
Test Procedure for

PREPARING CONTROL CHARTS FOR PERFORMANCE GRADED ASPHALT BINDERS



TxDOT Designation: Tex-536-C

Effective Date: November 2004

1. SCOPE

- 1.1 Use this method to graphically display and track test results for performance graded asphalt binder. The use of this chart is required to determine eligibility for bonus pay factors.
 - 1.2 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.
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2. PROCEDURE

- 2.1 Tabulate the Quality Assurance (QA) data for the project using [Form 1965](#), "Asphalt Binder G*/Sin δ Data Tabulation."
- 2.2 Complete the project identification and other heading information lines.
- 2.3 Calculate the average and standard deviation using all quality assurance data. Use an automatic electronic means such as an appropriate calculator or computer to complete the calculation, or use the following equations:

$$\bar{y} = \frac{\sum y_i}{n}$$

-AND-

$$s = \sqrt{\frac{1}{n-1} (\sum y_i^2 - n(\bar{y})^2)}$$

Where:

- \bar{y} = the mathematical average of all y values obtained
- y_i = individual values of G*/sin δ obtained in QA testing
- n = number of QA samples for the project
- s = standard deviation.

- 2.4 On the y-axis, locate and label the value of 2.20 and draw a line horizontally across the graph. Label the line Specification Limit. (Use Figure 1, “Asphalt Binder Statistical Process Control Chart,” for plotting purposes.)
 - 2.5 On the y-axis locate points at \bar{y} , $\bar{y} + s$, $\bar{y} + 2s$, $\bar{y} + 3s$, $\bar{y} - s$, $\bar{y} - 2s$, and $\bar{y} - 3s$ and draw horizontal lines across the graph.
 - 2.6 Label the horizontal lines at \bar{y} , $\bar{y} + 3s$ and $\bar{y} - 3s$ as Mean, UCL (Upper Control Limit) and LCL (Lower Control Limit), respectively.
 - 2.7 Label the area between \bar{y} and $\bar{y} + s$ as Zone C. Also label the area between \bar{y} and $\bar{y} - s$ as Zone C.
 - 2.8 Label the area between $\bar{y} + s$ and $\bar{y} - 2s$ as Zone B. Also label the area between $\bar{y} - s$ and $\bar{y} - 2s$ as Zone B.
 - 2.9 Label the area between $\bar{y} + 2s$ and $\bar{y} + 3s$ as Zone A. Also label the area between $\bar{y} - 2s$ and $\bar{y} - 3s$ as Zone A.
 - 2.10 Identify each data point below the x-axis with the sample identification and the numeric value of $G^*/\sin \delta$.
 - 2.11 Plot all QA data points on the Statistical Process Control (SPC) Chart above their sample identifications using a "•" symbol.
 - 2.12 Identify and plot Verification data points on the SPC Chart above their sample identifications using an "x" symbol.
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3. TEST RECORD FORMS

- 3.1 Use forms similar to [Form 1965](#) and Figure 1, “Asphalt Binder Statistical Process Control Chart,” for project data presentation to determine eligibility for bonus pay factors. Complete more than one form to represent an entire project, if necessary. Continue from form to form as needed. If using forms other than Form 1965 and “Asphalt Binder Statistical Process Control Chart,” the same data must be included. Examples are shown in Figures 2 and 3.



ASPHALT BINDER STATISTICAL PROCESS CONTROL CHART

Project _____

County _____

Asphalt Binder PG Grade _____

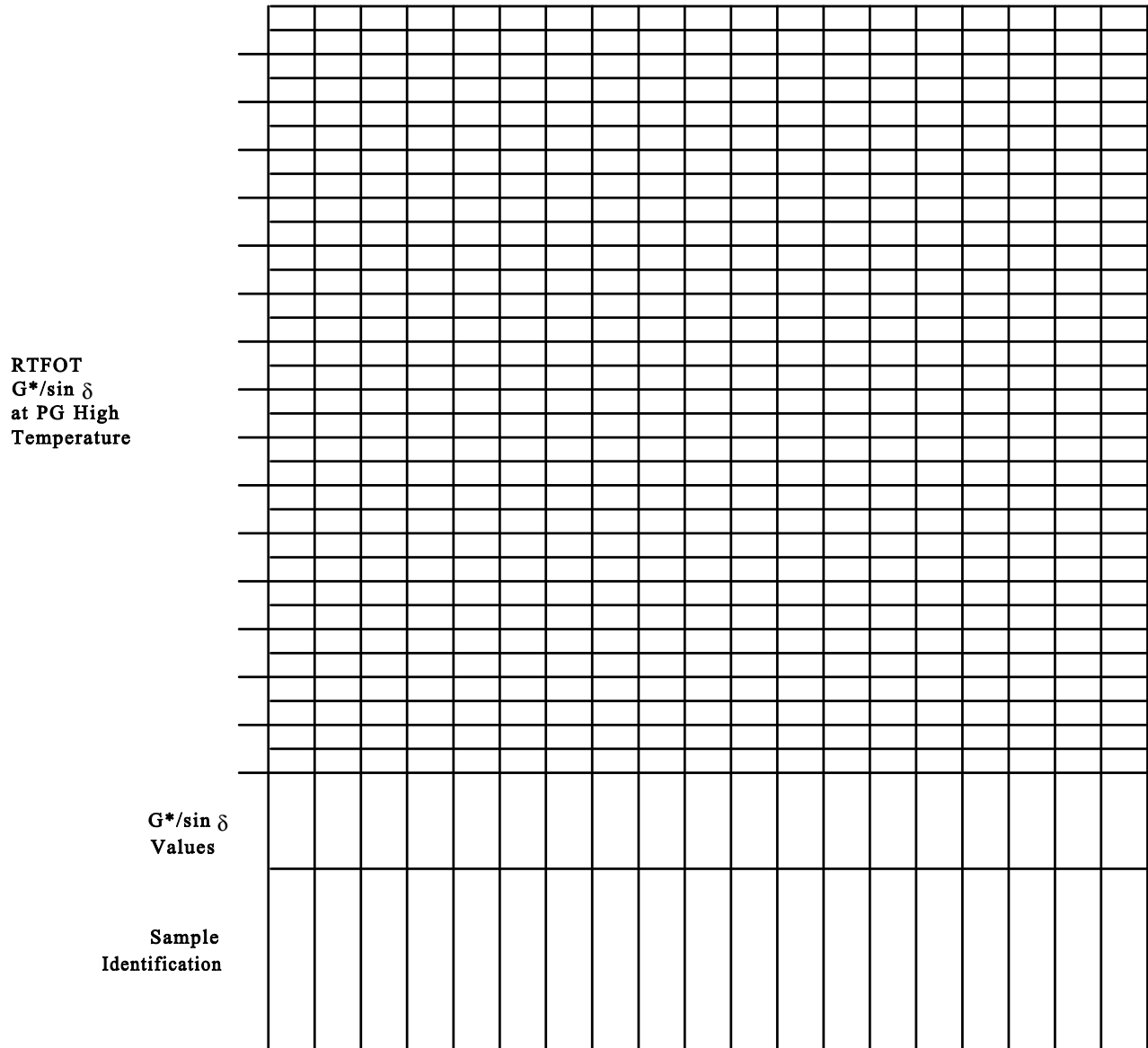


Figure 1—Asphalt Binder Statistical Process Control Chart



**ASPHALT BINDER
G*/SIN δ DATA TABULATION**

Project CPM-XX-X-XX
 County Travis
 Asphalt Binder PG Grade 64-22
 AASHTO TP5 Test Temperature 64

Sample	Date	Sample I.D.	y _i [G'/sin *]	y _i ² [(G'/sin *) ²]
1	06/06/96	L1-S-2	3.323	11.042
2	06/07/96	L2-S-1	2.9834	8.901
3	06/08/96	L3-S-3	3.1673	10.032
4	06/09/96	L4-S-2	2.8623	8.193
5	06/10/96	L5-S-4	2.932	8.597
6	06/11/96	L6-S-2	2.7724	7.686
7	06/12/96	L7-S-1	2.8938	8.374
8	06/13/96	L8-S-3	3.1032	9.630
9	06/14/96	L9-S-1	2.9737	8.843
10	06/15/96	L10-S-3	3.0632	9.383
11	06/16/96	L11-S-2	3.1293	9.792
12	06/17/96	L12-S-4	2.5703	6.606
3 y _i			35.7739	
3 y _i ²				107.079

$$\bar{y} = \frac{\sum y_i}{n} = 2.981$$

$$s = \sqrt{\frac{1}{n-1} (\sum y_i^2 - n(\bar{y})^2)} = 0.2006$$

\bar{y}	$\bar{y}+s$	$\bar{y}-s$	$\bar{y}+2s$	$\bar{y}-2s$	$\bar{y}+3s$	$\bar{y}-3s$
2.981	3.1816	2.7804	3.3822	2.5798	3.5828	2.3792

Figure 2—Example Asphalt Binder G*/Sin δ Data Tabulation



ASPHALT BINDER STATISTICAL PROCESS CONTROL CHART

Project CPM-XX-X-XX
 County Texas
 Asphalt Binder PG Grade 64-22

ASPHALT BINDER STATISTICAL PROCESS CONTROL CHART

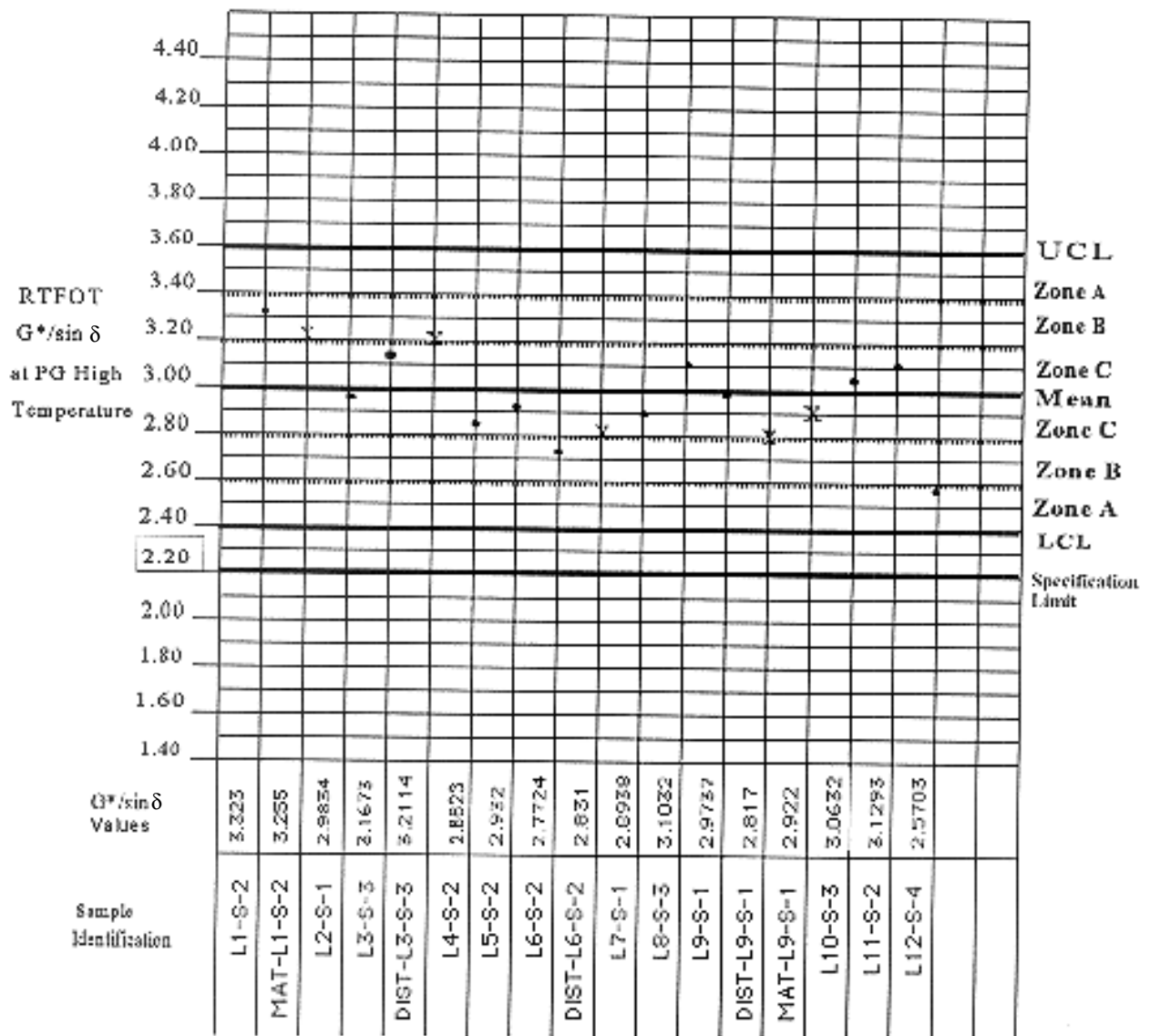


Figure 3—Example Asphalt Statistical Process Control Chart