

INTER LABORATORY TESTING SCHEME

ON

**"Testing of Mechanical parameters
in Textile Material"**

TC/ILTS/022/MECH/2017-18

Conducted by



**Proficiency Testing Provider
Laboratories**

TEXTILES COMMITTEE

(Ministry of Textiles, Government of India)

**P. Balu Road, Prabhadevi Chowk,
Prabhadevi, Mumbai – 400 025.**

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SCHEME : INTER LABORATORY TESTING SCHEME -TC/ILTS/22/MECH/2017-18-Testing of
Mechanical parameters in Textile Materials

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CONFIDENTIALITY :

All the information furnished by the participants shall be kept confidential by the PT Provider and the same shall not be revealed to others. However, if the accrediting body, for example NABL, requests the PT provider to furnish the performance of any of the participants, the same shall be provided to them directly, after obtaining permission of the concerned participant

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Disclaimer: The PT Programmes are meant for evaluation of performance of the participants for the specified tests undertaken in the programme only and are voluntary in nature. Further, it is clarified that reasonable care has been taken to meet the requirement of ISO/IEC 17043:2010, while designing and conducting the programmes. Participants are expected to exercise due diligence while carrying out the tests and meet all safety, statutory and accreditation body's requirements. PT Provider and Textiles Committee will not be responsible for any claim/damages arising out of participating in this programme.

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Report on Inter Laboratory Testing Scheme (TC/ILTS/022/MECH//2017-18)

Preamble:

Increasing awareness on textile quality and the buyer requirements are forcing textile manufacturers and traders to test textile products from reputed laboratories. Reputation of any laboratory depends upon the result it produces. The test report given by the laboratory should be precise, accurate, repeatable and reproducible. This means, a set of results obtained within a laboratory by testing a representative sample at any time interval should be comparable. And also, the result obtained over testing a representative sample in any laboratory should compare with that of other laboratory and fall within the statistical tolerance limit. In other words, the laboratory should be able to generate comparable results by performing the same test.

The repeatability and reproducibility of any test result involves the laboratory's competence in doing an assigned task/testing including the testing equipment, the skill and knowledge of technical manpower working in the laboratory, the testing conditions and test method adopted. In this pursuit, the laboratory has to meet a requirement of maintaining its own management system as per ISO/IEC 17025 as also, participate in Inter Laboratory Comparison (ILC) and/or Inter Laboratory Proficiency Testing Scheme (ILPT).

Inter laboratory Comparison is defined as' *“Organization, performance and evaluation of tests on the same or similar test items by two or more laboratories in accordance with predetermined conditions.”* The goal of the Inter-laboratory Comparisons (ILC) is to provide verification of each participating laboratory's technical capability by obtaining a measurement that agrees with all other Laboratories using different make & model of testing equipment and manpower. The requirement for inter laboratory comparisons remains in place today, and has been further entrenched into metrology management systems by its incorporation in the requirements of ISO/IEC 17025.

Textiles Committee:

Textiles Committee is a statutory organization under the Ministry of Textiles, Government of India, established in the year 1963. The Committee has set up 19 laboratories through out the country for catering to the testing requirements of the textile trade and industry in different centers. Fourteen laboratories of Textiles Committee are accredited as per ISO/IEC 17025 by National Accreditation Board for testing & calibration Laboratories (NABL), India.

PT-Provider:

The Laboratory, Textiles Committee at Mumbai participates in Inter Laboratory Proficiency Testing (ILPT) schemes conducted by different professional bodies like American Standard for Testing and Materials (ASTM), USA, Institute for Inter laboratory Studies (IIS), The Netherlands and NABL, India, from time to time. Apart from this, Textiles committee also conducts Inter Laboratory Comparisons (ILC) schemes by including its own laboratories and inviting other laboratories. In order to offer ILPT schemes professionally as a PT Provider, the laboratory of Textiles Committee at Mumbai has implemented the Management System in accordance with the requirements stipulated

in ILAC G13 and ISO/IEC 17043. The PT Provider has conducted 23 schemes since 2007. The details are given in Table – 1.

Table – 1 ILPT schemes conducted by the PT Provider

S.No	Identity of the ILPT	Year	Field	PT items	No. of test parameters	No. of Labs participated
1	TC/ILTS/MECH/01/07	2007	Mechanical	Fibre, Yarn & Fabric	17	70
2	TC/ILTS/CHEM/02/07	2007	Chemical	Fabric	13	70
3	TC/ILTS/MECH/03/08	2008	Mechanical	Fabric	11	60
4	TC/ILTS/CHEM/04/08	2008	Chemical	Fabric	10	60
5	TC/ILTS/MECH/05/09	2009	Mechanical	Fabric	11	50
6	TC/ILTS/MECH/06/09	2009	Mechanical	Yarn	12	31
7	TC/ILTS/MECH/07/09	2009	Mechanical	Fibre	15	14
8	TC/ILTS/CHEM/08/09	2009	Chemical	Fabric	7	51
9	TC/ILTS/CHEM/09/09	2009	Chemical	Fabric	4	45
10	TC/ILTS/CHEM/10/09	2009	Chemical	Fabric	2	20
11	TC/ILTS/MECH/11/10-11	2010-11	Mechanical	Fabric	10	65
12	TC/ILTS/CHEM/12/10-11	2010-11	Chemical	Fabric	10	70
13	TC/ILTS/MECH-1/2012-13	2012-13	Mechanical	Yarn and Fabric	13	42
14	TC/ILTS/Chem -1/2012-13	2012-13	Chemical	Fabric & Metal clothing accessories	12	56
15	TC/ILTS/15/MECH-2/2014	2014	Mechanical	Fabric	8	50
16	TC/ILTS/16/CHEM-2/2014	2014	Chemical	Fabric	8	45
17	TC/ILTS/17MECH-3/2015	2015	Mechanical	Fabric	8	24
18	TC/ILTS/18/CHEM -3/2015	2015	Chemical	Fabric	9	51
19	TC/ILTS/19/CHEM -3/2015	2015	Chemical	Fabric	2	30
20	TC/ILTS/20/MECH/2017-18	2017-18	Mechanical	Fabric	7	35
21	TC/ILTS/21/CHEM/2017-18	2017-18	Chemical	Fabric	8	29
22	TC/ILTS/22/MECH/2017-18	2017-18	Mechanical	Fabric	7	28
23	TC/ILTS/23/CHEM/2017-18	2017-18	Chemical	Fabric	8	36

The Present Program:

Design: In order to assess the reproducibility of the test results being reported by the various textile testing laboratories, a Proficiency Testing Scheme for Mechanical testing - **TC/ILTS/022/MECH//2017-18** was designed. The test parameters thus covered in the present PT Scheme are given in Table – 2.

Table – 2 : Tests covered in TC/ILTS/22/MECH/2017-18

S.No.	Test parameter	Standards suggested
1	Thickness of fabric	IS 7702 or Equivalent Test method
2	Threads per unit length (Ends & Picks)	IS1963 or Equivalent Test method
3	Twist of yarn removed from fabric	IS 832 or Equivalent Test method
4	Crease Recovery	IS 4681 or Equivalent Test method
5	Breaking strength-Ravelled strip	ISO 13934 or Equivalent Test method
6	Breaking strength-Ravelled strip	ASTM 5035 or Equivalent Test method
7	Pilling Resistance (box method)	IS 10971 or Equivalent Test method

While designing the Scheme the following objectives were considered.

- (1) Each accredited participant laboratory should get benefit so that at least one parameter may be covered under the lab's scope of accreditation.
- (2) Both geometry and performance verifying parameters to be included.
- (3) Both trade and industry oriented parameters to be included.
- (4) Test methods of ISO, ASTM and Indian Standards covered.

To satisfy the above objectives (1) Scope of accreditation of about 50 laboratories were consulted. (2) To enable the participant laboratories in evaluation of the performance for specific tests or measurements and monitoring laboratories' continuing performance (Ref: ISO/IEC 17043:2010), the geometric parameters viz., Thickness, Threads per unit length and performance parameters Pilling resistance (box method), (3) To satisfy Trade and industry requirements, performance parameters viz., Breaking strength by ravelled strip method by different methods and Crease Recovery were included.

Advisory Group:

As per the requirements stipulated in ILAC G13 and ISO/IEC 17043, an **Advisory Group** comprising the following experts having the necessary expertise in testing and/or statistics was constituted for designing and operating Proficiency Testing scheme in the field of Mechanical & Chemical testing of textiles: (Table – 3)

Table – 3 : Constitution of Advisory Group

S.No	Expert	Affiliation	Field of expertise
1.	Mr. Kartikay Dhanda Director (Labs), Textiles Committee, Mumbai	Chairman	Textile testing
2.	Dr. K.S.Muralidhara Joint Director (Lab), Textiles Committee, Mumbai	Member	Textile testing
3.	Mr.K.Selvaraj Joint Director (Lab), Textiles Committee, Mumbai	Member	Textile testing & Statistics
4.	Dr.P.Ravichandran Deputy Director (Lab), Textiles Committee, Mumbai	Member	Textile testing
5.	Mr. S.P. Singh Asst. Director (Lab), Textiles Committee, Jaipur.	Member	Textile testing
6.	Mr. Govind Prasad Asst. Director (EPQA), Textiles Committee, Mumbai	Member	Textile testing
7.	Mr.Venu B Quality Assurance Officer (Lab), Textiles Committee, Kochi	Member	Textile testing & Statistics
8.	Mrs. Sandhyarani Kamble Quality Assurance Officer (Lab) Textiles Committee, Mumbai	Member	Textile testing
9.	Dr. Rajkumar P. Sontakke Jr. Quality Assurance Officer (Lab), Textiles Committee, Mumbai	Member	Textile testing & Statistics

The terms of reference of the Advisory Group were as follows:

- a) Planning requirements
- b) Identification and resolution of any difficulties expected in the preparation and maintenance of homogeneous proficiency test items, or in the provision of stable assigned value for a proficiency test item;
- c) Preparation of detailed instructions for participants
- d) Comments on any technical difficulties raised by participants
- e) Provision of advice in evaluating the performance of participants
- f) Comments on the results and performance of participants as a whole and, where appropriate, groups of participants or individual participants;
- g) Provision of advice for participants (within limits of confidentiality), either individually or within the report;

- h) Responding to feedback from participants; and
- i) Planning or participating in technical meetings with participants.
- j) Arbitration of any dispute(s) between participating laboratories and the PT provider.

The following documents pertaining to the PT Schemes, "Testing of Mechanical parameters in textile material - **TC/ILTS/MECH/20/2017-18** & **TC/ILTS/MECH/22/2017-18** and "Testing of Chemical parameters in textile material - **TC/ILTS/Chem/21/2017-18** & **TC/ILTS/Chem/23/2017-18** were vetted by the Advisory Group on 5th February 2019:

- (i) Draft Protocol incorporating test parameters covered, suggested test methods, participation fees payable, expected schedule of the scheme, etc
- (ii) Draft instructions to the participants
- (iii) Draft format for reporting the test results

Participants:

28 laboratories were participated in this scheme.

Laboratories accredited by the following Accrediting Bodies were participated in this scheme:

- (1) *National Accreditation Board for testing and calibration Laboratories (NABL), India*
- (2) *American Association for Laboratory Accreditation (A2LA), USA*
- (3) *Deutsche Akkreditierungsstelle GmbH (DAKKS), Germany*

Proficiency Test Proceedings:

The laboratory of Textiles Committee (PT Provider), Mumbai, procured sufficient quantity of fabric (PT item) from a reputed textiles mill for designing and conducting Inter Laboratory Testing Scheme, on the basis of expected number of participants.

Population of PT items: On receipt of the procured materials, PT items meant for (i) homogeneity testing, (ii) stability testing, (iii) distribution among the participant laboratories, (iv) additional reserve samples for replacement in case of loss or damage, were prepared. While preparing the PT items for the above, it was ensured that the quantity of each PT item is adequate for the testing of all the parameters included in the scheme. The PT items thus prepared from the material procured were numbered serially. The prepared PT items were packed in polyethylene bags and labeled bearing the PT item identity such that the same are ready for dispatch. Thus a *finite population* of PT item was produced.

Sampling of PT items: Allotments of PT items were done by following appropriate Sampling procedures adopted by using Random Numbers generated by using computer. In order to evaluate the confidentiality of samples among the participants, two different set of samples were dispatched for the same parameter (crease recovery angle) and conducted performance evolution accordingly.

Sampling procedure for Homogeneity testing, Stability testing and for distribution among participant laboratories are provided in Table – 4:

Table – 4: Sampling procedure adopted for different purpose

1	Homogeneity testing,	<i>Systematic random sampling without replacement</i>
2	Stability Testing	<i>Systematic random sampling without replacement from the remaining population after homogeneity testing</i>
3	Distribution to participant laboratories	<i>Simple random sampling without replacement from the remaining population after homogeneity and stability testing.</i>

The remaining part of the population was kept as reserve for replacement in case of loss or damage. Henceforth, the allotted PT items can be referred as *sample*.

Homogeneity testing: To verify the homogeneity of the population of PT items homogeneity testing was conducted at the laboratory of Textiles Committee at Mumbai for all the test parameters covered in the scheme by adopting one of the suggested methods. However, while conducting performance evaluation of the participants, the “between- samples SD” calculated during homogeneity testing by a particular method was used for calculating “SD of PT assessment” for different methods adopted by the participants, as the inherent variation in the sample (degree of non homogeneity) is independent of the test method adopted. The procedure given in ISO 13528 was followed for conducting homogeneity testing.

The homogeneity of population was found to be satisfactory based on *analysis of variance* conducted on the test results obtained in homogeneity testing.

Stability testing: In order to verify the stability of the PT items, stability testing was conducted in accordance with ISO 13528, after the lapse of a week from the last date of conducting homogeneity testing. The stability was confirmed by testing the hypothesis that the difference between the average values obtained for each of the test parameters during homogeneity testing and stability testing were insignificant.

Estimation of Parameters: Population parameters viz., mean μ and standard deviation σ were estimated by using the results obtained in homogeneity and stability testing. Table - 5 consists of the estimates of population parameters.

Dispatch of PT items: The Proficiency Testing items were dispatched to the respective participant laboratories on 13th July 2018 and 14th August 2018 (for pilling resistance) along with the following:

- (a) Instructions to the participants in the Inter Laboratory Testing Scheme
- (b) Form for reporting test results by the participants in the Inter Laboratory Testing Scheme

The participant laboratories were requested to send the test results by 13th August 2018 and 14th September 2018 (for pilling resistance).

The participant laboratories were also requested to

- Treat the samples in the same manner as regularly tested samples and accordingly, codify the samples such that the technical staff testing them are not aware that they are meant for PT purposes;
- Adopt the latest test method which is routinely used by the laboratory for the testing of regular samples which may be any standard or validated in-house method;
- Forward (i) copy of the in-house method adopted (if applicable) for testing any parameter and also (ii) specify the standard method against which the validation has been done; and,
- Forward photo copy of NABL accreditation certificate as a proof of accreditation for the test method adopted (applicable to accredited laboratories only).

Table-5 : Estimates of population parameters

S.No	Test	Parameter	Estimation		
1	Thickness of fabric (IS 7702)	Population mean (μ) =	0.20		
		Population SD (σ) =	0.02		
		95% confidential limits for Population mean =	0.19	$\leq \mu \leq$	0.21
2	Threads per unit length (IS1963)	Population mean (μ) =	100.07		
		Population SD (σ) =	1.44		
		95% confidential limits for Population mean =	99.54	$\leq \mu \leq$	100.60
3	Twist of yarn removed from fabric (IS 832)	Population mean (μ) =	18.55		
		Population SD (σ) =	1.68		
		95% confidential limits for Population mean =	17.75	$\leq \mu \leq$	19.35
4	Crease Recovery (IS 4681)	Sample -Lot-A			
		Population mean (μ) =	164.42		
		Population SD (σ) =	15.6		
	Crease Recovery (IS 4681)	Sample -Lot-B			
		Population mean (μ) =	112.0		
		Population SD (σ) =	11.7		
5	Breaking strength- Ravelled strip (ISO 13934)	Population mean (μ) =	609.52		
		Population SD (σ) =	30.7		
		95% confidential limits for Population mean =	597.50	$\leq \mu \leq$	621.53
	Elongation % (ISO 13934)	Population mean (μ) =	6.28		
		Population SD (σ) =	2.1		
		95% confidential limits for Population mean =	5.42	$\leq \mu \leq$	7.15
6	Breaking strength- Ravelled strip (ASTM 5035)	Population mean (μ) =	605.82		
		Population SD (σ) =	50.7		
		95% confidential limits for Population mean =	582.37	$\leq \mu \leq$	629.26
	Elongation % (ASTM 5035)	Population mean (μ) =	9.62		
		Population SD (σ) =	8.14		
		95% confidential limits for Population mean =	5.86	$\leq \mu \leq$	13.38
7	Pilling Resistance (box method) (IS 10971)	Population mean (μ) =	N.A		
		Population SD (σ) =	N.A		
		95% confidential limits for Population mean =	N.A	$\leq \mu \leq$	N.A

The participant laboratories were informed that, in the absence of proof of accreditation, the laboratory's value will not be considered for arriving at "Assigned Value" for the concerned test parameter, although, performance of the laboratory will be evaluated for this parameter. Further, it was also informed that the test results that may be inappropriate for statistical

evaluation, for example, gross errors, miscalculations and transpositions may be excluded for calculation of summary statistics and performance evaluation of participants.

Compilation of the Test Results:

In order to maintain the confidentiality of the participants of the PT Scheme, the individual participant laboratories were given Code numbers which are generated by using computer. Subsequently, the test results reported by the participant laboratories were tabulated and statistically analyzed for the basic statistics viz., Mean, Median, Mode, Maximum, Minimum, Standard Deviation, etc., While doing so, test results inappropriate for statistical evaluation like gross errors, miscalculations and transpositions were examined.

Determination Assigned Value:

To ensure the measurement traceability, only **accredited laboratories** are considered for evaluating the Assigned Values. Thus due weightage is given to the accredited laboratories. However, this weightage is given only when the laboratory has submitted their Scope of accreditation and accredited for the specific test in which the ILPT is conducted.

Initially, the robust average and the standard deviation of values reported by the accredited laboratories (in respective tests) were determined for each parameter in accordance with the procedure given in ISO 13528: 2005. Subsequently, robust Z Score were calculated on the basis of the above. The test results of those laboratories which were found to be outliers (Z score more than +3 or less than -3) were deleted and Robust Average of the remaining expert laboratories was again calculated. This Robust average is treated as the assigned value for the concerned parameter.

In case of Ordinal/Subjective test, mode of the values reported by Accredited participant laboratories for that test is considered as Assigned Value. The deviation of laboratory result by more than ½ grade compared to Assigned Value is taken as unsatisfactory (and outliers) and all other results are taken as satisfactory.

The Assigned Value of both the parameters thus arrived are given in **Table-6**.

Table 6: Assigned Values

S.No.	Test	Assigned Value	Robust SD of Assigned Value	Uncertainty of Assigned Value	No. of Accredited Laboratories contributed	Total number of participants*
1	Thickness of fabric (IS 7702) (Unit: mm)	0.19	0.02	0.005	5	14
2	Threads per unit length (Ends & Picks) (IS1963)	99.8	0.81	0.18	26	28
3	Twist of yarn removed from fabric (IS 832)	18.7	0.09	0.06	14	17
4	Crease Recovery (IS 4681)- Sample -Lot-A	171.4	18.4	5.21	5	9
	Crease Recovery (IS 4681) Sample -Lot-B	115.3	5.71	4.76	3	6
5	Breaking strength- Ravelled strip (ISO 13934)	614.2	26.4	6.13	23	25
	Elongation % (ISO 13934)	5.9	0.61	0.13	22	23
6	Breaking strength- Ravelled strip (ASTM 5035)	603.7	38.8	12.0	14	18
	Elongation % (ASTM 5035)	7.84	1.07	0.42	14	18
7	Pilling Resistance (box method) (IS 10971)	4	NA	NA	15	22

Determination of Standard Deviation for Proficiency Assessment (σ):

The robust average and the robust standard deviation (σ_1) of all qualified values reported by the participant laboratories were calculated for each of the test separately in accordance with the procedure given in ISO 13528. Subsequently, the “between-samples standard deviation (S_s)” of homogeneity testing data was compared with the standard deviation of all the participants. If $S_s \leq 0.3 \sigma_1$, then the sample is considered as homogenous and the robust standard deviation of all the participant laboratories is treated as Standard Deviation for Proficiency Testing. That is $\sigma = \sigma_1$.

If $S_s > 0.3 \sigma_1$, then the sample is considered as heterogeneous and Standard Deviation for Proficiency Assessment is calculated by adding allowance for heterogeneity of the sample as stipulated in ISO 13528, by using the formula

$$\sigma = \sqrt{\sigma_1^2 + S_s^2}$$

Performance Evaluation of Participants:

The performance of the individual laboratory was evaluated by adopting Robust Z score technique given in ISO 13528, as per the following formula:

$$Z = \frac{x - X}{\sigma}$$

where x is the test result reported by the individual laboratory; X is the Assigned Value and σ is the standard deviation of the Proficiency Assessment.

Interpretation of Performance comment:

Table – 7: Interpretation of Performance comment

Range	Performance of Laboratory
Objective Tests	
$ Z - \text{Score} \leq 2$	Satisfactory
$2 < Z - \text{Score} \leq 3$	Straggler
$ Z - \text{Score} > 3$	Outlier
Subjective Test	
$ \text{Reported Value} - \text{Assigned Value} \leq \frac{1}{2} \text{ grade}$	Satisfactory
$ \text{Reported Value} - \text{Assigned Value} > \frac{1}{2} \text{ grade}$	Outlier

Outliers and Stragglers:

Overall performance of all the laboratories is good. Outliers and Stragglers are very rare and far. The Outlier and Straggler Analysis are given in Table – 8.

Table – 8: Outlier and Straggler Analysis

S. No	Test	No. of Labs Participated*	Valid Results	No. of Stragglers	% of Stragglers	No. of Outliers	% of Outliers
1	Thickness of fabric (IS 7702) (Unit: mm)	14	14	2	14.3	0	0.0
2	Threads per unit length (Ends & Picks) (IS1963)	28	28	1	3.6	2	7.1
3	Twist of yarn removed from fabric (IS 832)	17	17	0	0	4	23.5
4	Crease Recovery (IS 4681)- Sample -Lot-A	9	9	0	0.0	0	0.0
	Crease Recovery (IS 4681) Sample -Lot-B	6	6	0	0.0	0	0.0
5	Breaking strength-Ravelled strip (ISO 13934)	25	25	1	4.0	0	0.0
	Elongation % (ISO 13934)	23	23	0	0.0	3	13.0
6	Breaking strength-Ravelled strip (ASTM 5035)	18	18	1	5.6	0	0.0
	Elongation % (ASTM 5035)	18	18	1	5.6	3	16.7
7	Pilling Resistance (box method) (IS 10971)	22	22	NA	NA	1	4.5
Total		180	180	6	3.8*	13	7.2

* excluding Pilling resistance participants

Parameter-wise the outliers and stragglers are listed below:

Table – 9: List of Outliers and Stragglers

S. No	Test	Straggler		Outlier	
		No. of Labs	Lab codes	No. of Labs	Lab codes
1	Thickness of fabric (IS 7702) (Unit: mm)	2	22,24	0	Nil
2	Threads per unit length (Ends & Picks) (IS1963)	1	31	2	9, 22
3	Twist of yarn removed from fabric (IS 832)	0	Nil	4	7,15,22,24
4	Crease Recovery (IS 4681)- Sample -Lot-A	0	Nil	0	Nil
	Crease Recovery (IS 4681) Sample -Lot-B	0	Nil	0	Nil
5	Breaking strength- Ravelled strip (ISO 13934)	1	13	0	Nil
	Elongation % (ISO 13934)	0	Nil	3	3,13,33
6	Breaking strength- Ravelled strip (ASTM 5035)	1	7	0	Nil
	Elongation % (ASTM 5035)	1	33	3	3,7,13
7	Pilling Resistance (box method) (IS 10971)	NA	-	1	25

General Advise to the Laboratories on the performance:

If the laboratory is found to be “**Outlier**”, necessary corrective action should be taken after thorough investigation of the root cause of the problem. In case the laboratory is found to be “**Straggler**”, the method of testing, personnel error, use of correct materials / equipment, maintenance of environmental conditions etc., have to be re-examined to ensure that the test results being reported for the concerned test parameters are satisfactory.

Annexure

PERFORMANCE EVALUATION OF EACH LABORATORY- TEST WISE

1. Thickness of fabric

Lab code	Reported value (mm)	Test method adopted	Z- Score	Performance Remark
7	0.20	IS:7702-2012	0.714	Satisfactory
12	0.19	IS:7702	0.000	Satisfactory
13	0.17	IS:7702	-1.429	Satisfactory
15	0.17		-1.429	Satisfactory
20	0.19	ASTM-D-1777	0.000	Satisfactory
22	0.23	IS:7702	2.857	Straggler
24	0.23	IS:7702	2.857	Straggler
25	0.20	IS:7702	0.714	Satisfactory
31	0.20	IN HOUSE	0.714	Satisfactory
32	0.19	IS:7702	0.000	Satisfactory
33	0.20	IN HOUSE	0.714	Satisfactory
34	0.20	IN HOUSE	0.714	Satisfactory
40	0.19		0.000	Satisfactory
42	0.20	ASTM-D-1777	0.714	Satisfactory
No. of participants	14			
Maximum	0.23			
Minimum	0.17			
Mean	0.20			
Std Deviation	0.02			
Median	0.20			

SUMMARY

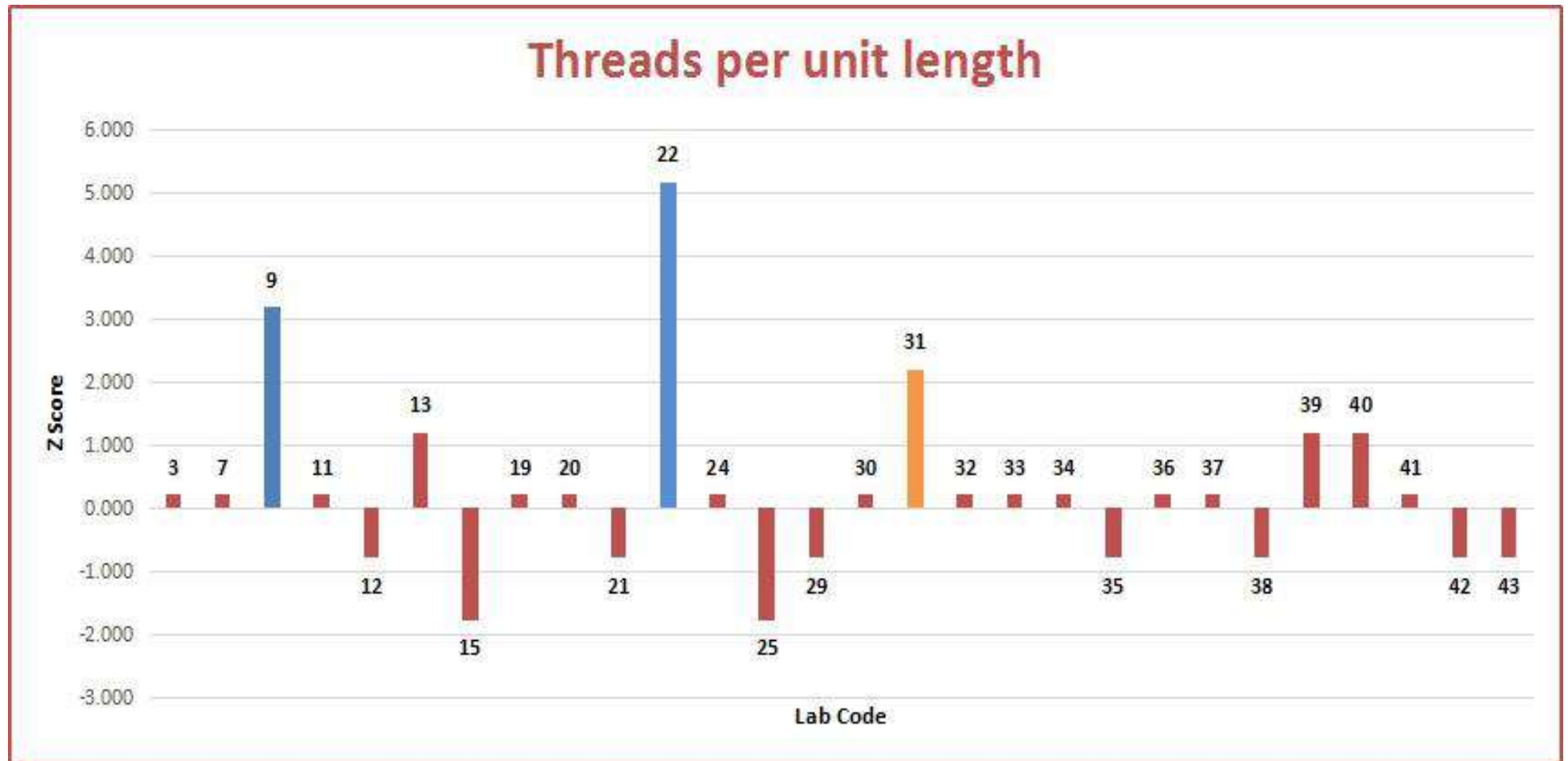
Robust Aaverage=	0.19
Robust SD for all valid participants (σ_1) =	0.014
Between sample SD of Homogeneity testing (S_S) =	0.002
SD for PT Scheme with allowance for the heterogeneity if any (σ) =	0.014
No Heterogeneity observed	
Assigned Value (X) =	0.19
SD of PT Scheme (σ) =	0.014



2. Threads per unit length

Lab code	Reported value (per Inch)	Test method adopted	Z- Score	Performance Remark
3	100	IS 1963-1981	0.198	Satisfactory
7	100	IS 1963-1981(RA 2014)	0.198	Satisfactory
9	103	IS 1963-1981 RA-2004-METHOD A	3.168	Outlier
11	100	IS 1963	0.198	Satisfactory
12	99	IS 1963-1981	-0.792	Satisfactory
13	101	IS 1963	1.188	Satisfactory
15	98		-1.782	Satisfactory
19	100	IS 1963:2004	0.198	Satisfactory
20	100	NOT MENTIONED	0.198	Satisfactory
21	99	IS 1963-1981 RA-2004	-0.792	Satisfactory
22	105	IS 1963	5.149	Outlier
24	100	IS 1963	0.198	Satisfactory
25	98	IS 1963	-1.782	Satisfactory
29	99	IS 1963-1981 RA-2004-METHOD A	-0.792	Satisfactory
30	100	NOT MENTIONED	0.198	Satisfactory
31	102	IS 1963	2.178	Straggler
32	100		0.198	Satisfactory
33	100	IS 1963	0.198	Satisfactory
34	100	IS 1963	0.198	Satisfactory
35	99	IS 1963	-0.792	Satisfactory
36	100	NOT MENTIONED	0.198	Satisfactory
37	100	IS 1963	0.198	Satisfactory
38	99	NOT MENTIONED	-0.792	Satisfactory
39	101	IS 1963-1981(RA 2014)	1.188	Satisfactory
40	101	IS 1963	1.188	Satisfactory
41	100	IS 1963-1981(RA 2008)	0.198	Satisfactory
42	99	IS 1963	-0.792	Satisfactory
43	99	IS 1963-1981 RA-2004-METHOD A	-0.792	Satisfactory
No. of participants	28			
Maximum	105			
Minimum	98			
Mean	100.07			
Std Deviation	1.44			
Median	100.00			

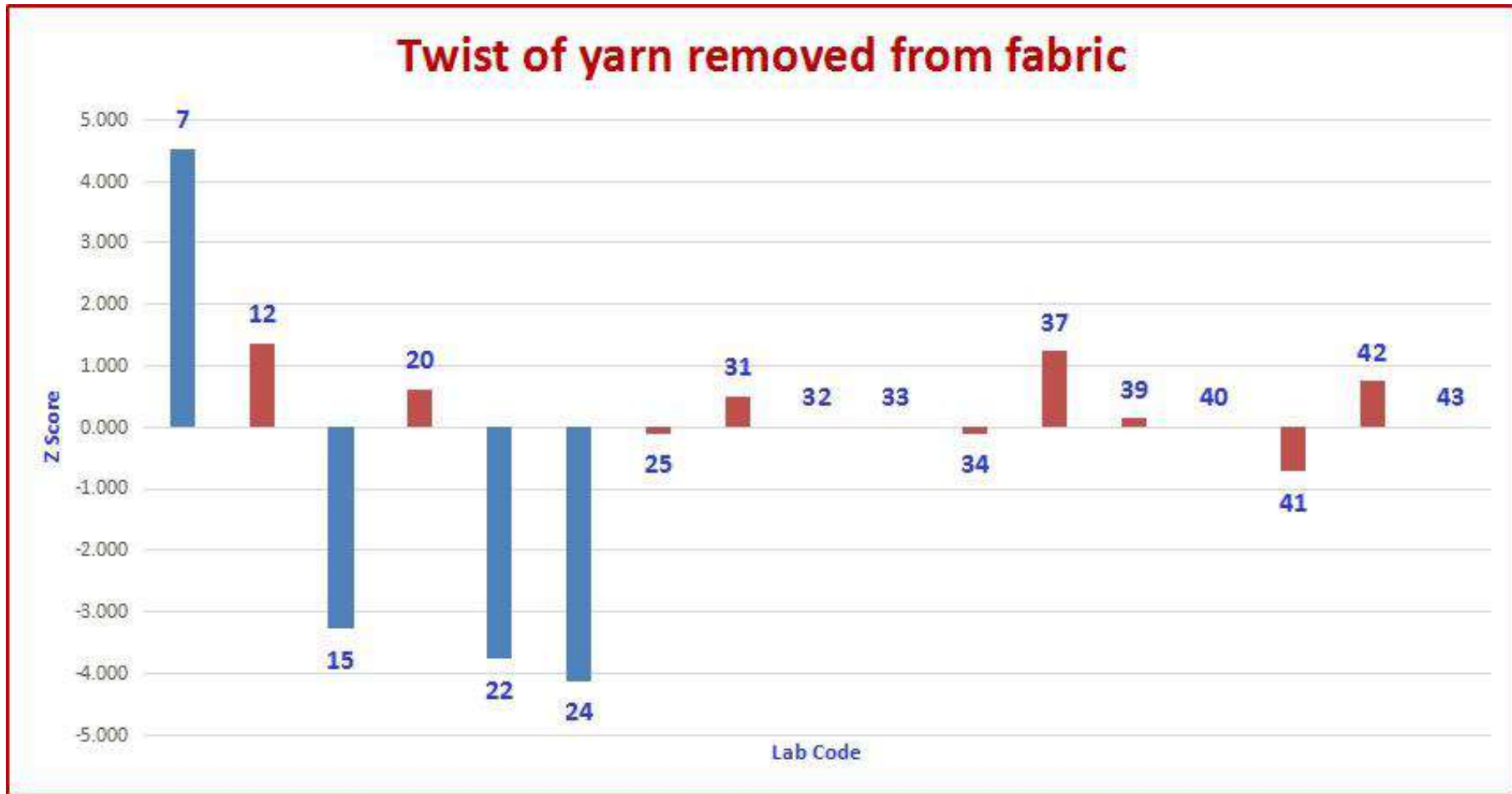
SUMMARY	
Robust Average=	99.8
Robust SD for all valid participants (σ_1) =	1.01
Between sample SD of Homogeneity testing (S_S) =	0.222
SD for PT Scheme with allowance for the heterogeneity if any (σ) =	1.01
No Heterogeneity observed	
Assigned Value (X) =	99.8
SD of PT Scheme (σ) =	1.01



3. Twist of yarn removed from fabric

Lab code	Reported value (per Inch)	Test method adopted	Z- Score	Performance Remark
7	22.4	NOT MENTIONED	4.512	Outlier
12	19.8	IS 832-2	1.341	Satisfactory
15	16	IS 832(PART-2:2011)	-3.293	Outlier
20	19.2	NOT MENTIONED	0.610	Satisfactory
22	15.6	IS 832	-3.780	Outlier
24	15.3	IS 832	-4.146	Outlier
25	18.6	IS 832	-0.122	Satisfactory
31	19.1		0.488	Satisfactory
32	18.7	IS 832(PART-2:2011)	0.000	Satisfactory
33	18.7	IS 832-1	0.000	Satisfactory
34	18.6	IS 832	-0.122	Satisfactory
37	19.7	IS 832	1.220	Satisfactory
39	18.8	IS 832(PART-2:2011)	0.122	Satisfactory
40	18.7	IS 832	0.000	Satisfactory
41	18.1	IS 832:1985(RA 2011)	-0.732	Satisfactory
42	19.3	IS 832	0.732	Satisfactory
43	18.7	IS 832(PART-2:2011)	0.000	Satisfactory
No. of participants	17			
Maximum	22.4			
Minimum	15.3			
Mean	18.55			
Std Deviation	1.68			
Median	18.70			

SUMMARY	
Robust Aaverage=	18.7
Robust SD for all valid participants (σ_1) =	0.82
Between sample SD of Homogeneity testing (S_S) =	0.233
SD for PT Scheme with allowance for the heterogeneity if any (σ) =	0.82
No Heterogeneity observed	
Assigned Value (X) =	18.7
SD of PT Scheme (σ) =	0.82



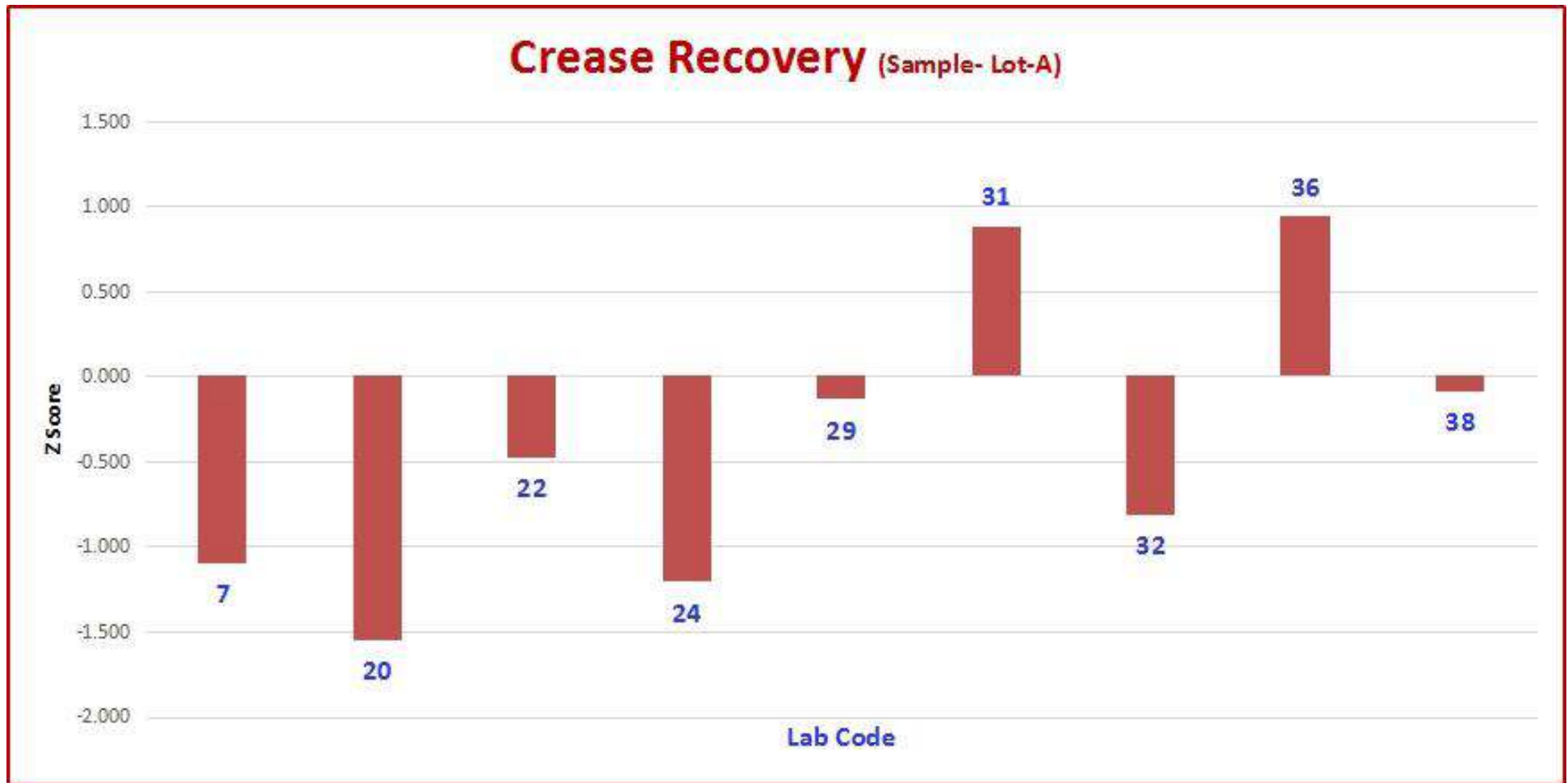
4. Crease Recovery (Sample- Lot-A)

Lab code	Reported value (in Deg.)	Test method adopted	Z- Score	Performance Remark
7	152	IS 4681-1968	-1.096	Satisfactory
20	144	NOT MENTIONED	-1.548	Satisfactory
22	163	IS 4681	-0.475	Satisfactory
24	150	IS 4681	-1.209	Satisfactory
29	169	IS 4681-1981(RA-2004)	-0.136	Satisfactory
31	187	IS 4681	0.881	Satisfactory
32	157		-0.814	Satisfactory
36	188	NOT MENTIONED	0.938	Satisfactory
38	169.8	NOT MENTIONED	-0.090	Satisfactory
No. of participants	9			
Maximum	188			
Minimum	144			
Mean	164.42			
Std Deviation	15.62			
Median	163.00			

SUMMARY

Robust Aaverage=	171.4
Robust SD for all valid participants (σ_1) =	17.7
Between sample SD of Homogeneity testing (S_s) =	3.25
SD for PT Scheme with allowance for the heterogeneity if any (σ) =	17.7
No Heterogeneity observed	

Assigned Value (X) =	171.4
SD of PT Scheme (σ) =	17.7



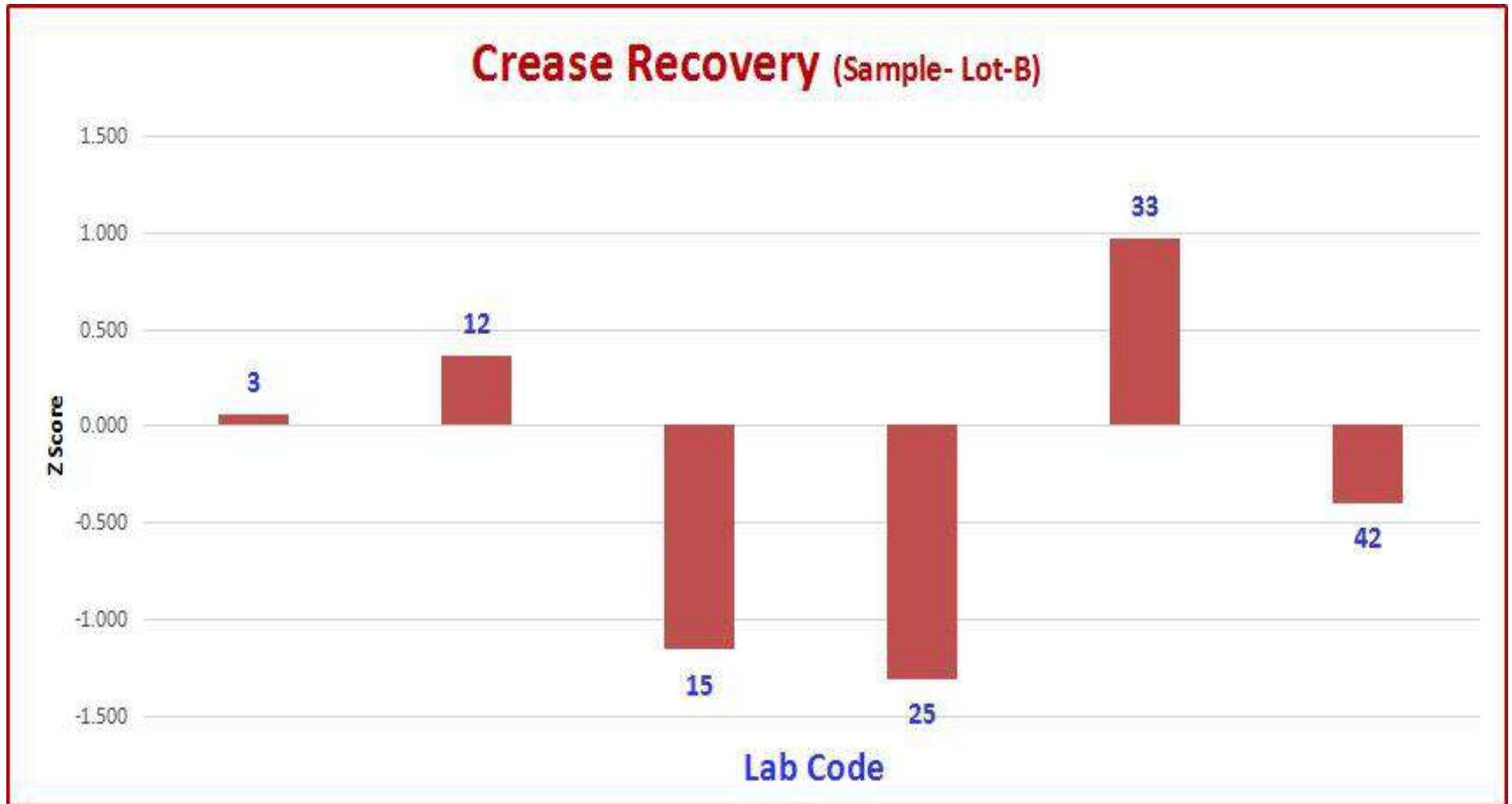
4. Crease Recovery (Sample- Lot- B)

Lab code	Reported value (in Deg.)	Test method adopted	Z- Score	Performance Remark
3	116	IS 4681-1981	0.053	Satisfactory
12	120	IS 4681-1968	0.356	Satisfactory
15	100		-1.159	Satisfactory
25	98	IS 4681	-1.311	Satisfactory
33	128	IS 4681	0.962	Satisfactory
42	110	IS 4681	-0.402	Satisfactory
No. of participants	6			
Maximum	128			
Minimum	98			
Mean	112.00			
Std Deviation	11.66			
Median	113.00			

SUMMARY

Robust Aaverage=	115.3
Robust SD for all valid participants (σ_1) =	13.2
Between sample SD of Homogeneity testing (S_s) =	3.82
SD for PT Scheme with allowance for the heterogeneity if any (σ) =	13.2
No Heterogeneity observed	

Assigned Value (X) =	115.3
SD of PT Scheme (σ) =	13.2

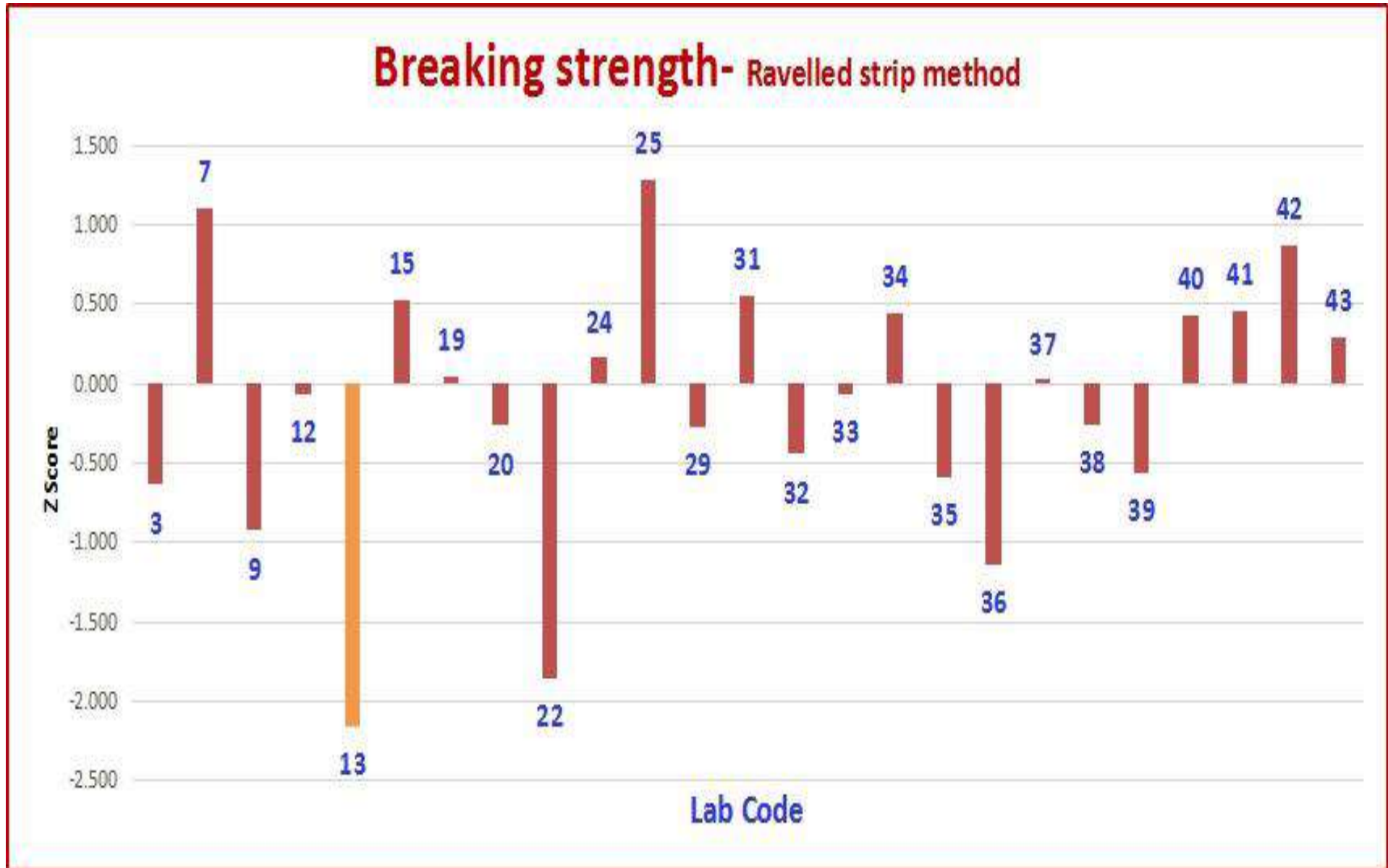


5. Breaking strength- Ravelled strip method

Lab code	Reported value (in N)	Test method adopted	Z- Score	Performance Remark
3	590.4	IS 1969 (PART-1):2009	-0.640	Satisfactory
7	655.3	ISO-13934-1-1999(RA-2014)	1.105	Satisfactory
9	579.6	IS 1969 (PART-1):2009	-0.930	Satisfactory
12	611.6	ISO-13934-1	-0.070	Satisfactory
13	533.6	ISO-13934	-2.167	Straggler
15	633.7		0.524	Satisfactory
19	615.7		0.040	Satisfactory
20	604.1	NOT MENTIONED	-0.272	Satisfactory
22	545	ISO-13934	-1.860	Satisfactory
24	620	ISO-13934 (PART-1)	0.156	Satisfactory
25	661.7	IS 1969	1.277	Satisfactory
29	604	IS 1969 (PART-1):2009	-0.274	Satisfactory
31	634.5	ISO-13934	0.546	Satisfactory
32	597.6		-0.446	Satisfactory
33	611.6	ISO-13934	-0.070	Satisfactory
34	630.6	ISO-13934	0.441	Satisfactory
35	592.1	IS 1969 (PART-1)	-0.594	Satisfactory
36	571.6	NOT MENTIONED	-1.145	Satisfactory
37	615	ISO-13934-1	0.022	Satisfactory
38	604.5	IS 1969-85	-0.261	Satisfactory
39	593.3	ISO-13934-1-2013	-0.562	Satisfactory
40	629.9	ISO-13934	0.422	Satisfactory
41	631.2	IS 1969:85:2010	0.457	Satisfactory
42	646.3	ISO-13934	0.863	Satisfactory
43	625	ISO-13934-1-2013	0.290	Satisfactory
No. of participants	25			
Maximum	661.7			
Minimum	533.6			
Mean	609.52			
Std Deviation	30.66			
Median	611.60			

SUMMARY

Robust Avarage=	614.2
Robust SD for all valid participants (σ_1) =	28.2
Between sample SD of Homogeneity testing (S_S) =	24.3
SD for PT Scheme with allowance for the heterogeneity if any (σ) =	37.2
Heterogeneity observed	
Assigned Value (X) =	614.2
SD of PT Scheme (σ) =	37.2

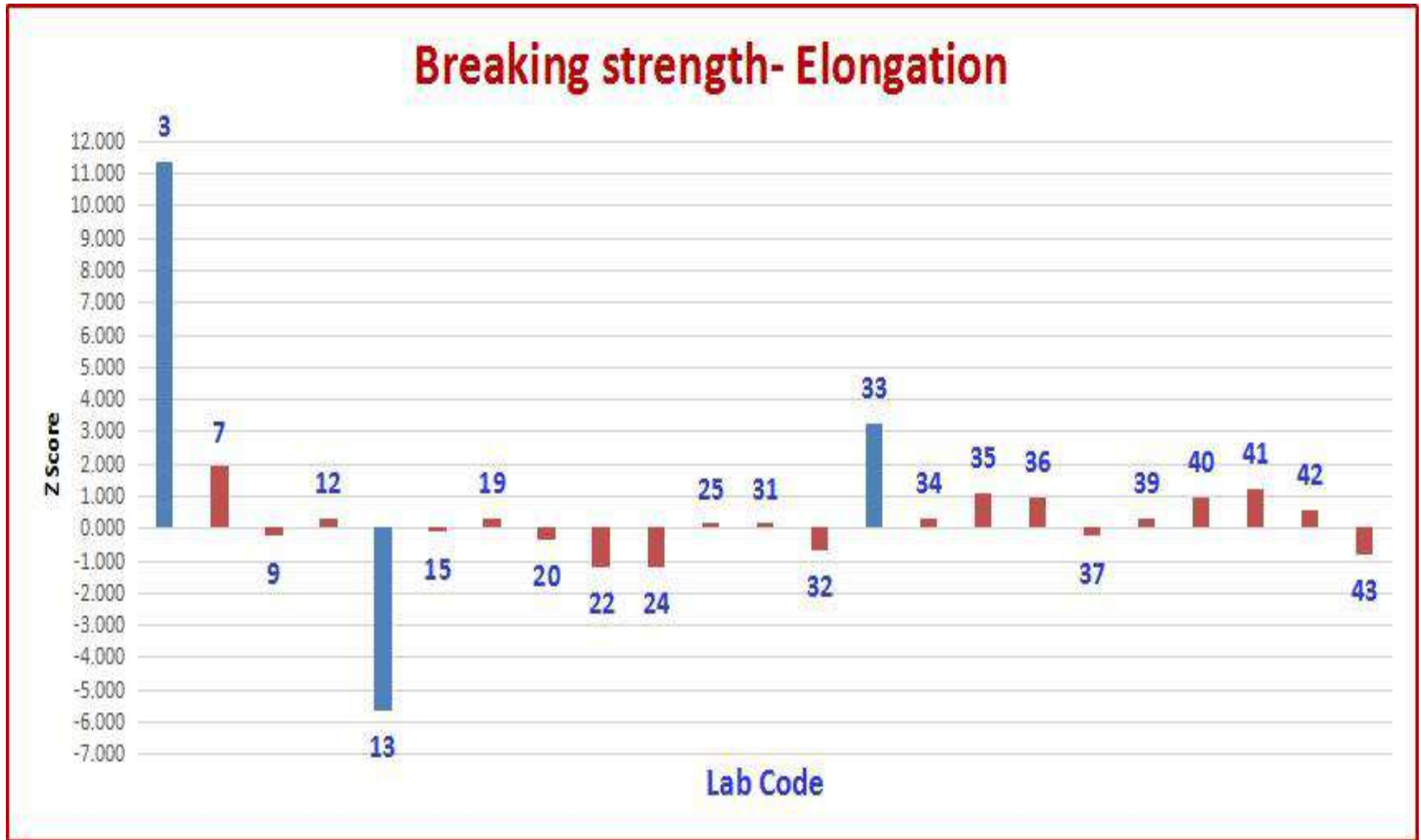


5. Breaking strength- Elongation

Lab code	Reported value (in %)	Test method adopted	Z- Score	Performance Remark
3	14.3	IS 1969 (PART-1):2009	11.351	Outlier
7	7.30	ISO-13934-1-1999(RA-2014)	1.892	Satisfactory
9	5.70	IS 1969 (PART-1):2009	-0.270	Satisfactory
12	6.10	ISO-13934-1	0.270	Satisfactory
13	1.70	ISO-13934	-5.676	Outlier
15	5.8		-0.135	Satisfactory
19	6.10		0.270	Satisfactory
20	5.63	NOT MENTIONED	-0.365	Satisfactory
22	5.00	ISO-13934	-1.216	Satisfactory
24	5.00	ISO-13934 (PART-1)	-1.216	Satisfactory
25	6.00	IS 1969	0.135	Satisfactory
31	6.00	ISO-13934	0.135	Satisfactory
32	5.4		-0.676	Satisfactory
33	8.30	ISO-13934	3.243	Outlier
34	6.10	ISO-13934	0.270	Satisfactory
35	6.70	IS 1969 (PART-1)	1.081	Satisfactory
36	6.60	NOT MENTIONED	0.946	Satisfactory
37	5.70	ISO-13934-1	-0.270	Satisfactory
39	6.10	ISO-13934-1-2013	0.270	Satisfactory
40	6.60	ISO-13934	0.946	Satisfactory
41	6.80	IS 1969:85:2010	1.216	Satisfactory
42	6.30	ISO-13934	0.541	Satisfactory
43	5.3	ISO-13934-1-2013	-0.811	Satisfactory
No. of participants	23			
Maximum	14.3			
Minimum	1.7			
Mean	6.28			
Std Deviation	2.11			
Median	6.10			

SUMMARY

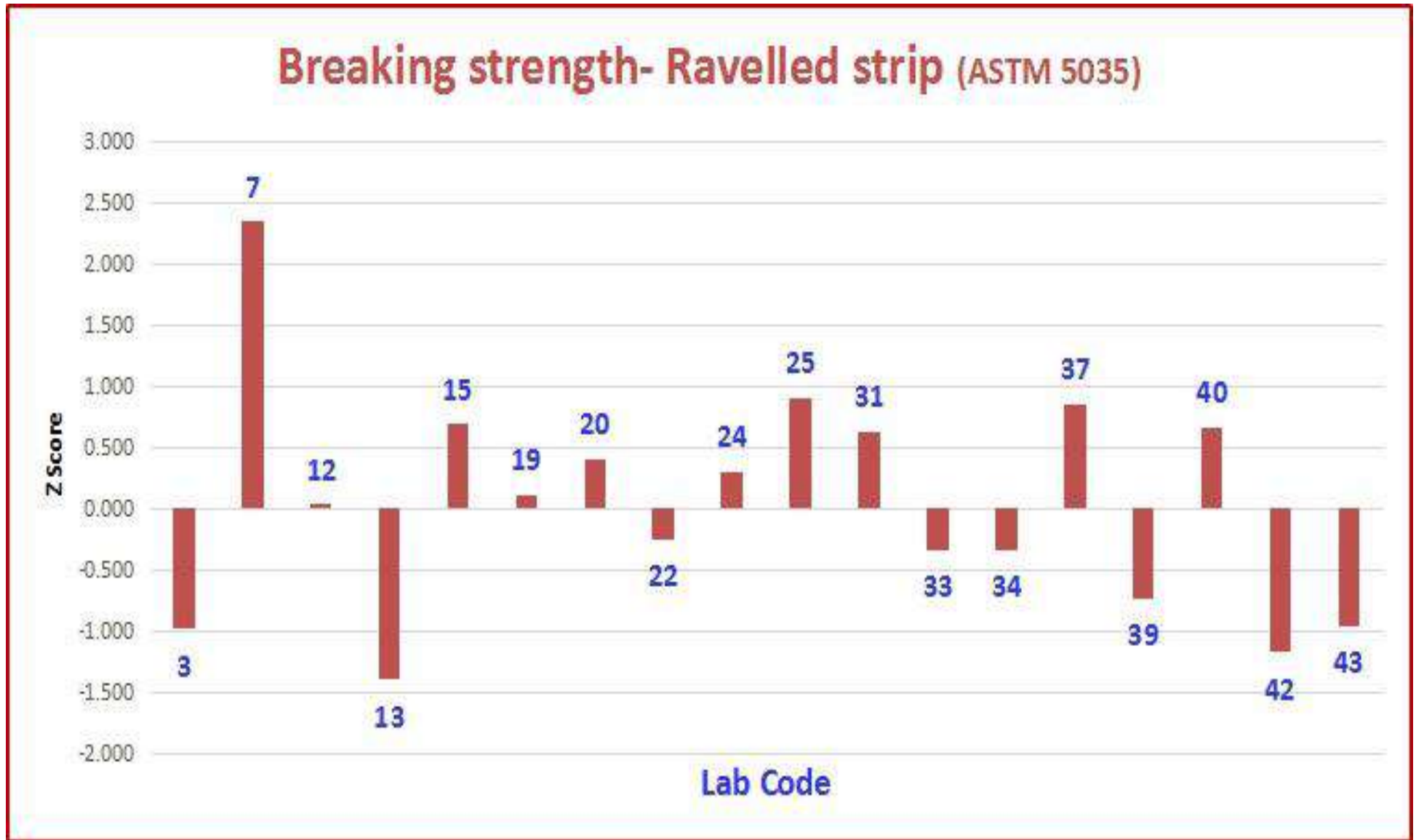
Robust Average=	5.9
Robust SD for all valid participants (σ_1) =	0.74
Between sample SD of Homogeneity testing (S_S) =	0.22
SD for PT Scheme with allowance for the heterogeneity if any (σ) =	0.74
No Heterogeneity observed	
Assigned Value (X) =	5.9
SD of PT Scheme (σ) =	0.74



6. Breaking strength- Ravelled strip (ASTM 5035)

Lab code	Reported value (in N)	Test adopted	method	Z- Score	Performance Remark
3	549.8	IS 1969 (PART-1);2009		-0.984	Satisfactory
7	731.8	ASTM-D-5035		2.338	Straggler
12	605.3	ASTM-D-5035		0.029	Satisfactory
13	527	ASTM-D-5035		-1.400	Satisfactory
15	641.2	ASTM-D-5035		0.684	Satisfactory
19	609.3	ASTM-D-5035-11		0.102	Satisfactory
20	625.4	NOT MENTIONED		0.396	Satisfactory
22	589.8	ASTM-D-5035		-0.254	Satisfactory
24	620	ASTM-D-5035		0.297	Satisfactory
25	652.9	ASTM-D-5035		0.898	Satisfactory
31	637.6	ASTM-D-5035		0.619	Satisfactory
33	585.3	ASTM-D-5035		-0.336	Satisfactory
34	585	ASTM-D-5035		-0.341	Satisfactory
37	650.4	ASTM-D-5035		0.852	Satisfactory
39	563.4	ASTM-D-5035-2011		-0.735	Satisfactory
40	640.1	ASTM-D-5035		0.664	Satisfactory
42	539.4	ASTM-D-5035		-1.173	Satisfactory
43	551	ASTM-D-5035-11 RA2015		-0.962	Satisfactory
No. of participants		18			
Maximum		731.8			
Minimum		527			
Mean		605.82			
Std Deviation		50.75			
Median		607.30			

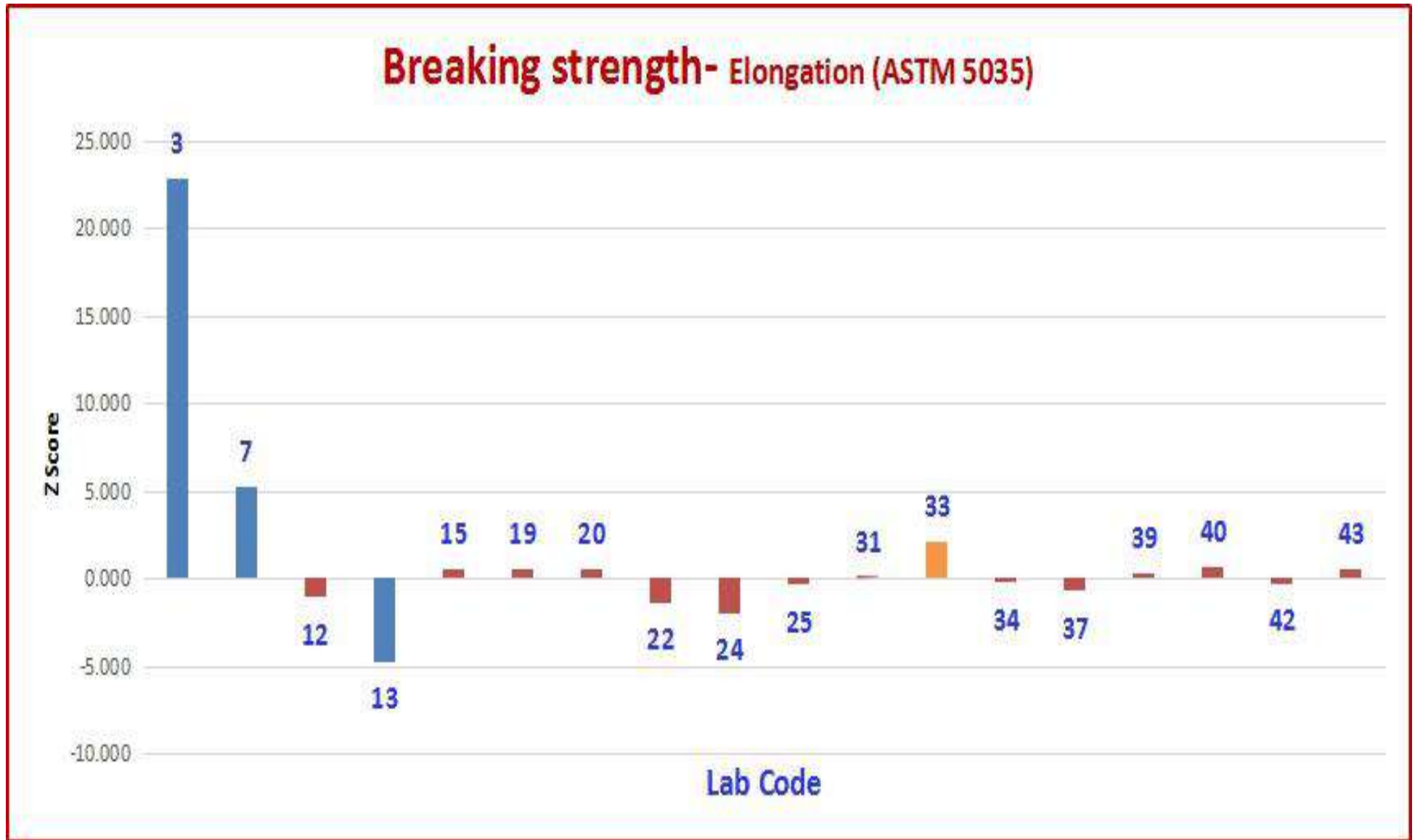
SUMMARY	
Robust Aaverage=	603.7
Robust SD for all valid participants (σ_1) =	49.1
Between sample SD of Homogeneity testing (S_s) =	24.3
SD for PT Scheme with allowance for the heterogeneity if any (σ) =	54.8
Heterogeneity observed	
Assigned Value (X) =	603.7
SD of PT Scheme (σ) =	54.8



6. Breaking strength- Elongation (ASTM 5035)

Lab code	Reported value (in %)	Test adopted	method	Z- Score	Performance Remark
3	40.3	IS 1969 (PART-1);2009		22.859	Outlier
7	15.30	ASTM-D-5035		5.254	Outlier
12	6.32	ASTM-D-5035		-1.070	Satisfactory
13	1.10	ASTM-D-5035		-4.746	Outlier
15	8.6	ASTM-D-5035		0.535	Satisfactory
19	8.60	ASTM-D-5035-11		0.535	Satisfactory
20	8.60	NOT MENTIONED		0.535	Satisfactory
22	5.90	ASTM-D-5035		-1.366	Satisfactory
24	5.00	ASTM-D-5035		-2.000	Satisfactory
25	7.30	ASTM-D-5035		-0.380	Satisfactory
31	8.00	ASTM-D-5035		0.113	Satisfactory
33	10.80	ASTM-D-5035		2.085	Straggler
34	7.50	ASTM-D-5035		-0.239	Satisfactory
37	6.80	ASTM-D-5035		-0.732	Satisfactory
39	8.30	ASTM-D-5035-2011		0.324	Satisfactory
40	8.80	ASTM-D-5035		0.676	Satisfactory
42	7.40	ASTM-D-5035		-0.310	Satisfactory
43	8.60	ASTM-D-5035-11 RA2015		0.535	Satisfactory
No. of participants	18				
Maximum	40.3				
Minimum	1.1				
Mean	9.62				
Std Deviation	8.14				
Median	8.15				

SUMMARY	
Robust Aaverage=	7.84
Robust SD for all valid participants (σ_1) =	1.42
Between sample SD of Homogeneity testing (S_s) =	0.40
SD for PT Scheme with allowance for the heterogeneity if any (σ) =	1.42
No Heterogeneity observed	
Assigned Value (X) =	7.84
SD of PT Scheme (σ) =	1.42



7. Pilling Resistance (box method)

Assigned Value

4

Lab code	Reported (Grade)	value	Test method adopted	Performance Remark
3	4		IS:10971 (PART-1)-2011	Satisfactory
7	4-5		IS:10971-1984 (RA-2006)	Satisfactory
11	3-4		ISO 12945-1-2000	Satisfactory
12	3-4		IS:10971	Satisfactory
13	3-4		IS:10971 (PART-1)-2011	Satisfactory
15	4		ISO 12945-1-2001	Satisfactory
19	3-4		BS EN ISO 12945-1	Satisfactory
21	3-4		IS:10971 (PART-1)-2011	Satisfactory
22	4-5		IS:10971 (PART-1)-2012	Satisfactory
24	4		IS:10971 (PART-1)-2011 RA 2017	Satisfactory
25	3		IS:10971	Outlier
29	4-5		IS:10971	Satisfactory
31	4		NOT MENTIONED	Satisfactory
32	4		IS:10971	Satisfactory
33	4		IS:10971 (PART-1)-2011	Satisfactory
34	4		IS:10971	Satisfactory
35	4		IS:10971	Satisfactory
36	4		IS:10971 (PART-1)-2011	Satisfactory
38	4-5		NOT MENTIONED	Satisfactory
41	4-5		IS:10971:84 RA 2010	Satisfactory
42	3-4		IS:10971 (PART-1)-2011	Satisfactory
43	4-5		IS:10971 (PART-1)-2011	Satisfactory
No. of participants		22		
Maximum		4-5		
Minimum		3		
Median		4		

Frequency distribution

Grade	Frequency
1	0
1-2	0
2	0
2-3	0
3	1
3-4	6
4	9
4-5	6
participants	22

