

DUBAI ACCREDITATION DEPARTMENT

REPORT ON PTP 200 INTER-LABORATORY PROFICIENCY TESTING PROGRAM DETERMINATION OF MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT RELATIONSHIP IN SOIL

Date: 13 January 2011

1. INTRODUCTION

This document presents the results of the 200 inter-laboratory proficiency-testing program conducted during the month of December involving the Determination of **Maximum Dry Density and Optimum Moisture Content Relationship in Soil** with thirty nine 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 and to ensure the competent of accredited and registered laboratories operating in Dubai as a requirement of the law no. 2/2010 and ISO/IEC 17011: 2004. Also laboratories from other emirates and from outside UAE were participated in this scheme.

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, (from each sample two portions A & B are tested). Based on the test results the homogeneity is statistically evaluated as per *ISO 13528:2005 as explained in DAC-G3-03*.

2.2 Participants:

Thirty nine laboratories were participated in this PTP including:

- Two governmental laboratories.
- Twenty two are private laboratories operating in Dubai including accredited and registered laboratories.
- Seven private laboratories are from other Emirates.
- Five laboratories are from Qatar.
- Two laboratories are from Oman
- One laboratory is from Bahrain.

2.3 Samples Tested:

One (1) soil sample of approximately 25 kg consists of brown fine to medium sand specimen was distributed to all participating laboratories. With each participant being given one sample with a unique identification number provided during the time of collection.

DUBAI ACCREDITATION DEPARTMENT

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.

4. TEST METHOD

Instructions were given to the participants to test the samples for Determination of Maximum Dry Density and Optimum Moisture Content Relationship as per BS 1377: Part 4:1990 T 3.5.4.2 AMD 13925: 2002)

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
Maximum Dry Density	Lab 68; Lab EX20; Lab EX16; Lab EX9
Optimum Moisture Content	Lab 68; Lab 67; Lab EX11; Lab EX16; Lab EX3; Lab EX14; Lab EX8; Lab EX9; Lab EX20

After evaluating the Z-Score the test results provided by the above mentioned laboratories are outside the Z - score limits of ± 3 , the above mentioned laboratories are 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.



DUBAI ACCREDITATION DEPARTMENT

Also other participating laboratories have showed Z-score values higher than **two** which are **not outlier** but as a warning limit, these laboratories are advised to investigate the potential root cause of such results and take the appropriate preventive action.

7. APPENDICES

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

---- End of Report ---

Table - 1: Maximum Dry Density & Optimum Moisture Content

Lab #	MDD Results	OMC Results
Lab G01	1.99	9.9
Lab 3	1.99	9.7
Lab 39	1.98	10
Lab 4	1.98	10
Lab 56	1.98	9.7
Lab 21	1.98	9.9
Lab 7	1.98	10
Lab 9	1.98	9.8
Lab 28	1.98	9.9
Lab 23	1.97	9.9
Lab EX8	1.98	11
Lab EX22	1.98	10
Lab 57	1.98	9.6
Lab 58	1.97	10
Lab 64	1.99	9.8
Lab 68	1.89	8
Lab 66	1.99	10
Lab 72	1.97	9.8
Lab 67	1.99	10.5
Lab 71	1.97	10
Lab 74	1.97	10
Lab EX9	1.94	11
Lab 79	1.98	9.9
Lab EX14	1.98	11
Lab 82	1.98	10
Lab 84	1.99	9.6
Lab EX1	1.98	9.9
Lab 89	1.98	9.9
Lab EX10	1.99	9.9
Lab EX3	1.96	10.9
Lab EX4	1.97	10
Lab EX6	1.97	10
Lab EX5	1.99	10
Lab EX20	1.93	11.1
Lab EX16	1.94	10.5
Lab EX11	1.98	9.4
Lab EX17	1.98	9.6
Lab EX12	1.98	10
Lab EX18	1.99	9.6

Table -1 Maximum Dry Density

Iteration	0	$\bar{x} - x^*$	1	$(\bar{x} - x^*)^2$	2	$(\bar{x} - x^*)^2$	3	$(\bar{x} - x^*)^2$	4	$(\bar{x} - x^*)^2$	5	$(\bar{x} - x^*)^2$	6	$(\bar{x} - x^*)^2$	Z Score
$\delta = 1.5 s^*$	---		0.02		0.02		0.02		0.02		0.01		0.01		
$x^* - \delta$	---		1.96		1.96		1.96		1.96		1.96		1.96		
$x^* + \delta$	---		2.00		1.99		1.99		1.99		1.99		1.99		
Lab 68	1.89	0.09	1.96	0.0004	1.96	0.0003	1.96	0.0003	1.96	0.0002	1.96	0.0002	1.96	0.0002	-9.00
Lab EX20	1.93	0.05	1.96	0.0004	1.96	0.0003	1.96	0.0003	1.96	0.0002	1.96	0.0002	1.96	0.0002	-4.93
Lab EX16	1.94	0.04	1.96	0.0004	1.96	0.0003	1.96	0.0003	1.96	0.0002	1.96	0.0002	1.96	0.0002	-3.91
Lab EX9	1.94	0.04	1.96	0.0004	1.96	0.0003	1.96	0.0003	1.96	0.0002	1.96	0.0002	1.96	0.0002	-3.91
Lab EX3	1.96	0.02	1.96	0.0003	1.96	0.0003	1.96	0.0003	1.96	0.0002	1.96	0.0002	1.96	0.0002	-1.87
Lab 23	1.97	0.01	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	-0.86
Lab 58	1.97	0.01	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	-0.86
Lab 71	1.97	0.01	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	-0.86
Lab 72	1.97	0.01	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	-0.86
Lab 74	1.97	0.01	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	-0.86
Lab EX4	1.97	0.01	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	-0.86
Lab EX6	1.97	0.01	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	1.97	0.0001	-0.86
Lab 21	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 28	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 39	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 4	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 56	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 57	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 7	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 79	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 82	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 89	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 9	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab EX1	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab EX11	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab EX12	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab EX14	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab EX17	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab EX22	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab EX8	1.98	0.00	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	1.98	0.0000	0.16
Lab 3	1.99	0.01	1.99	0.0002	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.18
Lab 64	1.99	0.01	1.99	0.0002	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.18
Lab 66	1.99	0.01	1.99	0.0002	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.18
Lab 67	1.99	0.01	1.99	0.0002	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.18
Lab 84	1.99	0.01	1.99	0.0002	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.18
Lab EX10	1.99	0.01	1.99	0.0002	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.18
Lab EX18	1.99	0.01	1.99	0.0002	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.18
Lab EX5	1.99	0.01	1.99	0.0002	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.18
Lab G01	1.99	0.01	1.99	0.0002	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.99	0.0001	1.18
Average	1.97		1.98	0.0038	1.98	0.0033	1.98	0.0031	1.98	0.0029	1.98	0.0029	1.98	0.0029	
SD	0.02		0.01	0.0001	0.01	0.0001	0.01	0.0001	0.01	0.0001	0.01	0.0001	0.01	0.0001	
New x^*	1.98	0.01	1.98	0.01	1.98	0.01	1.98	0.01	1.98	0.01	1.98	0.01	1.98	0.01	
New s^*	0.01		0.01		0.01		0.01		0.01		0.01		0.01		

N 39

Target value 1.98

Low Acceptable: 1.95

High Acceptable: 2.01

Acceptable Range: 1.95 - 2.01

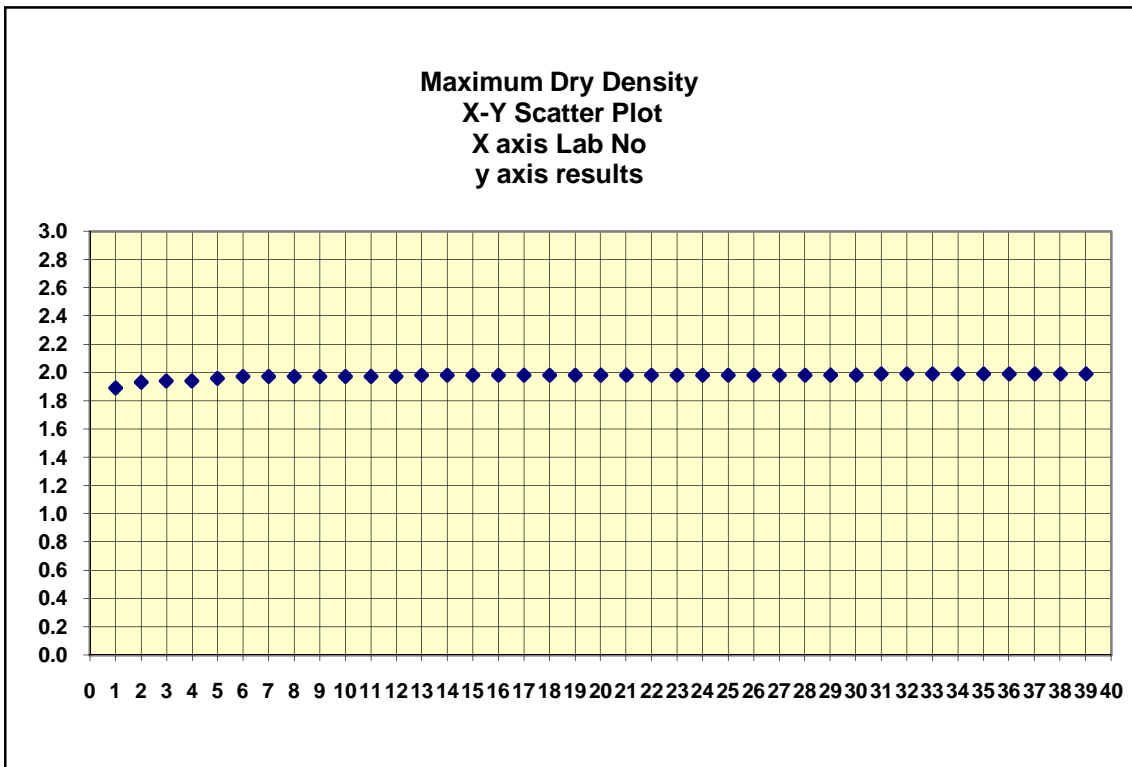
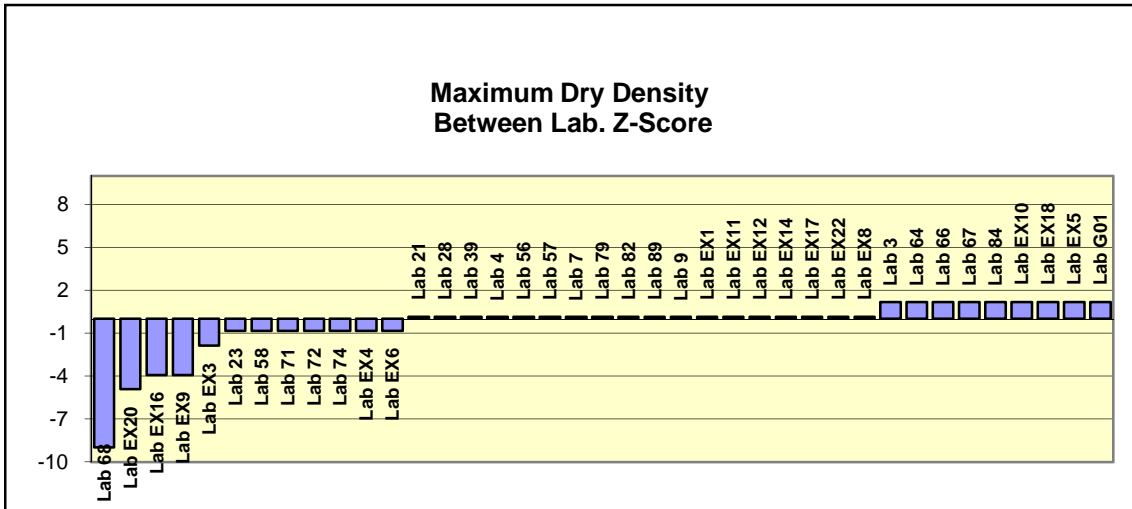
Table - 2 Optimum Moisture Content

Iteration	0	xi-x*	1	(xi-x*) ²	2	(xi-x*) ²	3	(xi-x*) ²	4	(xi-x*) ²	5	(xi-x*) ²	6	(xi-x*) ²	Z Score
$\delta = 1.5 s^*$	---		0.22		0.26		0.25		0.25		0.25		0.25		
$x^* - \delta$	---		9.78		9.70		9.70		9.70		9.71		9.71		
$x^* + \delta$	---		10.22		10.22		10.21		10.21		10.21		10.21		
Lab 68	8.0	2.00	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	-11.79
Lab EX11	9.4	0.60	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	-3.35
Lab 57	9.6	0.40	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	-2.14
Lab 84	9.6	0.40	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	-2.14
Lab EX17	9.6	0.40	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	-2.14
Lab EX18	9.6	0.40	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	-2.14
Lab 3	9.7	0.30	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	-1.54
Lab 56	9.7	0.30	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	9.78	0.03	-1.54
Lab 64	9.8	0.20	9.80	0.03	9.80	0.02	9.80	0.02	9.80	0.02	9.80	0.02	9.80	0.02	-0.94
Lab 72	9.8	0.20	9.80	0.03	9.80	0.02	9.80	0.02	9.80	0.02	9.80	0.02	9.80	0.02	-0.94
Lab 9	9.8	0.20	9.80	0.03	9.80	0.02	9.80	0.02	9.80	0.02	9.80	0.02	9.80	0.02	-0.94
Lab 21	9.9	0.10	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	-0.33
Lab 23	9.9	0.10	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	-0.33
Lab 28	9.9	0.10	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	-0.33
Lab 79	9.9	0.10	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	-0.33
Lab 89	9.9	0.10	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	-0.33
Lab EX1	9.9	0.10	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	-0.33
Lab EX10	9.9	0.10	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	-0.33
Lab G01	9.9	0.10	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	9.90	0.00	-0.33
Lab 39	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab 4	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab 58	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab 66	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab 7	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab 71	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab 74	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab 82	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab EX12	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab EX22	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab EX4	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab EX5	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab EX6	10.0	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	0.27
Lab 67	10.5	0.50	10.22	0.07	10.22	0.07	10.21	0.07	10.21	0.06	10.21	0.06	10.21	0.06	3.28
Lab EX16	10.5	0.50	10.22	0.07	10.22	0.07	10.21	0.07	10.21	0.06	10.21	0.06	10.21	0.06	3.28
Lab EX3	10.9	0.90	10.22	0.07	10.22	0.07	10.21	0.07	10.21	0.06	10.21	0.06	10.21	0.06	5.70
Lab EX14	11.0	1.00	10.22	0.07	10.22	0.07	10.21	0.07	10.21	0.06	10.21	0.06	10.21	0.06	6.30
Lab EX8	11.0	1.00	10.22	0.07	10.22	0.07	10.21	0.07	10.21	0.06	10.21	0.06	10.21	0.06	6.30
Lab EX9	11.0	1.00	10.22	0.07	10.22	0.07	10.21	0.07	10.21	0.06	10.21	0.06	10.21	0.06	6.30
Lab EX20	11.1	1.10	10.22	0.07	10.22	0.07	10.21	0.07	10.21	0.06	10.21	0.06	10.21	0.06	6.90
Average	10.0		9.96	0.87	9.96	0.85	9.96	0.84	9.96	0.83	9.96	0.82	9.96	0.81	
SD	0.54		0.15	0.02	0.15	0.02	0.15	0.02	0.15	0.02	0.15	0.02	0.15	0.02	
New x*	10.00	0.10	9.96	0.15	9.96	0.15	9.96	0.15	9.96	0.15	9.96	0.15	9.96	0.15	
New s*	0.15		0.17		0.17		0.17		0.17		0.17		0.17		

N 39

Target value: 9.96 Low Acceptable: 9.46 High Acceptable: 10.45 Acceptable Range: 9.46 - 10.45

Appendix - C Charts Dry Density Moisture Content Relationship in Soil



Appendix - C Charts Dry Density Moisture Content Relationship in Soil

