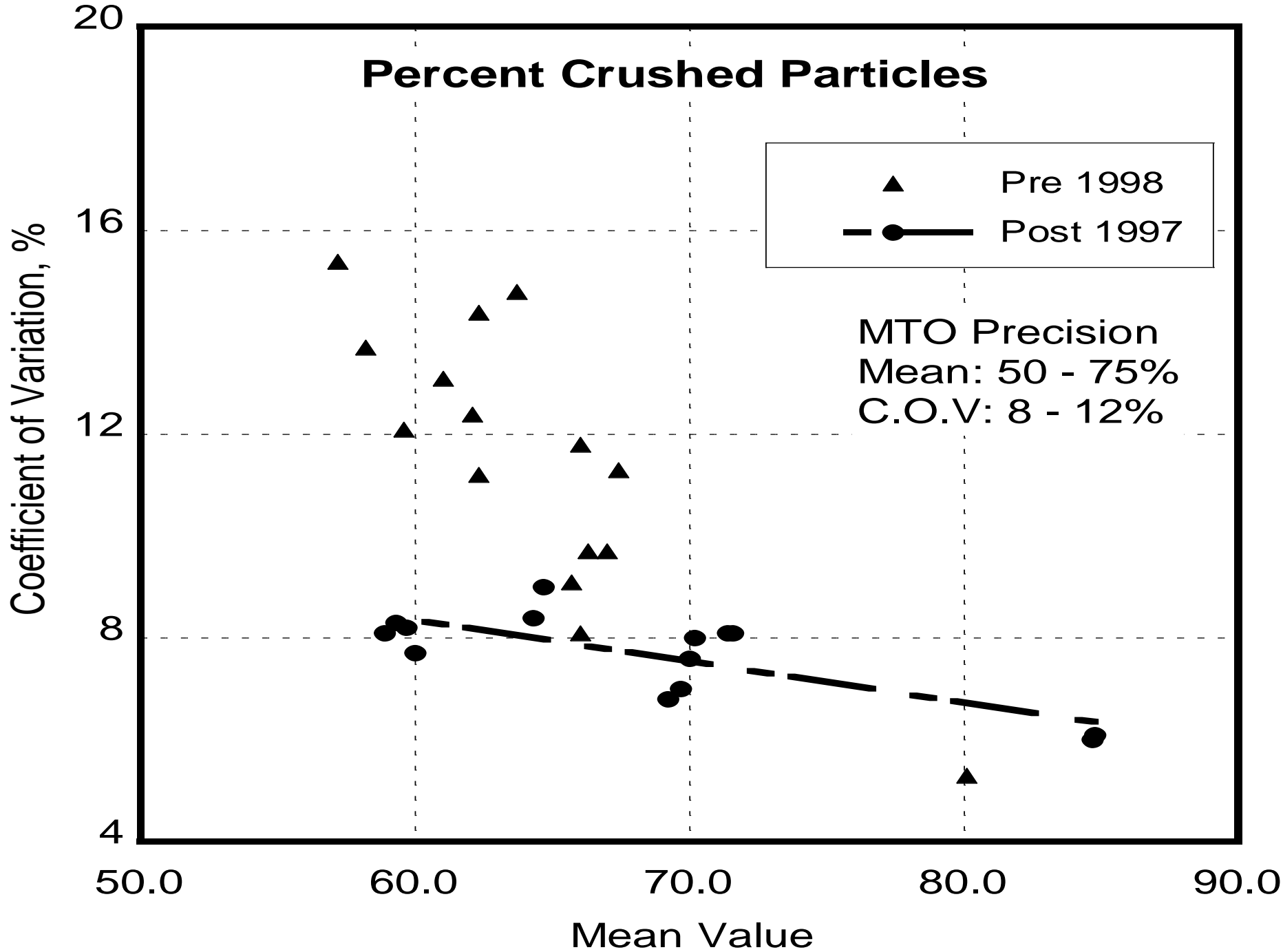
CCIL Certification Program; % AC – Ignition Correlation Results

	2008	2010	2012	2014	2016
Mean, BC	5.11	5.04	5.11	5.05	5.08
Mean, ON	5.03	5.06	5.10	5.09	5.08
SD, BC	0.17	0.15	0.12	0.16	0.12
SD, ON	0.10	0.10	0.10	0.15	0.11

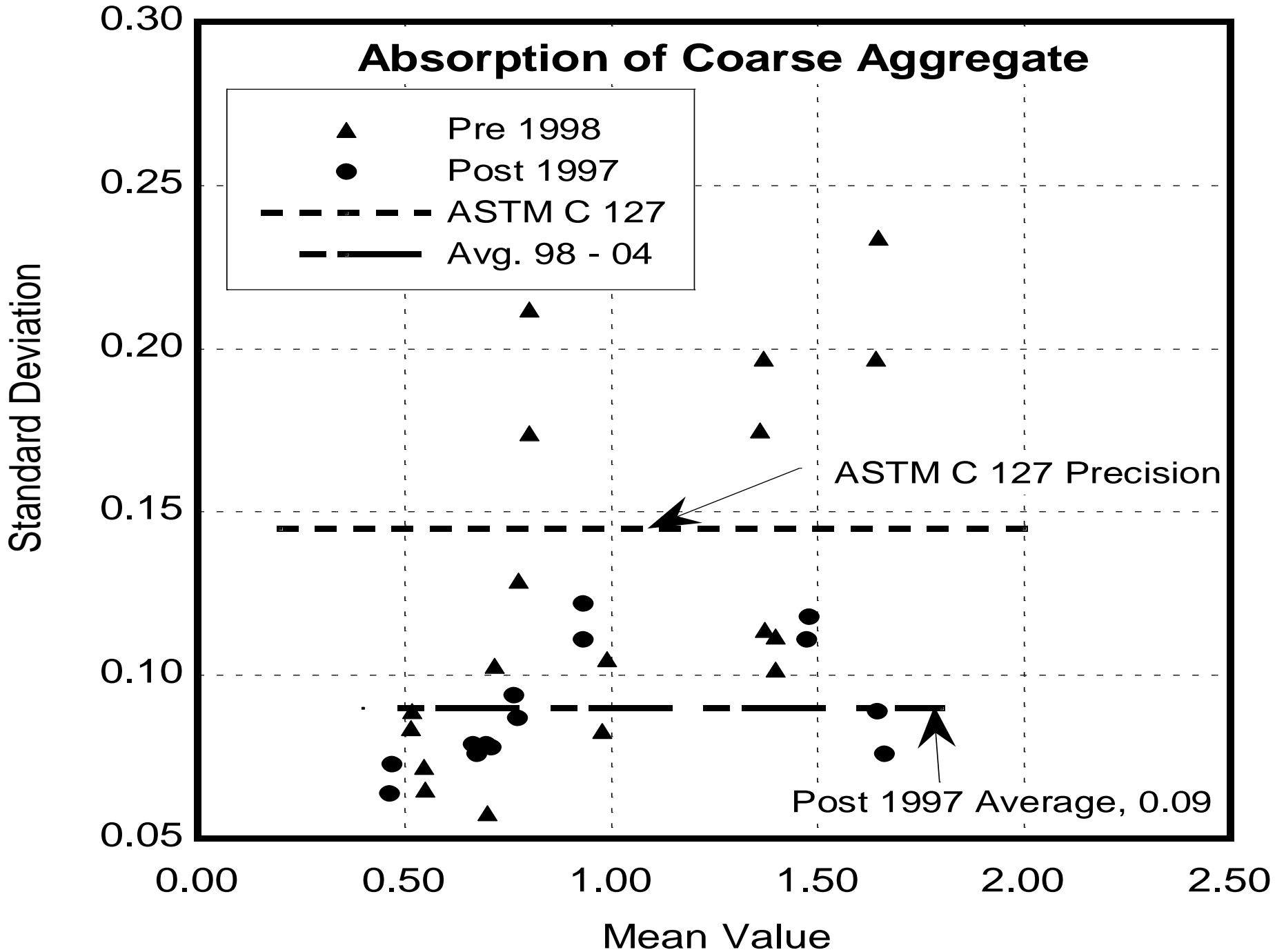
CCIL Certification Program: Mix Compliance Correlation Results

	2008	2010	2012	2014	2016
SD, BRD, BC	0.091	0.015	0.050	0.008	0.014
SD, BRD, ON	0.010	0.010	0.010	0.016	0.013
SD, AV, BC	1.269	0.624	1.185	0.86	0.71
SD, AV, ON	0.405	0.572	0.441	0.55	0.65
SD, VMA, BC	1.583	0.496	??	0.25	0.41
SD, VMA, ON	0.500	0.376	0.616	0.59	0.48

Percent Crushed Particles



Absorption of Coarse Aggregate



Summary and Conclusions

To minimize test variations

- Follow proper test procedure & practices,
- Ensure adequate staffing
- Ensure adequate training
- Ensure equipment maintenance, scheduled tolerance checks, scheduled calibration and regular use of control samples
- Follow your Quality Manual
- Carry Out Regular Internal Audits
- Lab certification & participation in Proficiency Testing Significantly Reduce Testing Variability

Summary and Conclusions


Regular lab auditing & participation in Proficiency

- Ensures Up-to-date & uniform test procedures
- Ensures testing is by qualified and trained staff
- Ensures equipment are calibrated and maintained
- Encourage technician training/certification
- Improves standard of excellence in testing
- Increases confidence in test results
- Reduces test variations and potential for job interruptions and contract disputes



Summary and Conclusions

Lab Certification is a win-win to all

- Regulators: the assurance that regulation is supported by valid test data
 - Owners: the assurance that the project is built in accordance with the specified test requirements
 - Contractors, producers, consultants & testing laboratories: improved confidence in testing results and reduced potential for job interruptions, construction delays and contract disputes
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*2016 CCIL Laboratory Certification
Programs Update*

Thank you

Questions?

