DUBAI ACCREDITATION DEPARTMENT

REPORT ON PTP 204 INTER-LABORATORY PROFICIENCY TESTING PROGRAM DETERMINATION OF TENSILE TEST OF CARBON STEEL BARS

Date: 31 March 2011

1. INTRODUCTION

This document presents the results of the 204 inter-laboratory proficiency-testing program conducted during the month of February- March involving the determination of **Tensile Strength of Carbon Steel Bars** with twenty five 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 GCC were participated in this scheme.

2. EXPERIMENTAL DESIGN

2.1 Participants:

Twenty five laboratories were participated in this PTP including:

- Two governmental laboratories.
- Seventeen are private laboratories operating in Dubai including accredited and registered laboratories.
- Four private laboratories are from other Emirates.
- One laboratory is from Qatar.
- One laboratories is from Oman

2.2 Samples Tested:

One (1) Steel sample Comprises of Three (3) specimens of 20 mm Diameter Carbon Steel Bar of approximately one meter long was distributed to all participating laboratories. With each participant being given his sample with a unique identification number provided during the time of collection.

Test certificate was provided by the manufacturer which includes the test results for the dispatch from which the samples were taken.

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.

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4. TEST METHOD

Instructions were given to the participants to test the samples for Determination of Tensile Strength Test of Carbon Steel Bars as per **BS 4449:1997**

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 also based on an international Standard (***ISO 13528:2005)***.

6.3.1 Outlier Results

Test	Labs outside the z-scores ±3
Tensile Strength	**Lab EX17; Lab 74**
Yield Strength	**Lab 27**

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. For accredited laboratories these evidence shall be available for checking by assessment team during the nearest assessment visit.

Also other participating laboratories have showed Z-score values two or 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

---- End of Report ---

Determination of Tesile Test of Steel Bars

Appendix A: Raw Data

Table - 1 : Tensile Strength (R_m) N/mm^2

Lab #	Specimen No.1	Specimen No.2	Specimen No.3	Ave.
Lab G01	630	641	637	636
Lab 3	617	625	634	625
Lab 39	626	627	614	622
Lab 4	642	636	640	639
Lab 56	621	623	621	622
Lab 21	644	625	644	638
Lab 26	636	633	633	634
Lab 9	629	632	638	633
Lab 28	646	638	638	641
Lab 23	616	624	626	622
Lab 83	636	645	640	640
Lab EX10	657	637	628	641
Lab EX14	637	638	641	639
Lab 58	636	636	637	636
Lab 111	656	635	623	638
Lab 2	627	637	642	635
Lab 27	624	642	635	634
Lab 74	611	609	610	610
Lab 79	632	642	643	639
Lab 82	645	630	642	639
Lab 84	631	630	624	628
Lab EX17	610	617	611	613
Lab EX11	637	642	644	641
Lab EX4	644	631	633	636
Lab EX6	643	623	636	634

Determination of Tesile Test of Steel Bars

Appendix A: Raw Data

Table - 2 : Yield Strength (R_e) N/mm^2

Lab #	Specimen No.1	Specimen No.2	Specimen No.3	Ave.
Lab G01	522	534	531	529
Lab 3	510	513	520	514
Lab 39	520	514	510	515
529	529	520	521	523
Lab 56	513	513	514	513
Lab 21	535	508	535	526
Lab 26	521	522	529	524
Lab 9	514	519	532	522
Lab 28	544	520	531	532
Lab 23	507	513	521	514
Lab 83	525	534	536	532
Lab EX10	547	529	517	531
Lab EX14	526	527	527	527
Lab 58	527	526	528	527
Lab 111	548	526	512	529
Lab 2	510	517	525	517
Lab 27	489	500	505	498
Lab 74	506	507	508	507
Lab 79	515	530	532	526
Lab 82	536	518	535	530
Lab 84	521	528	516	522
Lab EX17	506	508	507	507
Lab EX11	525	531	534	530
Lab EX4	524	525	520	523
Lab EX6	537	515	515	522

Determination of Tesile Test of Steel Bars

Appendix A: Raw Data

Table - 3 : Elongation at Fracture (A_5) %

Lab #	Specimen No.1	Specimen No.2	Specimen No.3	Ave.
Lab G01	23	22	22	22.3
Lab 3	20	20	21	20.3
Lab 39	21.4	20.4	20.4	20.7
Lab 4	21.5	22	19	20.8
Lab 56	21	21	21	21.0
Lab 21	20	20	18	19.3
Lab 26	21	20	21	20.7
Lab 9	21	19	22	20.7
Lab 28	18	20	20	19.3
Lab 23	21	22.5	23	22.2
Lab 83	18	14	23	18.3
Lab EX10	19.5	21	20.5	20.3
Lab EX14	20	21	21	20.7
Lab 58	20	21	20	20.3
Lab 111	19	20	23	20.7
Lab 2	21	22	22	21.7
Lab 27	22	19	21	20.7
Lab 74	19	22	22	21.0
Lab 79	22	20.5	20	20.8
Lab 82	20.5	21	20.5	20.7
Lab 84	18.5	18.5	19	18.7
Lab EX17	20.9	19.7	21.3	20.6
Lab EX11	23	23	20	22.0
Lab EX4	21	23	23	22.3
Lab EX6	22.5	21.5	22.5	22.2

Determination of Tensile Test of Carbon Steel Bars

Appendex - B Calcualations of Z-Score and Other Statistics

Table - 1 : Tensile Strength (R_m) N/mm^2

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	
δ = 1.5 s *	---		6.67		7.33		7.33		7.33		7.33		7.33		
x* - δ	---		629.33		627.79		627.79		627.79		627.79		627.79		
x* + δ	---		642.67		642.45		642.45		642.45		642.45		642.45		Z Score
Lab 74	610	26.00	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	-5.14
Lab EX17	613	23.33	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	-4.59
Lab 56	622	14.33	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	-2.75
Lab 23	622	14.00	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	-2.68
Lab 39	622	13.67	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	-2.62
Lab 3	625	10.67	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	-2.00
Lab 84	628	7.67	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	629.33	33.54	-1.39
Lab 9	633	3.00	633.00	4.49	633.00	4.49	633.00	4.49	633.00	4.49	633.00	4.49	633.00	4.49	-0.43
Lab 27	634	2.33	633.67	2.11	633.67	2.11	633.67	2.11	633.67	2.11	633.67	2.11	633.67	2.11	-0.30
Lab 26	634	2.00	634.00	1.25	634.00	1.25	634.00	1.25	634.00	1.25	634.00	1.25	634.00	1.25	-0.23
Lab EX6	634	2.00	634.00	1.25	634.00	1.25	634.00	1.25	634.00	1.25	634.00	1.25	634.00	1.25	-0.23
Lab 2	635	0.67	635.33	0.05	635.33	0.05	635.33	0.05	635.33	0.05	635.33	0.05	635.33	0.05	0.04
Lab EX4	636	0.00	636.00	0.78	636.00	0.78	636.00	0.78	636.00	0.78	636.00	0.78	636.00	0.78	0.18
Lab 58	636	0.33	636.33	1.48	636.33	1.48	636.33	1.48	636.33	1.48	636.33	1.48	636.33	1.48	0.25
Lab 21	638	1.67	637.67	6.50	637.67	6.50	637.67	6.50	637.67	6.50	637.67	6.50	637.67	6.50	0.52
Lab G01	636	0.00	636.00	0.78	636.00	0.78	636.00	0.78	636.00	0.78	636.00	0.78	636.00	0.78	0.18
Lab 111	638	2.00	638.00	8.31	638.00	8.31	638.00	8.31	638.00	8.31	638.00	8.31	638.00	8.31	0.59
Lab EX14	639	2.67	638.67	12.59	638.67	12.59	638.67	12.59	638.67	12.59	638.67	12.59	638.67	12.59	0.73
Lab 79	639	3.00	639.00	15.07	639.00	15.07	639.00	15.07	639.00	15.07	639.00	15.07	639.00	15.07	0.79
Lab 82	639	3.00	639.00	15.07	639.00	15.07	639.00	15.07	639.00	15.07	639.00	15.07	639.00	15.07	0.79
Lab 4	639	3.33	639.33	17.77	639.33	17.77	639.33	17.77	639.33	17.77	639.33	17.77	639.33	17.77	0.86
Lab 83	640	4.33	640.33	27.20	640.33	27.20	640.33	27.20	640.33	27.20	640.33	27.20	640.33	27.20	1.07
Lab 28	641	4.67	640.67	30.79	640.67	30.79	640.67	30.79	640.67	30.79	640.67	30.79	640.67	30.79	1.14
Lab EX10	641	4.67	640.67	30.79	640.67	30.79	640.67	30.79	640.67	30.79	640.67	30.79	640.67	30.79	1.14
Lab EX11	641	138.00	641.00	34.60	641.00	34.60	641.00	34.60	641.00	34.60	641.00	34.60	641.00	34.60	1.20
Average	632.6		635.12	445.64	635.12	445.64	635.12	445.64	635.12	445.64	635.12	445.64	635.12	445.64	
SD	8.77		4.31	18.57	4.31	18.57	4.31	18.57	4.31	18.57	4.31	18.57	4.31	18.57	
New x*	636.00	3.00	635.12	4.31	635.12	4.31	635.12	4.31	635.12	4.31	635.12	4.31	635.12	4.31	
New s*	4.45		4.89		4.89		4.89		4.89		4.89		4.89		

N	25
Target value	635
Low Acceptable	620
High Acceptable	650
Acceptable Range	620 -650

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Appendex - B Calcualations of Z-Score and Other Statistics

Table - 2 : Yield Strength (R_e) N/mm^2

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	
δ = 1.5 s *	---		13.35		12.41		12.41		12.41		12.41		12.41		
x* - δ	---		509.99		509.84		509.84		509.84		509.84		509.84		
x* + δ	---		536.68		534.66		534.66		534.66		534.66		534.66		Z Score
Lab 27	498	25	510	150	510	150	510	150	510	150	510	150	510	150	-3
Lab 74	507	16	510	150	510	150	510	150	510	150	510	150	510	150	-2
Lab EX17	507	16	510	150	510	150	510	150	510	150	510	150	510	150	-2
Lab 56	513	10	513	80	513	80	513	80	513	80	513	80	513	80	-1
Lab 23	514	10	514	74	514	74	514	74	514	74	514	74	514	74	-1
Lab 3	514	9	514	63	514	63	514	63	514	63	514	63	514	63	-1
Lab 39	515	9	515	58	515	58	515	58	515	58	515	58	515	58	-1
Lab 2	517	6	517	24	517	24	517	24	517	24	517	24	517	24	-1
Lab 84	522	2	522	0	522	0	522	0	522	0	522	0	522	0	0
Lab 9	522	2	522	0	522	0	522	0	522	0	522	0	522	0	0
Lab EX6	522	1	522	0	522	0	522	0	522	0	522	0	522	0	0
Lab EX4	523	0	523	1	523	1	523	1	523	1	523	1	523	1	0
Lab 4	523	0	523	1	523	1	523	1	523	1	523	1	523	1	0
Lab 26	524	1	524	3	524	3	524	3	524	3	524	3	524	3	0
Lab 79	526	2	526	12	526	12	526	12	526	12	526	12	526	12	0
Lab 21	526	3	526	14	526	14	526	14	526	14	526	14	526	14	0
Lab EX14	527	3	527	19	527	19	527	19	527	19	527	19	527	19	1
Lab 58	527	4	527	23	527	23	527	23	527	23	527	23	527	23	1
Lab 111	529	5	529	41	529	41	529	41	529	41	529	41	529	41	1
Lab G01	529	6	529	46	529	46	529	46	529	46	529	46	529	46	1
Lab 82	530	6	530	55	530	55	530	55	530	55	530	55	530	55	1
Lab EX11	530	7	530	60	530	60	530	60	530	60	530	60	530	60	1
Lab EX10	531	8	531	77	531	77	531	77	531	77	531	77	531	77	1
Lab 28	532	8	532	89	532	89	532	89	532	89	532	89	532	89	1
Lab 83	532	8	532	89	532	89	532	89	532	89	532	89	532	89	1
Average	522		522	1278	522	1278	522	1278	522	1278	522	1278	522	1278	
SD	9		7	53	7	53	7	53	7	53	7	53	7	53	
New x*	523	6	522	7	522	7	522	7	522	7	522	7	522	7	
New s*	9		8		8		8		8		8		8		

N 25

Target value	522
Low Acceptable	498
High Acceptable	547
Acceptable Range	498 - 547

Determination of Tensile Test of Carbon Steel Bars

Appendex - B Calcualations of Z-Score and Other Statistics

Table - 3 : Elongation at Fracture (A_5) %

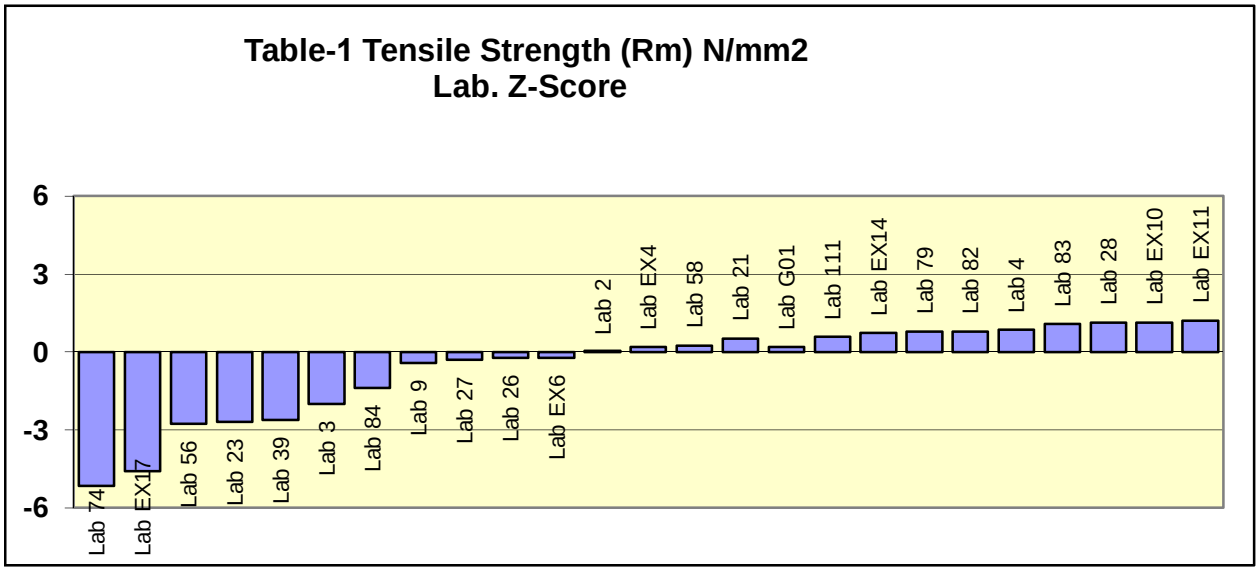
Iteration	0	xi-x*	1	$(xi-x^*)^2$	2	$(xi-x^*)^2$	3	$(xi-x^*)^2$	4	$(xi-x^*)^2$	5	$(xi-x^*)^2$	6	$(xi-x^*)^2$	
δ = 1.5 s *	---		1.50		1.56		1.55		1.54		1.54		1.54		
x* - δ	---		19.17		19.22		19.23		19.24		19.24		19.24		
x* + δ	---		22.17		22.33		22.33		22.32		22.32		22.32		Z Score
Lab 83	18	2	19	3	19	2	19	2	19	2	19	2	19	2	-2
Lab 84	19	2	19	3	19	2	19	2	19	2	19	2	19	2	-2
Lab 21	19	1	19	2	19	2	19	2	19	2	19	2	19	2	-1
Lab 28	19	1	19	2	19	2	19	2	19	2	19	2	19	2	-1
Lab 3	20	0	20	0	20	0	20	0	20	0	20	0	20	0	0
Lab 58	20	0	20	0	20	0	20	0	20	0	20	0	20	0	0
Lab EX10	20	0	20	0	20	0	20	0	20	0	20	0	20	0	0
Lab EX17	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 111	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 26	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 27	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 82	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 9	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab EX14	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 39	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 4	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 79	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 56	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 74	21	0	21	0	21	0	21	0	21	0	21	0	21	0	0
Lab 2	22	1	22	1	22	1	22	1	22	1	22	1	22	1	1
Lab EX11	22	1	22	2	22	1	22	1	22	1	22	1	22	1	1
Lab 23	22	2	22	2	22	2	22	2	22	2	22	2	22	2	1
Lab EX6	22	2	22	2	22	2	22	2	22	2	22	2	22	2	1
Lab EX4	22	2	22	2	22	2	22	2	22	2	22	2	22	2	2
Lab G01	22	2	22	2	22	2	22	2	22	2	22	2	22	2	2
Average	21		21	20	21	20	21	20	21	20	21	20	21	20	
SD	1		1	1	1	1	1	1	1	1	1	1	1	1	
New x*	21	0	21	1	21	1	21	1	21	1	21	1	21	1	
New s*	1		1		1		1		1		1		1		

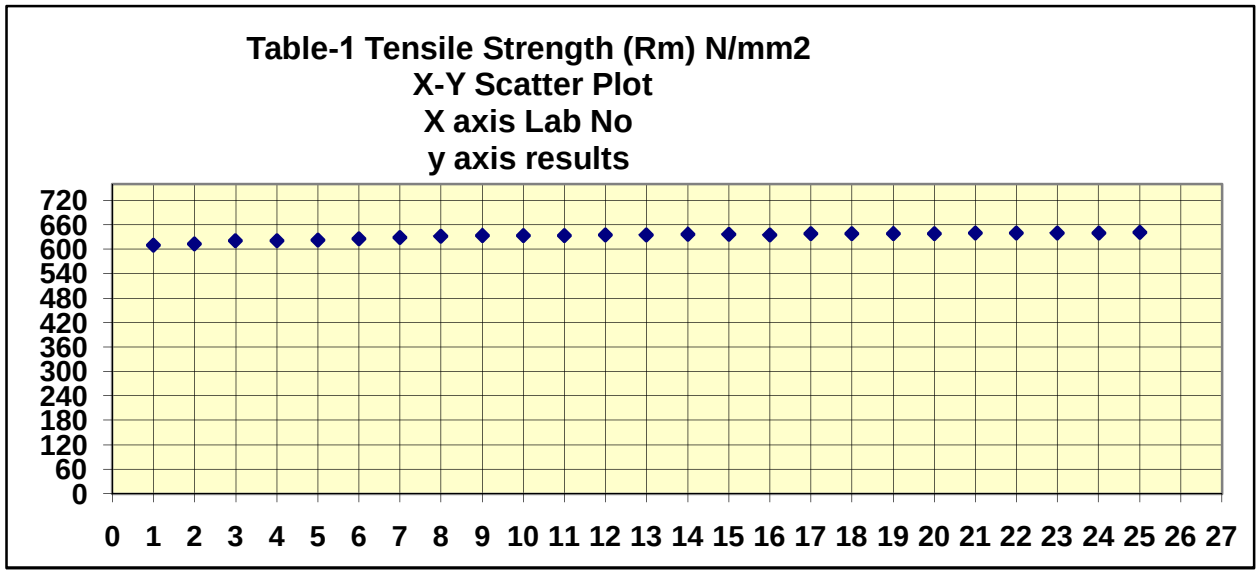
N 25

Target value	21
Low Acceptable	18
High Acceptable	24
Acceptable Range	18 - 24

Determination of Tensile Test of Carbon Steel Bars

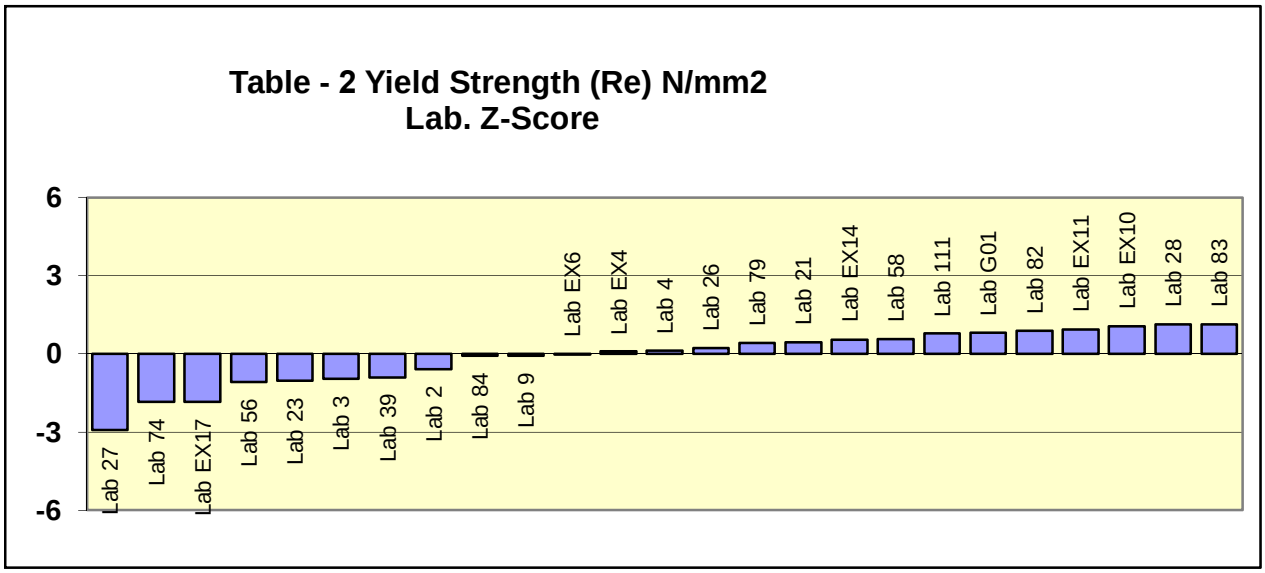
Appendex - C Charts Tensile Test of Steel Bars

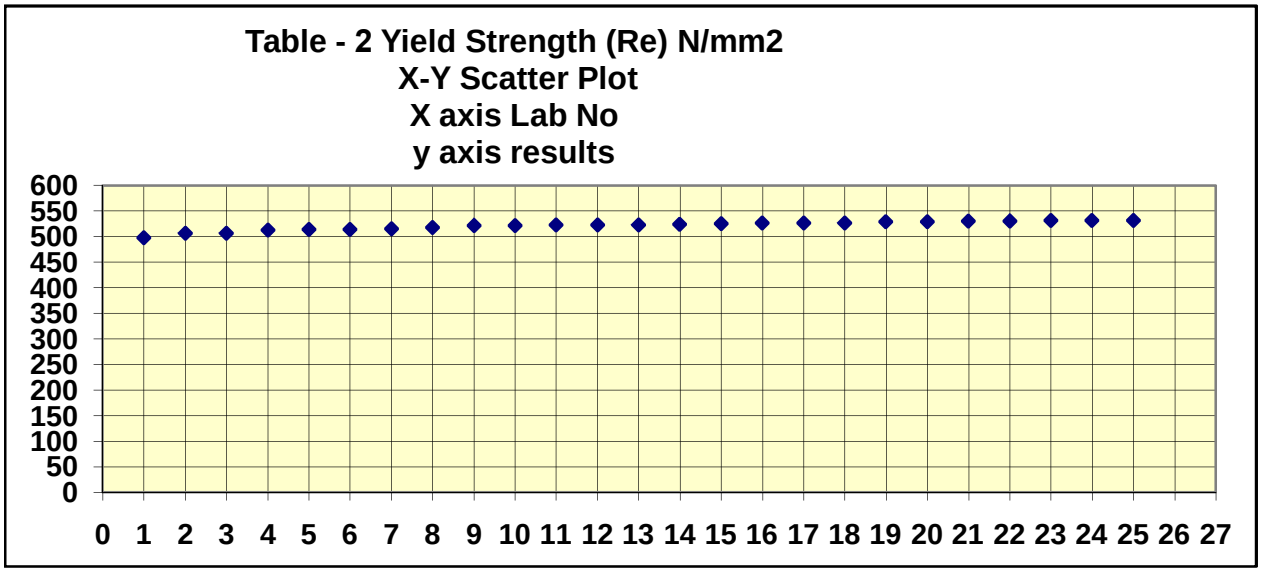




Determination of Tensile Test of Carbon Steel Bars

Appendex - C Charts Tensile Test of Steel Bars





Determination of Tensile Test of Carbon Steel Bars

Appendex - C Charts Tensile Test of Steel Bars