

**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 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 (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, Xi represents a data point, S(Xi - U) 2 is the sum of the square of the difference of the data points from the mean, the standard deviation would be;

$$s = \{S(Xi - u) ^2 \} ^{1/2} / (N - 1) ^{1/2}$$

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

Data

<b>Company</b>	<b>ODOT</b>	<b>Aexcel</b>	<b>Sherwin-Williams</b>	<b>Ennis @ Richmond, VA</b>	<b>Ennis @ Ennis, TX</b>	<b>Polycarb</b>	<b>Epolpex</b>
<b>Total solids</b>	54.14	54.08	53.92	53.99	54.36	54.6	54.16
<b>Pigment</b>	29.43	29.27	28.68	29.44	29.13	29.30	29.08
<b>Weight (lbs./gal)</b>	10.91	10.96	10.90	10.91	10.89	10.95	10.87
<b>Viscosity (KU)</b>	106	106	102	108	105	106	X

**% Total Solids**

$u = 54.18$

$S(Xi - u)^2 = .32$

$(N - 1) = 6$

$s = \{ .32/6 \}^{1/2}$

$s = 0.23$

<b>Company</b>	<b>Xi</b>	<b>(Xi - u)</b>	<b>(Xi - u) 2</b>
<b>ODOT</b>	54.14	-.04	.002
<b>Aexcel</b>	54.08	-.10	.01
<b>Sherwin Williams (traffic)</b>	53.92	-.26	.068
<b>Ennis Paint, VA</b>	53.99	-.19	.036
<b>Ennis Paint, TX</b>	54.36	.18	.032
<b>Polycarb</b>	54.60	.42	.176
<b>Epoplex</b>	54.16	.02	0

<b>Company</b>	<b>(Xi - u)</b>	<b>(Xi - u)/s</b>
<b>ODOT</b>	-.04	-.17
<b>Aexcel</b>	-.1	-.43
<b>Sherwin-Williams (traffic)</b>	-.26	-1.13
<b>Ennis Paint, VA</b>	-.19	-.83
<b>Ennis Paint, TX</b>	.18	.88
<b>Polycarb</b>	.42	1.35
<b>Epoplex</b>	0	0

The results for the Total Solid data show a range of 0 to 1.35 standard deviations from the mean value. No procedural problems are apparent for ASTM D2369 .

### Pigment Content

$$u = 29.19$$

$$S(X_i - u)^2 = .415$$

$$(N - 1) = 6$$

$$s = \{.415/6\}^{1/2}$$

$$s = .26$$

Company	$X_i$	$(X_i - u)$	$(X_i - u)^2$
ODOT	29.43	.24	.058
Aexcel	29.27	.08	.006
Sherwin-Williams (traffic)	28.68	-.51	.260
Ennis Paint, VA	29.44	.25	.063
Ennis Paint, TX	29.13	-.06	.004
Polycarb	29.30	.11	.012
Epoplex	29.08	-.11	.012

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	.24	.92
Aexcel	.08	.31
Sherwin-Williams (traffic)	-.51	-1.96
Ennis Paint, VA	.25	.96
Ennis Paint, TX	-.06	-.23
Polycarb	.11	.42
Epoplex	-.11	-.42

The results for the percent pigment ranges from .23 to 1.96 standard deviations from the mean value. No procedural problems are apparent for ASTM D3723.

### Weight per Gallon

$$u = 10.91$$

$$S(X_i - u)^2 = 0.007$$

$$(N - 1) = 6$$

$$s = \{0.007\}^{1/2}$$

$$s = 0.034$$

Company	$X_i$	$(X_i - u)$	$(X_i - u)^2$
ODOT	10.91	0	0
Aexcel	10.96	.05	.003
Sherwin-Williams (traffic)	10.90	-.01	0
Ennis Paint, VA	10.91	0	0
Ennis Paint, TX	10.89	-.02	0
Polycarb	10.95	.04	.002
Epoplex	10.87	-.04	.002

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	0	0
Aexcel	.05	1.47
Sherwin-Williams (traffic)	-.01	.29
Ennis Paint, VA	0	0
Ennis Paint, TX	-.02	-.59
Polycarb	.04	1.18
Epoplex	-.04	-1.18

Results for weight per gallon range from 0 to 1.18 standard deviations from the mean value. There are no procedural problems apparent for ASTM D1475.

### Stormer Viscosity

$u = 105.50$   
 $S(X_i - u)^2 = 19.50$   
 $(N - 1) = 5$   
 $s = \{19.5/5\}^{1/2}$   
 $s = 1.97$

Company	$X_i$	$(X_i - u)$	$(X_i - u)^2$
ODOT	106	.5	.25
Aexcel	106	.5	.25
Sherwin-Williams (traffic)	102	-3.5	12.25
Ennis Paint, VA	108	2.5	6.25
Ennis Paint, TX	105	-.5	.25
Polycarb	106	.5	.25
Epoplex	X	X	X

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	.5	.25
Aexcel	.5	.25
Sherwin-Williams (traffic)	-3.5	-1.78
Ennis Paint, VA	2.5	1.27
Ennis Paint, TX	-.5	-.25
Polycarb	106	.25
Epoplex	X	X

The results of the Stormer Viscosity shows a range of .25 to 1.78 standard deviations from the mean value. There are no procedural problems evident for ASTM D562..

### 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. No companies were 2 or more standard deviations from the mean for any of the tests in 2006 . Uniformity in the performance of testing among participating 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 everyone for taking the time to participate in this program. Your cooperation and your timely responses are appreciated.

Sincerely,

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