

**OHIO DEPARTMENT OF TRANSPORTATION**  
**Office Of Materials Management**  
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 Chemical Section  
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Subject: Results of the Round Robin tests on bridge paint and comparison of data to show uniformity of results using specified methodology.

Introduction

The resulting data of the paint round robin testing program is analyzed and summarized around the arithmetic mean ( $\bar{u}$ ). The standard deviation ( $s$ ) is defined as the square root of the average square deviation of each data point from the mean. If  $N$  is the total number of data points, which becomes  $(N - 1)$  considering degrees of freedom,  $X_i$  represents a data point,  $\sum (X_i - \bar{u})^2$  is the sum of the square of the difference of the data points from the mean, the standard deviation would be;

$$s = \left\{ \sum (X_i - \bar{u})^2 \right\}^{1/2} / (N - 1)^{1/2}$$

The number of standard deviations a data point is away from the mean,  $(X_i - \bar{u})/s$ , is an indication, for the purposes of this program, of the uniformity of testing between the participants. ***A  $(X_i - \bar{u})/s$  value of 2 or greater infers a procedural problem.***

Data

Company	odot	Sherwin Williams	Ameron	Carboline	ICI	International
<b>Total solids</b>	58.08	57.92	58.82	41.98*	57.4	57.52
<b>Pigment</b>	18.90	19.22	19.13		18.70	19.09
<b>Weight (lbs./gal)</b>	8.73	8.72	8.77	8.68	8.73	8.72
<b>Viscosity (KU)</b>	85	81	82	77	88	85

\* Value too far out of range for use

**% Total Solids**

$u = 57.95$

$S(X_i - u)^2 = 1.26$

$(N - 1) = 4$

$s = \{1.26/4\}^{1/2}$

$s = .562$

Company	$X_i$	$(X_i - u)$	$(X_i - u)^2$
ODOT	58.08	.13	.017
Sherwin-Williams	57.92	-.03	.001
Ameron	58.82	.87	.757
Carboline	41.98		
ICI	57.40	-.55	.303
International	57.52	-.43	.185

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	.017	.231
Sherwin-Williams	.001	.002
Ameron	.757	1.347
Carboline		
ICI	.303	.539
International	.185	.329

The results for the Total Solid data show a range of .002 to 1.347 standard deviations from the mean value. Carboline has a procedural problem for ASTM D 2369..

**Pigment Content**

$u = 19.01$

$S(X_i - u)^2 = .172$

$(N - 1) = 4$

$s = \{ .172/4 \}^{1/2}$

$s = .207$

Company	$X_i$	$(X_i - u)$	$(X_i - u)^2$
ODOT	18.90	-.11	.012
Sherwin-Williams	19.22	.21	.044
Ameron	19.13	.12	.014
Carboline			
ICI	18.70	-.31	.096
International	19.09	.08	.006

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	.012	.058
Sherwin-Williams	.044	.213
Ameron	.014	.068
Carboline		
ICI	.096	.464
International	.006	.029

The results for the percent pigment data ranges from 0.29 to .464 standard deviations from the mean value. There are no procedural problems for ASTM D 2698.

**Weight per Gallon**

$u = 8.73$

$S(X_i - u)^2 = .005$

$(N - 1) = 5$

$s = \{ .005/5 \}^{1/2}$

$s = .001$

Company	$X_i$	$(X_i - u)$	$(X_i - u)^2$
ODOT	8.73	0	0
Sherwin-Williams	8.72	-.01	0
Ameron	8.77	.04	.002
Carboline	8.68	-.05	.003
ICI	8.73	0	0
International	8.72	-.01	0

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	0	0
Sherwin-Williams	0	0
Ameron	.002	2
Carboline	.003	3
ICI	0	0
International	0	0

Due to the extremely small range, the 2 and 3 by Ameron and Carboline are not considered a procedural problem.

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**Stormer Viscosity**

$u = 83$

$S(X_i - u)^2 = 74$

$(N - 1) = 5$

$s = \{74/5\}^{1/2}$

$s = 14.80$

Company	$X_i$	$(X_i - u)$	$(X_i - u)^2$
ODOT	85	2	4
Sherwin-Williams	81	-2	4
Ameron	82	-1	1
Carboline	77	-6	36
ICI	88	5	25
International	85	2	4

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	4	.27
Sherwin-Williams	4	.27
Ameron	1	.07
Carboline	36	2.43
ICI	25	1.69
International	4	.27

The results of the Stormer Viscosity shows a range of 0.07 to 2.43 standard deviations from the mean value. Carboline has a procedural problem for ASTM D 562.

### **Conclusion**

This program was established to ensure uniformity in testing paint according to specified methods.

**(Xi - u)/s**, represents the distance of the submitted data from the arithmetical mean of the data submitted by all participants. A data point which is 2 or more standard deviations from the mean should be considered suspect. Companies with values that were 2 or more standard deviations from the mean will be contacted and asked to explain their results. Uniformity in the performance of testing among participating producers and between these producers and the Ohio DOT is important. Uniformity of testing must exist in order to determine the validity of the results of testing problem paint samples when there is controversy as to whose test results reflect the actual condition of paint batches used on ODOT projects.

Thanks to all the participants for taking the time to participate in this program.

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