

DUBAI ACCREDITATION DEPARTMENT

REPORT ON 175TH LABORATORY PROFICIENCY TESTING DETERMINATION OF LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX

29 April 2009

1. INTRODUCTION

This document presents the results of the 175th inter-laboratory proficiency-testing program conducted during the month of April involving the determination **Liquid Limit Plastic Limit and Plasticity Index** with twenty seven laboratories participating.

This program is part of the Inter-laboratory Comparison Programs organized by Dubai Accreditation Department (DAC) of Dubai Municipality (DM) for monitoring the validity of test results of laboratories operating in Dubai as a requirement of the Local Order 52/1990 and ISO/IEC 17011: 2004.

2. EXPERIMENTAL DESIGN

2.1 Homogeneity:

DAC had ensured the homogeneity of the samples prior to their distribution to the participating laboratories by conducting homogeneity test on six samples (randomly selected). Based on the test results the homogeneity is statistically evaluated as per *ISO 13528:2005 as explained in DAC-G3-03*.

2.2 Participants:

Twenty seven laboratories are participated in this program; two governmental laboratories and twenty five are private laboratories (two of them are from Qatar). Nineteen of the participating laboratories are accredited by DAC for construction materials testing.

2.3 Samples Tested:

One (1) Sample of Clayey Soil Approximately 1 Kg was distributed to all participating laboratories.

3. CONFIDENTIALITY

Each laboratory is given a code number to maintain confidentiality of results and to protect their identities. Only the concerned laboratory knows its code number. If you have doubt about your code number please don't hesitate to contact Dr. Yaser Saleh Rahag (Tel: 302 7074) to know your code number.

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4. TEST METHOD

Instructions were given to the participants to test the samples as per:

- 4.1 Determination of Liquid Limit in accordance with BS 1377:1990 Part 2 Cl. 4.5/4.3 Amd 9027:1996, Sample Preparation shall be as per Cl .4.2.4.
- 4.2 Determination of Plastic Limit and Plasticity Index as per BS 1377: 1990 Part 2 Cl.5, 5.3, 5.4 Amd .9027:1996
- 4.3 Use 80 Degree oven Temperatures

5. TEST RESULTS

The test results submitted by the participating laboratories are presented in Appendix A. In order to protect the identity of the participating laboratories, each one was assigned a code number. The numbers in the column headings, Lab #, of the tables represents the code numbers for the participating laboratories.

6. EVALUATION OF RESULTS

6.1 Method of Analysis

The analysis of the participant's results is based on *ISO 13528:2005 (Statistical Methods for the Use in Proficiency Testing by Inter-laboratory Comparisons)*

6.2 Calculations of Z- scores

Appendix B gives the details of the calculation of the laboratories results and their Z- Scores which are obtained from the raw data. Also Z- Score and participant's results are represented in a bar chart and X-Y scattered plots C. The Z-Score analysis is based on an international Standard (*ISO 13528:2005*).

6.3 Outlier Results

Test	Labs outside the z-scores ± 3
Liquid Limit Plasticity Index	Lab No. 67

After evaluating the Z-Score the test results provided by the above mentioned laboratory is outside the Z - score limits of ± 3 , the above mentioned laboratory is requested to investigate the root cause of the outlier results, implement corrective action and a report shall be available for checking by assessment team during the nearest assessment visit.



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Also other participating laboratories have showed Z-score values higher than **two** which representing **not outlier** but a warring limit, these laboratories are advised to investigate the potential root cause of such results.

7. APPENDICES

- 7.1 Appendix A: Raw Data
- 7.2 Appendix B: Calculation of z-scores and other statistics
- 7.3 Appendix C: Charts

Determination of Liquid Limit, Plastic Limit, And Plasticity Index

Appendix A: Raw Data

Liquid Limit %

Lab #	Results
Lab 1	44
Lab 3S	46
Lab 3	48
Lab 4	48
Lab 39	48
Lab 56	48
Lab 21	48
Lab 35	48
Lab 28	48
Lab 9	48
Lab 23	48
Lab 57	47
Lab 68	49
Lab 66	47
Lab 74	48
Lab 79	45
Lab 71	48
Lab 78	48
Lab 64	47
Lab 72	47
Lab 58	48
Lab 85	52.36
Lab 7	47
Lab 82	48
Lab FQ	47
Tech-Q	49
Lab 67	38

Plastic Limit %

Lab #	Results
Lab 1	23
Lab 3S	22
Lab 3	23
Lab 4	23
Lab 39	23
Lab 56	23
Lab 21	22
Lab 35	23
Lab 28	23
Lab 9	23
Lab 23	23
Lab 57	22
Lab 68	22
Lab 66	22
Lab 74	23
Lab 79	24
Lab 71	23
Lab 78	23
Lab 64	21
Lab 72	21
Lab 58	24
Lab 85	24.2
Lab 7	22
Lab 82	22
Lab FQ	21
Tech-Q	20
Lab 67	22

Plasticity Index

Lab #	Results
Lab 1	21
Lab 3S	24
Lab 3	25
Lab 4	25
Lab 39	25
Lab 56	25
Lab 21	26
Lab 35	25
Lab 28	25
Lab 9	25
Lab 23	25
Lab 57	25
Lab 68	27
Lab 66	25
Lab 74	25
Lab 79	21
Lab 71	25
Lab 78	25
Lab 64	26
Lab 72	26
Lab 58	24
Lab 85	28.16
Lab 7	25
Lab 82	26
Lab FQ	26
Tech-Q	29
Lab 67	16

Determination of Liquid Limit, Plastic Limit, And Plasticity Index

Appendix B: Calculation of z-scores and other statistics

Liquid Limit %

Iteration	0		1		2		3		4		5		6		Z Score						
$\delta = 1.5 s$	---	xi-x*	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$							
$x^* - \delta$	---		48.00		48.00		48.00		48.00		48.00		48.00		48.00	48.00	48.00	48.00	48.00	48.00	
$x^* + \delta$	---		48.00		48.00		48.00		48.00		48.00		48.00		48.00	48.00	48.00	48.00	48.00	48.00	
Lab 67	38	10.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-4.26						
Lab 1	44	4.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-1.70						
Lab 79	45	3.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-1.28						
Lab 3S	46	2.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-0.85						
Lab 57	47	1.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-0.43						
Lab 64	47	1.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-0.43						
Lab 66	47	1.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-0.43						
Lab 7	47	1.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-0.43						
Lab 72	47	1.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-0.43						
Lab FQ	47	1.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	-0.43						
Tech-Q	49	1.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.43						
Lab 21	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 23	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 28	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 3	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 35	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 39	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 4	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 56	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 58	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 71	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 74	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 78	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 82	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 9	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.00						
Lab 68	49	1.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	0.02						
Lab 85	52.36	4.36	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	1.86						
Average	47.31		48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00							
SD	2.35		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
New x*	48	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00	48.00	0.00							
New s*	0.00		0.00		0.00		0.00		0.00		0.00		0.00								

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Target value	48
Low Acceptable	41
High Acceptable	55
Acceptable Range	41-55

Determination of Liquid Limit, Plastic Limit, And Plasticity Index

Appendix B: Calculation of z-scores and other statistics

Plastic Limit %

Iteration	0		1		2		3		4		5		6		Z Score
$\delta = 1.5 s$	---	xi-x*	2.22	(xi-x*) ²	1.70	(xi-x*) ²	1.69	(xi-x*) ²	1.69	(xi-x*) ²	1.69	(xi-x*) ²	1.69	(xi-x*) ²	
$x^* - \delta$	---		20.78		20.82		20.83		20.83		20.83		20.83		
$x^* + \delta$	---		25.22		24.22		24.21		24.21		24.21		24.21		
Tech-Q	20	3.00	20.78	3.03	20.82	2.89	20.83	2.86	20.83	2.85	20.83	2.84	20.83	2.84	-2.24
Lab 64	21	2.00	21.00	2.30	21.00	2.31	21.00	2.31	21.00	2.31	21.00	2.31	21.00	2.31	-1.35
Lab 72	21	2.00	21.00	2.30	21.00	2.31	21.00	2.31	21.00	2.31	21.00	2.31	21.00	2.31	-1.35
Lab FQ	21	2.00	21.00	2.30	21.00	2.31	21.00	2.31	21.00	2.31	21.00	2.31	21.00	2.31	-1.35
Lab 21	22	1.00	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	-0.46
Lab 3S	22	1.00	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	-0.46
Lab 57	22	1.00	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	-0.46
Lab 66	22	1.00	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	-0.46
Lab 67	22	1.00	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	-0.46
Lab 68	22	1.00	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	-0.46
Lab 7	22	1.00	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	-0.46
Lab 82	22	1.00	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	22.00	0.27	-0.46
Lab 1	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 23	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 28	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 3	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 35	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 39	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 4	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 56	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 71	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 74	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 78	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 9	23	0.00	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	23.00	0.23	0.43
Lab 58	24	1.00	24.00	2.20	24.00	2.19	24.00	2.19	24.00	2.19	24.00	2.19	24.00	2.19	1.32
Lab 79	24	1.00	24.00	2.20	24.00	2.19	24.00	2.19	24.00	2.19	24.00	2.19	24.00	2.19	1.32
Lab 85	24.2	1.20	24.20	2.83	24.20	2.83	24.20	2.82	24.20	2.82	24.20	2.82	24.20	2.82	1.49
Average	22.49		22.52	22.11	22.52	21.96	22.52	21.92	22.52	21.91	22.52	21.91	22.52	21.91	
SD	0.99		0.92	1.00	0.92	0.99	0.92	0.98	0.92	0.98	0.92	0.98	0.92	0.98	
New x*	23	1.00	22.52	1.00	22.52	0.99	22.52	0.99	22.52	0.99	22.52	0.99	22.52	0.99	
New s*	1.48		1.13		1.13		1.12		1.12		1.12		1.12		

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Target value	23
Low Acceptable	19
High Acceptable	26
Acceptable Range	19 - 26

Determination of Liquid Limit, Plastic Limit, And Plasticity Index

Appendix B: Calculation of z-scores and other statistics

Plasticity Index

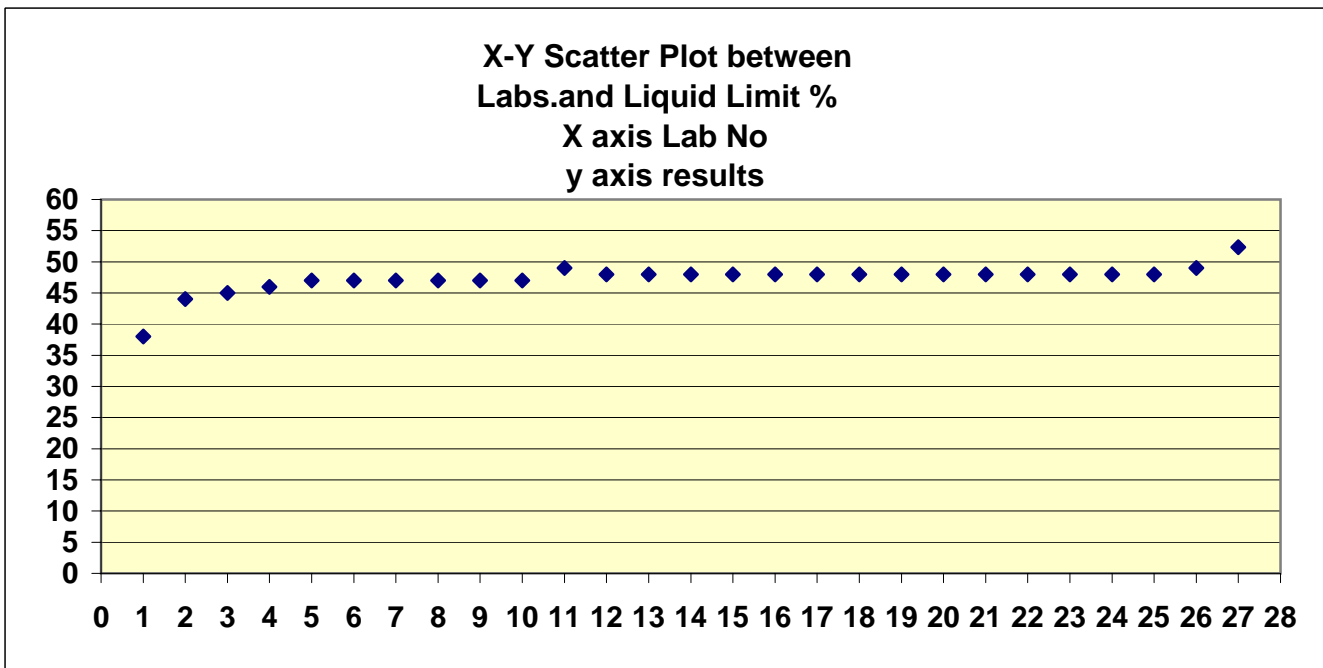
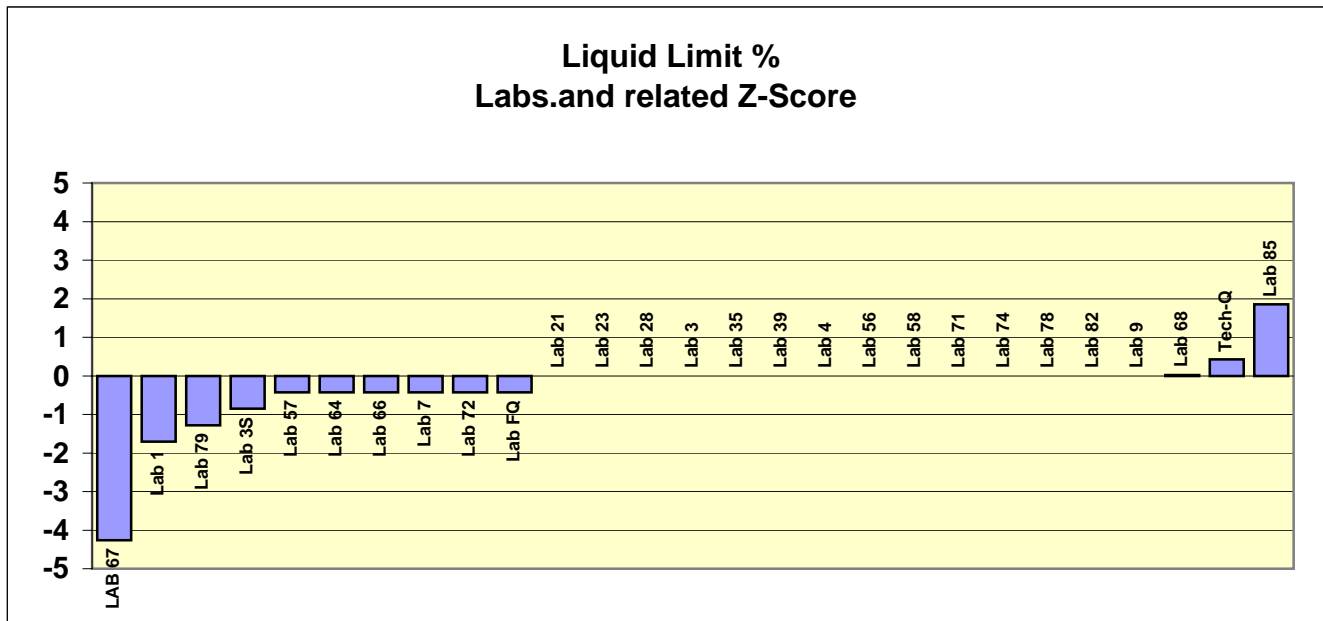
Iteration	0		1		2		3		4		5		6		Z Score						
$\delta = 1.5 s$	---	xi-x*	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$	0.00	$(xi-x^*)^2$							
$x^* - \delta$	---		25.00		25.00		25.00		25.00		25.00		25.00		25.00	25.00	25.00	25.00	25.00	25.00	
$x^* + \delta$	---		25.00		25.00		25.00		25.00		25.00		25.00		25.00	25.00	25.00	25.00	25.00	25.00	
Lab 67	16	9.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	-3.76						
Lab 1	21	4.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	-1.67						
Lab 79	21	4.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	-1.67						
Lab 3S	24	1.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	-0.42						
Lab 58	24	1.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	-0.42						
Lab 23	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 28	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 3	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 35	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 39	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 4	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 56	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 57	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 66	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 7	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 71	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 74	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 78	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 9	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00						
Lab 21	26	1.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.42						
Lab 64	26	1.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.42						
Lab 72	26	1.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.42						
Lab 82	26	1.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.42						
Lab FQ	26	1.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.42						
Lab 68	27	2.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.84						
Lab 85	28.16	3.16	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	1.32						
Tech-Q	29	4.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	1.67						
Average	24.82		25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00							
SD	2.39		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
New x*	25	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00							
New s*	0.00		0.00		0.00		0.00		0.00		0.00		0.00								

N 27

Target value	25
Low Acceptable	18
High Acceptable	32
Acceptable Range	18-32

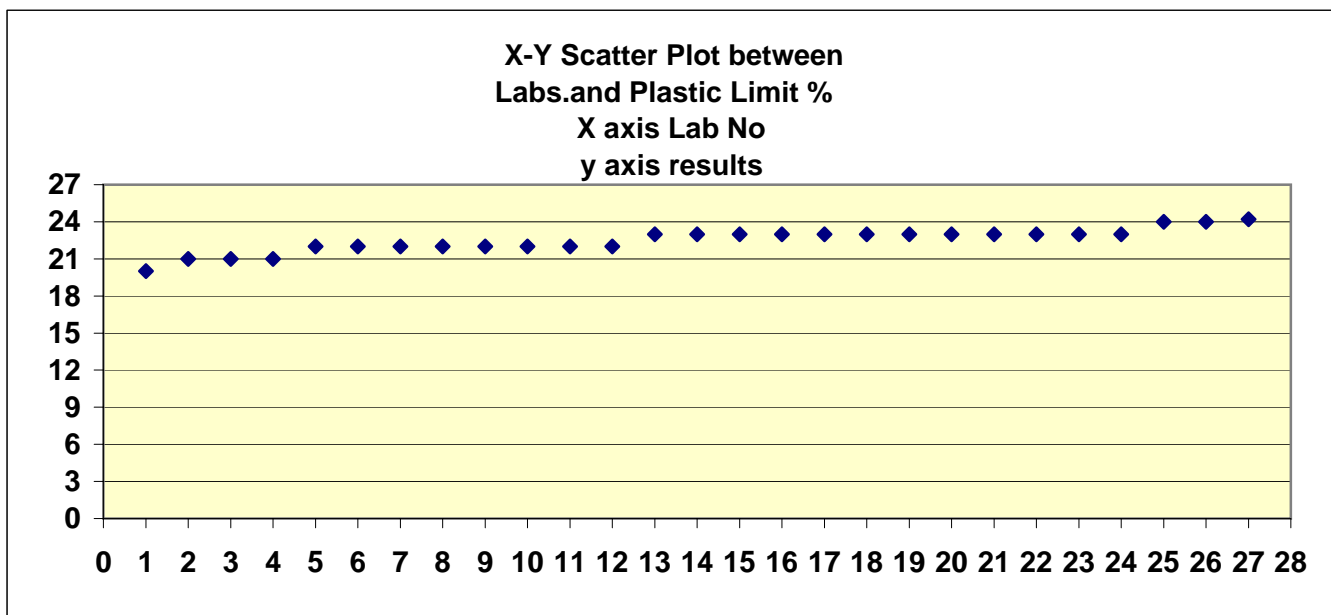
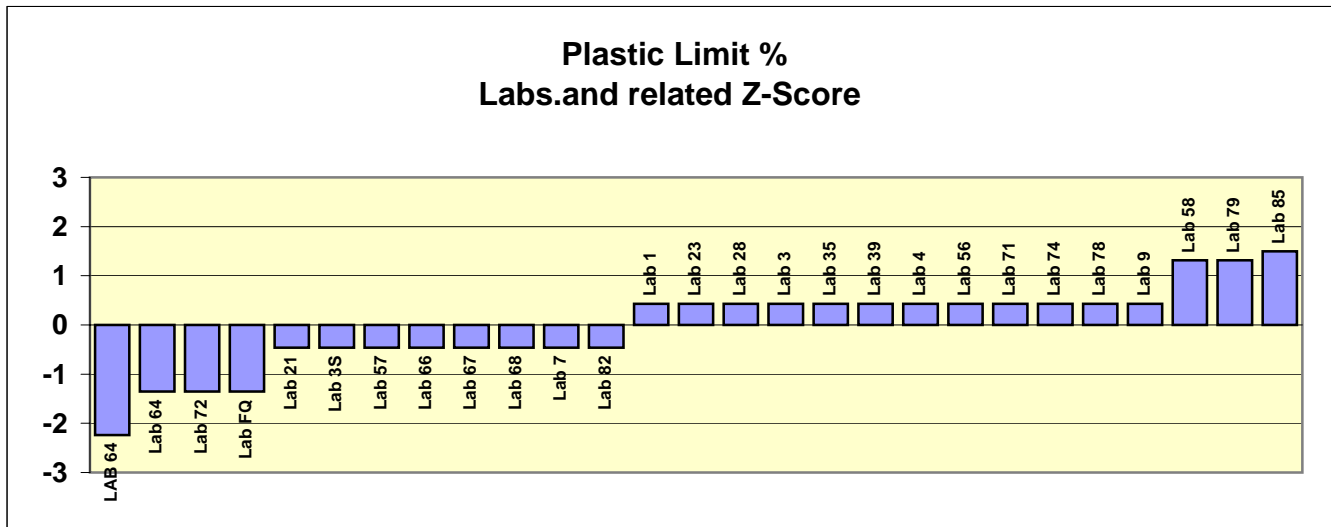
Determination of Liquid Limit, Plastic Limit, And Plasticity Index

Appendix C:Charts



Determination of Liquid Limit, Plastic Limit, And Plasticity Index

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