

## TECHNICAL ADVISORY T 6120.3

Use of Contractor Test Results in the  
Acceptance Decision ...

NCAUPG  
Lafayette, IN  
January 27, 2005

U.S. Department of Transportation  
Federal Highway Administration

## TECHNICAL ADVISORY T 6120.3

[www.fhwa.dot.gov/legregs/electdirs.htm](http://www.fhwa.dot.gov/legregs/electdirs.htm)  
[www.fhwa.dot.gov/pavement/ta.htm](http://www.fhwa.dot.gov/pavement/ta.htm)

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## TECHNICAL ADVISORY

### Why?

- Outline for effective QA stewardship and implementation
- Clarification of existing regulation on independent samples, split samples and the validation of test results
- Unified Agency goals  
Statistically valid specifications,  
Percent within Limits (PWL), Risk Analysis

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## TECHNICAL ADVISORY

### Background

Title 23 Code of  
Federal Regulations  
Part 637  
(23 CFR 637)  
June 29, 1995

[http://www.access.gpo.gov/nara/cfr/waisidx\\_03/23cfr637\\_03.html](http://www.access.gpo.gov/nara/cfr/waisidx_03/23cfr637_03.html)

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## 33 States using Contractor Test Results in the Acceptance Decision

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## TECHNICAL ADVISORY

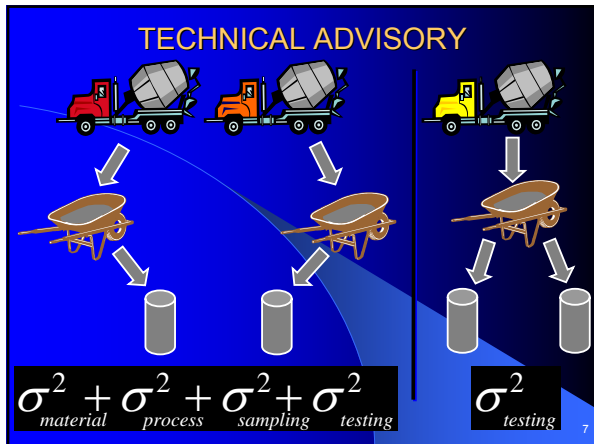
### Independent Samples

23CFR637B Sec. 637.207 QA Program

Contractor sampling and test results can be used as part of the acceptance decision provided:

(a)(1)(ii)(B) ... they are **validated** by verification sampling and testing ... verification testing shall be performed on samples taken independently of the contractor samples

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#### Independent Samples

23CFR637B Sec. 637.205 Policy

(d) The **verification sampling and testing** are to be performed by qualified testing personnel employed by the State or its designated agent, excluding the contractor and vendor.

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#### Independent Samples

When is it possible to allow some limited contractor involvement in taking independent verification samples for the State?

- Labor Regulations
- Hazardous Conditions
- Liability Issues

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### TECHNICAL ADVISORY

#### Independent Samples

When is it possible to allow some limited contractor involvement in taking independent verification samples for the State?

- Labor Regulations
- Hazardous Conditions
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**EXCEPTION NOT THE RULE**

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#### Independent Samples

The State can use the services of the contractor's personnel to assist in obtaining independent verification samples when the following requirements are adhered to:

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#### Independent Samples


- ✓ The verification sample location or time is randomly selected by the State and is only given to the contractor immediately prior to sampling.
- ✓ The contractor's personnel are used only to provide labor to assist in physically obtaining the verification sample of the material.
- ✓ The State is present to witness the taking of the verification sample.

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#### Independent Samples

- Both the State witness and contractor labor are qualified sampling personnel.
- The State witness controls the sampling process by choosing the location or timing and directing the taking of the verification sample.
- The State witness immediately takes possession of the verification sample.

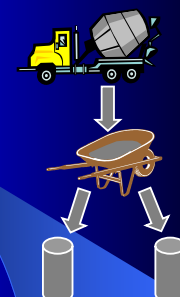



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#### Split Samples

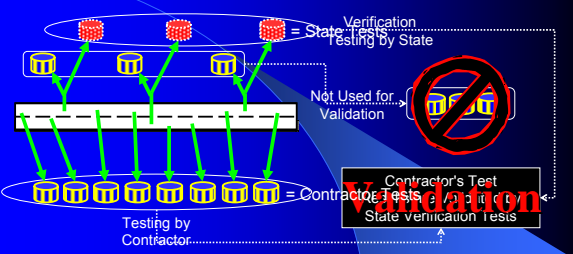
Can be used in the acceptance decision if the test results are independently validated.

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#### Split Samples – Independent Validation



Verification Testing by State

Not Used for Validation

Contractor's Test Results are Validated by State Verification Tests

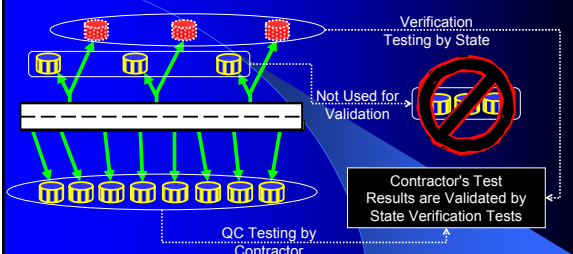
Testing by Contractor

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### TECHNICAL ADVISORY

#### Split Samples – Independent Validation

☐ = Contractor Tests    ☐ = State Tests



Verification Testing by State

Not Used for Validation

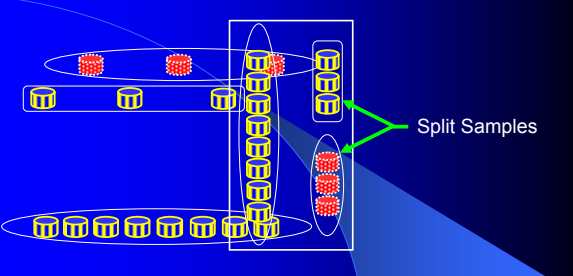
Contractor's Test Results are Validated by State Verification Tests

QC Testing by Contractor

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☐ = Contractor Tests    ☐ = State Tests



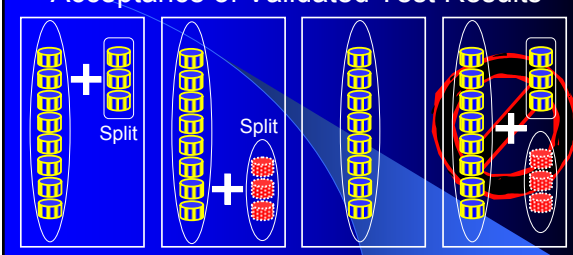
Split Samples

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#### Acceptance of Validated Test Results

☐ = Contractor Tests    ☐ = State Tests



(a) (b) (c) (d)

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**Independent Sample Validation**

**F-test**  
 $H_0$ : variances are equal,  $s^2_{\text{contractor}} = s^2_{\text{state}}$

**t-test (independent)**  
 $H_0$ : means are equal,  $\bar{X}_{\text{contractor}} = \bar{X}_{\text{state}}$

Contractor      State

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**Independent Sample Validation**

If either the  $F$ -test or the  $t$ -test show a significant difference ( $F \geq F_{\text{crit}}$  or  $t \geq t_{\text{crit}}$ ), it is questionable whether the data is really from the same population

Contractor      State

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**Independent Sample Validation**

- Both  $F$ -test and  $t$ -test are run at a level of significance
  - Risk of incorrectly rejecting  $H_0$
  - Typical values
    - 0.10
    - 0.05
    - 0.01

Contractor      State

- If 0.01 is used and the null hypothesis is rejected, then there is only 1 chance in 100 that  $H_0$  is true and was rejected in error (a "false alarm")

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**Level of Significance**

- Many agencies select a value of 0.01 to minimize the likelihood of incorrectly concluding that the results are different when they actually came from the same population (a "false alarm")
- However, selecting a low value reduces the chance of detecting a real difference when one actually exists

- The only way to improve the test's power without increasing the "false alarm" rate is to use an increased number of samples

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**Power of the  $F$ -test**

Ratio of Standard Deviations	Number of Contractor Tests	Number of Agency Tests	Probability of Detecting a Difference
2	3	3	0.10
	5	5	0.21
	20	5	0.49
	⋮	⋮	⋮
	40	10	0.77
	50	15	0.90

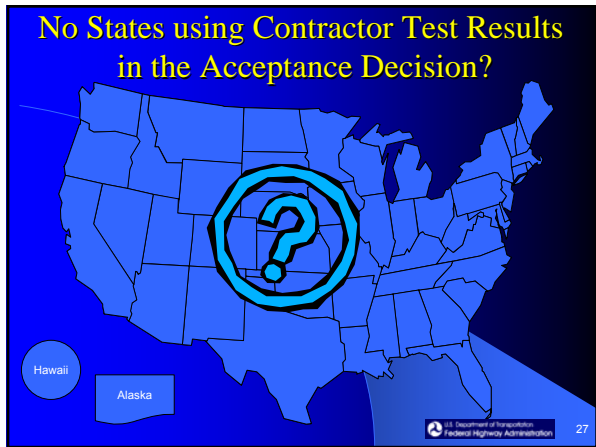
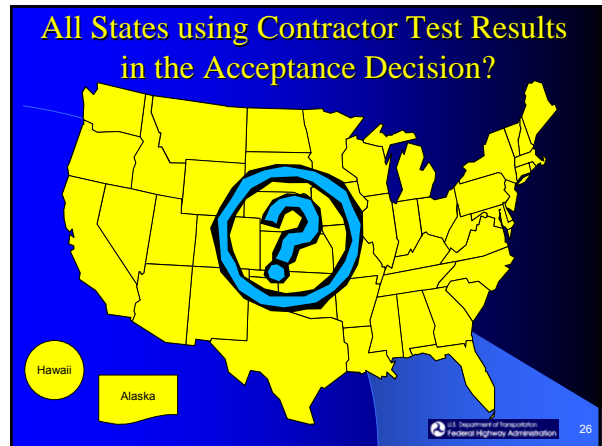
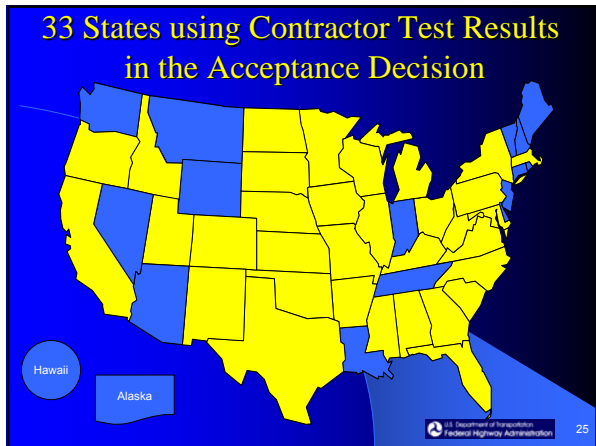
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**Power of the (independent)  $t$ -test**

Difference in Means	Number of Contractor Tests	Number of Agency Tests	Probability of Detecting a Difference
3	5	1	0.34
	6	1	0.42
	7	1	0.46
	8	1	0.53
	9	1	0.54
	10	1	0.58
		10	1

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