

**INTERLABORATORY PROFICIENCY  
TRIAL OF GLOVE TESTING  
LABORATORIES, 2011**

**MAIN REPORT**

**AUGUST, 2011**



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# ENERSOL Interlaboratory Proficiency Trial of Glove Testing Laboratories, 2011

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## 1 Introduction

This report describes the results of the 13<sup>th</sup> annual Enersol Interlaboratory Proficiency Trial of glove testing laboratories.

The trial was conducted between May and August, 2011. Twenty five laboratories enrolled in the trial. Some laboratories requested additional samples for some tests; in this report these were referred to as separate laboratories, and were provided with their own identification numbers, there are thus up to 27 sets of data in tests this year.

The first such trial was conducted in 1998, on behalf of the Department of Medical Sciences, Thailand, and since then it is being done annually. This trial is funded by contributions from the participating laboratories.

## 2 Trial Aims

The aims of the 2011 trial were:

1. to identify those laboratories disagreeing in a statistical sense or in a practical sense, from the majority, so that their results can be the subject of further consideration;
2. to give laboratories feedback on their performance relative to the consensus results;
3. to give laboratories sufficient data to enable them to identify and correct techniques and calibrations;
4. in the longer term, to maintain international confidence in the results from all the laboratories;
5. to be used by accredited laboratories as a tool for the compliance with the ISO 17025;
6. to have an estimate of the precision components of the various measurements as defined in ISO 5725.

## 3 Analysis and Reporting

In addition to this main report, each laboratory receives an Individual Report showing its own performance.

Generally, the analysis of results can be used to suggest possible causes for deviations from consensus results, and these need to be analysed by an expert examining the equipment, the test methods and the results of this trial.

This report gives graphs and tables that show the results of all the laboratories, test by test. In addition, each laboratory has been given a summary showing its own performance, compared with consensus values.

At the Enersol Pty Ltd laboratory, the tests were conducted by staff that had nothing to do with the preparation of samples, where that preparation could have given a prior knowledge of the results. Enersol Pty Ltd staff involved in running and analysing the trial, were:

John Gerofi - Managing Director, Lisa Henretty - Business Manager, Grace Iskander - Laboratory Manager, Manhong Huang - Technical Officer, Kely Silveira - Administrative Assistant

## 4 The statistics in this report

Repeatability is the closeness of agreement between two test results, conducted twice by one laboratory. There are two ways of estimating repeatability. One is based on replicates of the same sample, and comparison of the dispersion of the results. The second is based on single values or sample means of two samples with different properties. In the latter case, the repeatability is based on calculating a consensus figure for the difference, and comparing this difference with the values obtained by the individual labs. In this trial, the first method is used, except for powder-free gloves, where the test method does not call for replicates, and only the second method is applicable.

Reproducibility is the closeness of agreement between two test results, conducted by different laboratories. It is assessed by analysing the distribution of mean values obtained by the participants for each test.

Most of the tests performed on gloves are inherently destructive, and are performed on a sample from the population submitted. The products are inherently variable to some extent, so perfect agreement amongst sub-samples cannot be expected. Further, for many of the tests, there is no "right" answer available beforehand, against which results may be compared. In these cases, the statistical techniques establish a consensus value from all results, ignoring extreme results (so different in value or range from the others that it is improbable that they are correct).

In the case of the Watertightness test, Enersol included in each sub-sample, a known number of defective samples with holes in specific places. In those cases, there is a high probability that the "correct" answer for the number of defectives is the number introduced, although some variation is possible. For these tests, the results obtained for each region of the gloves are compared with the number of defectives introduced in those regions.

While the techniques used here may identify laboratories which do not agree with the consensus result, all inferences are based on probability and statistics. Where a laboratory is identified as being an outlier or straggler, that means that its results are improbable, not that they are definitely wrong (definitions in Section 9).

## 5 Participating laboratories

Eight new laboratories joined the Interlaboratory Proficiency trial in 2011. Enersol welcomes these new participants.

The 25 participating laboratories in 2011 included:

Akron Rubber Development Laboratory Inc., Akron, OH, USA  
Anresco Laboratories, San Francisco, CA, USA  
Ansell Shah Alam Sdn Bhd, S&T Innovation Centre, Selangor Darul Ehsan, MALAYSIA  
British Standards Institution, BSI Product Services, Hemel Hempstead, UK  
Department of Medical Sciences, Nonthaburi, THAILAND  
Descarpack Descartáveis do Brasil Ltda, Brazil  
Enersol Pty Ltd, Annandale, NSW, AUSTRALIA  
Enersol Sdn Bhd, Penang, MALAYSIA  
Fábrica de Artefatos de Látex São Roque S.A. São Paulo, BRAZIL  
Guilin Latex Factory, Guilin, CHINA  
Instituto Lab System De Pesquisas E Ensaios, São Paulo, BRAZIL  
Instituto Nacional de Tecnologia, Rio de Janeiro, BRAZIL  
Instituto Nacional de Vigilancia de Medicamentos y Alimentos – Invima, Bogotá, Colombia  
L.A. Falcão Bauer C.T.C.Q Ltda, São Paulo, BRAZIL  
Medicines Control Authority of Zimbabwe (MCAZ), Harare, ZIMBABWE

# ENERSOL Interlaboratory Proficiency Trial of Glove Testing Laboratories, 2011

National Rubber and Latex Products Quality Supervision and Inspection Center, Yunnan, CHINA  
Regional Medical Science Centre, Songkhla, THAILAND  
SGS Laboratory Services (M) Sdn Bhd, Selangor, MALAYSIA  
Siam Sempermed Corporation Ltd, Songkhla, THAILAND  
Tanda Laboratories Inc., Markham, Ontario, CANADA  
The Standards Institution of Israel, ISRAEL  
Turkish Standards Institution (Ankara Chem. Lab), Ankara, TURKEY  
TÜV SÜD PSB Pte Ltd, SINGAPORE  
United States Food and Drug Administration (FDA), Irvine, CA, USA  
US Food and Drug Administration, Winchester Engineering and Analytical Center, USA

## 6 Test methods covered

The tests on which the trial was conducted include those required in the ISO and ASTM standards for medical gloves:

- Length
- Width
- Thickness (finger-tip and palm)
- Watertightness
- Tensile Properties:
  - Force at break
  - Elongation at break
  - Tensile strength at break
  - Force at 300% elongation
  - Stress at 500% elongation
- Powder removal:
  - Powder-free gloves
  - Powdered gloves

The test methods were primarily based on ISO 11193 (Examination Gloves), whose requirements are very similar to ASTM D3578. For tensile requirements, ISO 10282 (for force at 300% elongation), ASTM D3577 (for tensile strength at break and stress at 500% elongation) were also used. The ISO standards call only for the 4 mm Type II dumbbell, but participants were given the opportunity to choose any or all of the three main dumbbell sizes in standards (3, 4 and 6mm). EN 455-1 defines the European test for holes in gloves, and is very similar to the ISO requirements. EN 455-2 describes the other physical tests on gloves. The tensile tests performed similarly to the ISO tests, except that an ASTM Type D dumbbell is used, and the force at break is the only parameter specified. Nonetheless, users of the EN standards can also use this trial to verify their competence.

ISO 21171 and ASTM D6124 were used for powder removal. Due to the similarity among standards these measures make the trial relevant for laboratories using ISO, ASTM, EN and other standards. Participants were allowed to use alternative methods, provided they documented these methods.

## 7 Instructions to participants

Samples were shipped with an instruction letter that directed participants to the Enersol website to download the Instruction Booklet and data spreadsheet. The Instruction Booklet was as brief as possible and participants were instructed to follow the methods in the appropriate standards.

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Participants were requested to return results by E-mail and send holed samples from the Watertightness tests and their cut tensile samples to Enersol by courier or post. All laboratories successfully used the electronic data submission system.

### 8 Sample selection

For most tests, two different samples were selected. Latex and one other material were used in each case

For all samples except those "seeded" with flaws (i.e. Watertightness tests H 1 and H 2), the entire sample was divided at random into the sub-samples sent to each laboratory. For samples H 1 and H 2 the deliberately damaged samples and the intact samples were assembled into the sub-samples which were sent out to participants. Brief details about the samples follow.

#### 8.1 Dimensions

Two samples identified as LWT 1 and LWT 2 were chosen for Length, Width and Thickness.

Different sizes were chosen for each sample. LWT 1 and LWT 2 were large and small sizes respectively. The LWT 1 samples were vinyl gloves and LWT 2 samples were made of natural rubber latex.

#### 8.2 Watertightness

The Watertightness test consisted of two samples identified as H 1 and H 2. Gloves in sample H 1 were made of natural rubber latex and H 2 were vinyl.

Holes were deliberately made by Enersol in a proportion of the gloves; they were located in one or more of 16 distinct locations (regions) on the glove. The locations were illustrated on the data spreadsheet supplied for the submission of results, and are described in Table 1. A known number of gloves with holes were introduced into each sub-sample and the number of gloves with holes in each region per sub-sample was also known.

**Table 1: Region, location and number of holes introduced into sub-samples**

Region and Location of holes		H 1		H 2	
		# holes	Needle size	# holes	Needle size
A	Thumb tip	0	-	1	0.5 mm diam.
B	Finger-tip 1	1	1.2 mm diam.	0	-
C	Finger-tip 2	2	1.2 mm diam.	2	0.5 mm diam.
D	Finger-tip 3	2	1.2 mm diam.	0	-
E	Finger-tip 4	1	1.2 mm diam.	0	-
F	Between thumb and finger 1	0	-	2	0.3 mm diam.
G	Between finger 1 and 2	0	-	2	0.4mm diam.
H	Between fingers 2 and 3	2	0.5 mm diam.	2	0.4 mm diam.
I	Between fingers 3 and 4	2	0.5 mm diam.	0	-
J	Centre of palm	0	-	0	-
K	Cuff, 50mm from open end	1	0.5 mm diam.	0	-
L	Middle – thumb	0	-	1	0.3 mm diam.
M	Middle – finger 1	1	0.8 mm diam.	1	0.4mm diam.
N	Middle – finger 2	2	0.8 mm diam.	1	0.4 mm diam.
O	Middle – finger 3	2	0.8 mm diam.	1	0.4 mm diam.
P	Middle – finger 4	0	-	1	0.8 mm diam.

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A random sample of the gloves with holes was pre-tested and holes were found in the appropriate regions in all gloves tested.

Each participating laboratory received 100 gloves in each of the H 1 and H 2 bags. Sample H 1 had 16 gloves with introduced holes and sample H 2 had 14 gloves with introduced holes. The introduced hole sizes and regions varied (refer to Table 1).

### 8.3 Tensile properties

Two different kinds of gloves, one of natural rubber latex and the other of vinyl, were used. Each participating laboratory received 10 gloves in each bag:

TBL 1 and TBL 2:	Sub-samples to be cut and tested by the participant TBL 1 was natural rubber latex and TBL 2 was vinyl
TBLA 3 and TBLA 4:	Sub-samples to be oven-conditioned, cut and tested by the participant (Samples identical to TBL 1 and TBL 2 respectively)
CETL 5:	Sub-samples of 30 pre-cut dumbbells for testing by the participant (Samples identical to TBL 1 sample)
CLTE 6:	Sub- samples to be cut and returned to Enersol for testing (Samples identical to TBL 1 sample)

The trial catered for three dumbbell sizes, 3mm, 4mm and 6 mm. In all cases, laboratories could choose one or more of the dumbbell sizes. Participating laboratories were supplied with the sizes they pre-selected during the invitation process.

### 8.4 Powder removal

Three natural rubber latex and one nitrile product were used for powder removal, all the products were different.

RP 1 and RP 2 were powder-free gloves, and RP 3 and RP 4 were powdered. There are minor differences in the methods prescribed for the powder-free and powdered gloves, including the number of gloves to be tested. This results in a slightly different method of expressing the results, and a different analysis in this report.

## 9 Packaging and dispatch of samples

Each laboratory's sub-samples were packed in re-sealable plastic bags. The bags were placed in a strong cardboard box, which was sent to the laboratories by courier or airmail.

Samples were sent on 20<sup>th</sup> April 2011 and laboratories were asked to confirm receipt of their samples by fax or by email. Of the 25 participants only a few laboratories supplied a receipt or returned the form supplied by Enersol. Confirming receipt is an important part of the trial process to ensure timely dispatch and receipt of samples. Enersol hopes that all laboratories will confirm receipt in future trials.

## 10 Receipt of results

Laboratories were initially requested to complete the tests by June 6<sup>th</sup> 2011, although most did not submit results on time and an extension was required.

In general, communications with the laboratories were effective. The first results were received on May 16<sup>th</sup> 2011 (Laboratory 11). Results from 7 other laboratories arrived before the deadline and most of the remaining data was received during July. The last data set arrived on August 8<sup>th</sup> 2011.

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Late submissions from twelve laboratories delayed the analysis and reporting process. Late submissions delay the feedback to all participants. Enersol hopes all participants return data before the deadline in future trials.

## 11 Presentation of results in this report

Each test involved the generation of a large number of results. The purpose of statistical analysis is to reduce these results to comprehensible summaries and to infer conclusions.

**Section 12** presents the main definitions to help in the understanding of this report

**Section 13** highlights the overall mean results, indicates the extreme results and provides comments and discussion of the results. It includes tables showing the consensus results, repeatability and reproducibility, after removing the extreme results. For the freedom from holes test, there are tables showing how many holes each laboratory found in each location, enabling comparison with the number of holes made by Enersol, and the number counted by Enersol from the gloves returned from the laboratories.

**Section 14** summarises the extreme results and

**Section 15** presents the overall conclusions

**Appendix A** provides graphical presentations and tables with the results for each test and laboratory in a number of ways, including:

- Histograms of laboratories' mean results
- Histograms of laboratories' standard deviations
- Summary statistics and extreme results

Histograms (frequency distributions) of the laboratories' mean results are presented for each of the samples. The mean results, by test and sample, of each laboratory relative to the others can be seen on the graphs. Each laboratory's result is shown by its code number. From these histograms, which are aligned vertically, one can in most cases examine the consistency of performance of each laboratory. The resolution of these histograms is limited, so the class intervals are not ideal in all cases.

Histograms of the standard deviations of the laboratories' results are also presented. These give a comparison of the repeatability of each laboratory's results on each test. Within each test, the same scale is used wherever possible.

The summary statistics, by test and sample, are presented in tables with the traditional statistical parameters, before and after removing the extreme results. The laboratories which had extreme results are identified by their code number. The repeatability and the reproducibility with their uncertainties, after removal of extreme results, are also presented.

### 11.1 Individual Laboratory Results

A unique laboratory code number was supplied to each participant and extra samples also received a separate code number. In addition to this main report, participants receive an individual report designed to provide, at a glance, information about how they performed.

The individual laboratory results are presented in the individual reports as three tables, these are:

**Table 1** - the results for **Watertightness** reported compared with the holes introduced

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**Table 2** - compares the laboratory's **mean results** with consensus means calculated from the analysis of all results

**Table 3** - compares the laboratory's **standard deviations** with a "pooled" standard deviation, calculated from the analysis of all results

Participants should investigate reasons for tests results on columns (2-3; >3); in Table 2 and 3 of the individual reports and further instruction on the interpretation appears in the individual reports.

## 12 Definitions

The following definitions are intended to help the understanding to this report.

**Accuracy** - the closeness of agreement between a test result and the "true" value.

**Coefficient of variation** - the ratio of the standard deviation to the mean (may be expressed as a percentage)

**Consensus mean** - the mean of the reported mean results calculated after excluding all extreme results (i.e. stragglers or outliers).

**Extreme result** - a result within a set of results that appears to have been derived from a different statistical distribution than the majority of the remaining results. It can be a straggler or an outlier.

**Outlier** - see repeatability outlier or reproducibility outlier.

**Pooled STD DEV** - a "consensus" standard deviation for a particular test result, taken over all participating laboratories, after excluding all extreme results. In principle it is calculated by taking square root of the sum of the squares of the individual standard deviations, and dividing by the number of laboratories.

**Precision** - the closeness of agreement of results obtained under stipulated conditions.

**Repeatability conditions** - conditions where mutually independent test results are obtained with the same method on identical test material in the same laboratory by the same operator using the same equipment within short intervals of time.

**Repeatability value (r)** - the value below which the absolute difference between two single test results obtained under repeatability conditions may be expected to lie with a probability of 95%.

**Reproducibility conditions** - conditions where test results are obtained with the same test method on identical test material in different laboratories with different operators using different equipment.

**Reproducibility value (R)** - the value below which the absolute difference between two single value test results obtained under reproducibility conditions may be expected to lie with a probability of 95%.

**Random error** - the deviation of a result from the "true" result, due to random causes.

**Repeatability extreme result** - an extreme result whose underlying distribution appears to have larger random error variability - either a straggler or an outlier.

**Repeatability straggler** - a repeatability extreme result significant at the 5% level but not significant at the 1% level.

**Repeatability outlier** - a repeatability extreme result significant at the 1% level.

**Reproducibility extreme result** - an extreme result whose underlying distribution appears to have a mean not from the population of means for the majority of the remaining results (straggler or outlier).

**Reproducibility straggler** - a reproducibility extreme result significant at the 5% level but not significant at the 1% level.

**Reproducibility outlier** - a reproducibility extreme result significant at the 1% level.

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**Sample** - for the purposes of this trial, a set of gloves for a particular test, taken from a production lot of gloves, and mixed in preparation for division amongst participating laboratories.

**STD DEV of means** - the standard deviation of the distribution of laboratory mean values (with extreme results excluded).

**Standard error** - the standard deviation of a distribution of value divided by the square root of the number of values in the data set. This value is also the standard deviation of the distribution of means obtained if the experiment is repeated.

**Straggler** - an extreme result significant at the 5% level but not at the 1% level.

**Sub-sample** - a selection of gloves from one sample sent to a particular laboratory. For watertightness, each sub-sample had a known number of gloves with artificially made holes included.

**Strength at break** also known as **Tensile strength (at break)** - the force at break divided by the original sample cross-sectional area

**Uncertainty** - the deviation from the "true" value for which 99 in every 100 estimates, independently estimated, are not expected to exceed. (Note that in many other situations, 95 out of 100 is used instead of 99 out of 100).

## 13 Summary and discussion of results

### 13.1 Dimensions

The definition of a test result on each measurement is as shown below:

Length:	single measurement on a glove (to nearest mm)
Width:	single measurement on a glove (to nearest mm)
Thickness:	one single-wall measurement at the designated point

Histograms of the mean, standard deviation and summary statistics are shown in Appendix A.

All results are summarised in Table 2, showing the precision components (repeatability and reproducibility).

**Table 2: Results - Dimensions**

Test	Sample	No. labs in estimate	Mean (mm)	Repeatability (mm)	Reproducibility (mm)
Length	LWT 1	22	251	17	21
	LWT 2	22	245	7	10
Width	LWT 1	16	108.0	2.1	4.0
	LWT 2	19	84.1	2.3	4.6
Thickness Finger-tip	LWT 1	17	0.274	0.084	0.124
	LWT 2	17	0.161	0.027	0.037
Thickness Palm	LWT 1	18	0.111	0.017	0.023
	LWT 2	17	0.139	0.011	0.018

#### 13.1.1 Length

Twenty two laboratories participated in this test.

There were no extreme results for both samples LWT 1 and LWT 2.

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### 13.1.2 Width

Twenty two laboratories participated in this test.

Laboratories 11, 55 and 228 were repeatability outliers in LWT 1 and laboratories 16, 47 and 52 were repeatability outliers for both samples LWT 1 and LWT 2.

### 13.1.3 Thickness

Twenty one laboratories performed finger-tip thickness and palm thickness.

The ISO standard states that the double wall thickness shall be measured, but that the single wall thickness shall be reported. Two laboratories (49 and 55) appeared to report double wall thickness for both samples LWT 1 and LWT 2. The mean values for laboratories 49 and 55 were approximately double the consensus value in all cases.

For finger-tip thickness, laboratories 23 and 49 were repeatability outliers on LWT 1. Laboratory 47 was a repeatability outlier for both LWT 1 and LWT 2 samples. Laboratories 49 and 55 were reproducibility outliers for both LWT 1 and LWT 2 samples. Laboratory 51 was a reproducibility straggler and laboratory 47 was a reproducibility outlier for the LWT 2 sample.

For palm thickness, laboratory 47 was a repeatability outlier for both LWT 1 and LWT 2 samples. They were also a reproducibility straggler for LWT 1 and reproducibility outlier on sample LWT 2. Laboratories 49 and 55 were reproducibility outliers for both samples LWT 1 and LWT 2. Laboratories 26 and 55 were repeatability outliers for LWT 2. Once again, laboratory 47 was a reproducibility outlier for LWT 2.

If the suspected double wall results were excluded and the results were re-analysed, it is likely that some other laboratories would show up as extreme results.

## 13.2 Watertightness

Twenty seven laboratories participated in this test.

The analysis of this test differs from the dimensions test in that the result of the latter is the mean of a series of measurements of a continuous variable, while the watertightness test is a test of attributes yielding a single integer as the result - the number of holes found.

Gloves are known not to be entirely hole-free. In order to minimise the probability of a naturally-occurring hole being confused with one introduced for the trial, the artificially made holes were placed at pre-determined locations.

The assembly of samples and the successful creation of holes was checked as carefully as practicable.

In view of the above, the techniques of analysis are different from those used for dimensions. In this case, the results obtained are compared with the number of holes introduced by Enersol, and not with consensus values.

The following summaries of results are presented:

1. Histograms of total holes found (Appendix A)
2. Summary of results (Table 3 and Table 4 in this main report)

Table 3 and Table 4 show the total number of holes and the location of holes reported by laboratories, by region on the glove, for samples H 1 and H 2, respectively.

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**Table 3: Watertightness - H 1 (regions and number of holes reported)**

Lab. code	Regions and numbers of holes										Total made by Enersol & found by labs	Extras found in Enersol regions	Total found in other regions	Total found
	B	C	D	E	H	I	K	M	N	O				
1	1	2	2	1	2	2	1	1	2	2	16	0	1	17
2	1	2	2	1	2	2	1	1	2	2	16	3	1	20
5	1	2	2	1	2	2	1	1	2	2	16	0	0	16
11	1	2	2	1	2	2	1	0	2	2	15	2	1	18
14	0	1	1	0	0	1	1	1	0	1	6	2	2	10
16	1	2	2	1	2	2	1	1	2	2	16	1	1	18
21	0	2	0	0	2	0	0	1	1	1	7	0	7	14
221	1	2	2	0	2	2	1	1	2	2	15	0	1	16
321	0	2	2	1	2	2	1	1	2	2	15	1	0	16
23	1	2	2	1	2	2	1	1	2	2	16	0	1	17
26	1	1	2	0	1	2	0	0	2	2	11	0	0	11
28	1	2	2	1	2	2	1	1	2	2	16	1	1	18
228	1	2	2	1	2	2	1	1	2	1	15	2	3	20
31	1	2	2	1	2	2	1	1	2	1	15	1	1	17
34	1	2	2	0	2	2	1	1	2	2	15	2	0	17
43	1	2	1	1	2	2	1	1	2	2	15	1	0	16
243	1	2	2	1	2	2	1	1	2	2	16	0	0	16
343	1	2	2	1	2	2	1	1	2	2	16	1	2	19
44	1	2	2	1	2	2	1	1	2	2	16	0	0	16
47	1	2	2	1	0	1	1	0	2	0	10	3	3	16
49	0	2	0	0	2	1	0	1	1	2	9	0	17	26
50	1	2	1	1	2	2	1	1	1	2	14	2	0	16
51	1	1	1	1	2	2	1	1	2	0	12	0	2	14
52	1	2	2	1	2	2	1	1	2	2	16	1	2	19
53	1	2	2	1	2	1	1	1	2	2	15	0	1	16
54	1	2	2	1	2	2	1	1	2	2	16	0	0	16
55	1	2	2	1	2	2	1	1	1	2	15	0	0	15
<b>Made</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>16</b>	<b>0</b>	<b>0</b>	

**Table 4: Watertightness - H 2 (regions and number of holes reported)**

Lab. code	Regions and numbers of holes										Total made by Enersol & found by labs	Extras found in Enersol regions	Total found in other regions	Total found
	A	C	F	G	H	L	M	N	O	P				
1	1	2	2	2	2	1	1	1	1	1	14	1	0	15
2	1	2	2	2	2	1	1	1	1	1	14	5	9	28
5	1	2	2	2	2	1	1	1	1	1	14	0	3	17
11	1	2	2	2	2	1	1	1	1	1	14	0	3	17
14	0	0	0	0	2	0	1	0	1	0	4	2	3	9
16	1	2	2	2	2	1	1	1	1	1	14	0	1	15
21	0	2	1	0	2	0	1	1	1	1	9	2	5	16
221	1	2	2	2	2	1	0	1	1	1	13	0	2	15
321	1	2	2	2	2	1	1	1	1	1	14	0	3	17
23	1	2	2	2	2	1	1	1	1	1	14	0	0	14
26	1	2	1	2	1	0	1	1	1	1	11	0	1	12
28	1	2	2	1	2	1	1	0	1	1	12	6	7	25
228	1	2	2	1	2	0	1	1	0	1	11	3	11	25
31	1	2	2	2	2	0	1	0	1	1	12	3	2	17
34	0	2	2	2	2	1	1	0	0	1	11	0	3	14
43	1	2	2	2	2	1	1	1	1	1	14	0	1	15
243	1	2	1	0	1	1	1	1	1	1	10	4	2	16
343	1	2	2	2	2	1	1	1	1	1	14	0	4	18
44	1	2	2	2	2	1	1	1	1	1	14	4	12	30
47	1	2	1	1	0	1	1	0	1	0	8	3	2	13
49	0	2	0	0	2	0	1	1	1	0	7	3	8	18
50	1	2	2	2	1	1	1	1	1	1	13	2	4	19
51	1	2	2	0	2	1	1	1	1	1	12	0	2	14
52	1	2	2	2	2	1	1	1	1	1	14	2	2	18
53	1	2	2	2	1	1	1	1	0	1	12	0	0	12
54	1	2	2	2	2	1	1	1	1	1	14	0	0	14
55	1	2	2	2	2	1	1	1	1	1	14	0	1	15
<b>Made</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>14</b>	<b>0</b>	<b>0</b>	

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Overall, the laboratories found 88% of the holes introduced in the natural rubber latex gloves and 86.5% of the introduced holes in the vinyl gloves.

There were 11 laboratories (1, 2, 5, 16, 23, 28, 44, 52, 54, 243 and 343) that found all holes introduced into the H 1 samples and 13 laboratories (1, 2, 5, 11, 16, 23, 43, 44, 52, 54, 55, 321 and 343) that found all holes introduced into the H 2 samples. Nine laboratories found all holes in both samples, compared with only 2 laboratories last year.

For sample H 1, nine laboratories missed one hole, and 2 laboratories missed one hole for sample H 2.

Laboratory 14 found the least number of holes in both samples. This laboratory found only 6 out of 16 holes in H 1 and 4 out of the 14 holes in H 2 (only 33% of the holes made in the 2 samples). This laboratory should check its testing equipment, technicians and test methodology. Laboratories 21, 47 and 49 also found relatively few holes on both samples (53 to 60% of the holes made).

Based on the returned data and gloves with holes, it appears that laboratories 21 and 49 may have swapped their samples of H1 and H2. If this were correct, then these two laboratories would have found almost all the introduced holes rather than only half of the holes

Examination of the results shows that many laboratories found additional holes in the products, which were not introduced by Enersol, and therefore must have been present in the product as supplied.

For the H 1 samples, a total of 70 additional holes were found out of 2700 gloves tested, and a total of 131 additional holes were found for H 2. These holes were not evenly distributed among the laboratories. It must be concluded that the vinyl gloves used in this study, although sold as examination gloves, do not conform to the watertightness requirements of the international standards.

The areas where the fewest holes were found in H 1 samples were at the E, B and C (the tip of the fingers) regions. For H 2 samples the fewest holes were found in the G, L and N regions.

### 13.3 Tensile properties

The commonly used standards use the following five tensile properties:

- Force at break
- Elongation at break
- Force at 300% elongation
- Tensile strength at break (ASTM standard)
- Stress at 500% elongation (ASTM standard)

Tensile strength at break is no longer used in ISO and EN standards, both of which use force as a measure of strength. Tensile strength at break is calculated from force at break and physical dimensions, and was included for those laboratories working with the ASTM standard. Elongation is not required in the EN standard, but remains in the ISO and ASTM standards.

Information is presented here in the same format as the results for dimensions.

For tensile properties, the sample cutter is a dumbbell, which can be a throat size of 6mm, 4mm or 3mm, depending on the standard used. For the ISO standard, only the type 2 (4 mm throat) cutter is used. The ASTM uses type C (6mm throat) and type D cutters (3 mm throat). Laboratories were given the opportunity to use any or all of these cutters. The European standard also uses 3mm type D cutters.

All participating laboratories received glove sub-samples for each the dumbbell size chosen to test and were requested to cut and test 3 pieces per glove and return the median result of each set of 3 pieces. Similarly for the CLTE 6 samples laboratories were requested to cut 3 pieces per glove and return them to Enersol for testing. The median result of each set of 3 pieces is used in the analysis. Some

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laboratories returned only 2 pieces per glove and in these cases Enersol used the average. For CETL 5, laboratories received 30 dumbbell samples (3 dumbbell pieces per glove individually wrapped) cut by Enersol, and were asked to test them, and return the results.

### 13.3.1 Force at break

Eighteen laboratories returned results for 6mm dumbbells, sixteen laboratories returned results for 4mm dumbbells and twelve laboratories returned results for 3mm dumbbells.

#### 13.3.1.1 6mm dumbbell

Table 5 summarises the results for 6mm dumbbells. There were no extreme results for TBL 1.

Laboratory 26 was a repeatability outlier on the TBL 2 sample, and laboratory 46 was a repeatability straggler. Lab 49, although not a statistical outlier, reported the lowest mean force for TBL-1, TBL-2, TBLA-3 and TBLA-4. Their results were slightly higher for CLTE-6, and significantly better for CETL-5. This suggests that the lab has problems with sample cutting.

For the oven-aged samples, laboratory 14 was a reproducibility outlier for both samples TBLA 3 and TBLA 4. This lab returned results much higher than the consensus mean. It is recommended the laboratory checks the oven temperature and the calibration. Lab 14's mean was also towards the high end of the forces for TBL-1, TBL-2, and CLTE-6.

For the samples cut by Enersol, CETL5 and cut by laboratories CLTE 6, there were no extreme results for both samples.

**Table 5: Results for force at break (N) - 6mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	18	12.2	4.0	4.4
	TBL 2	16	6.9	1.2	2.5
Oven-aged, cut and tested by laboratories	TBLA 3	17	11.7	4.6	4.9
	TBLA 4	17	6.7	1.2	2.2
Pieces cut by Enersol and tested by laboratories	CETL 5	18	12.6	5.0	5.1
Pieces cut by labs and tested by Enersol	CLTE 6	18	13.2	5.4	5.7

#### 13.3.1.2 4mm dumbbell

Table 6 summarizes the results for 4mm dumbbells.

Laboratory 47 was a reproducibility straggler for sample TBL 1 and a repeatability outlier on TBL 2.

For the oven-aged samples, there were no extreme results on TBLA 3. Laboratory 47 was a repeatability outlier on TBLA 4.

For the samples cut by Enersol (CETL 5), laboratory 47 was a reproducibility straggler, as they were in sample TBL 1. Laboratory 47 needs to examine its tensile testing equipment and methodology. Although their results were not extreme. Laboratories 49 and 51 reported consistently low means .

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There were no extreme results for CLTE 6.

**Table 6: Results for force at break (N) - 4mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	15	8.9	3.0	3.6
	TBL 2	14	4.9	1.0	2.4
Oven-aged, cut and tested by laboratories	TBLA 3	16	8.0	3.3	4.0
	TBLA 4	14	5.0	0.9	2.3
Pieces cut by Enersol and tested by laboratories	CETL 5	14	8.9	3.3	3.5
Pieces cut by labs and tested by Enersol	CLTE 6	16	9.2	3.8	4.2

### 13.3.1.3 3mm dumbbell

Table 7 summarises the results for 3mm dumbbells. As in previous years, this size of dumbbell was used by fewer laboratories than the others.

For the unaged samples, there were no extreme results. For the oven-aged samples, there were no extreme results on TBLA 3. Laboratory 243 was a repeatability outlier for TBLA 4.

For the samples cut by Enersol, CETL5, and cut by laboratories CLTE 6, there were no extreme results.

**Table 7: Results for force at break (N) - 3mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	12	7.1	3.0	3.2
	TBL 2	12	3.7	0.8	1.3
Oven-aged, cut and tested by laboratories	TBLA 3	12	6.3	2.5	2.8
	TBLA 4	11	3.6	0.7	1.3
Pieces cut by Enersol and tested by laboratories	CETL 5	12	6.8	2.8	3.1
Pieces cut by labs and tested by Enersol	CLTE 6	12	6.8	2.8	2.8

### 13.3.2 Elongation at break

Elongation is normally measured at the same time as force at break.

#### 13.3.2.1 6mm dumbbell

Table 8 summarises the results for 6mm dumbbells.

Laboratory 51 was a repeatability straggler on TBL 1, with the lowest mean results. There were no extreme results in TBL 2. Labs 44 and 244 had high means on TBL 1 but were not extreme.

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For the oven-aged samples, laboratories 44, 244 and 51 were reproducibility outliers in TBLA 3. Laboratory 51 reported the lowest values for TBLA 3 and laboratories 44 and 244 reported higher values than the consensus mean.

Laboratory 1 was a repeatability straggler for TBLA 3 and a repeatability outlier in TBLA 4. This laboratory needs to check the calibration and temperature of its oven.

For samples cut by Enersol (CETL 5), laboratory 51 was a reproducibility straggler and laboratory 244 was a reproducibility outlier. As in TBL 1, laboratory 51 reported the lowest mean and laboratory 244 reported the highest mean results compared with the consensus mean. These laboratories should check their machinery and calculations carefully if they are using a manual tensile machine.

For the samples cut by participants (CLTE 6), there were no extreme results.

Measurement of elongation appears to be an issue in this test, since the distribution of mean results is much narrower for CLTE 6 (where all the elongations were measured by Enersol) than for TBL 1, TBLA 3 and CETL 5.

**Table 8: Results for elongation at break (%) - 6mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	17	622	85	156
	TBL 2	18	374	62	145
Oven-aged, cut and tested by laboratories	TBLA 3	14	578	77	101
	TBLA 4	17	360	58	122
Pieces cut by Enersol and tested by laboratories	CETL 5	16	612	93	103
Pieces cut by labs and tested by Enersol	CLTE 6	18	609	105	107

### 13.3.2.2 4mm dumbbell

Table 9 summarises the results for 4mm dumbbells.

There were no extreme results for TBL 1.

Laboratory 44 was a repeatability outlier for TBL 2 with a high standard deviation.

Laboratory 51 reported the lowest mean values in both samples of TBL 1 and TBL 2.

For the oven-aged samples, Laboratory 44 was a repeatability outlier for both samples of TBLA 3 and TBLA 4.

For samples cut by Enersol (CETL 5) and samples cut by laboratories (CLTE 6), there were no extreme results.

The distribution of mean results is much narrower for CLTE 6 (where all the elongations were measured by Enersol) than other 5 samples tested by the participants.

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**Table 9: Results for elongation at break (%) - 4mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	16	597	91	149
	TBL 2	14	381	60	176
Oven-aged, cut and tested by laboratories	TBLA 3	15	572	95	106
	TBLA 4	14	371	55	186
Pieces cut by Enersol and tested by laboratories	CETL 5	15	606	96	125
Pieces cut by labs and tested by Enersol	CLTE 6	16	610	112	115

### 13.3.2.3 3mm dumbbell

Table 10 summarises the results for 3mm dumbbells.

There were no extreme results for all 6 samples tested.

Laboratory 50 reported lowest values in all 5 samples tested by them, they should check their tensile machine and the calculations if they are using manual elongation determination.

**Table 10: Results for elongation at break (%) - 3mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	10	628	102	114
	TBL 2	10	394	64	145
Oven-aged, cut and tested by laboratories	TBLA 3	10	591	78	107
	TBLA 4	10	389	59	162
Pieces cut by Enersol and tested by laboratories	CETL 5	10	622	85	102
Pieces cut by labs and tested by Enersol	CLTE 6	12	606	101	102

### 13.3.3 Force at 300% elongation

Table 11 summarises the results. This test is required for the ISO standard for new surgical gloves only and the 4mm dumbbell is used.

Laboratory 51 was a repeatability outlier for TBL 1. Laboratories 44 and 50 were repeatability outliers for TBL 2.

For the samples cut by Enersol (CETL 5), there were no extreme results.

For the samples cut by participants (CLTE 6), laboratory 51 was reproducibility straggler.

Laboratory 51 should check their equipment and methodology carefully, as they reported the lowest for this test and also for the elongation.

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**Table 11: Results for force at 300% elongation (N) - 4mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	14	1.51	0.37	0.60
	TBL 2	10	3.99	0.64	0.99
Pieces cut by Enersol and tested by laboratories	CETL 5	14	1.51	0.38	0.64
Pieces cut by labs and tested by Enersol	CLTE 6	15	1.48	0.45	0.51

### 13.3.4 Tensile strength at break

This test is only required for the ASTM standards and the 6mm and 3mm dumbbells are used.

Table 12 and Table 13 summarise the results for 6mm and 3mm dumbbells respectively.

#### 13.3.4.1 6mm dumbbell

There were no extreme results for the TBL 1 and TBL 2 samples. Lab 2 reported the highest mean for both samples.

For the samples cut by Enersol (CETL 5), laboratory 1 was a repeatability straggler.

For the samples cut by laboratories and tested by Enersol (CLTE 6), there were no extreme results.

**Table 12: Results for tensile strength at break (MPa) - 6mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	18	18.5	4.7	5.2
	TBL 2	18	15.0	2.5	4.9
Pieces cut by Enersol and tested by laboratories	CETL 5	17	18.4	4.9	6.5
Pieces cut by labs and tested by Enersol	CLTE 6	18	18.5	5.9	6.2

#### 13.3.4.2 3mm dumbbell

Laboratories 46 and 49 were reproducibility stragglers on TBL 1, with the highest and lowest means, respectively. There were no extreme results for TBL 2 samples, but laboratories 46 and 49 again had the highest and lowest means.

For the samples cut by Enersol (CETL 5) and the samples cut by participants and tested by Enersol (CLTE 6) there were no extreme results.

**Table 13: Results for tensile strength at break (MPa) - 3mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	8	21.2	5.9	5.9
	TBL 2	10	16.1	2.9	4.6
Pieces cut by Enersol and tested by laboratories	CETL 5	10	19.9	5.7	6.6
Pieces cut by labs and tested by Enersol	CLTE 6	12	19.4	6.4	6.9

### 13.3.5 Stress at 500% elongation

This test is only required for the ASTM standards, and the 6mm and 3mm dumbbells are used. It was done only on the latex samples.

Table 14 and Table 15 summarise the results for 6mm and for 3mm dumbbells, respectively.

#### 13.3.5.1 6mm dumbbell

Laboratory 51 was a repeatability outlier for TBL 1.

For the samples cut by Enersol (CETL 5), laboratories 14 and 51 were repeatability outliers. Lab 34 had the highest mean for both TBL 1 and CETL 5.

For the samples cut by participants and tested by Enersol (CLTE 6) there were no extreme results.

**Table 14: Results for stress at 500% elongation (MPa) - 6mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	16	9.5	3.3	5.9
Pieces cut by Enersol and tested by laboratories	CETL 5	14	9.6	3.6	5.2
Pieces cut by labs and tested by Enersol	CLTE 6	18	9.6	3.8	4.0

#### 13.3.5.2 3mm dumbbell

There were no extreme results for all samples tested (TBL 1, CETL 5 and CLTE 6). Lab 50 reported a high mean for both TBL 1 and CETL 5, while lab 26 reported the lowest.

**Table 15: Results for stress at 500% elongation (MPa) - 3mm Dumbbell**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
New gloves, cut and tested by laboratories	TBL 1	10	9.7	4.2	5.1
Pieces cut by Enersol and tested by laboratories	CETL 5	10	9.7	3.5	4.3
Pieces cut by labs and tested by Enersol	CLTE 6	12	10.3	4.1	4.3

### **13.3.6 Tensile sample cutting**

Sample CLTE 6 involved laboratories cutting samples and sending them to Enersol for testing. Therefore it was possible for Enersol to examine the appearance of the cut samples before being testing them. The standard of cutting of the dumbbell throat and nearby portions was generally good. Only one laboratory (51) sent samples without a clean cut along the narrow part of the 4mm dumbbell sample. This caused low results in the elongation properties.

### **13.3.7 Comparison of dumbbell sizes**

Comparison of Force at Break results show that the 6mm dumbbells on average give a force 1.85 times the equivalent 3 mm sample, while it would be expected that the force should be double. On the other hand, the 4 mm dumbbells gave a mean result of 1.32 times the equivalent 3 mm result, approximately what would be expected if the force were proportional to the throat width.

Strength at Break results show that the 3mm dumbbell, on average, gave a tensile strength about 7.5% higher than the 6mm dumbbell.

For elongation, the mean results for the 3 mm and 4 mm samples were almost identical, but the 6 mm samples gave an approximately 3% lower mean.

By comparison with the differences between laboratories, these differences between sample types are relatively small. As far as test design is concerned, any dumbbell size can be chosen, as long as the limits (especially for force) are selected appropriately.

## **13.4 Powder removal**

The ISO 21171 and ASTM D-6124 standards provide two very similar methods for measuring powder content on gloves. They both involve washing the powder off the gloves and collecting it on filter paper, which is dried and weighed before and after filtering. The details of the method vary according to whether powdered or powder-free gloves are tested.

For powder-free gloves, the procedure involves washing 5 gloves with the same water. For powdered gloves, gloves are washed two at a time. In the case of the powdered gloves, three replicate samples of two gloves were supplied for the test.

In both cases, the standards require the result to be reported as the average mass of powder per glove. For powder-free gloves, the result is required to be in mg. For powdered gloves, the requirement for units is less specific.

Samples RP 1 and RP 2 were powder free gloves, and RP 3 and RP 4 were powdered gloves.

Table 16 summarises the results for Powder removal.

For powder-free samples, the extreme results were calculated for the pair of samples, as there is only one measurement per sample. Laboratory 50 was a repeatability extreme result - a straggler for RP 1 - with high values for RP 1 and low values for RP 2 and it also had a very high mean for RP 1. Lab 52 also had high means for both samples, but was not an extreme result.

For powdered samples, there were no extreme results for RP 3. Laboratory 28 was a reproducibility straggler for RP 4, with a relatively high mean.

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Although according to the standard and the spreadsheet for data return the data should be in mg, still one lab (14) appeared to have sent its data in grams.

The spreadsheet (and the standard) required reporting the average results of the five powder-free gloves. There were four laboratories (28, 49, 50 and 52) who may have sent the total powder removal from the 5 gloves instead of the average required in the standard

For the powdered samples, one laboratory (28) may have sent the results for the two gloves for RP 4 instead of the average of the two gloves tested.

There is a wide range in the results for both types of samples, especially the powder-free samples. Examination of the test method in the standards show areas where the method is imprecisely defined, particularly the amplitude of shaking to be done and the amount of washing. For the powder free samples, the reproducibility is more than three times the mean result. This suggests that the numerical value of the result is not very meaningful. As the mean results are both less than 1 mg, it must be recognised that what is being washed off the gloves may not be all powder, and that some of the material may have landed on the glove in the testing lab or the box.

**Table 16: Results for powder removal (mg)**

Test	Sample	Number of laboratories in estimate	Mean	Repeatability	Reproducibility
Powder-free	RP 1	9	0.84	0.25	2.87
	RP 2	9	0.76		
Powdered	RP 3	9	70.41	15.97	94.05
	RP 4	8	40.17	18.50	69.83

### 14 Extreme results

Table 17 shows the number of tests performed and the number of extreme results for each participating laboratory.

Only those tests with a variable as an outcome are included in the extreme results.

In analysing this table, it should be borne in mind that an extreme result can occur by chance, and that if the laboratory does enough tests on inherently variable products, it is likely that one will occur.

All extreme results should be investigated, but laboratories with many extreme results should investigate particularly thoroughly.

While every extreme result should be investigated, those laboratories with several extreme results should pay attention not only to the test methods concerned, but to their procedures, equipment, calibration and laboratory skills in general.

In addition, laboratories identified in the test discussions should also pay attention to the methods, procedures, equipment, calibration and laboratory skills in general.

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**Table 17: Extreme results by laboratories**

Lab. Code	No. tests	Total Extreme Results	Total No. Extremes / No. tests	Lab. Code	No. tests	Total Extreme Results	No. Extremes / No. tests
1	43	3	0.07	343	8	0	0.00
2	43	0	0.00	44	42	5	0.12
5	66	0	0.00	244	19	2	0.11
11	26	1	0.04	45	11	0	0.00
14	31	3	0.10	46	54	2	0.04
16	25	2	0.08	47	21	10	0.48
23	62	1	0.02	49	65	5	0.08
26	50	2	0.04	50	66	2	0.03
28	66	1	0.02	51	39	8	0.21
228	46	1	0.02	52	17	2	0.12
34	43	0	0.00	53	17	0	0.00
43	66	0	0.00	55	8	5	0.63
243	66	1	0.02				

The watertightness test is shown separately in Table 18 where the proportion of introduced holes found by each laboratory is shown.

No formal definition of extreme results has been attempted, but the lower the proportion of holes found, the more pressing the need for the laboratory concerned to investigate the causes.

**Table 18: Proportion of holes found by each laboratory**

Lab. Code	% Holes found (H1 and H2)	Lab. Code	% Holes found (H1 and H2)	Lab. Code	% Holes found (H1 and H2)
1	100	23	100	44	100
2	100	26	73	47	60
5	100	28	93	49	53
11	97	228	87	50	90
14	33	31	90	51	80
16	100	34	87	52	100
21	53	43	97	53	90
221	93	243	87	54	100
321	97	343	100	55	97

In many cases, new participants in the trial had a high proportion of extreme results. This should not be regarded as bad; it is part of the value of participation in an Interlaboratory proficiency trial, as it indicates where improvement needs to be made. It is to be expected that with repeated participation, laboratories will find that they have fewer extreme results.

## 15 Conclusions

This trial has shown the level of agreement amongst laboratories on the tests usually conducted on gloves. It is clear that most laboratories understand the fundamentals of the testing procedures and reporting.

It should be noted that the criteria for defining extreme results used in this report are relatively liberal, and that some of the results that are not statistically extreme could still be the cause of important differences in practice.

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The length tests were generally well done, with no extreme results for both samples tested.

For the width tests there were a few laboratories with repeatability stragglers and outliers for both samples tested.

In the thickness test, two laboratories reported what appears to be double-wall thickness results instead of the single-wall thickness value required in the standards. We hope that in next year's trial they remember to report the data as single-wall. While some laboratories may consider this to be a minor clerical error, their customers have no way of knowing that such an error has been made, and may make wrong decisions based on the data.

For watertightness, there were 4 laboratories who found 60% or fewer of the introduced holes, and one of these found only 33%. In the Watertightness test about 88% of the introduced holes were detected overall, which is about 3% higher than last year. Clearly, while there is an overall improvement, some laboratories are still not discovering all the introduced holes. The number of holes found in sample H2 (Vinyl gloves) which were not introduced by Enersol raises concerns about the quality of the gloves being supplied, but labs who found very high numbers of these should verify that their technicians are not being over-zealous in their handling of the gloves.

Based on the returned data and gloves with holes, it appears that 2 laboratories may have swapped their samples of H1 and H2. If this were correct, then these two laboratories would have found almost all the introduced holes rather than only half of the holes. While the test may have been done correctly, the result is not useful to the client if the sample identities are exchanged.

Tensile properties of various kinds dominate the trial, and the majority of extreme results occurred in the tensile tests.

Sample cutting is no longer a dominant contributor to bad tensile results and the testing technique and the tensile testing machine itself now appear to have a larger effect. Special care should be taken when inserting the sample into the grips and care should also be taken for those laboratories who read data manually, to ensure the extension is being read correctly.

Determination of powder quantity on powdered gloves now appears to be performed at a level of competence approaching that of other tests. There is still a very large range of results for the powder-free products, casting continuing doubt on the value of numerical results from the test. In fact, the reproducibility was worse than in 2010. The procedures given in the standards for these tests need to be revised to define the amplitude of shaking and the method of washing, before any further consistency can be expected.

This year's trial produced one repeatability extreme result for the powder free samples and there was one laboratory with extreme results on one of the powdered gloves samples. There was still a substantial range in the mean results for all four samples.

While the range of results in some tests is relatively large, it must be remembered that this is due partly to the inherent variability of the product.

It is to be hoped that laboratories whose results are not close to the consensus will study the relevant standards, their calibration, equipment, procedures and training to try to identify possible causes for the differences. In many cases, the assistance of an outside expert, familiar with glove testing techniques, would be useful. You can contact Enersol for technical advice on glove testing or manufacturing.

## **16 Contact Enersol**

If you have any inquiries about this trial or to discuss your results, please contact ENERSOL using one of the methods below:

Phone: +61 2 9552 1707

Fax: +61 2 9552 1709

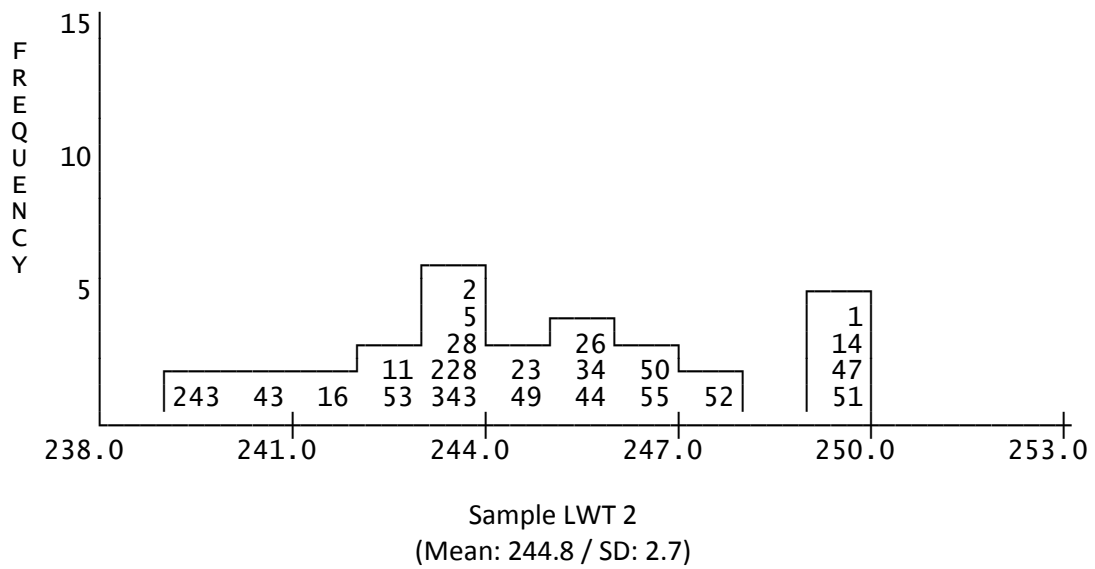
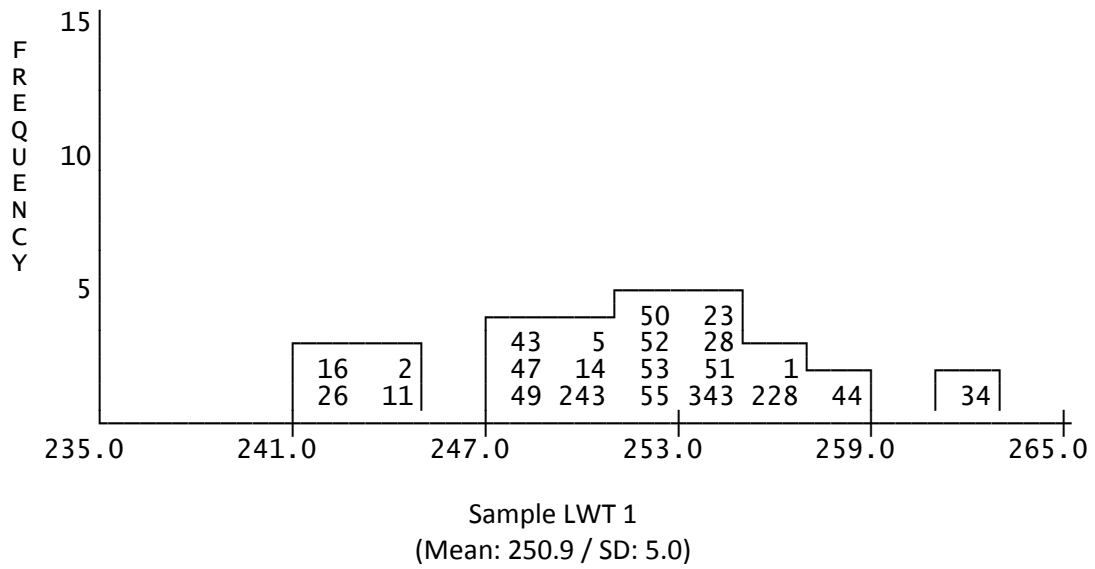
E-Mail: [interlab-trials@enersol.com.au](mailto:interlab-trials@enersol.com.au)

**APPENDIX A**

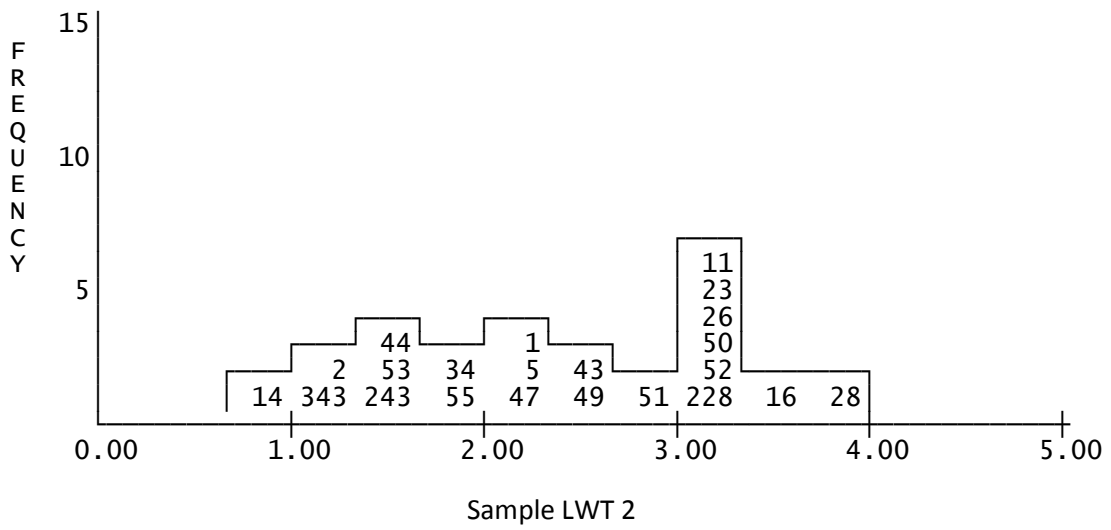
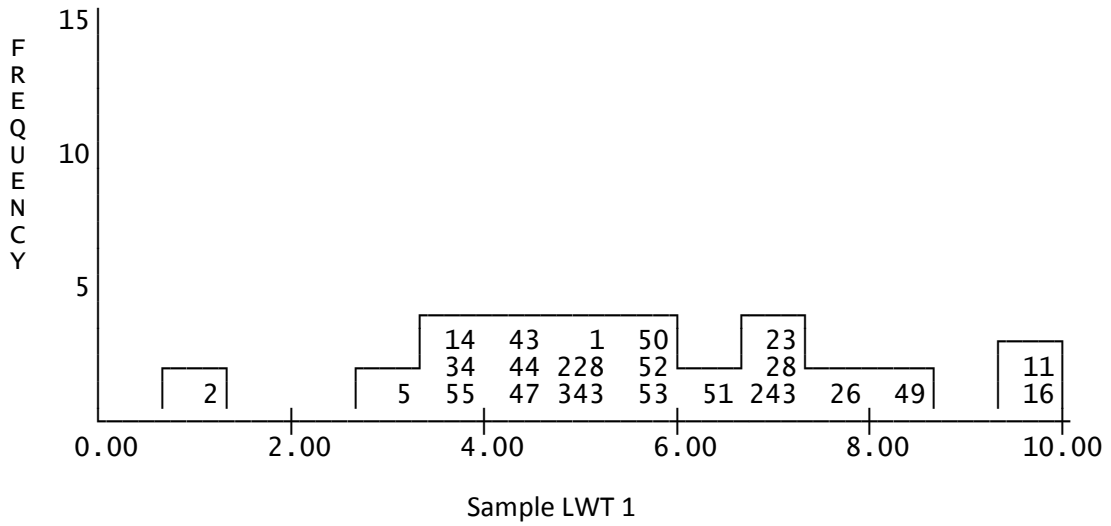
**HISTOGRAMS AND SUMMARY  
STATISTICS BY TEST**

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**Length (mm) - Laboratory Means**



**Length (mm) - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Length (mm)**

**Sample LWT 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	22	22	Repeatability Outliers	None
Mean	250.9	250.9	Reproduc'tility Stragglers	None
Std Dev'n	5.0	5.0	Reproduc'tility Outliers	None
Std Error	1.1	1.1		
Coef Var'n	2.0	2.0		
Minimum	242.2	242.2		
Maximum	261.5	261.5		
Range	19.3	19.3		

**Sample LWT 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	22	22	Repeatability Outliers	None
Mean	244.8	244.8	Reproduc'tility Stragglers	None
Std Dev'n	2.7	2.7	Reproduc'tility Outliers	None
Std Error	0.6	0.6		
Coef Var'n	1.1	1.1		
Minimum	239.6	239.6		
Maximum	249.1	249.1		
Range	9.5	9.5		

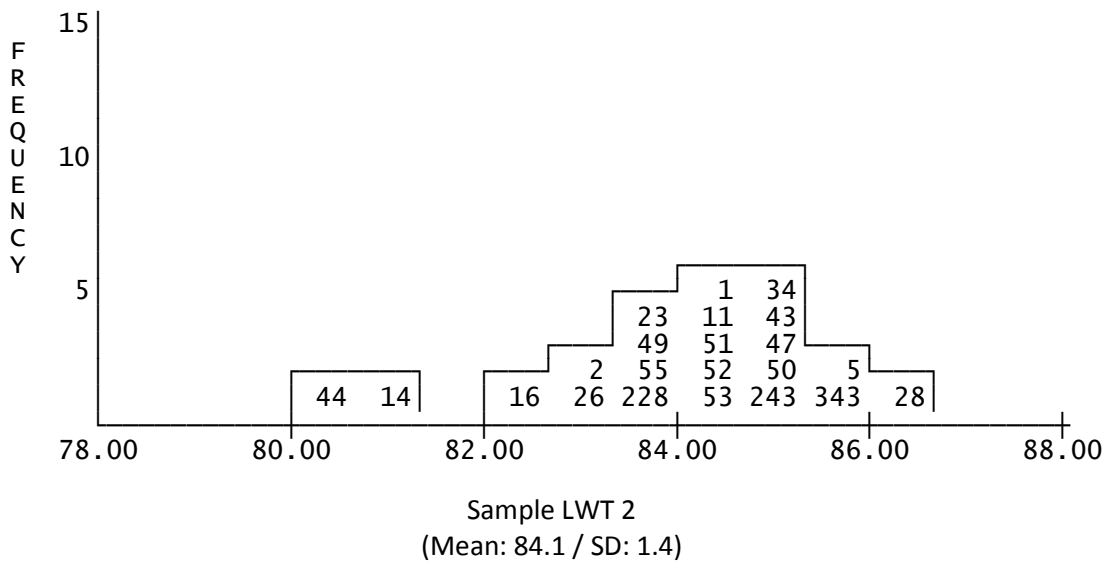
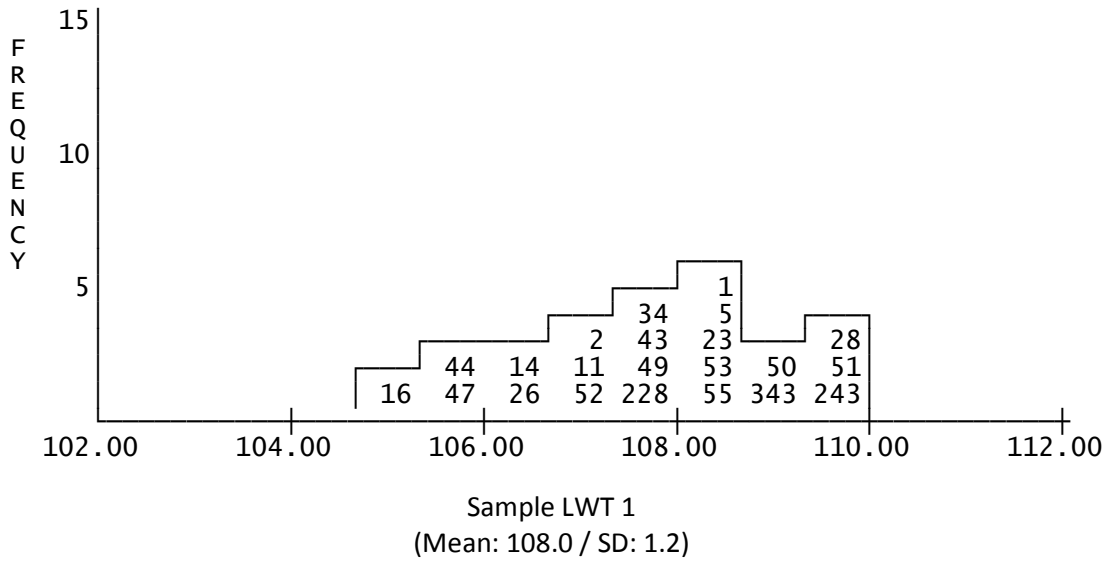
**PRECISION ACHIEVED (after removal of extreme results)**

LENGTH (mm)

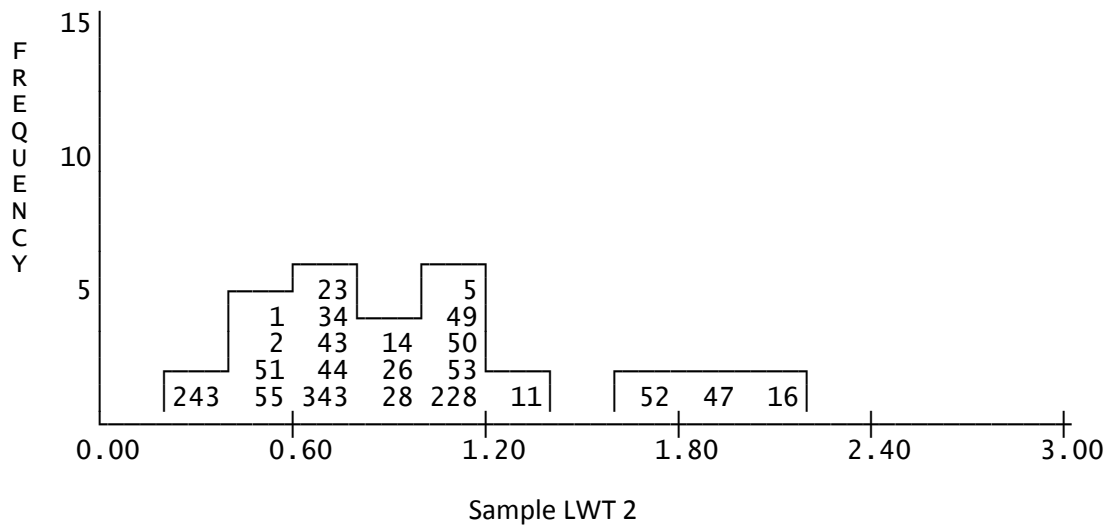
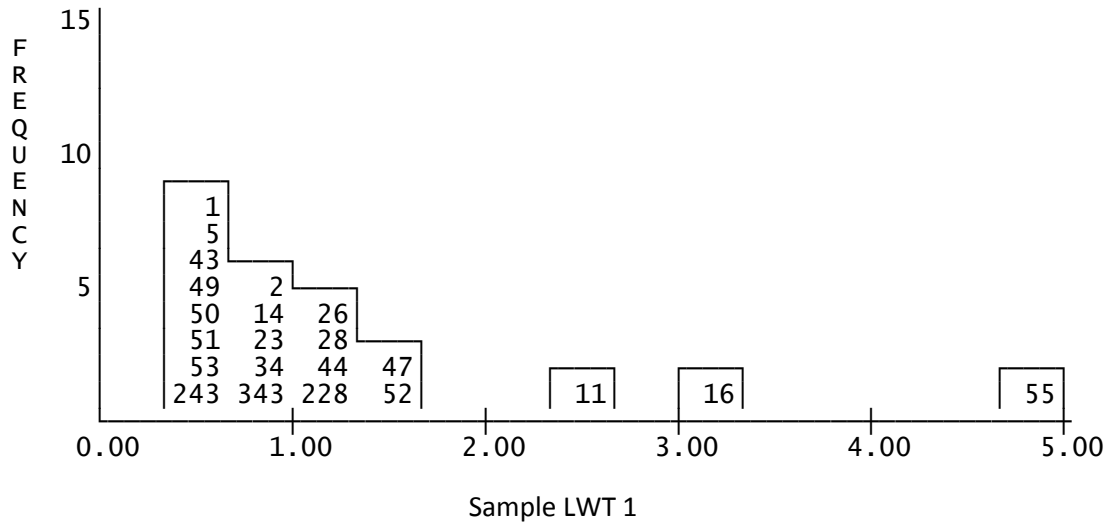
Sample : LWT 1  
 Number of Laboratories : 22  
 Consensus Mean : 250.9  
 Repeatability Estimate : 16.8 ± 2.5  
 Reproducibility Estimate : 21.3 ± 4.7

Sample : LWT 2  
 Number of Laboratories : 22  
 Consensus Mean : 244.8  
 Repeatability Estimate : 7.1 ± 1.1  
 Reproducibility Estimate : 10.2 ± 2.8

**Width (mm) - Laboratory Means**



**Width (mm) - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Width (mm)**

**Sample LWT 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	Reproducibility Outliers
No. Labs	22	16	None	
Mean	107.7	108.0	11,16,47,52,55,228	
Std Dev'n	1.4	1.2		
Std Error	0.3	0.3		
Coef Var'n	1.3	1.1	None	
Minimum	104.8	105.6		
Maximum	109.8	109.8		
Range	5.0	4.2	None	

**Sample LWT 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	Reproducibility Outliers
No. Labs	22	19	None	
Mean	84.0	84.1	16,47,52	
Std Dev'n	1.4	1.4		
Std Error	0.3	0.3		
Coef Var'n	1.6	1.7	None	
Minimum	80.3	80.3		
Maximum	86.1	86.1		
Range	5.8	5.8	None	

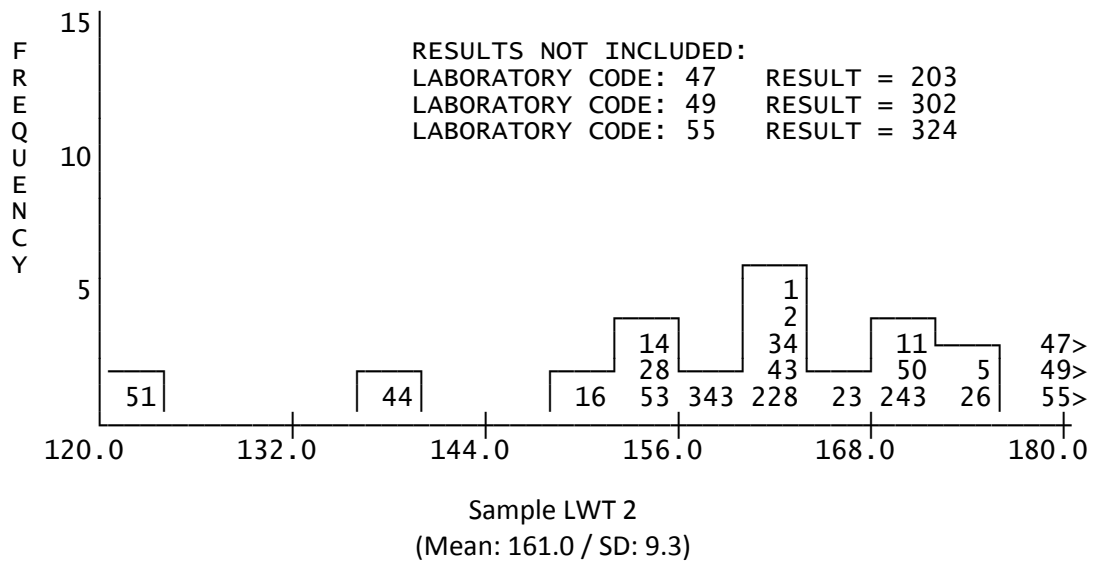
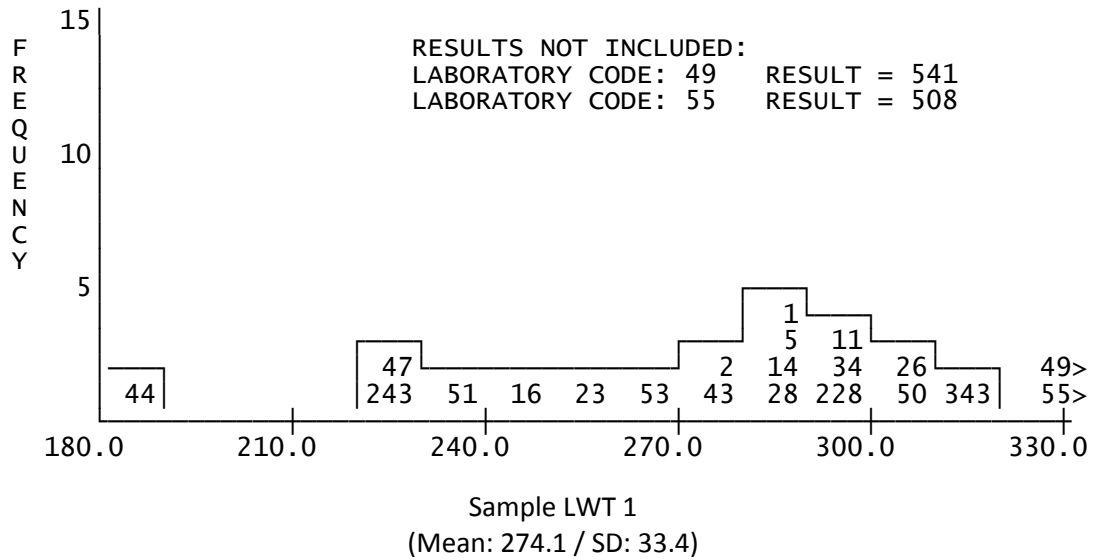
**PRECISION ACHIEVED (after removal of extreme results)**

WIDTH (mm)

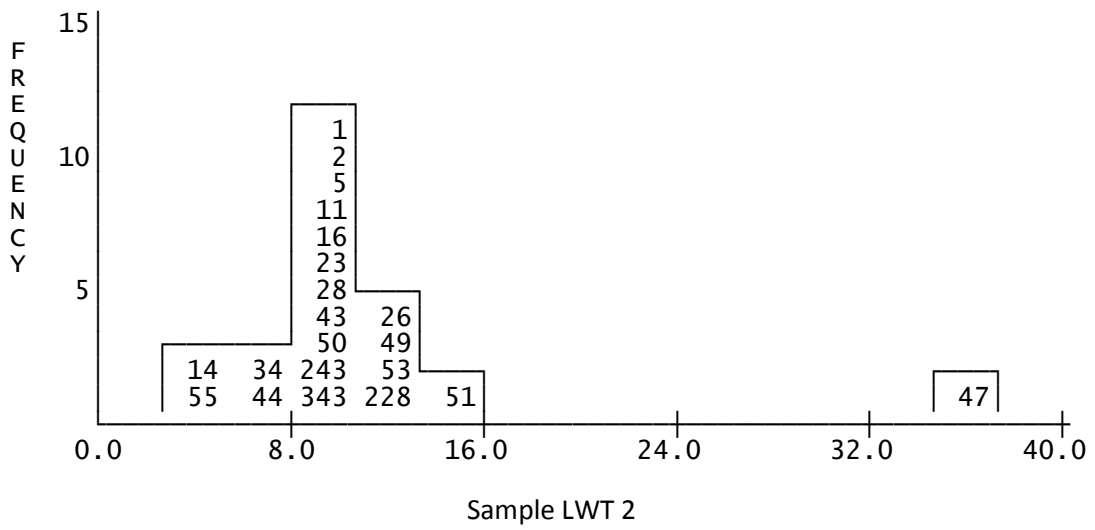
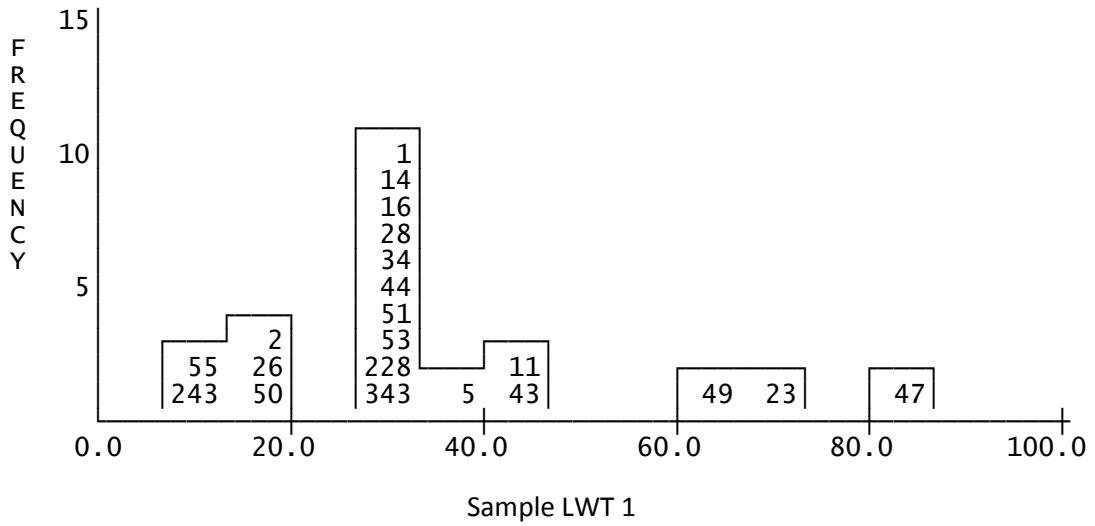
Sample : LWT 1  
 Number of Laboratories : 16  
 Consensus Mean : 108.0  
 Repeatability Estimate :  $2.1 \pm 0.4$   
 Reproducibility Estimate :  $4.0 \pm 1.7$

Sample : LWT 2  
 Number of Laboratories : 19  
 Consensus Mean : 84.1  
 Repeatability Estimate :  $2.3 \pm 0.4$   
 Reproducibility Estimate :  $4.6 \pm 1.8$

**Finger-Tip Thickness (microns) - Laboratory Means**



**Finger-Tip Thickness (microns) - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Finger-Tip Thickness (microns)**

**Sample LWT 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	21
Mean	294.6	274.1	Repeatability Outliers	23,47,49
Std Dev'n	83.0	33.4	Reproduc'ility Stragglers	None
Std Error	18.1	8.1	Reproduc'ility Outliers	49,55
Coef Var'n	28.2	12.2		
Minimum	188.4	188.4		
Maximum	541.0	315.7		
Range	352.6	127.3		

**Sample LWT 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	21
Mean	175.5	161.0	Repeatability Outliers	47
Std Dev'n	48.4	9.3	Reproduc'ility Stragglers	51
Std Error	10.6	2.3	Reproduc'ility Outliers	47,49,55
Coef Var'n	27.5	5.8		
Minimum	120.9	136.4		
Maximum	324.0	173.5		
Range	203.1	37.1		

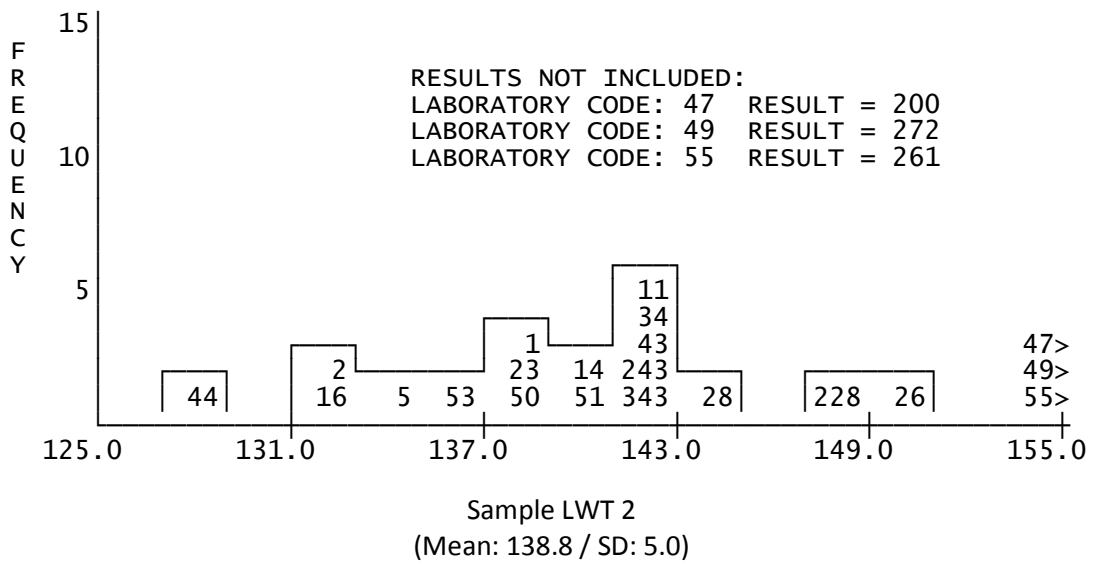
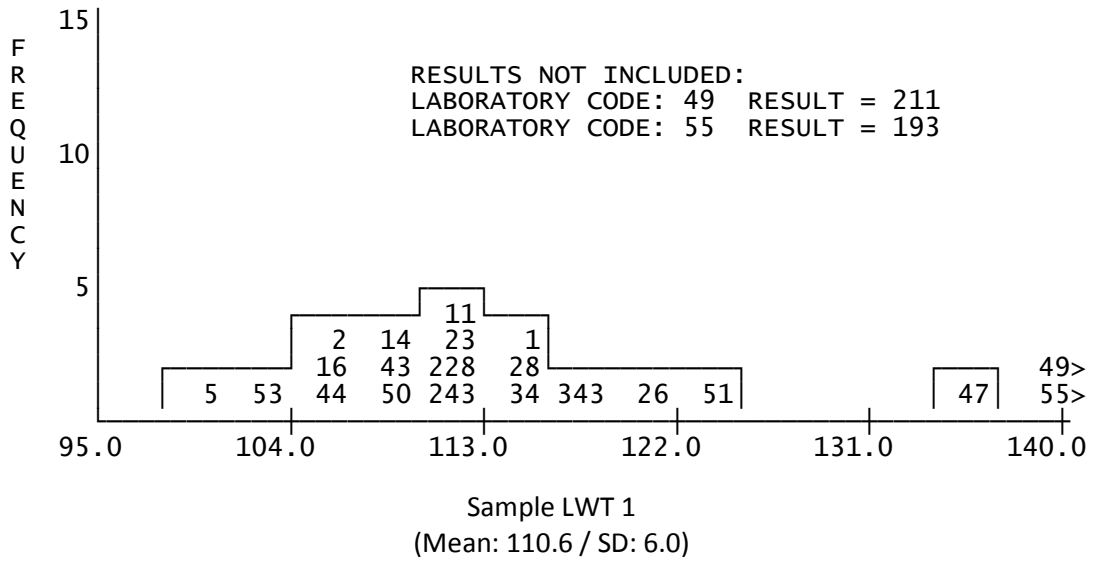
**PRECISION ACHIEVED (after removal of extreme results)**

Finger Thickness (microns)

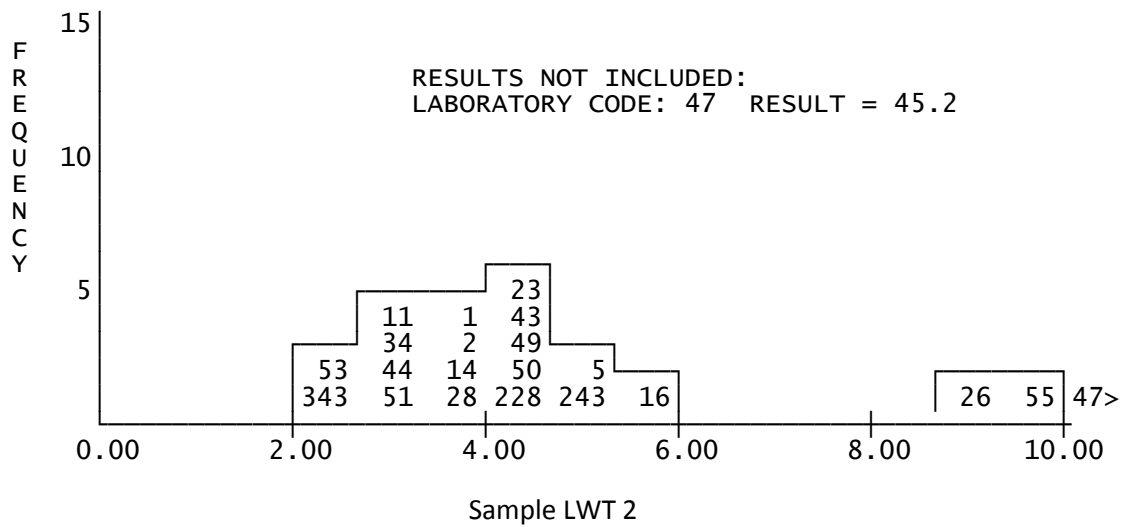
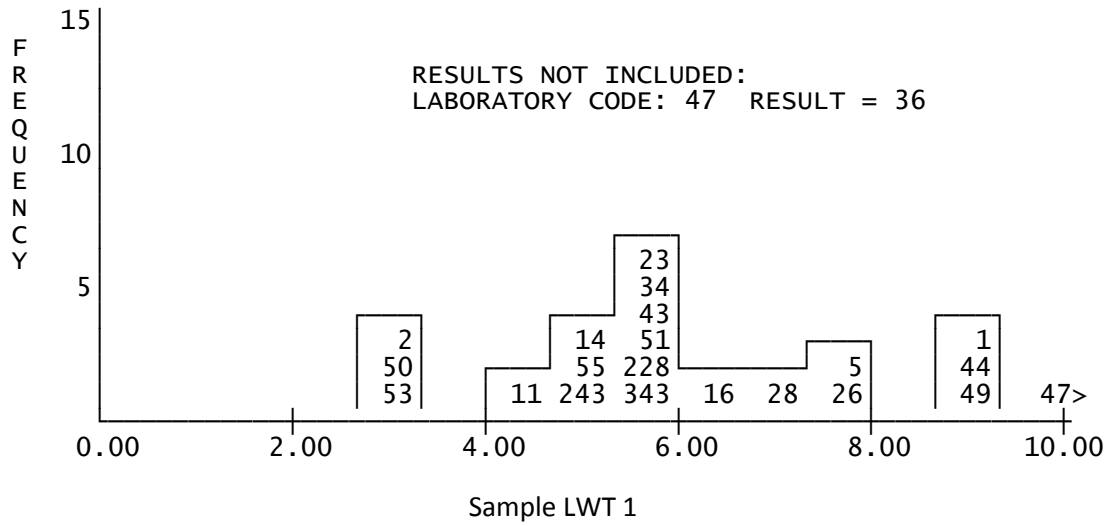
Sample : LWT 1  
 Number of Laboratories : 17  
 Consensus Mean : 274.1  
 Repeatability Estimate : 84.4 ± 14.5  
 Reproducibility Estimate : 123.8 ± 39.2

Sample : LWT 2  
 Number of Laboratories : 17  
 Consensus Mean : 161.0  
 Repeatability Estimate : 27.4 ± 4.7  
 Reproducibility Estimate : 37.0 ± 10.4

**Palm Thickness (microns) - Laboratory Means**



**Palm Thickness (microns) - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Palm Thickness (microns)**

**Sample LWT 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	21	18	Repeatability Outliers	47
Mean	120.4	110.6	Reproduc'tility Stragglers	47
Std Dev'n	28.3	6.0	Reproduc'tility Outliers	49, 55
Std Error	6.2	1.4		
Coef Var'n	23.5	5.4		
Minimum	100.3	100.3		
Maximum	211.0	123.9		
Range	110.7	23.6		

**Sample LWT 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	21	17	Repeatability Outliers	26, 47, 55
Mean	154.4	138.8	Reproduc'tility Stragglers	None
Std Dev'n	39.9	5.0	Reproduc'tility Outliers	47, 49, 55
Std Error	8.7	1.2		
Coef Var'n	25.8	3.6		
Minimum	127.8	127.8		
Maximum	272.0	147.4		
Range	144.2	19.6		

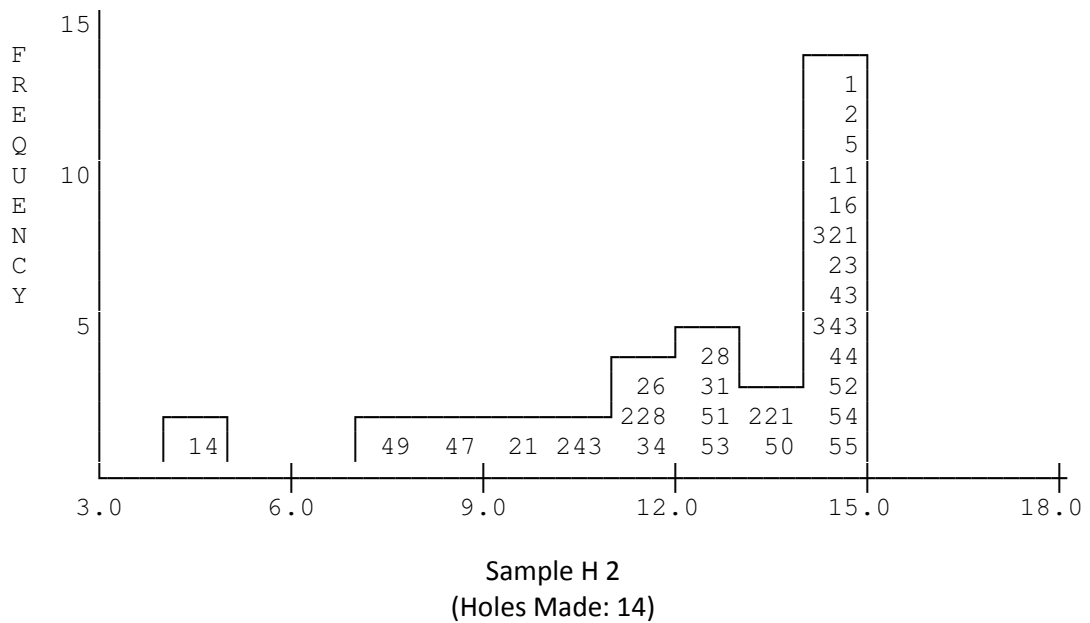
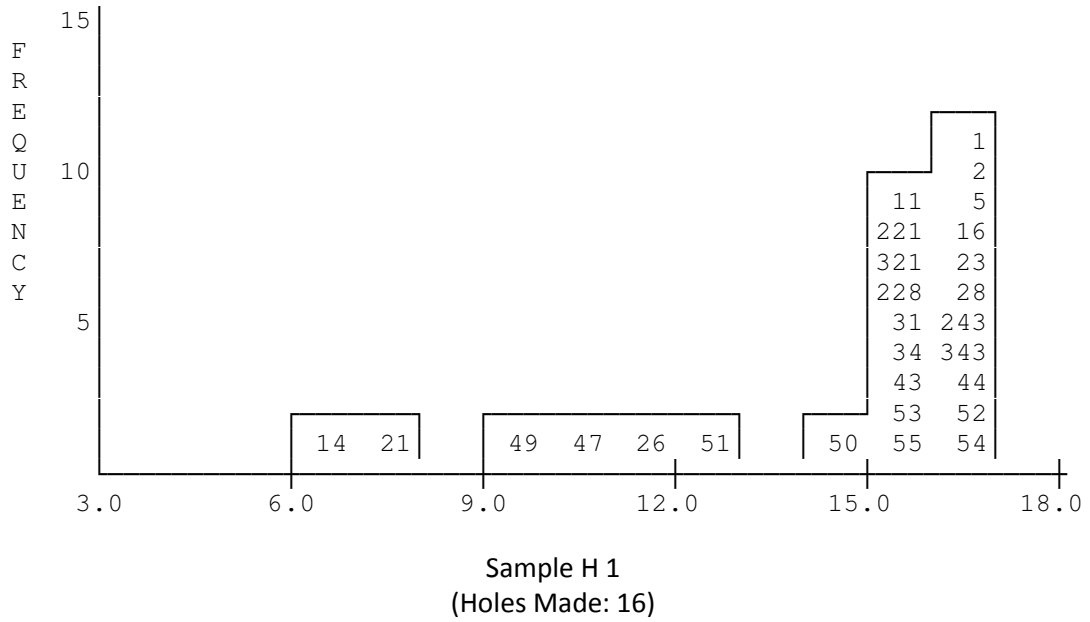
**PRECISION ACHIEVED (after removal of extreme results)**

Palm Thickness (microns)

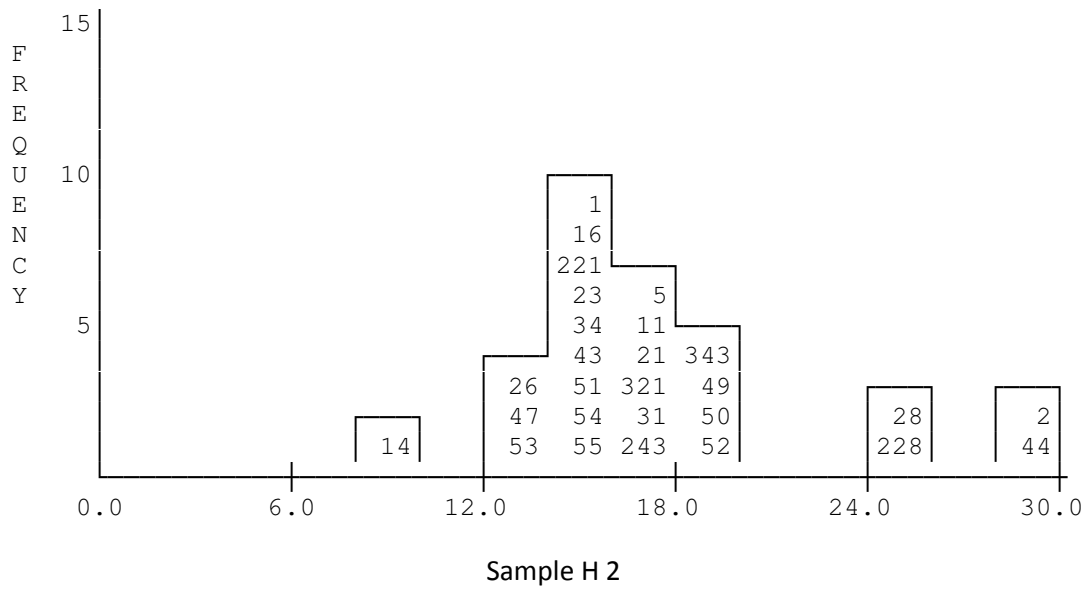
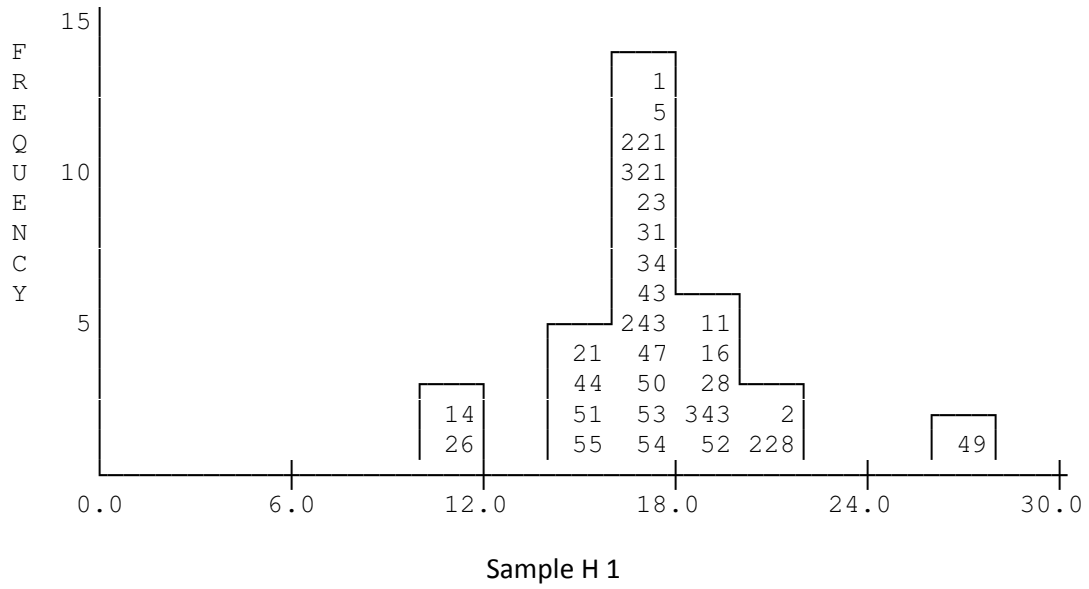
Sample : LWT 1  
 Number of Laboratories : 18  
 Consensus Mean : 110.6  
 Repeatability Estimate : 17.0 ± 2.8  
 Reproducibility Estimate : 23.4 ± 6.5

Sample : LWT 2  
 Number of Laboratories : 17  
 Consensus Mean : 138.8  
 Repeatability Estimate : 11.1 ± 1.9  
 Reproducibility Estimate : 17.7 ± 6.2

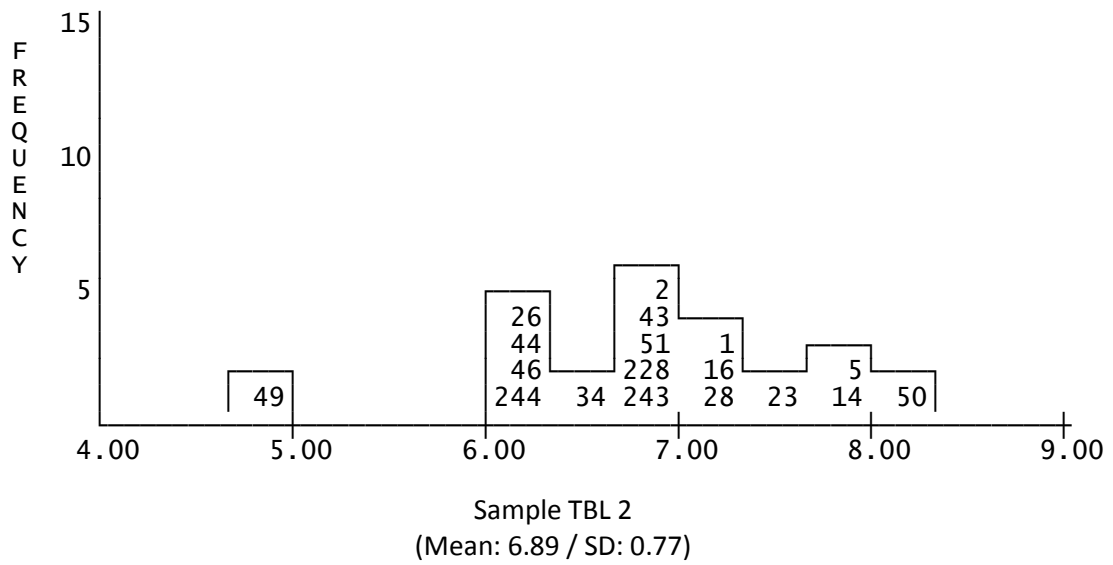
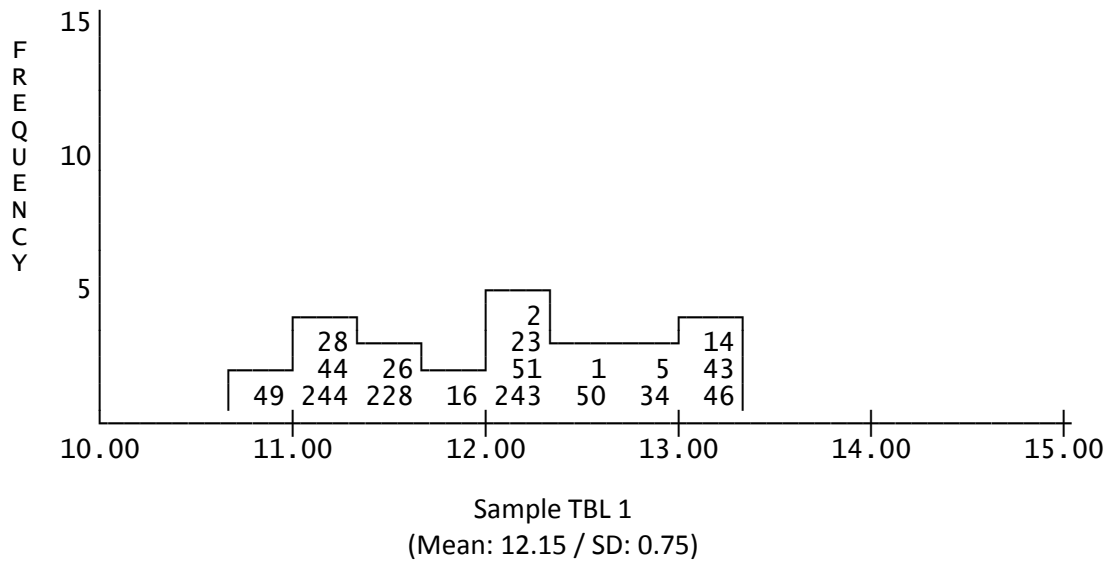
**Watertightness - Gloves with Holes - Made by Enersol and found by Laboratory**



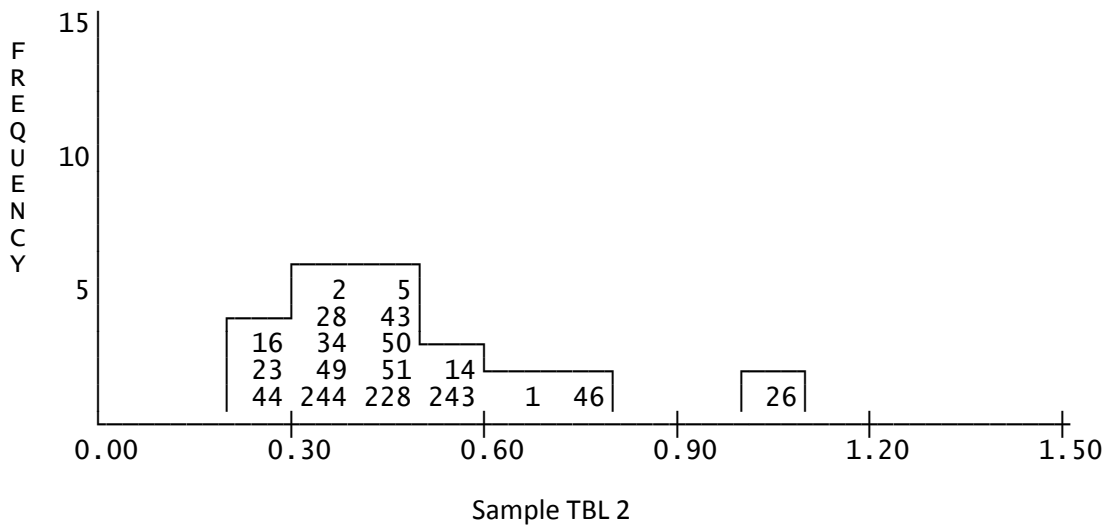
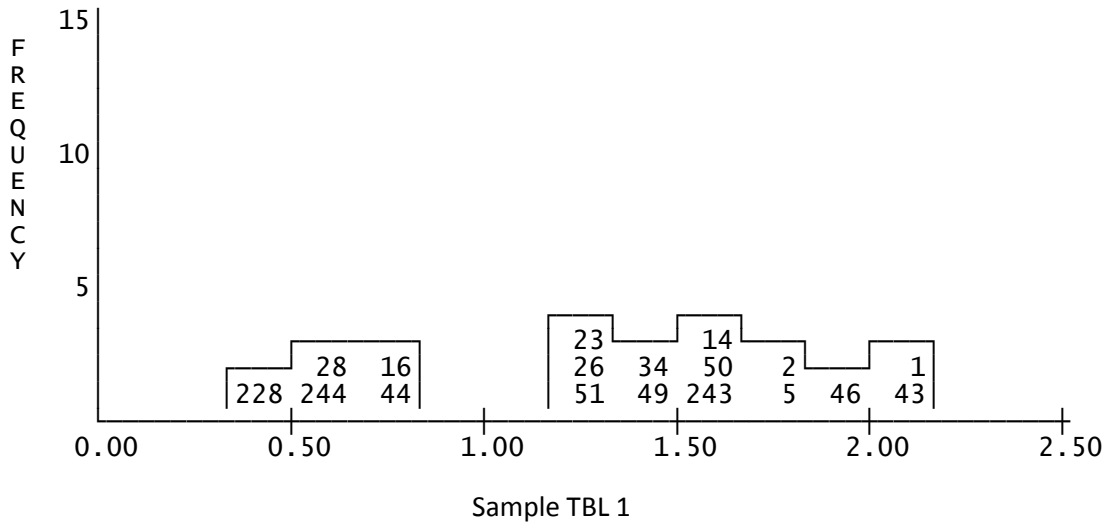
**Watertightness - Gloves with Holes - All Holes Reported**



**Tensile Force at Break (N) - 6mm Dumbbell - Laboratory Means**



**Tensile Force at Break (N) - 6mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Force at Break (N) - 6mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	18	18	Repeatability Outliers	None
Mean	12.15	12.15	Reproduc'tility Stragglers	None
Std Dev'n	0.75	0.75	Reproduc'tility Outliers	None
Std Error	0.18	0.18		
Coef Var'n	6.18	6.18		
Minimum	10.99	10.99		
Maximum	13.26	13.26		
Range	2.27	2.27		

**Sample TBL 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	46
No. Labs	18	16	Repeatability Outliers	26
Mean	6.82	6.89	Reproduc'tility Stragglers	None
Std Dev'n	0.75	0.77	Reproduc'tility Outliers	None
Std Error	0.18	0.19		
Coef Var'n	11.06	11.23		
Minimum	4.85	4.85		
Maximum	8.16	8.16		
Range	3.31	3.31		

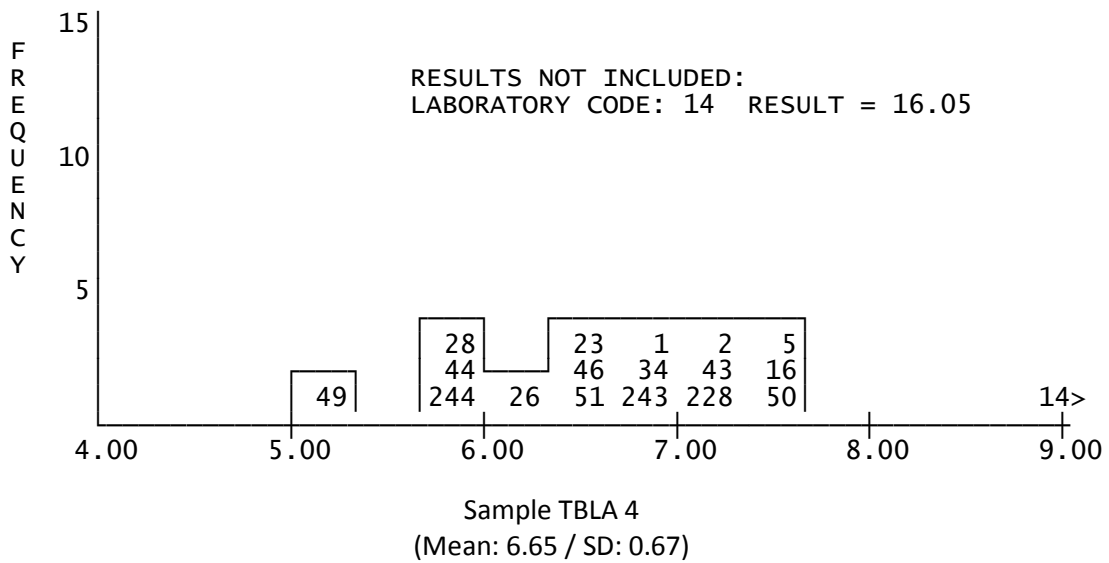
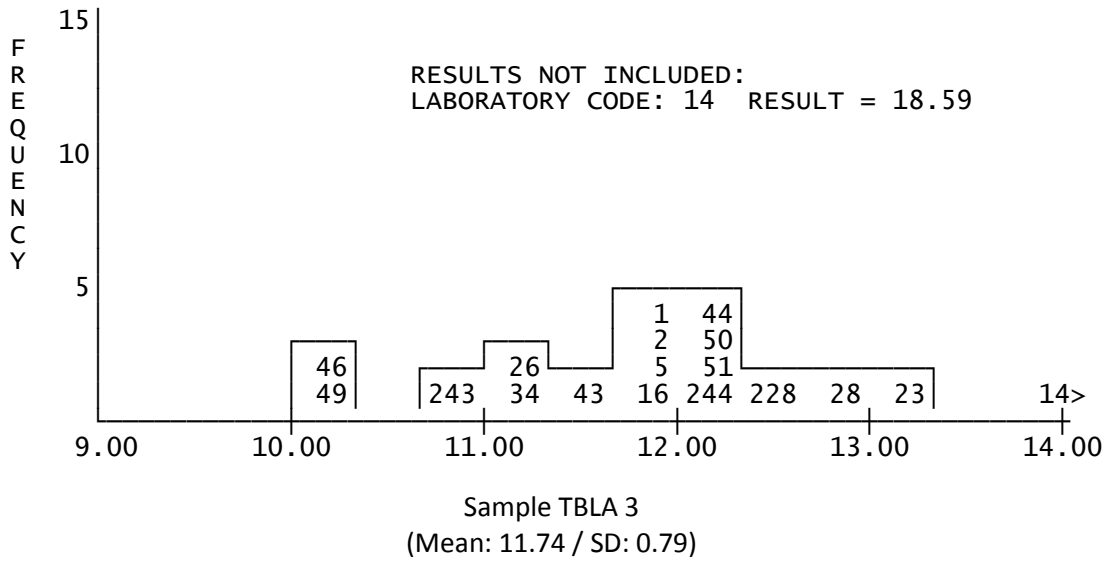
**PRECISION ACHIEVED (after removal of extreme results)**

Force at Break (N) - 6mm dumbbell

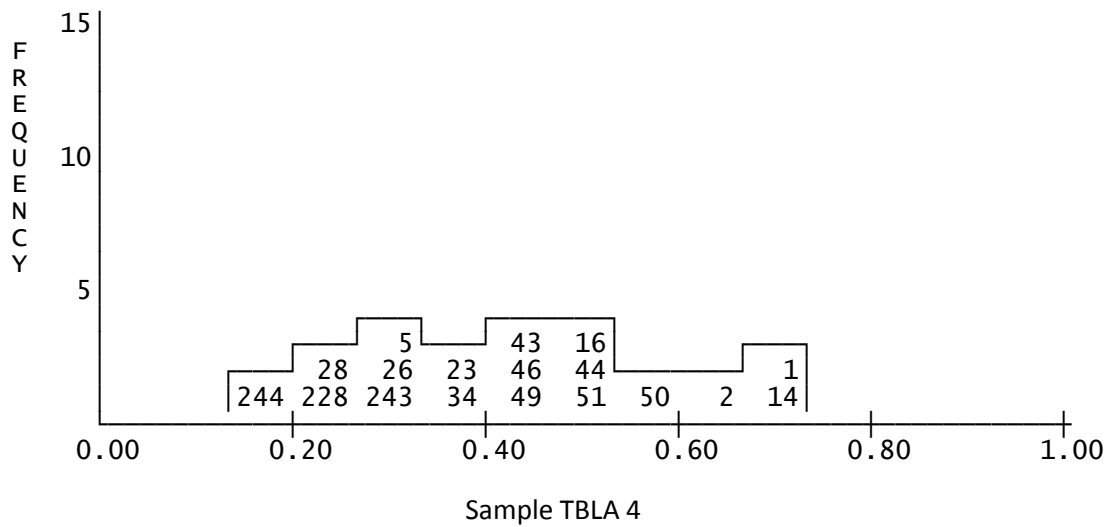
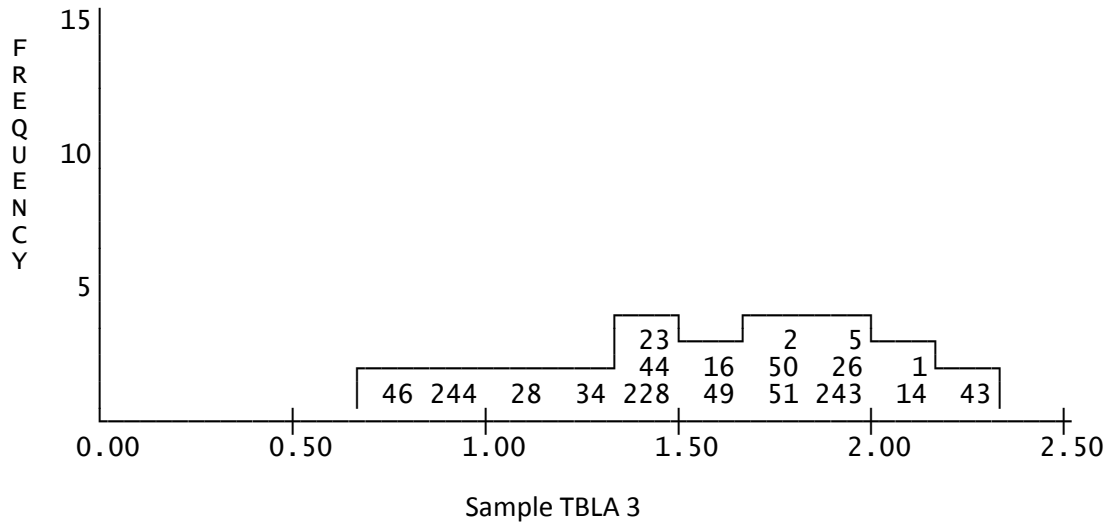
Sample : TBL 1  
 Number of Laboratories : 18  
 Consensus Mean : 12.15  
 Repeatability Estimate : 4.03 ± 0.67  
 Reproducibility Estimate : 4.38 ± 0.77

Sample : TBL 2  
 Number of Laboratories : 16  
 Consensus Mean : 6.89  
 Repeatability Estimate : 1.19 ± 0.21  
 Reproducibility Estimate : 2.46 ± 1.07

**Tensile Force at Break (Oven-Conditioned) (N) - 6mm Dumbbell - Laboratory Means**



**Tensile Force at Break (Oven-Conditioned) (N) - 6mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Force at Break (Oven-Conditioned) (N) - 6mm Dumbbell**

**Sample TBLA 3:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	12.12	11.74	Repeatability Outliers	None
Std Dev'n	1.79	0.79	Reproduc'tility Stragglers	None
Std Error	0.42	0.19	Reproduc'tility Outliers	14
Coef Var'n	14.74	6.71		
Minimum	10.15	10.15		
Maximum	18.59	13.05		
Range	8.44	2.90		

**Sample TBLA 4:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	7.17	6.65	Repeatability Outliers	None
Std Dev'n	2.31	0.67	Reproduc'tility Stragglers	None
Std Error	0.54	0.16	Reproduc'tility Outliers	14
Coef Var'n	32.21	10.15		
Minimum	5.13	5.13		
Maximum	16.05	7.56		
Range	10.92	2.43		

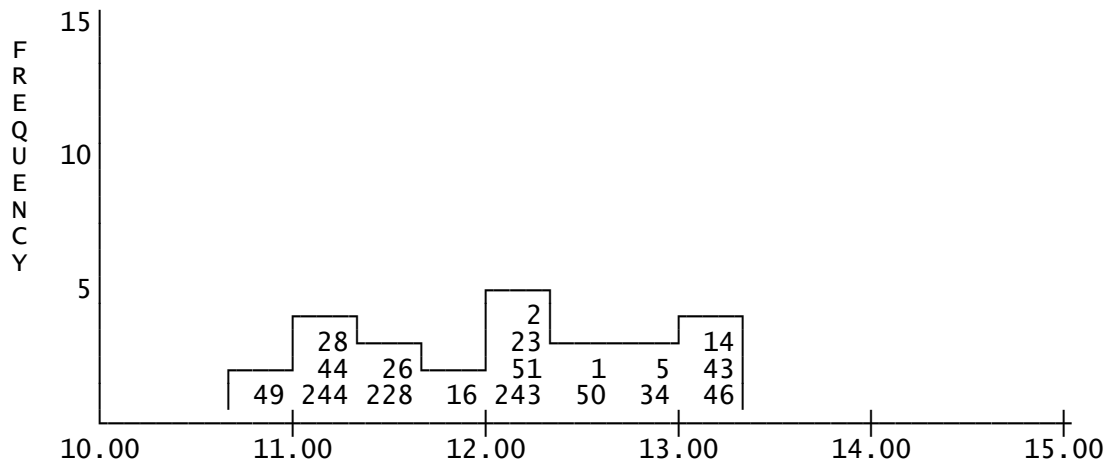
**PRECISION ACHIEVED (after removal of extreme results)**

Force (Oven-Conditioned) (N) - 6mm dumbbell

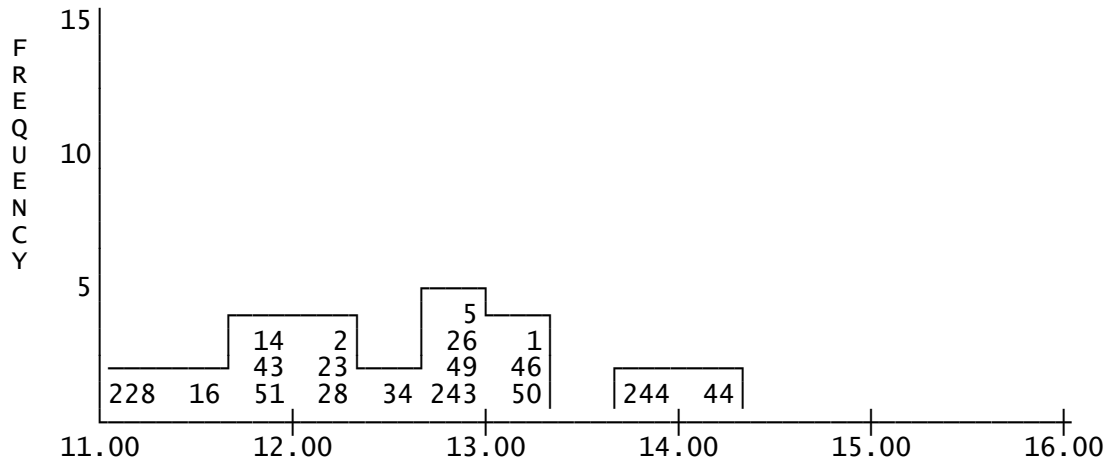
Sample : TBLA 3  
 Number of Laboratories : 17  
 Consensus Mean : 11.74  
 Repeatability Estimate : 4.59 ± 0.79  
 Reproducibility Estimate : 4.89 ± 0.85

Sample : TBLA 4  
 Number of Laboratories : 17  
 Consensus Mean : 6.65  
 Repeatability Estimate : 1.24 ± 0.21  
 Reproducibility Estimate : 2.24 ± 0.87

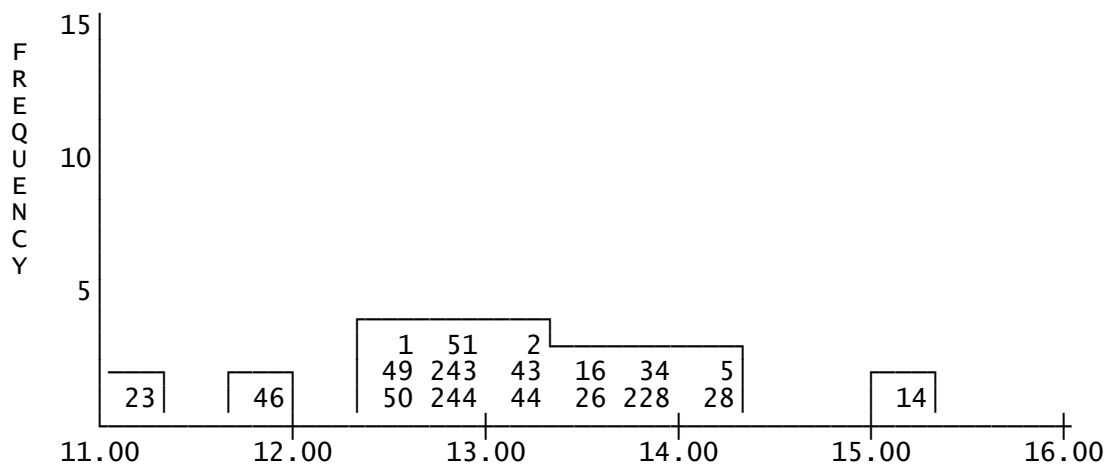
**Tensile Force at Break (N) - 6 mm Dumbbell - Laboratory Means**



Sample TBL 1  
(Mean: 12.15 / SD: 0.75)

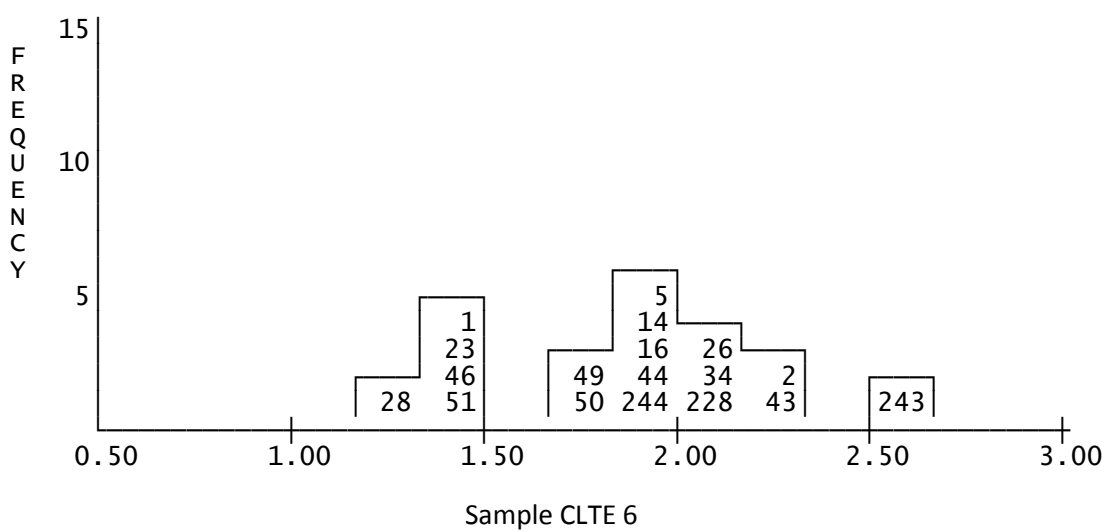
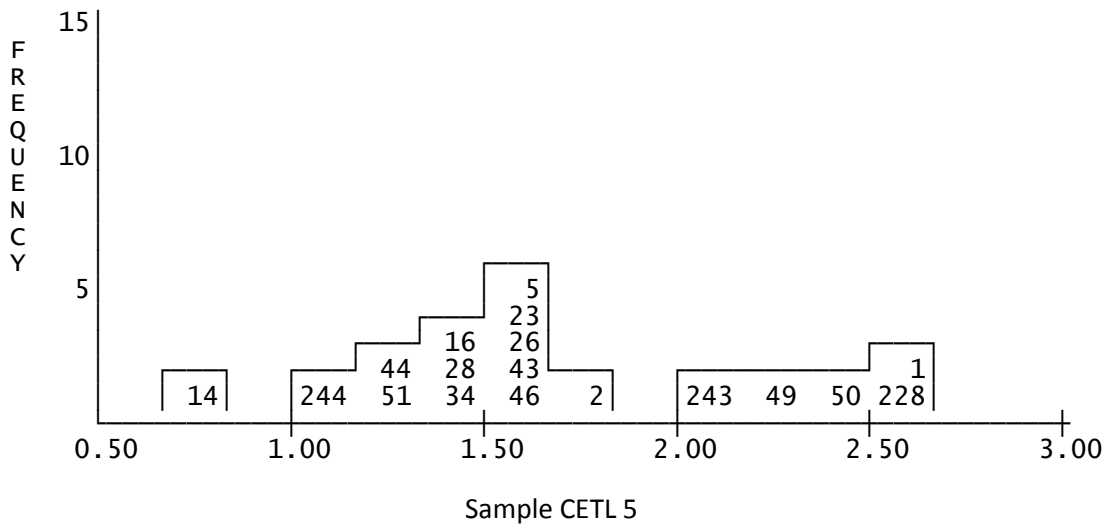
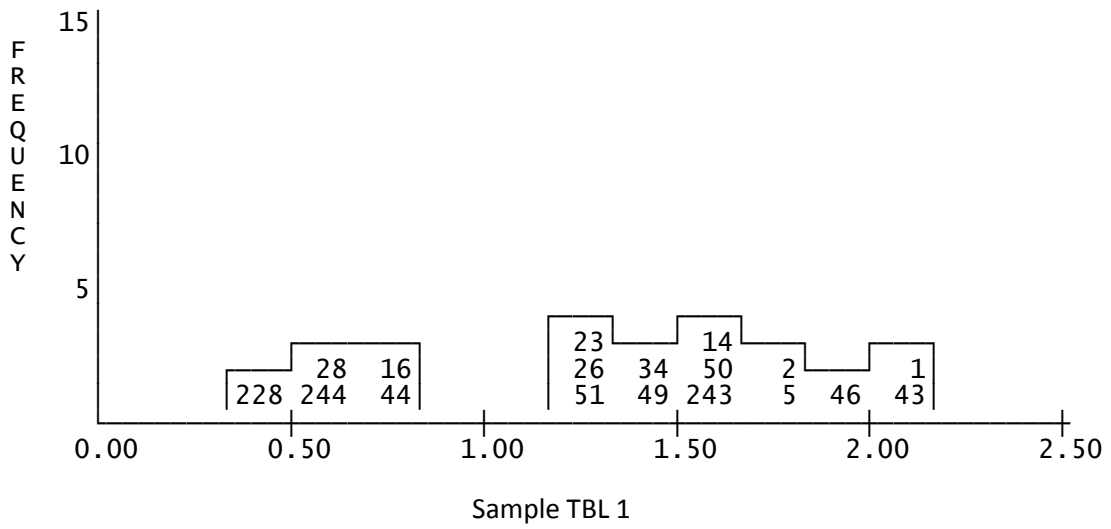


Sample CETL 5  
(Mean: 12.55 / SD: 0.73)



Sample CLTE 6  
(Mean: 13.16 / SD: 0.94)

**Tensile Force at Break (N) - 6 mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Force at Break (N) - 6 mm dumbbell**

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	12.55	12.55	Repeatability Outliers	None
Std Dev'n	0.73	0.73	Reproduc'lity Stragglers	None
Std Error	0.17	0.17	Reproduc'lity Outliers	None
Coef Var'n	5.85	5.85		
Minimum	11.32	11.32		
Maximum	14.02	14.02		
Range	2.70	2.70		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	13.16	13.16	Repeatability Outliers	None
Std Dev'n	0.94	0.94	Reproduc'lity Stragglers	None
Std Error	0.22	0.22	Reproduc'lity Outliers	None
Coef Var'n	7.17	7.17		
Minimum	11.17	11.17		
Maximum	15.28	15.28		
Range	4.11	4.11		

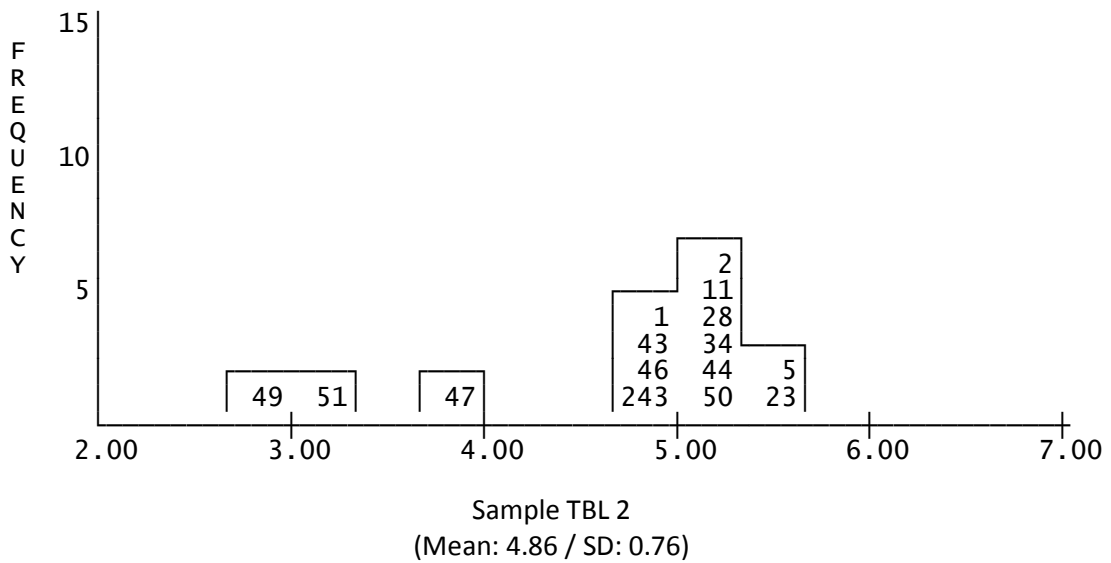
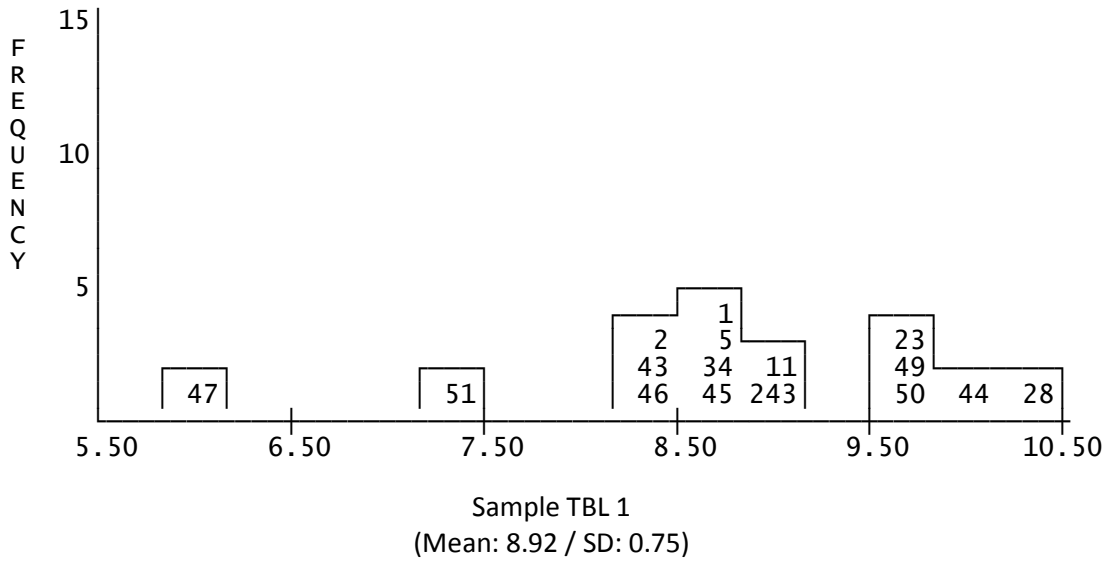
**PRECISION ACHIEVED (after removal of extreme results)**

Force at Break (N) - 6 mm dumbbell

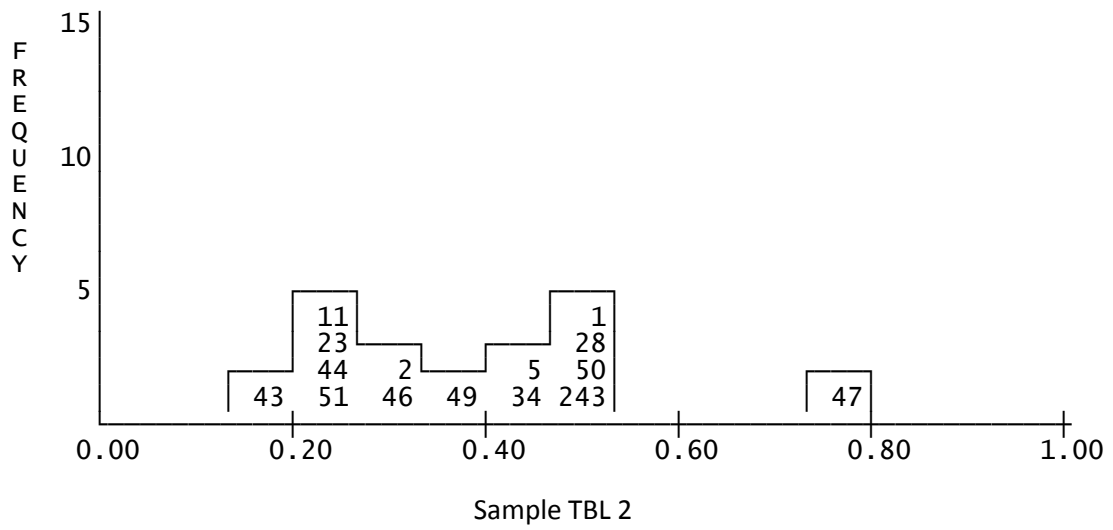
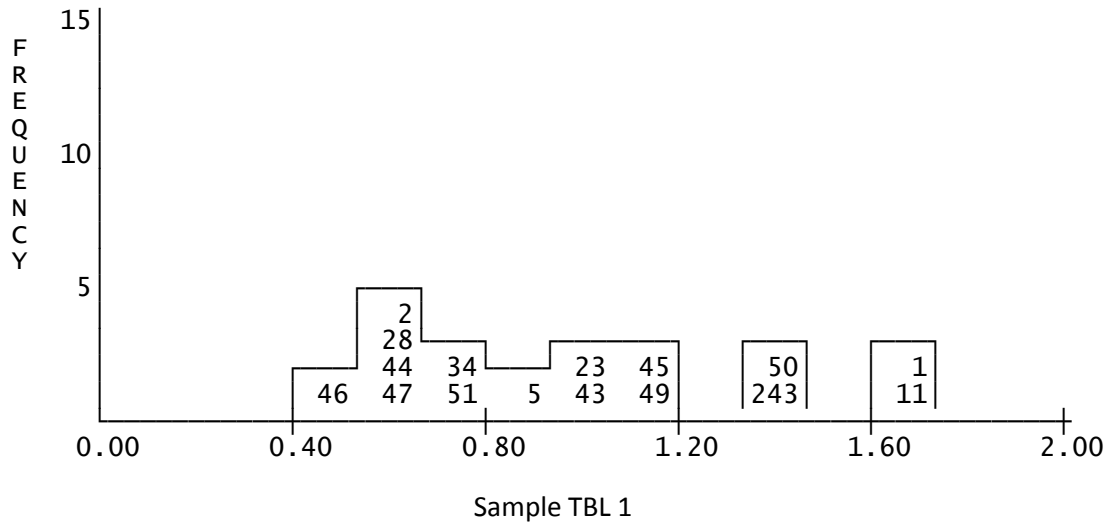
Sample : CETL 5  
 Number of Laboratories : 18  
 Consensus Mean : 12.55  
 Repeatability Estimate : 4.95 ± 0.83  
 Reproducibility Estimate : 5.14 ± 0.84

Sample : CLTE 6  
 Number of Laboratories : 18  
 Consensus Mean : 13.16  
 Repeatability Estimate : 5.35 ± 0.89  
 Reproducibility Estimate : 5.73 ± 0.98

**Tensile Force at Break (N) - 4mm Dumbbell - Laboratory Means**



**Tensile Force at Break (N) - 4mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Force at Break (N) - 4mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	16	15	Repeatability Outliers	None
Mean	8.73	8.92	Reproduc'tility Stragglers	47
Std Dev'n	1.03	0.75	Reproduc'tility Outliers	None
Std Error	0.26	0.19		
Coef Var'n	11.84	8.42		
Minimum	5.97	7.30		
Maximum	10.18	10.18		
Range	4.21	2.88		

**Sample TBL 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	15	14	Repeatability Outliers	47
Mean	4.80	4.86	Reproduc'tility Stragglers	None
Std Dev'n	0.77	0.76	Reproduc'tility Outliers	None
Std Error	0.20	0.20		
Coef Var'n	16.08	15.67		
Minimum	2.94	2.94		
Maximum	5.48	5.48		
Range	2.54	2.54		

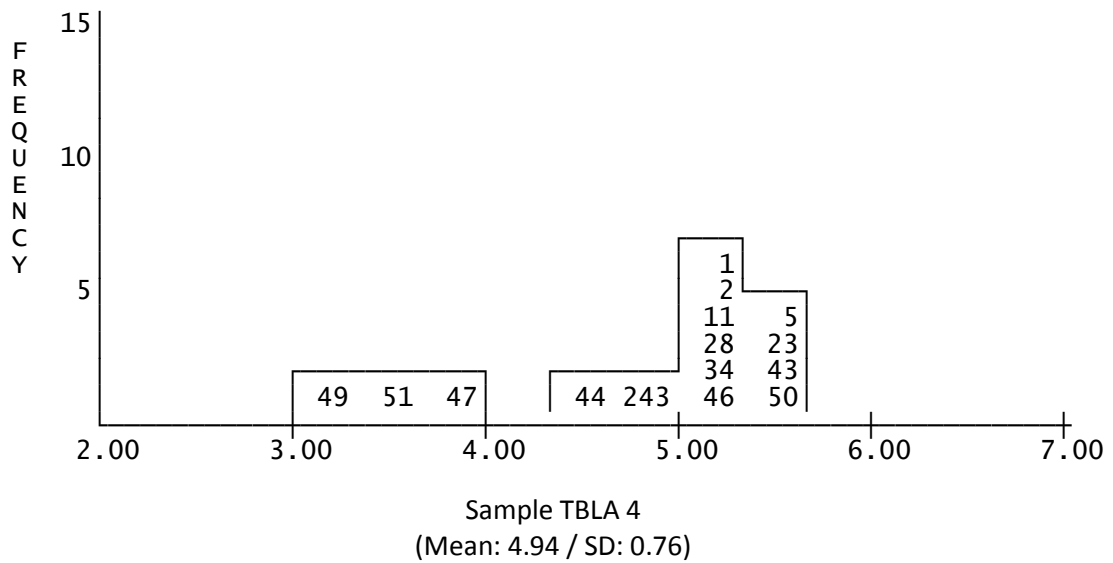
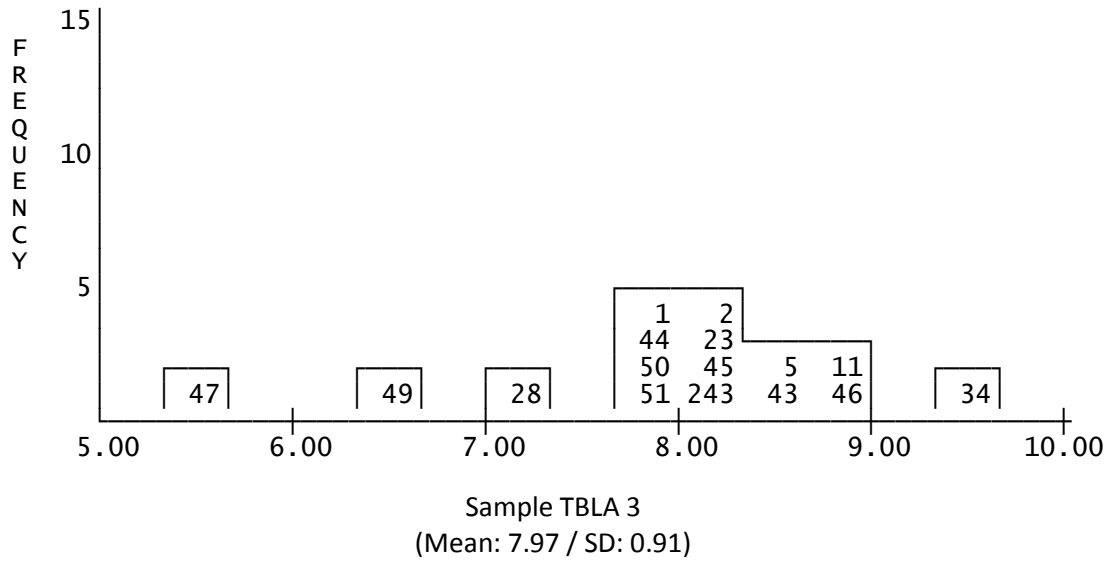
**PRECISION ACHIEVED (after removal of extreme results)**

Force at Break (N) - 4mm dumbbell

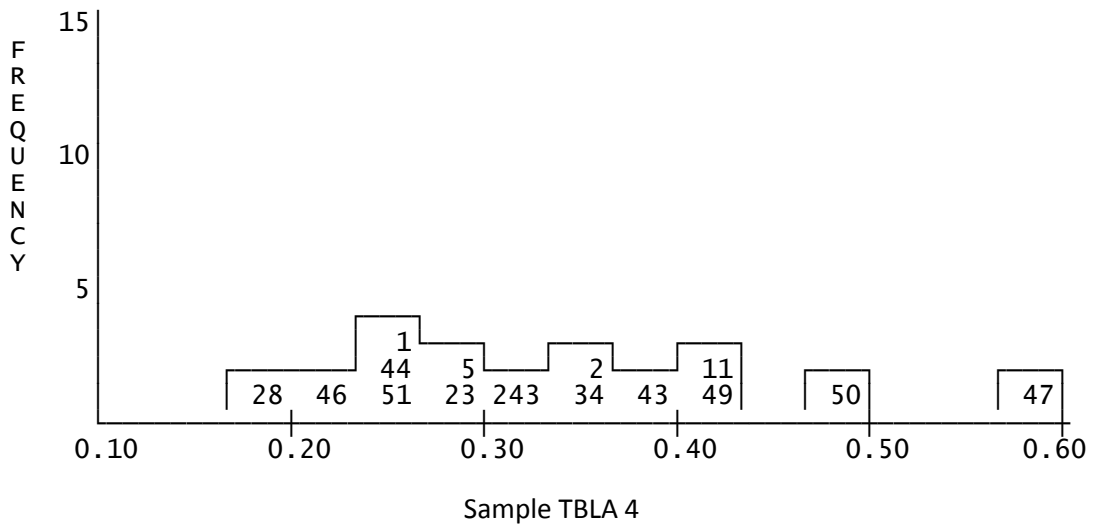
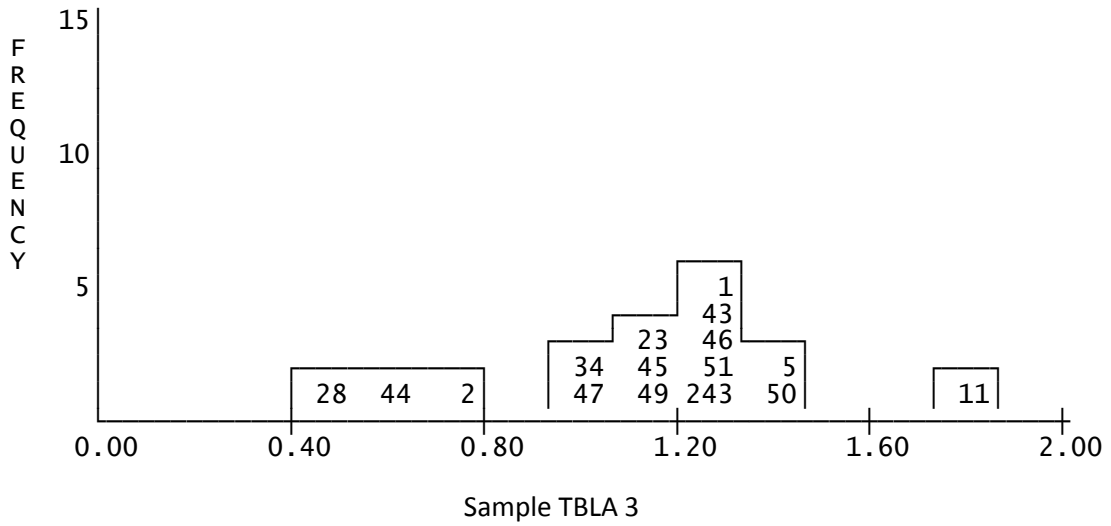
Sample : TBL 1  
 Number of Laboratories : 15  
 Consensus Mean : 8.92  
 Repeatability Estimate : 3.04 ± 0.55  
 Reproducibility Estimate : 3.58 ± 0.83

Sample : TBL 2  
 Number of Laboratories : 14  
 Consensus Mean : 4.86  
 Repeatability Estimate : 1.04 ± 0.20  
 Reproducibility Estimate : 2.37 ± 1.16

**Tensile Force at Break (Oven-Conditioned) (N) - 4mm Dumbbell - Laboratory Means**



**Tensile Force at Break (Oven-Conditioned) (N) - 4mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Force at Break (Oven-Conditioned) (N) - 4mm Dumbbell**

**Sample TBLA 3:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results
No. Labs	16	16
Mean	7.97	7.97
Std Dev'n	0.91	0.91
Std Error	0.23	0.23
Coef Var'n	11.47	11.47
Minimum	5.65	5.65
Maximum	9.40	9.40
Range	3.75	3.75

Extreme Results (Laboratory code no's)	
Repeatability Stragglers	None
Repeatability Outliers	None
Reproduc'lity Stragglers	None
Reproduc'lity Outliers	None

**Sample TBLA 4:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results
No. Labs	15	14
Mean	4.87	4.94
Std Dev'n	0.78	0.76
Std Error	0.20	0.20
Coef Var'n	16.03	15.39
Minimum	3.13	3.13
Maximum	5.62	5.62
Range	2.49	2.49

Extreme Results (Laboratory code no's)	
Repeatability Stragglers	None
Repeatability Outliers	47
Reproduc'lity Stragglers	None
Reproduc'lity Outliers	None

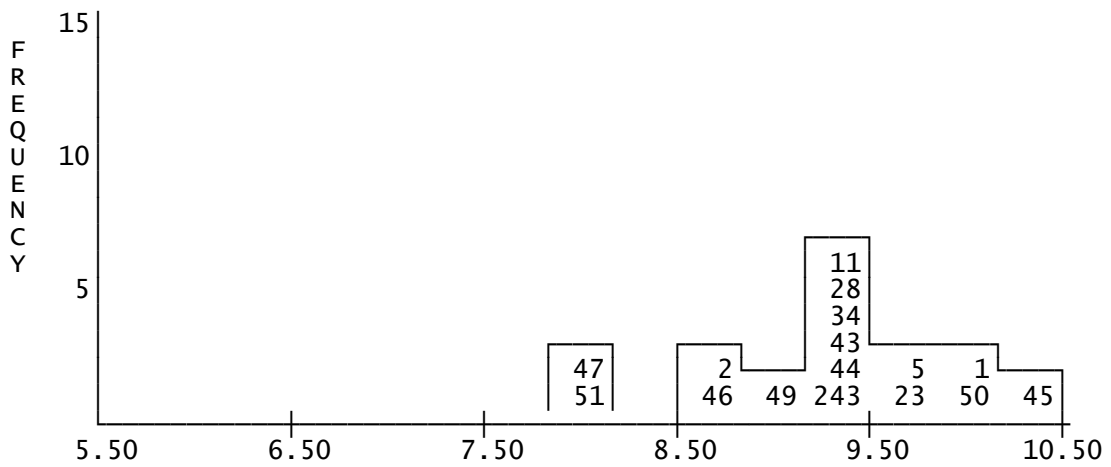
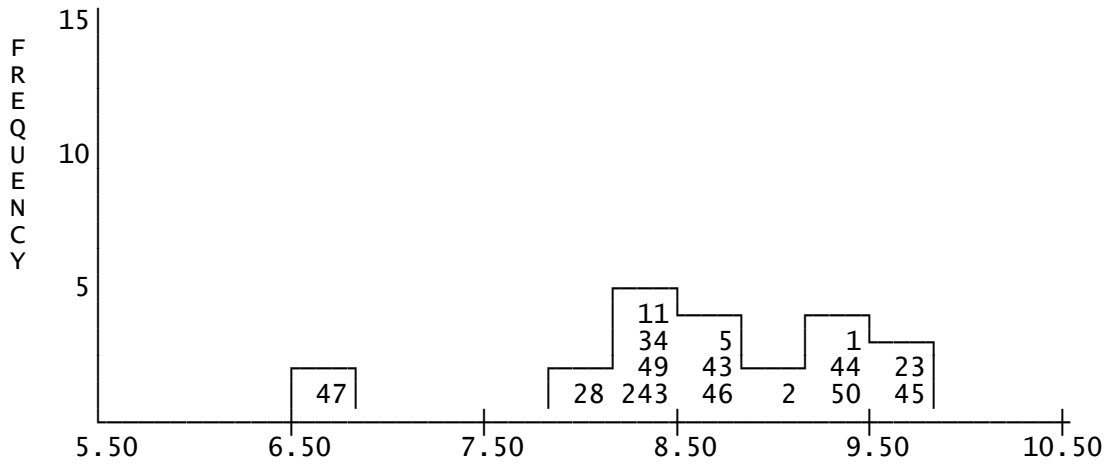
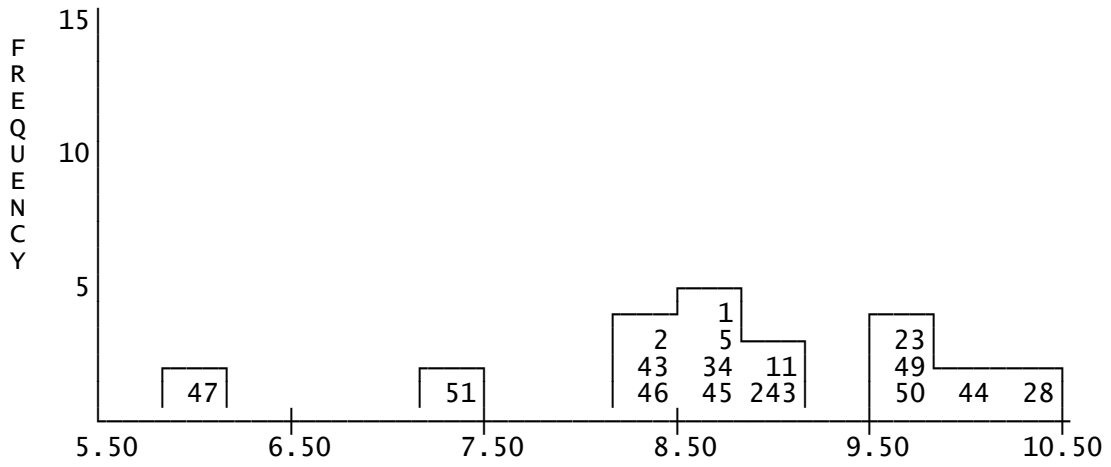
**PRECISION ACHIEVED (after removal of extreme results)**

Force (Oven-Conditioned) (N) - 4mm dumbbell

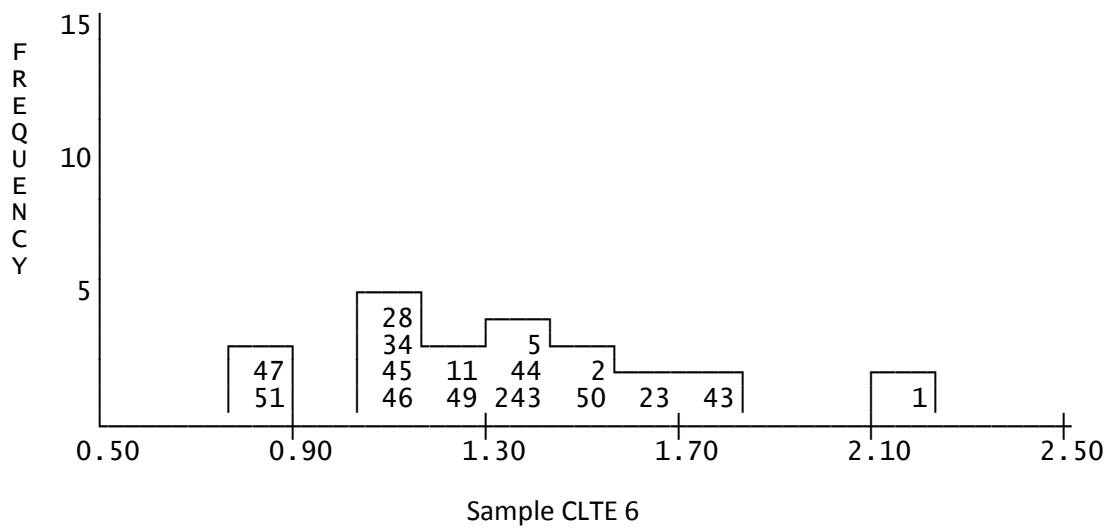
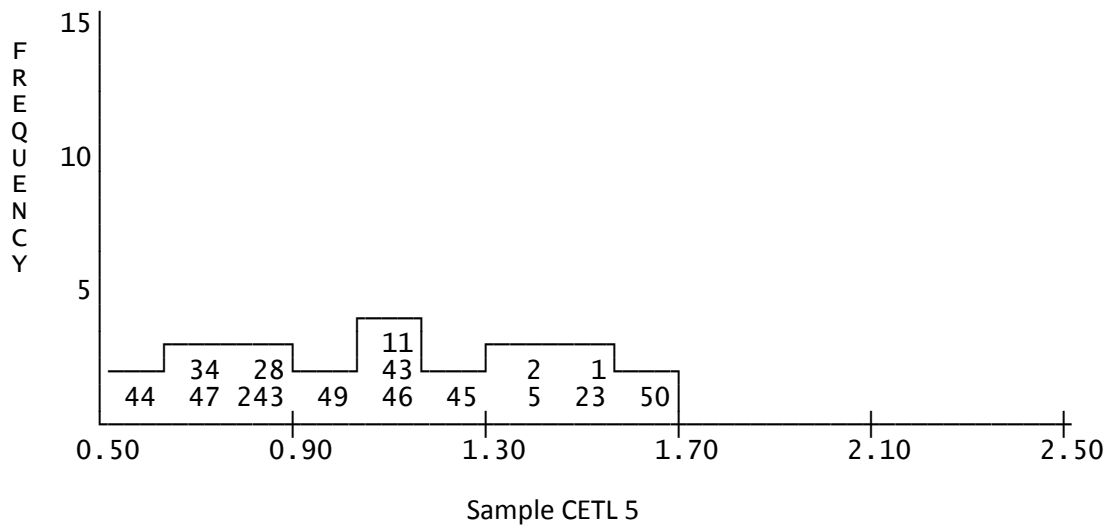
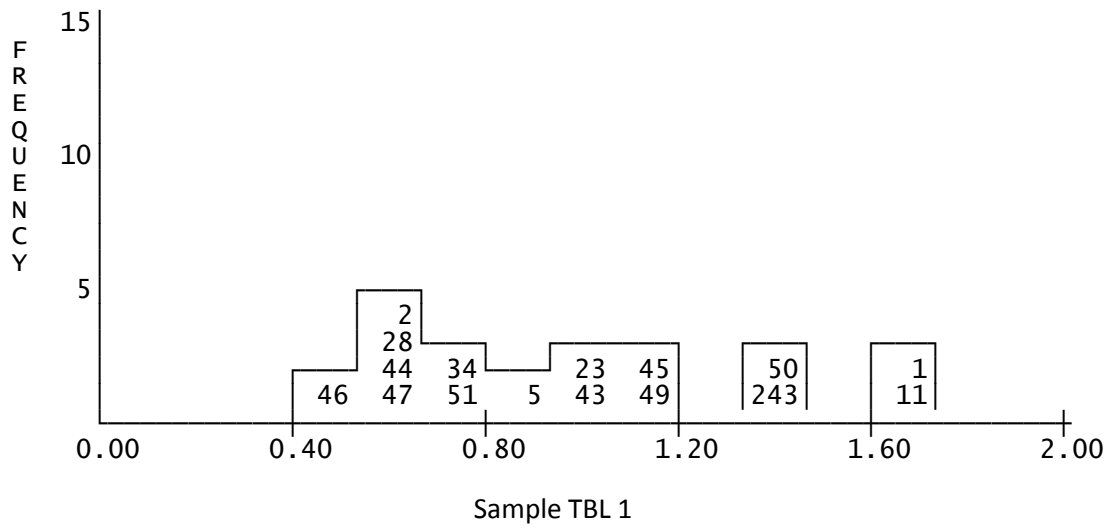
Sample : TBLA 3  
 Number of Laboratories : 16  
 Consensus Mean : 7.97  
 Repeatability Estimate : 3.29 ± 0.58  
 Reproducibility Estimate : 4.05 ± 1.00

Sample : TBLA 4  
 Number of Laboratories : 14  
 Consensus Mean : 4.94  
 Repeatability Estimate : 0.92 ± 0.17  
 Reproducibility Estimate : 2.32 ± 1.17

**Tensile Force at Break (N) - 4 mm Dumbbell - Laboratory Means**



**Tensile Force at Break (N) - 4 mm dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Force at Break (N) - 4 mm dumbbell**

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	15	14	Repeatability Outliers	None
Mean	8.74	8.88	Reproduc'tility Stragglers	47
Std Dev'n	0.74	0.52	Reproduc'tility Outliers	None
Std Error	0.19	0.14		
Coef Var'n	8.45	5.83		
Minimum	6.77	8.05		
Maximum	9.69	9.69		
Range	2.92	1.64		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	16	16	Repeatability Outliers	None
Mean	9.22	9.22	Reproduc'tility Stragglers	None
Std Dev'n	0.72	0.72	Reproduc'tility Outliers	None
Std Error	0.18	0.18		
Coef Var'n	7.77	7.77		
Minimum	7.85	7.85		
Maximum	10.38	10.38		
Range	2.53	2.53		

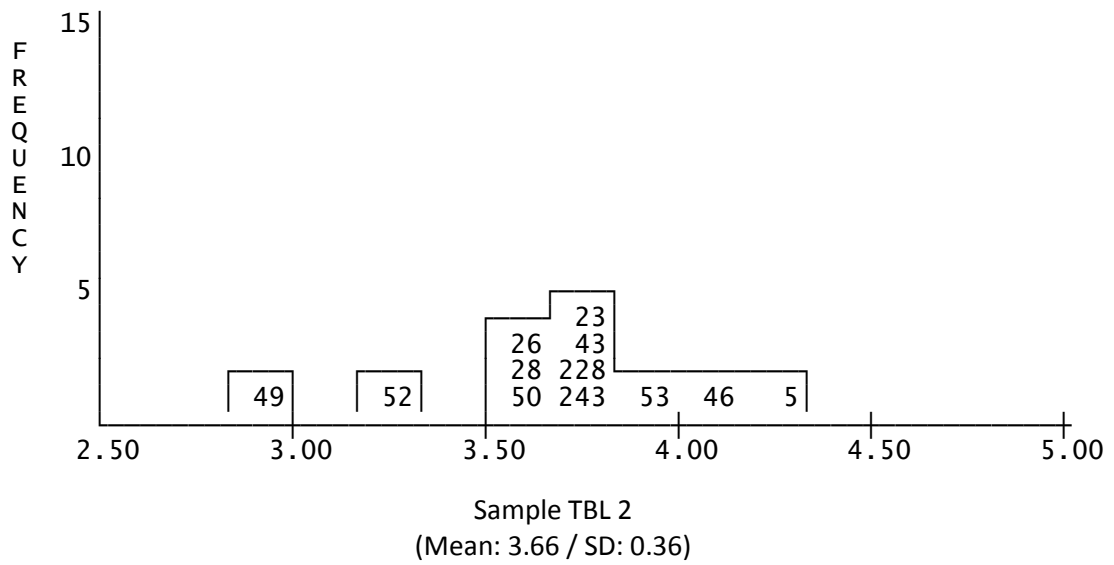
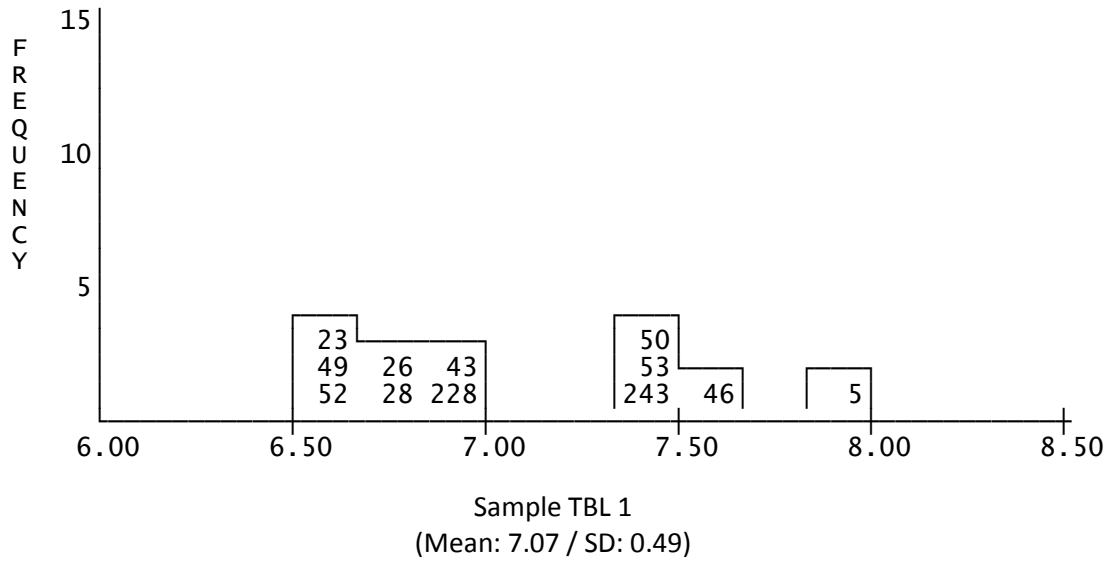
**PRECISION ACHIEVED (after removal of extreme results)**

Force at Break (N) - 4 mm dumbbell

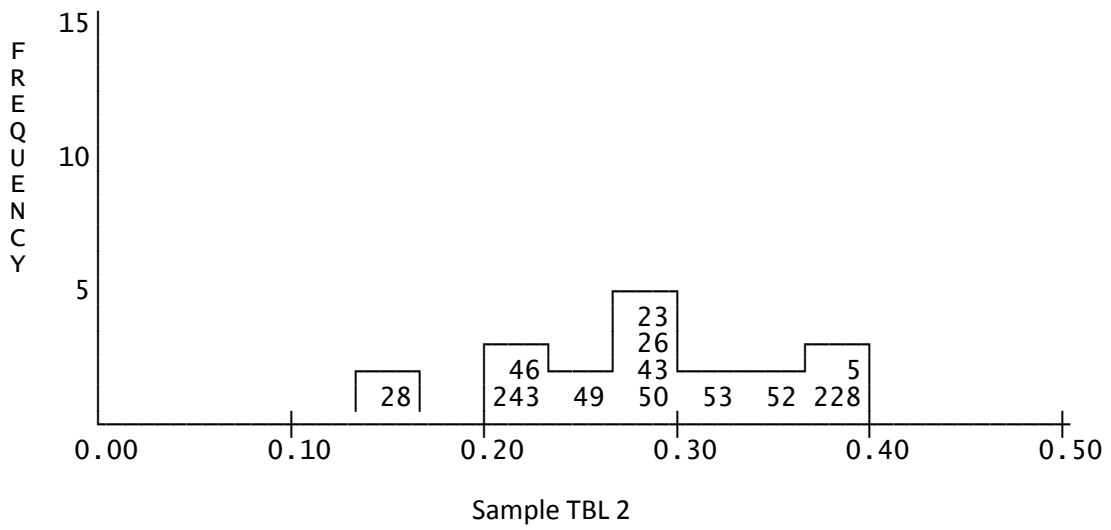
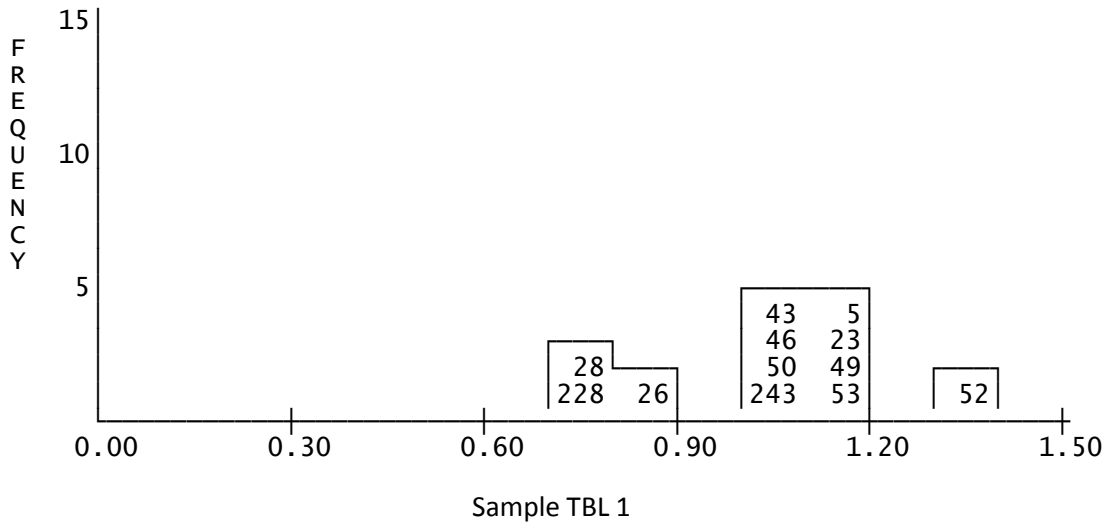
Sample : CETL 5  
 Number of Laboratories : 14  
 Consensus Mean : 8.88  
 Repeatability Estimate : 3.34 ± 0.63  
 Reproducibility Estimate : 3.49 ± 0.65

Sample : CLTE 6  
 Number of Laboratories : 16  
 Consensus Mean : 9.22  
 Repeatability Estimate : 3.82 ± 0.68  
 Reproducibility Estimate : 4.15 ± 0.78

**Tensile Force at Break (N) - 3mm Dumbbell - Laboratory Means**



**Tensile Force at Break (N) - 3mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Force at Break (N) - 3mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	12	12	Repeatability Outliers	None
Mean	7.07	7.07	Reproduc'tility Stragglers	None
Std Dev'n	0.49	0.49	Reproduc'tility Outliers	None
Std Error	0.14	0.14		
Coef Var'n	6.97	6.97		
Minimum	6.51	6.51		
Maximum	7.99	7.99		
Range	1.48	1.48		

**Sample TBL 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	12	12	Repeatability Outliers	None
Mean	3.66	3.66	Reproduc'tility Stragglers	None
Std Dev'n	0.36	0.36	Reproduc'tility Outliers	None
Std Error	0.10	0.10		
Coef Var'n	9.71	9.71		
Minimum	2.86	2.86		
Maximum	4.21	4.21		
Range	1.35	1.35		

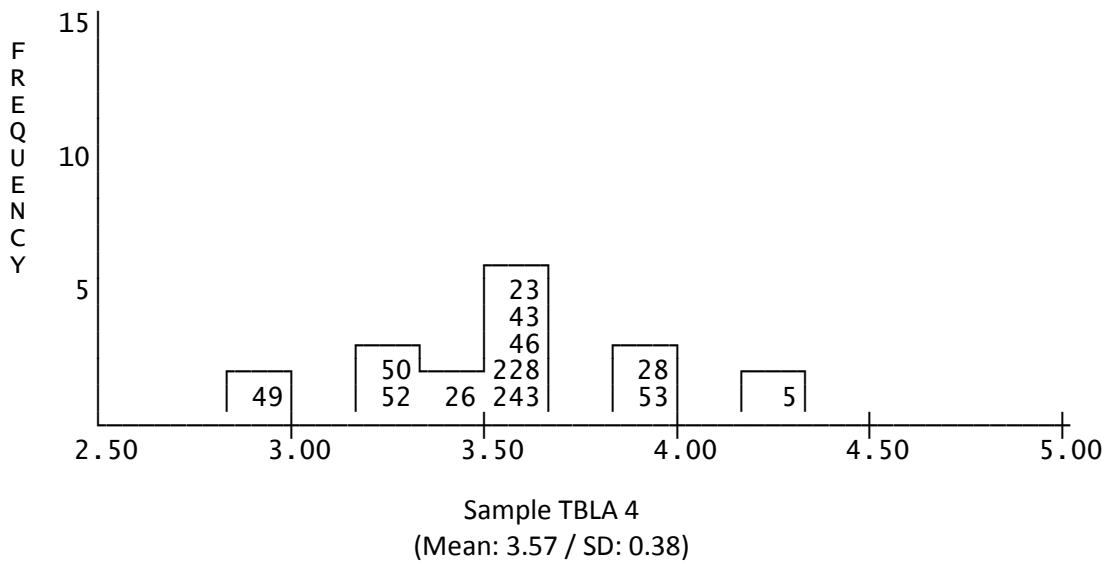
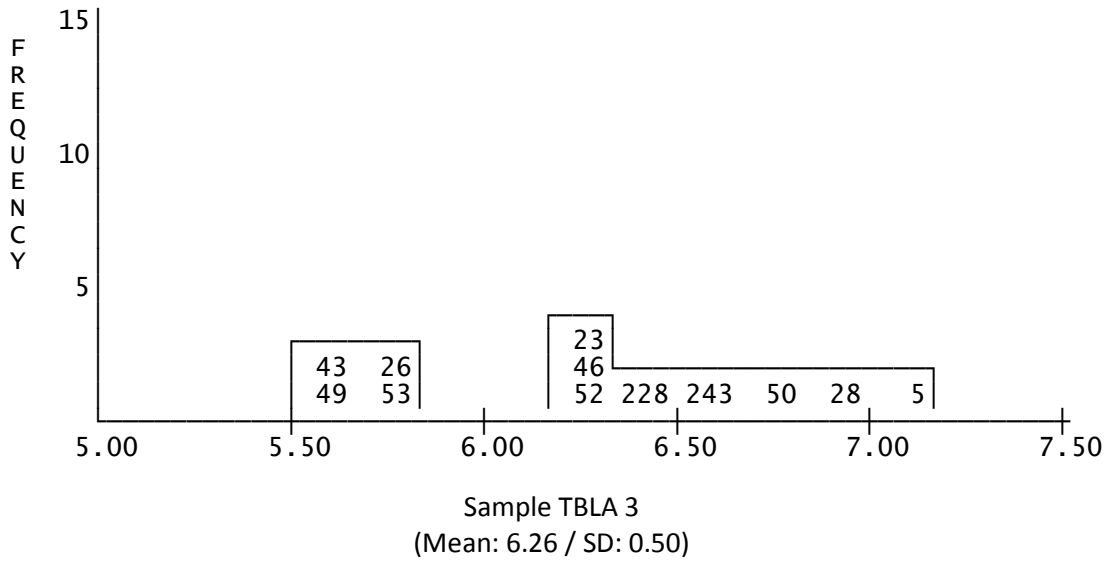
**PRECISION ACHIEVED (after removal of extreme results)**

Force at Break (N) - 3mm dumbbell

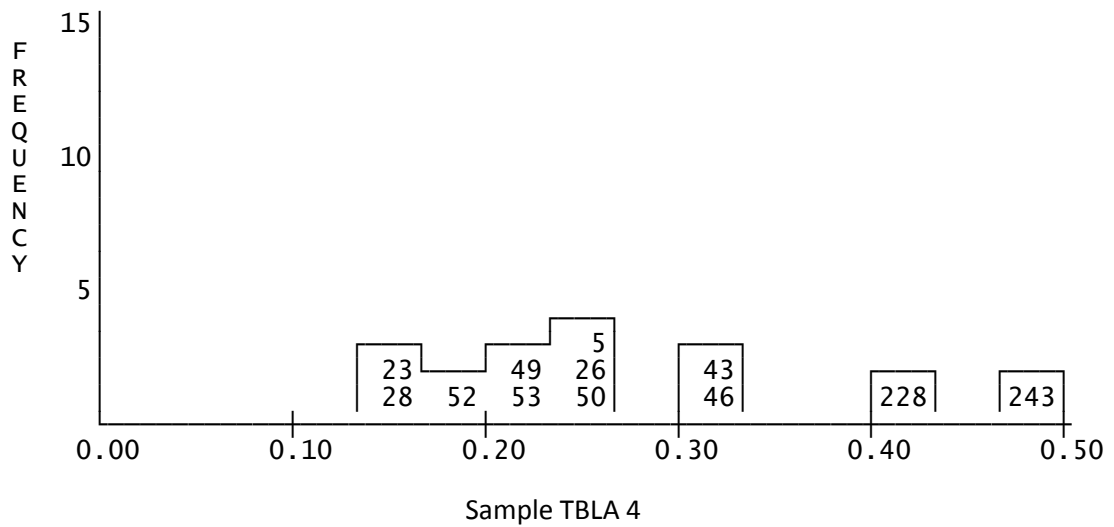
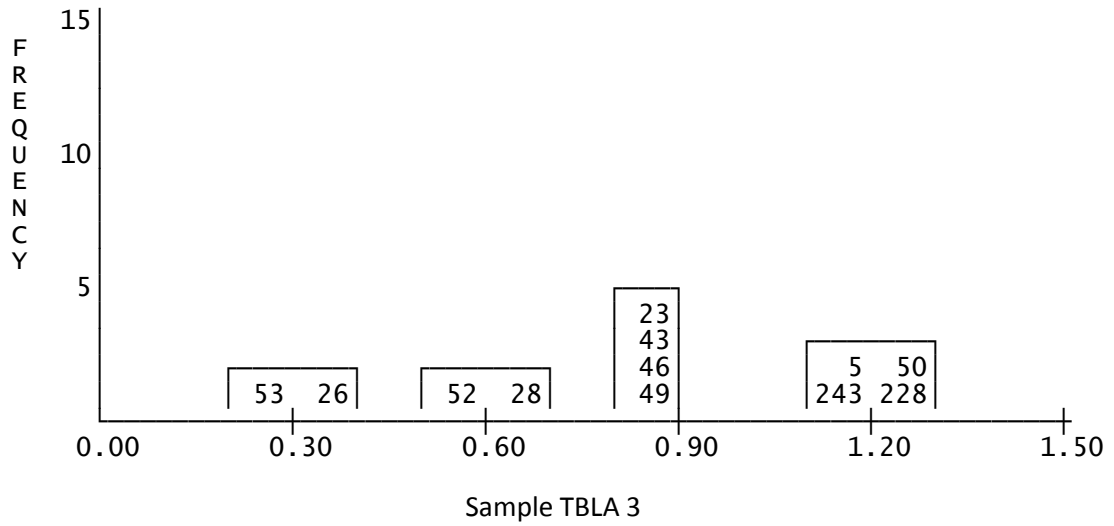
Sample : TBL 1  
 Number of Laboratories : 12  
 Consensus Mean : 7.07  
 Repeatability Estimate : 3.00 ± 0.61  
 Reproducibility Estimate : 3.17 ± 0.65

Sample : TBL 2  
 Number of Laboratories : 12  
 Consensus Mean : 3.66  
 Repeatability Estimate : 0.82 ± 0.17  
 Reproducibility Estimate : 1.27 ± 0.52

**Tensile Force at Break (Oven-Conditioned) (N) - 3mm Dumbbell - Laboratory Means**



**Tensile Force at Break (Oven-Conditioned) (N) - 3mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Force at Break (Oven-Conditioned) (N) - 3mm Dumbbell**

**Sample TBLA 3:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	12	12	Repeatability Outliers	None
Mean	6.26	6.26	Reproduc'tility Stragglers	None
Std Dev'n	0.50	0.50	Reproduc'tility Outliers	None
Std Error	0.14	0.14		
Coef Var'n	7.93	7.93		
Minimum	5.59	5.59		
Maximum	7.02	7.02		
Range	1.43	1.43		

**Sample TBLA 4:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	12	11	Repeatability Outliers	243
Mean	3.58	3.57	Reproduc'tility Stragglers	None
Std Dev'n	0.36	0.38	Reproduc'tility Outliers	None
Std Error	0.10	0.11		
Coef Var'n	10.05	10.54		
Minimum	2.85	2.85		
Maximum	4.29	4.29		
Range	1.44	1.44		

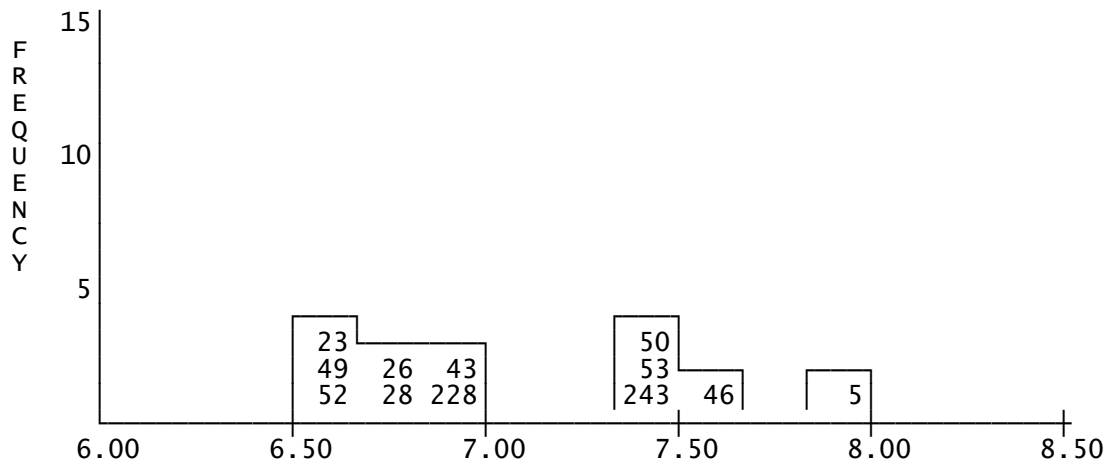
**PRECISION ACHIEVED (after removal of extreme results)**

Force (Oven-Conditioned) (N) - 3mm dumbbell

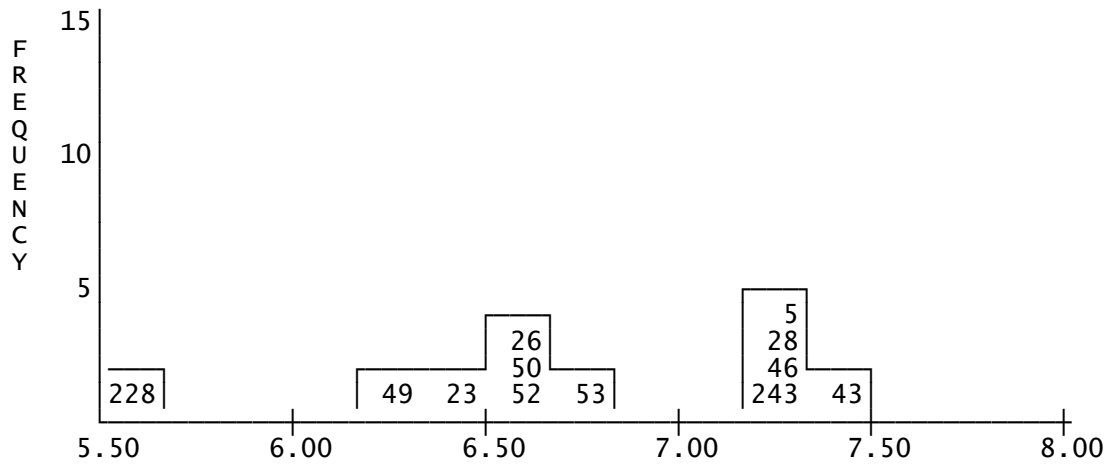
Sample : TBLA 3  
 Number of Laboratories : 12  
 Consensus Mean : 6.26  
 Repeatability Estimate :  $2.51 \pm 0.51$   
 Reproducibility Estimate :  $2.76 \pm 0.62$

Sample : TBLA 4  
 Number of Laboratories : 11  
 Consensus Mean : 3.57  
 Repeatability Estimate :  $0.72 \pm 0.15$   
 Reproducibility Estimate :  $1.26 \pm 0.61$

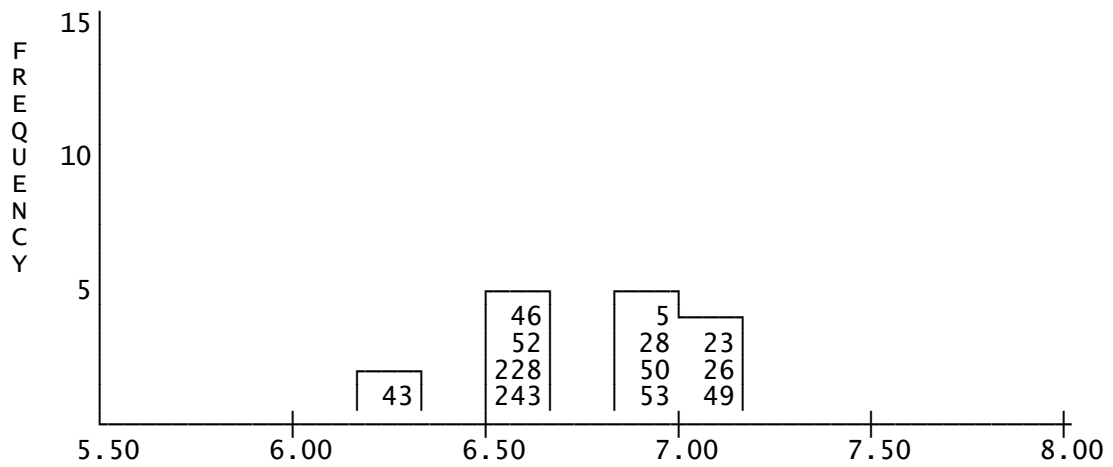
**Tensile Force at Break (N) - 3mm Dumbbell - Laboratory Means**



Sample TBL 1  
(Mean: 7.07 / SD: 0.49)

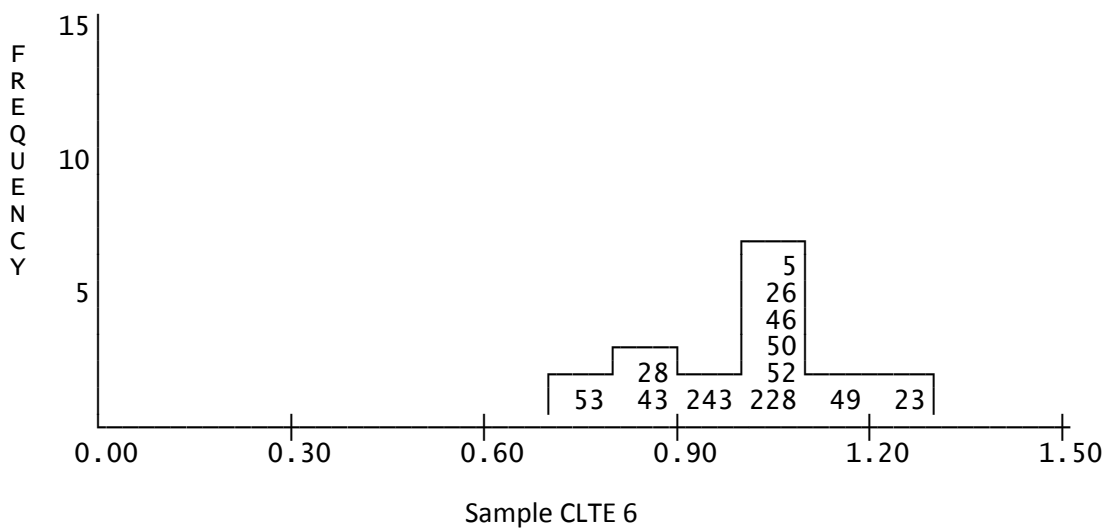
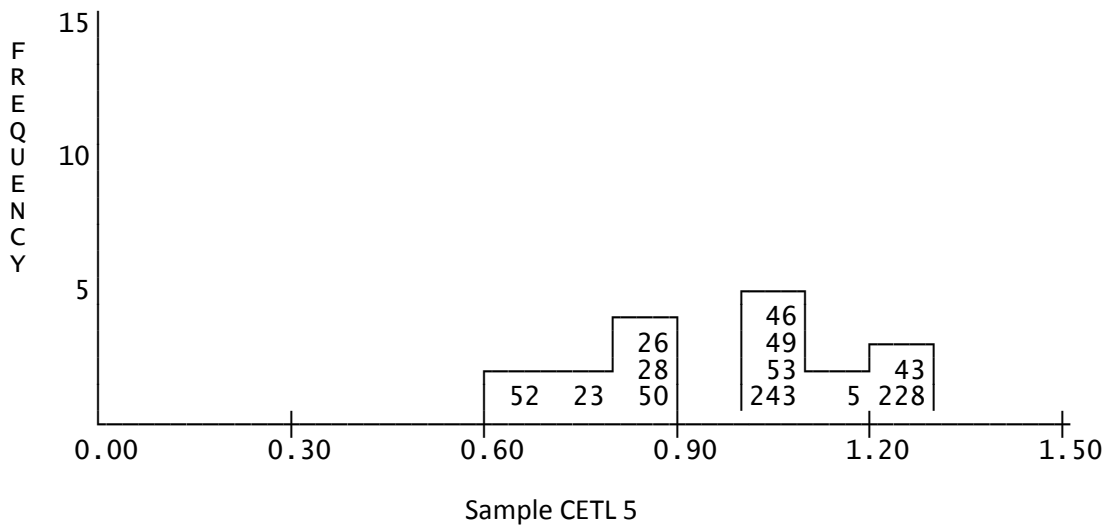
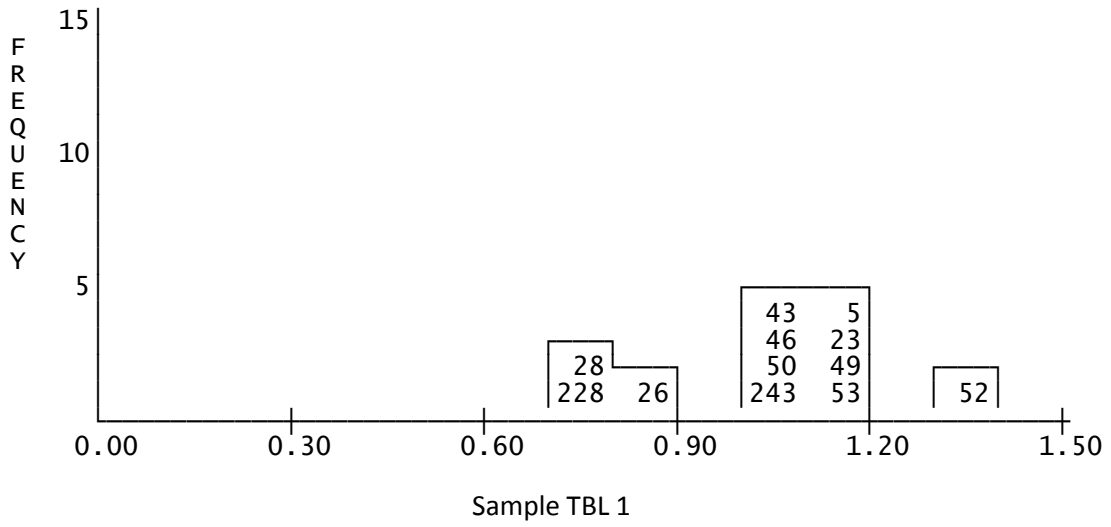


Sample CETL 5  
(Mean: 6.79 / SD: 0.53)



Sample CLTE 6  
(Mean: 6.80 / SD: 0.27)

**Tensile Force at Break (N) - 3mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Force at Break (N) - 3 mm dumbbell**

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	12
Mean	6.79	6.79	Repeatability Outliers	None
Std Dev'n	0.53	0.53	Reproduc'ility Stragglers	None
Std Error	0.15	0.15	Reproduc'ility Outliers	None
Coef Var'n	7.82	7.82		
Minimum	5.61	5.61		
Maximum	7.47	7.47		
Range	1.86	1.86		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	12
Mean	6.80	6.80	Repeatability Outliers	None
Std Dev'n	0.27	0.27	Reproduc'ility Stragglers	None
Std Error	0.08	0.08	Reproduc'ility Outliers	None
Coef Var'n	3.98	3.98		
Minimum	6.31	6.31		
Maximum	7.16	7.16		
Range	0.85	0.85		

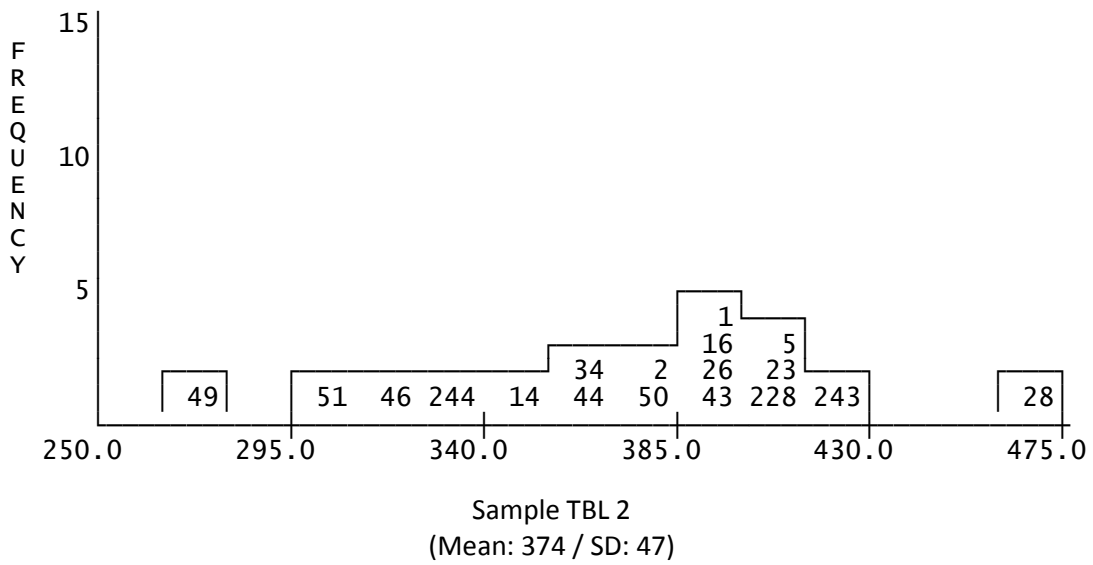
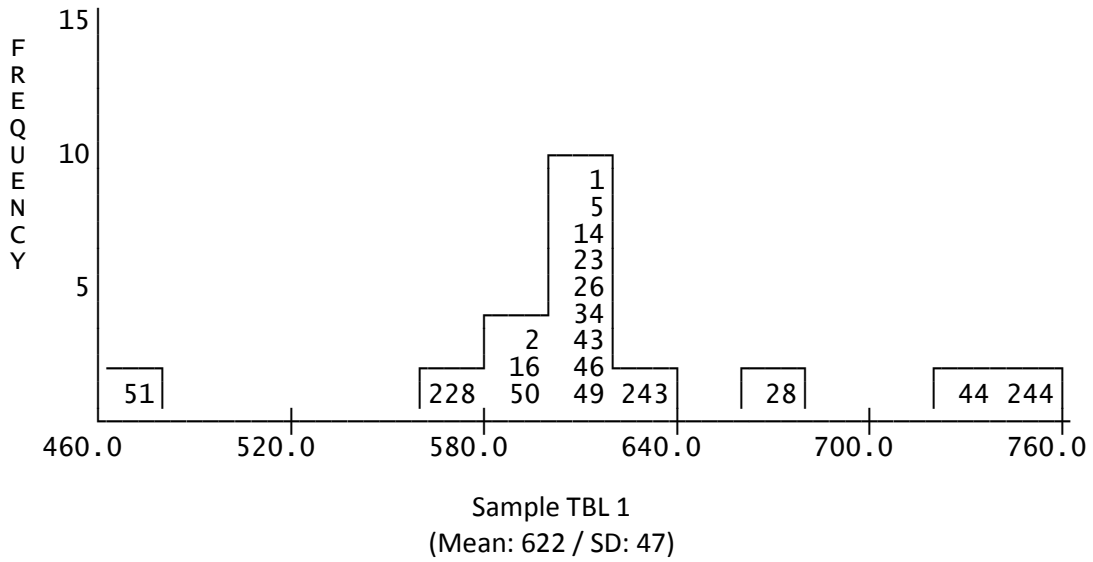
**PRECISION ACHIEVED (after removal of extreme results)**

Force at Break (N) - 3 mm dumbbell

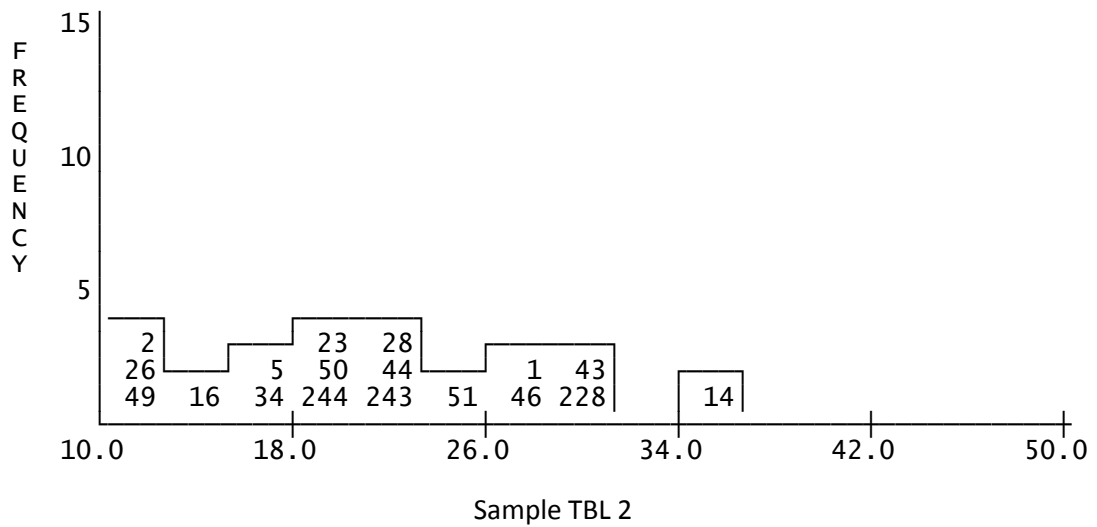
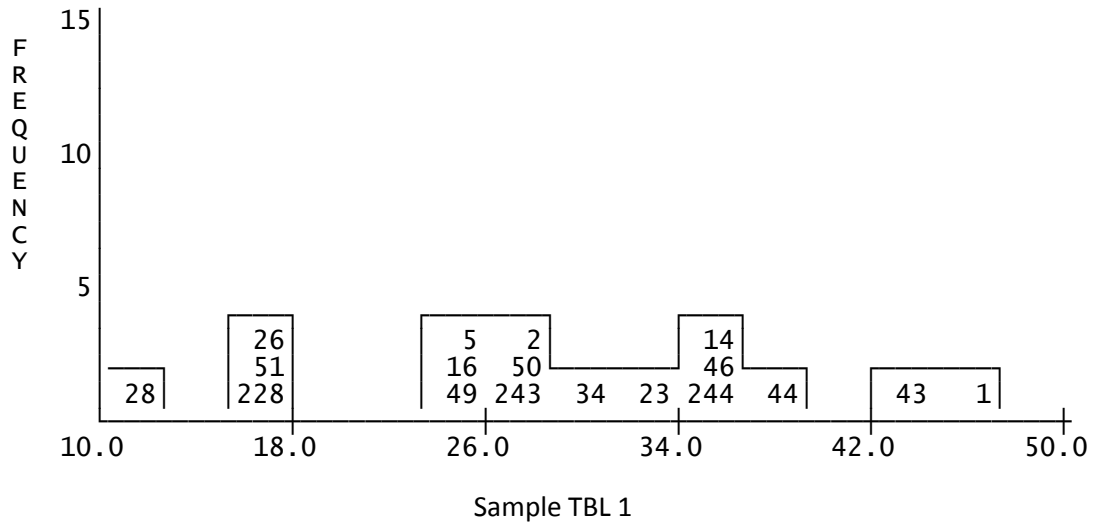
Sample : CETL 5  
 Number of Laboratories : 12  
 Consensus Mean : 6.79  
 Repeatability Estimate : 2.82 ± 0.58  
 Reproducibility Estimate : 3.07 ± 0.67

Sample : CLTE 6  
 Number of Laboratories : 12  
 Consensus Mean : 6.80  
 Repeatability Estimate : 2.82 ± 0.58  
 Reproducibility Estimate : 2.82 ± 0.55

**Elongation at Break (%) - 6mm Dumbbell - Laboratory Means**



**Elongation at Break (%) - 6mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Elongation at Break (%) - 6mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	18	17	Repeatability Outliers	None
Mean	613	622	Reproduc'tility Stragglers	51
Std Dev'n	59	47	Reproduc'tility Outliers	None
Std Error	14	11		
Coef Var'n	10	8		
Minimum	460	574		
Maximum	740	740		
Range	281	166		

**Sample TBL 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	18	18	Repeatability Outliers	None
Mean	374	374	Reproduc'tility Stragglers	None
Std Dev'n	47	47	Reproduc'tility Outliers	None
Std Error	11	11		
Coef Var'n	12	12		
Minimum	277	277		
Maximum	461	461		
Range	184	184		

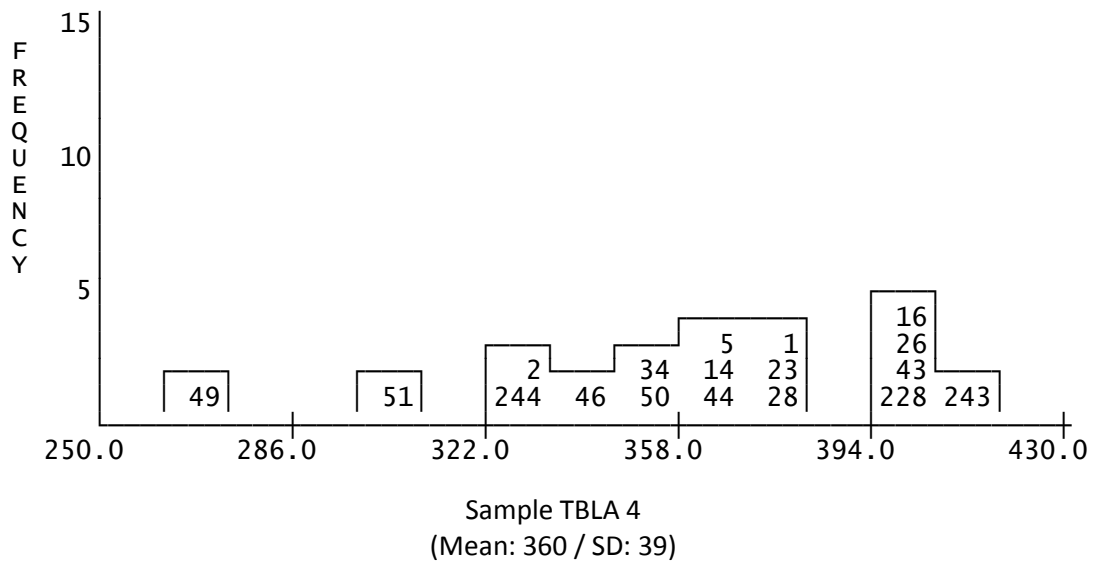
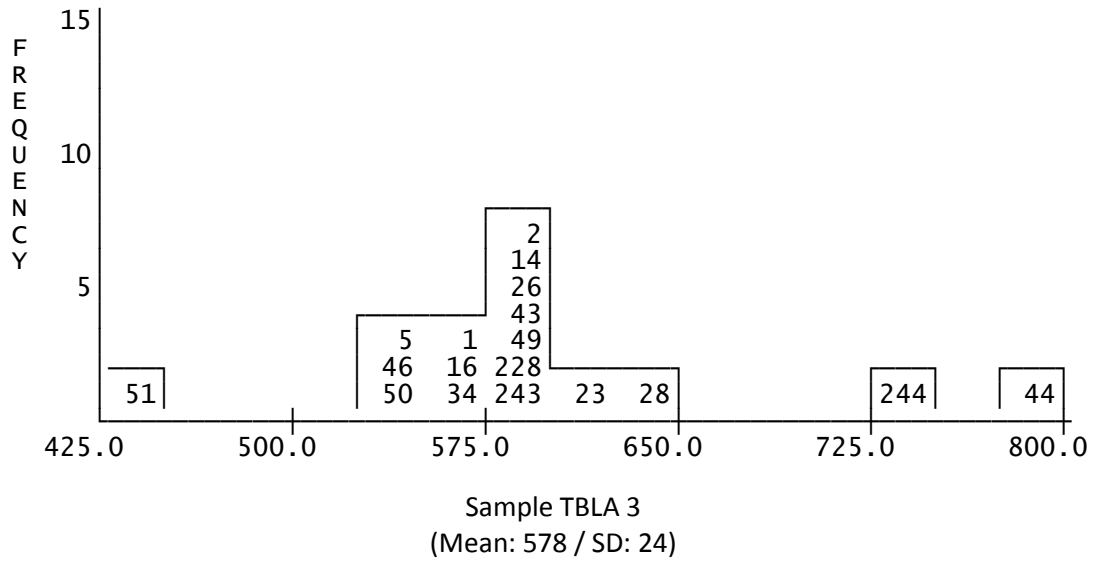
**PRECISION ACHIEVED (after removal of extreme results)**

Elongation at Break (%) - 6mm Dumbbell

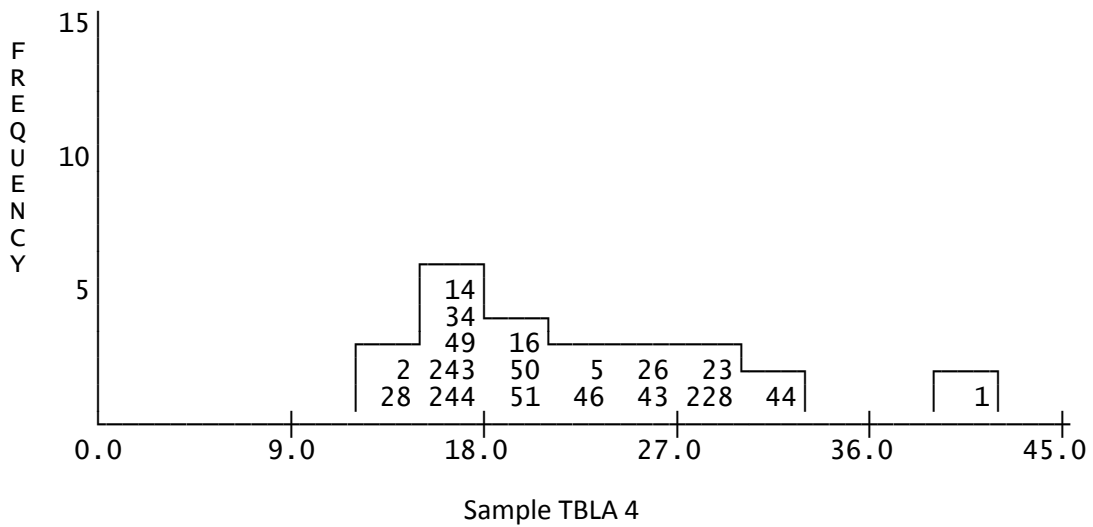
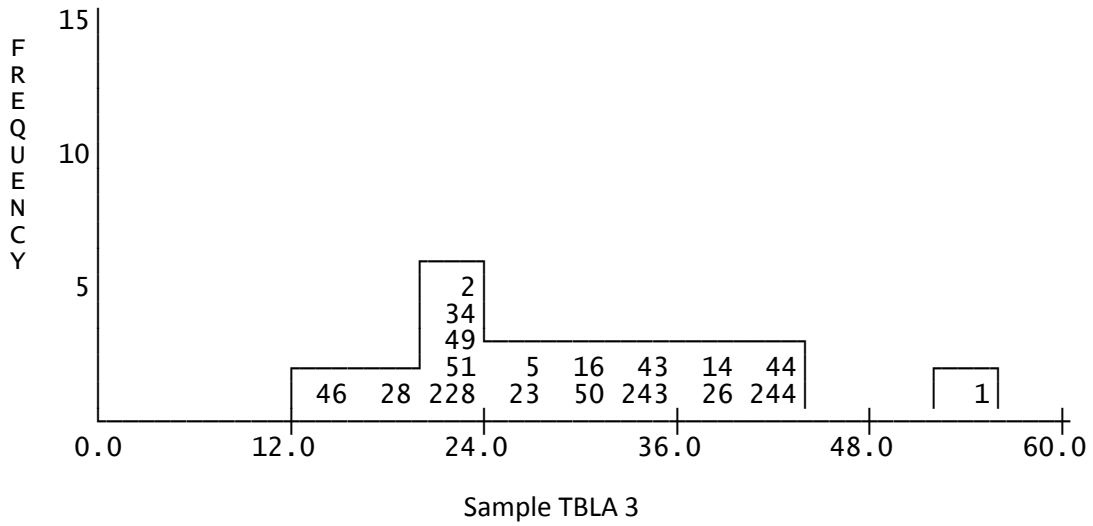
Sample : TBL 1  
 Number of Laboratories : 17  
 Consensus Mean : 622  
 Repeatability Estimate : 85 ± 15  
 Reproducibility Estimate : 156 ± 61

Sample : TBL 2  
 Number of Laboratories : 18  
 Consensus Mean : 374  
 Repeatability Estimate : 62 ± 10  
 Reproducibility Estimate : 145 ± 62

**Elongation at Break (Oven-Conditioned) (%) - 6mm Dumbbell - Laboratory Means**



**Elongation at Break (Oven-Conditioned) (%) - 6mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Elongation at Break (Oven-Conditioned) (%) - 6mm Dumbbell**

**Sample TBLA 3:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	592	578	Repeatability Outliers	None
Std Dev'n	76	24	Reproduc'ility Stragglers	None
Std Error	18	7	Reproduc'ility Outliers	44,51,244
Coef Var'n	13	4		
Minimum	444	540		
Maximum	793	629		
Range	349	89		

**Sample TBLA 4:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	362	360	Repeatability Outliers	1
Std Dev'n	38	39	Reproduc'ility Stragglers	None
Std Error	9	9	Reproduc'ility Outliers	None
Coef Var'n	10	11		
Minimum	263	263		
Maximum	414	414		
Range	151	151		

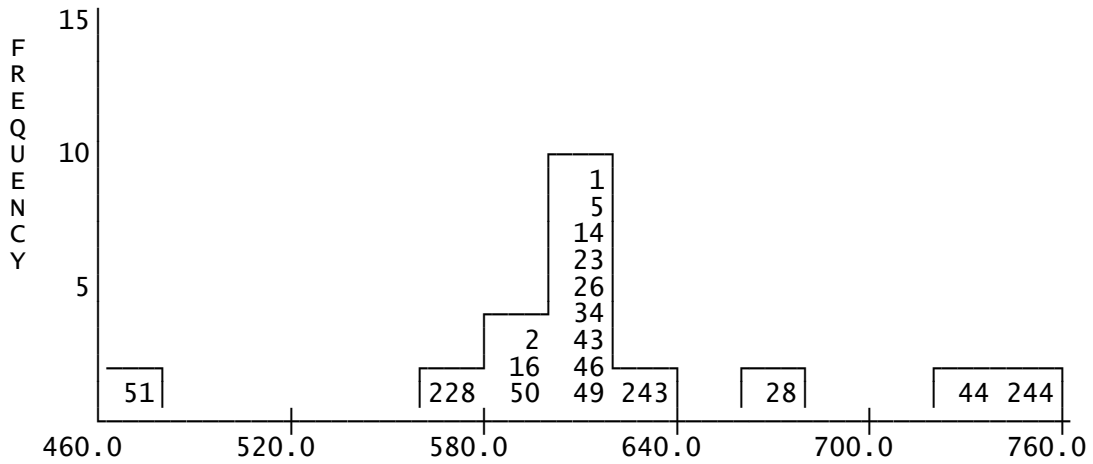
**PRECISION ACHIEVED (after removal of extreme results)**

Elongation at Break Oven Conditions (%) - 6mm dumbbell

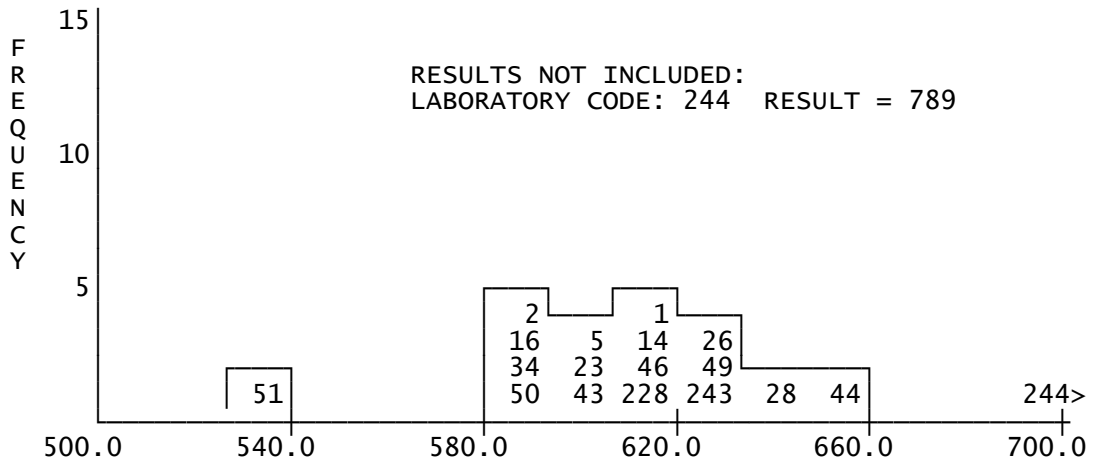
Sample : TBLA 3  
 Number of Laboratories : 14  
 Consensus Mean : 578  
 Repeatability Estimate :  $77 \pm 15$   
 Reproducibility Estimate :  $101 \pm 30$

Sample : TBLA 4  
 Number of Laboratories : 17  
 Consensus Mean : 360  
 Repeatability Estimate :  $58 \pm 10$   
 Reproducibility Estimate :  $122 \pm 52$

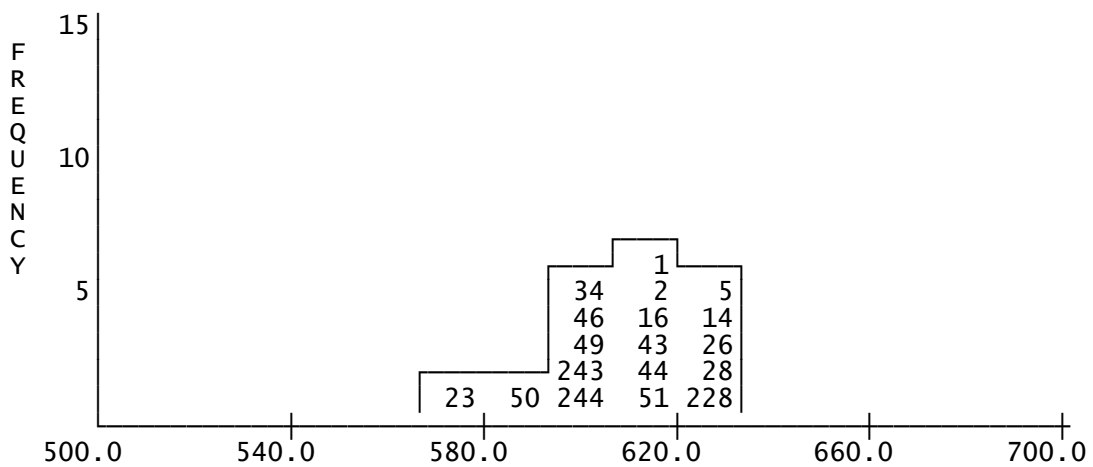
**Elongation at Break (%) - 6mm Dumbbell - Laboratory Means**



Sample TBL 1  
(Mean: 622 / SD: 47)

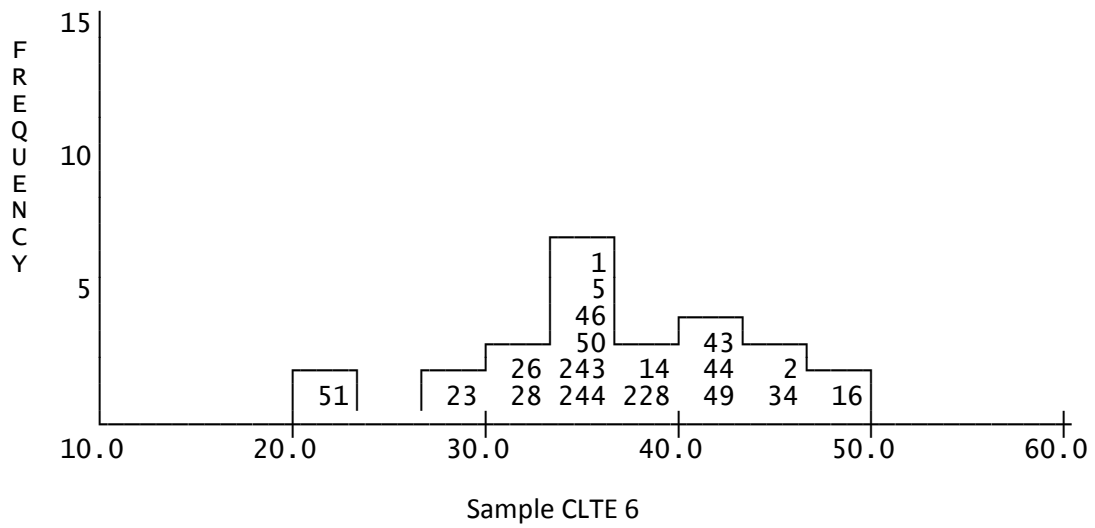
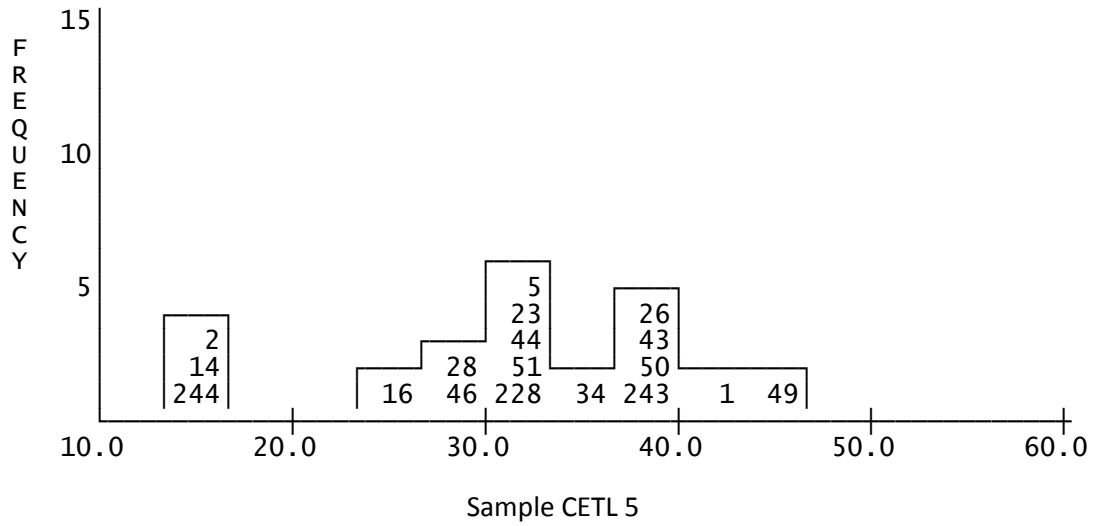
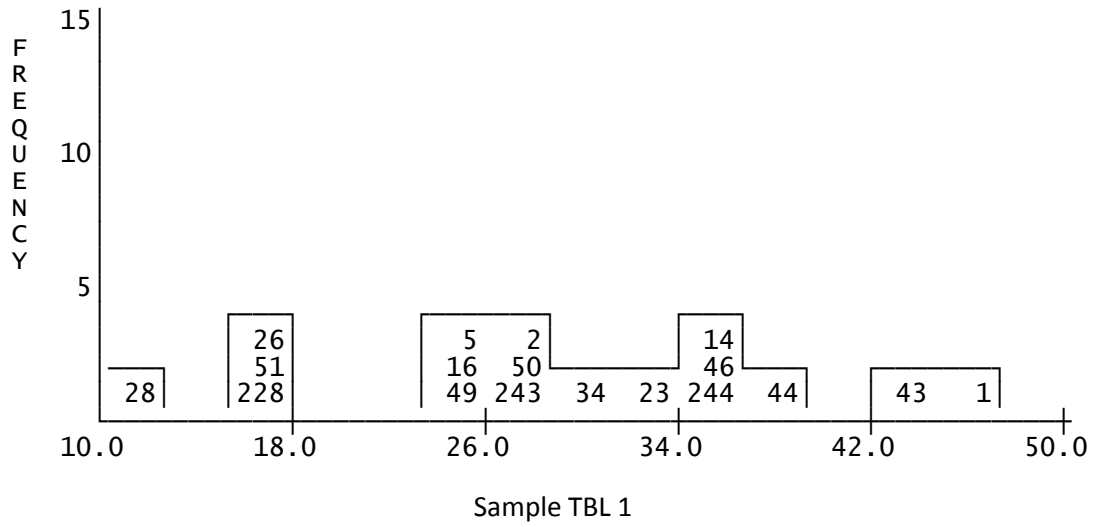


Sample CETL 5  
(Mean: 612 / SD: 19)



Sample CLTE 6  
(Mean: 609 / SD: 14)

**Elongation at Break (%) - 6mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Elongation at Break (%) - 6mm Dumbbell**

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	617	612	Repeatability Outliers	None
Std Dev'n	51	19	Reproduc'tility Stragglers	51
Std Error	12	5	Reproduc'tility Outliers	244
Coef Var'n	8	3		
Minimum	528	587		
Maximum	789	652		
Range	262	65		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	609	609	Repeatability Outliers	None
Std Dev'n	14	14	Reproduc'tility Stragglers	None
Std Error	3	3	Reproduc'tility Outliers	None
Coef Var'n	2	2		
Minimum	577	577		
Maximum	626	626		
Range	49	49		

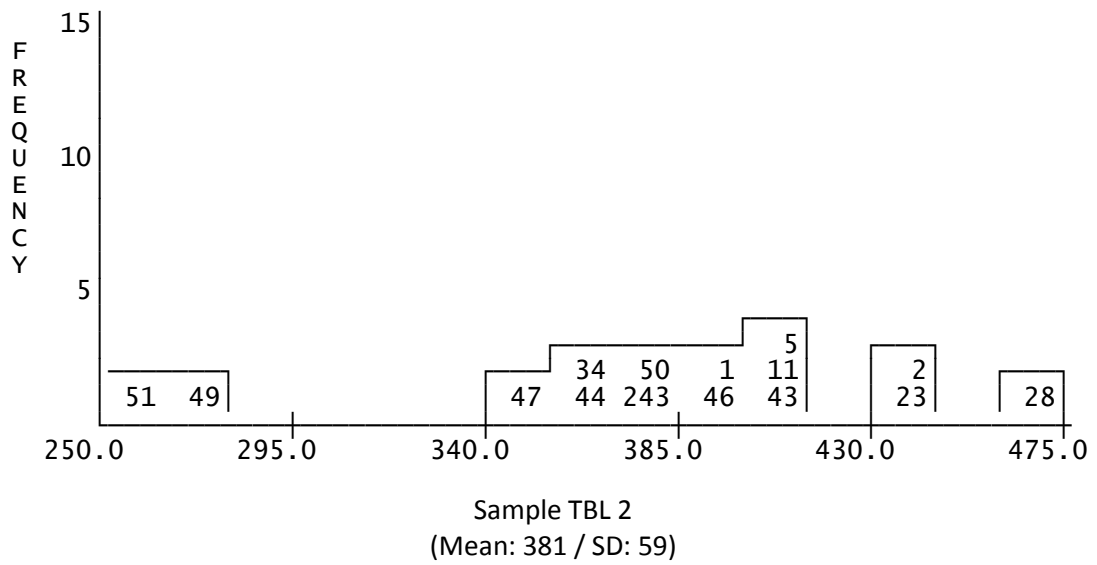
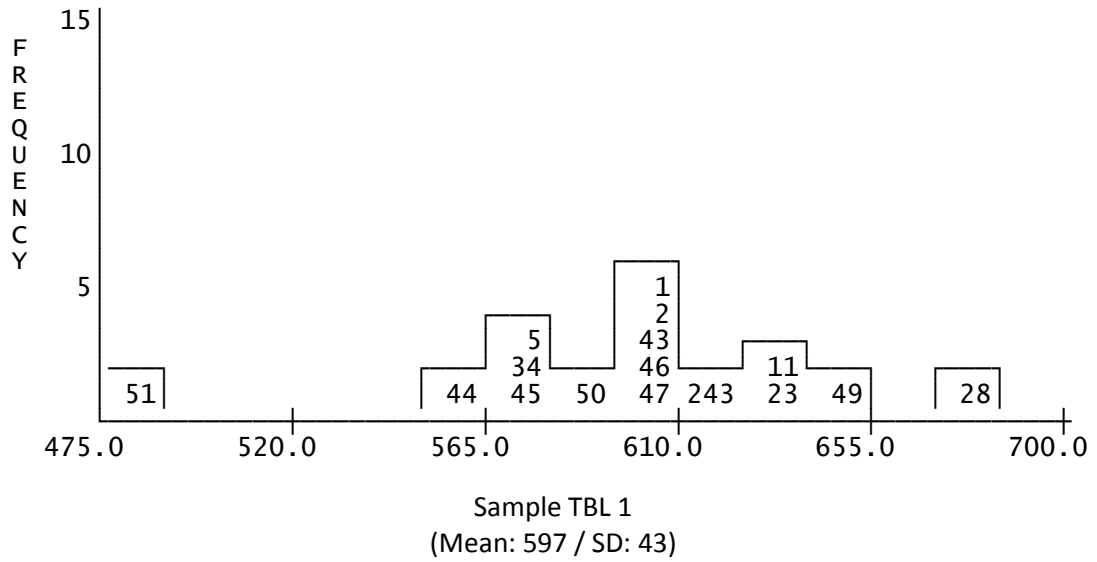
**PRECISION ACHIEVED (after removal of extreme results)**

Elongation at Break (%) - 6mm dumbbell

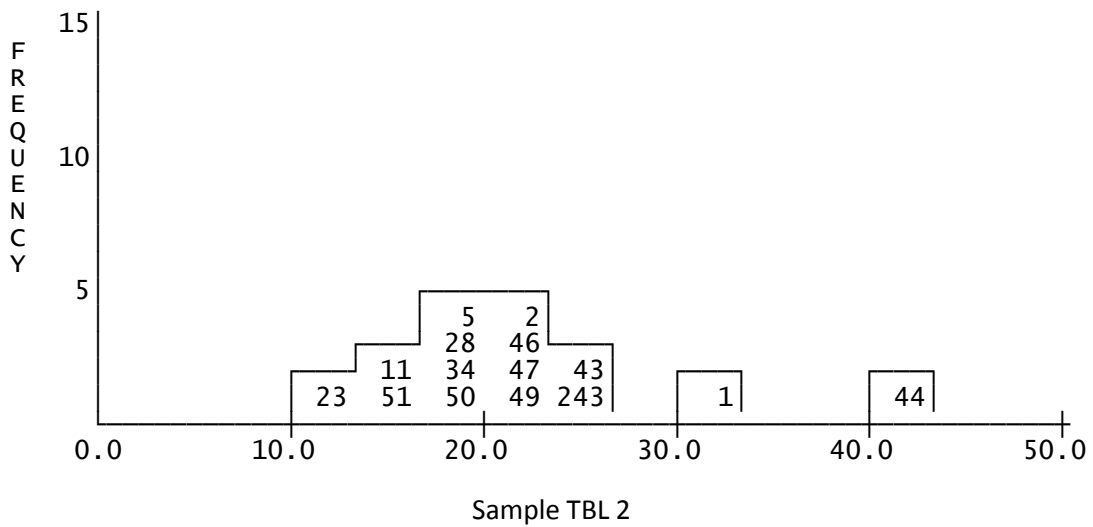
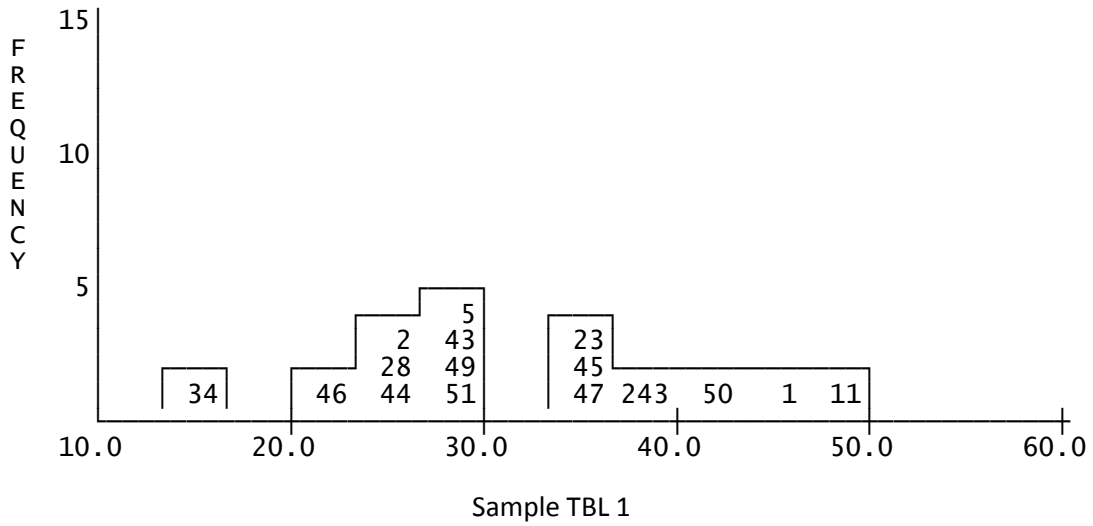
Sample : CETL 5  
 Number of Laboratories : 16  
 Consensus Mean : 612  
 Repeatability Estimate : 93 ± 16  
 Reproducibility Estimate : 103 ± 20

Sample : CLTE 6  
 Number of Laboratories : 18  
 Consensus Mean : 609  
 Repeatability Estimate : 105 ± 18  
 Reproducibility Estimate : 107 ± 17

**Elongation at Break (%) - 4mm Dumbbell - Laboratory Means**



**Elongation at Break (%) - 4mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Elongation at Break (%) - 4mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	16
Mean	597	597	Repeatability Outliers	None
Std Dev'n	43	43	Reproduc'lity Stragglers	None
Std Error	11	11	Reproduc'lity Outliers	None
Coef Var'n	7	7		
Minimum	488	488		
Maximum	677	677		
Range	189	189		

**Sample TBL 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	15
Mean	379	381	Repeatability Outliers	44
Std Dev'n	57	59	Reproduc'lity Stragglers	None
Std Error	15	16	Reproduc'lity Outliers	None
Coef Var'n	15	16		
Minimum	256	256		
Maximum	468	468		
Range	212	212		

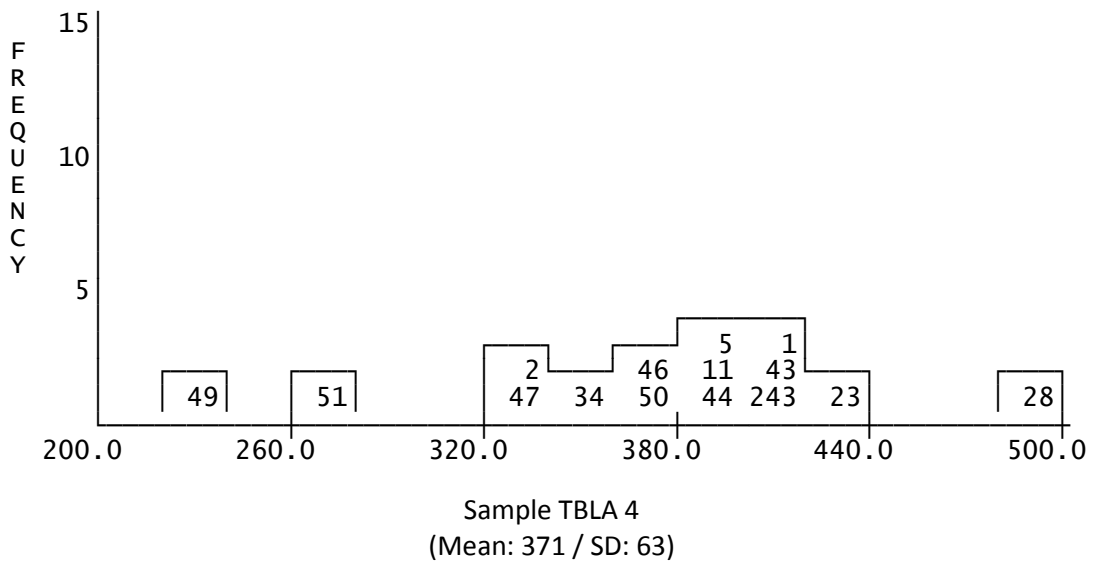
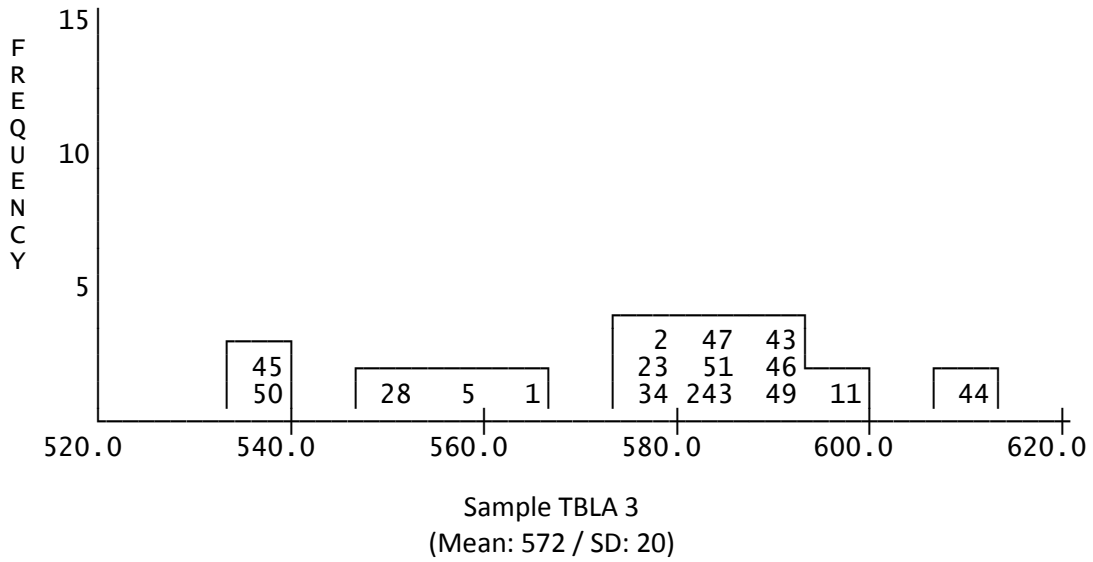
**PRECISION ACHIEVED (after removal of extreme results)**

Elongation at Break (%) - 4mm Dumbbell

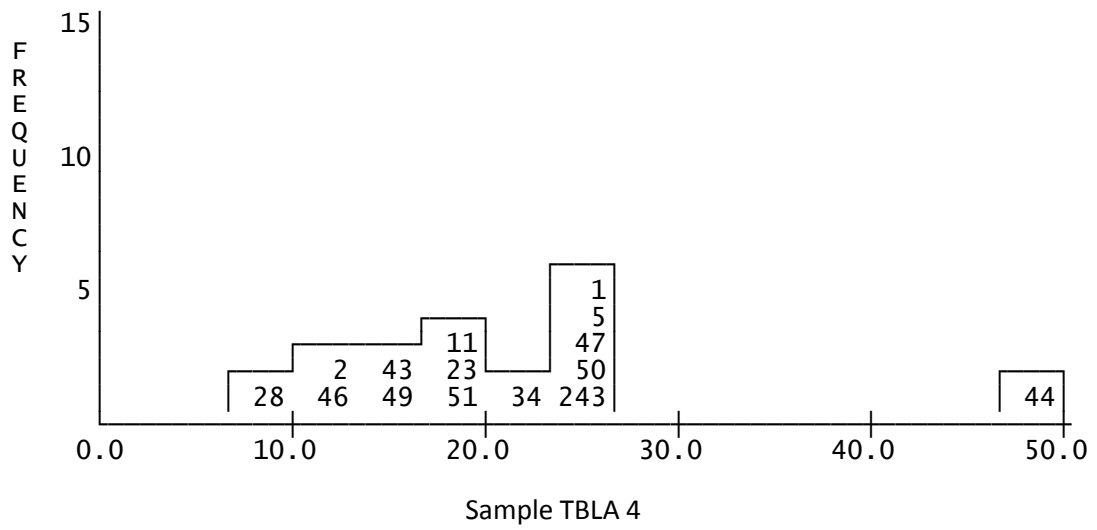
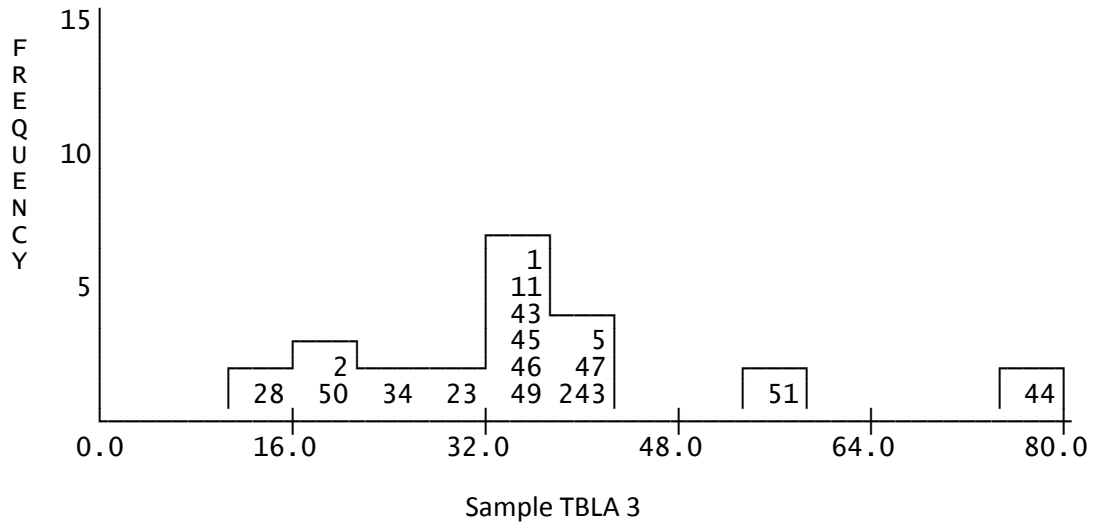
Sample : TBL 1  
 Number of Laboratories : 16  
 Consensus Mean : 597  
 Repeatability Estimate :  $91 \pm 16$   
 Reproducibility Estimate :  $149 \pm 55$

Sample : TBL 2  
 Number of Laboratories : 14  
 Consensus Mean : 381  
 Repeatability Estimate :  $60 \pm 11$   
 Reproducibility Estimate :  $176 \pm 93$

**Elongation at Break (Oven-Conditioned) (%) - 4mm Dumbbell - Laboratory Means**



**Elongation at Break (Oven-Conditioned) (%) - 4mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Elongation at Break (Oven-Conditioned) (%) - 4mm Dumbbell**

**Sample TBLA 3:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	16
Mean	575	572	Repeatability Outliers	44
Std Dev'n	21	20	Reproduc'ility Stragglers	None
Std Error	5	5	Reproduc'ility Outliers	None
Coef Var'n	4	3		
Minimum	537	537		
Maximum	612	599		
Range	75	62		

**Sample TBLA 4:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	15
Mean	372	371	Repeatability Outliers	44
Std Dev'n	61	63	Reproduc'ility Stragglers	None
Std Error	16	17	Reproduc'ility Outliers	None
Coef Var'n	16	17		
Minimum	233	233		
Maximum	482	482		
Range	249	249		

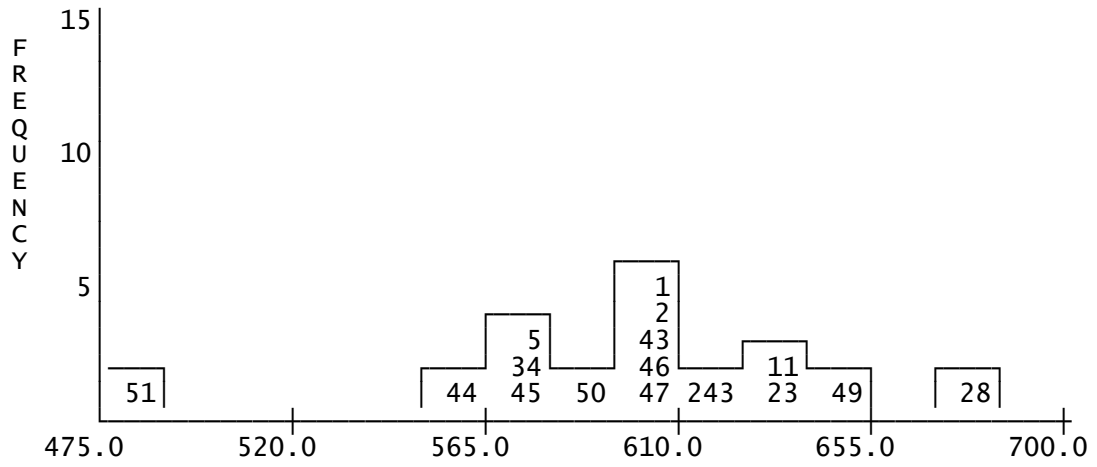
**PRECISION ACHIEVED (after removal of extreme results)**

Elongation at Break Oven Conditions (%) - 4mm dumbbell

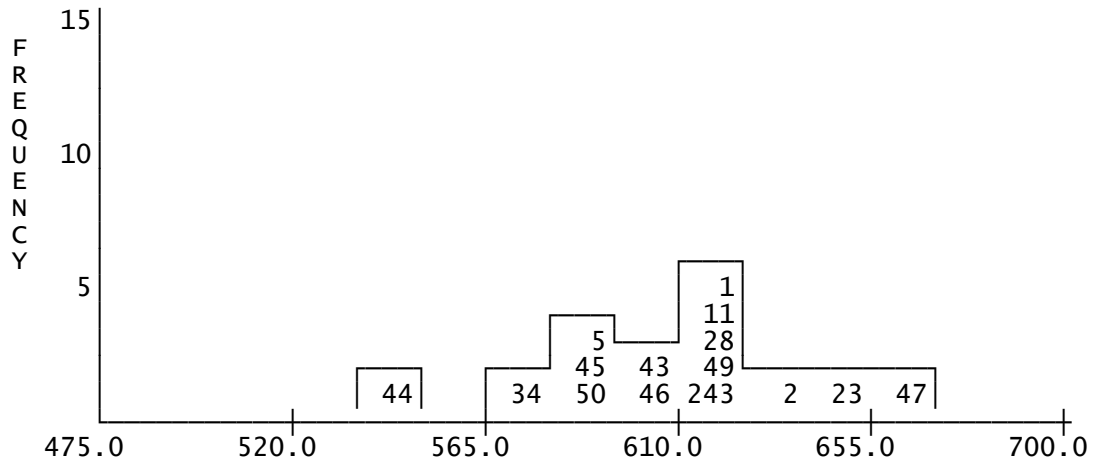
Sample : TBLA 3  
 Number of Laboratories : 15  
 Consensus Mean : 572  
 Repeatability Estimate :  $95 \pm 17$   
 Reproducibility Estimate :  $106 \pm 22$

Sample : TBLA 4  
 Number of Laboratories : 14  
 Consensus Mean : 371  
 Repeatability Estimate :  $55 \pm 10$   
 Reproducibility Estimate :  $186 \pm 101$

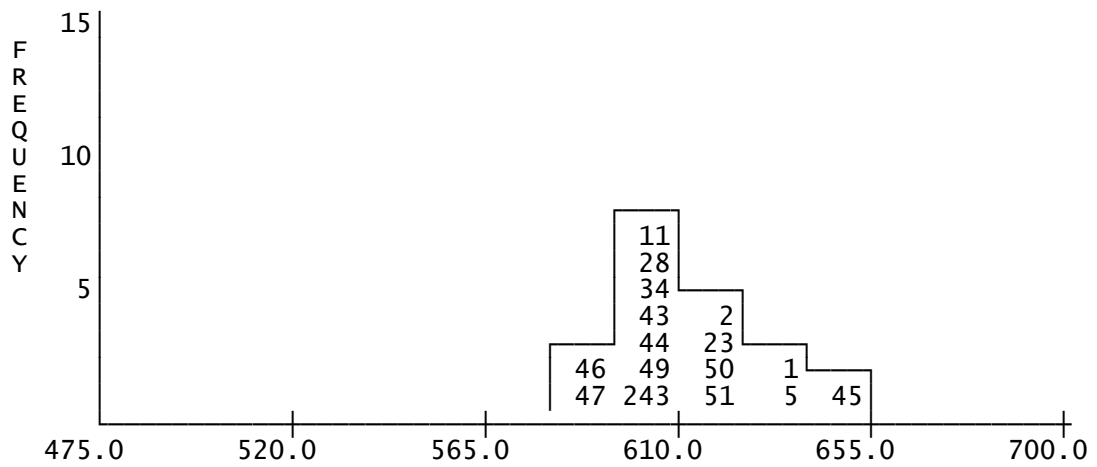
**Elongation at Break (%) - 4mm Dumbbell - Laboratory Means**



Sample TBL 1  
(Mean: 597 / SD: 43)

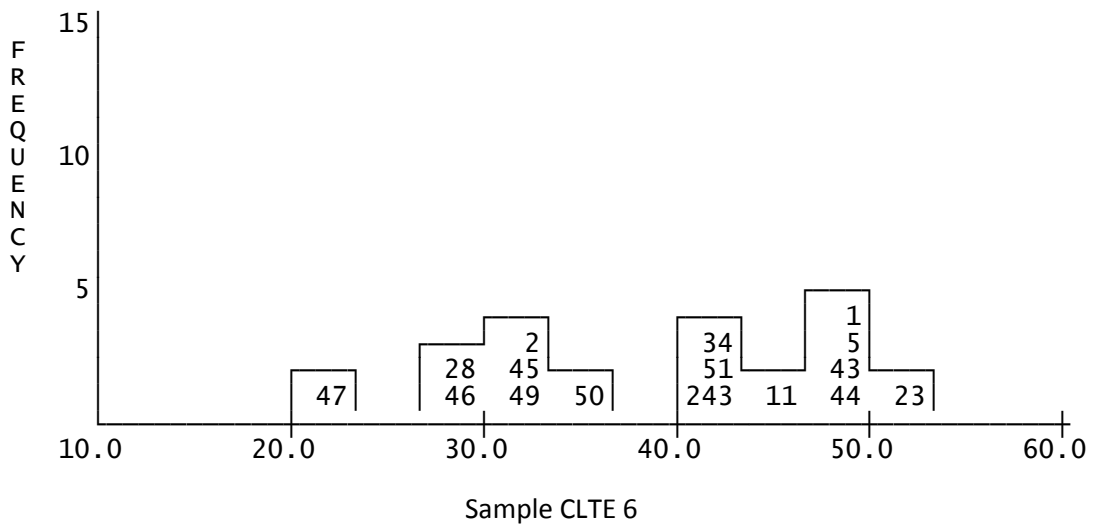
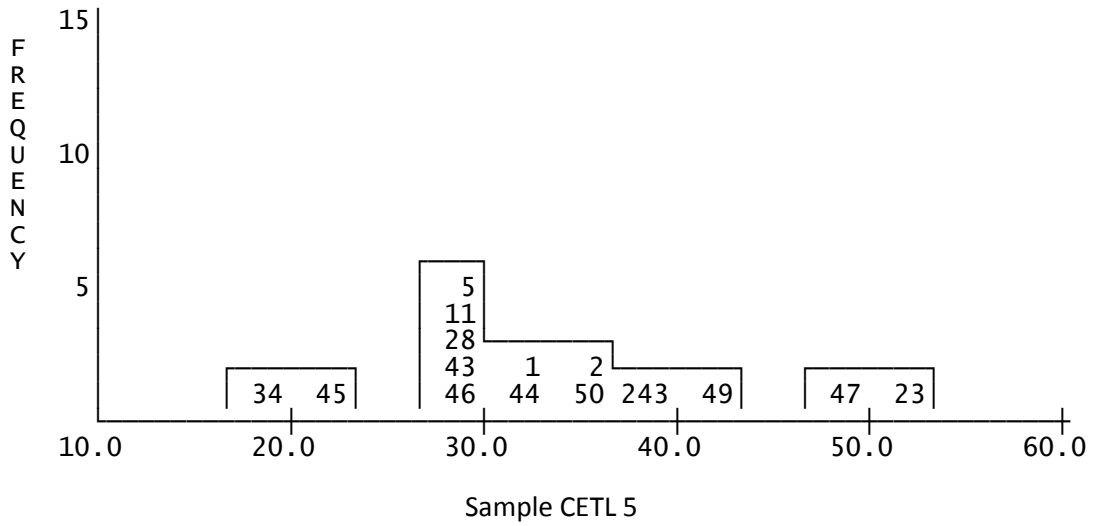
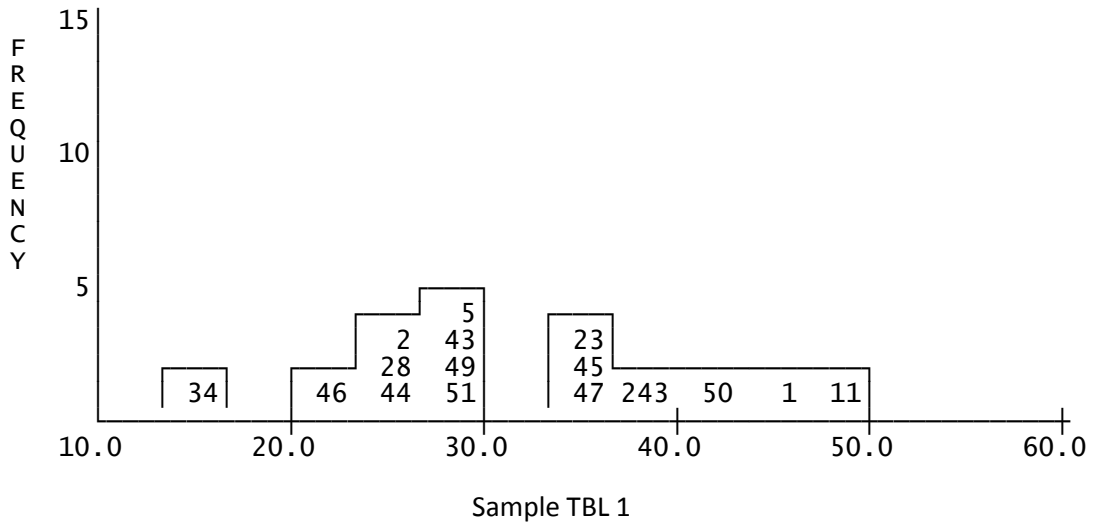


Sample CETL 5  
(Mean: 606 / SD: 30)



Sample CLTE 6  
(Mean: 610 / SD: 16)

**Elongation at Break (%) - 4mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Elongation at Break (%) - 4mm Dumbbell**

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	15
Mean	606	606	Repeatability Outliers	None
Std Dev'n	30	30	Reproduc'ility Stragglers	None
Std Error	8	8	Reproduc'ility Outliers	None
Coef Var'n	5	5		
Minimum	543	543		
Maximum	664	664		
Range	121	121		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	16
Mean	610	610	Repeatability Outliers	None
Std Dev'n	16	16	Reproduc'ility Stragglers	None
Std Error	4	4	Reproduc'ility Outliers	None
Coef Var'n	3	3		
Minimum	585	585		
Maximum	644	644		
Range	58	59		

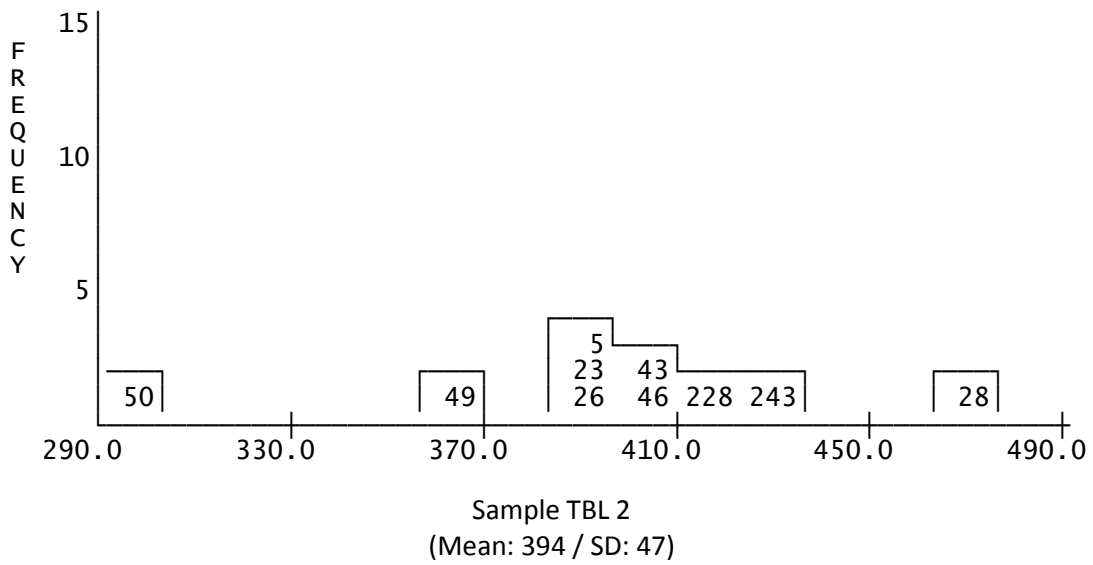
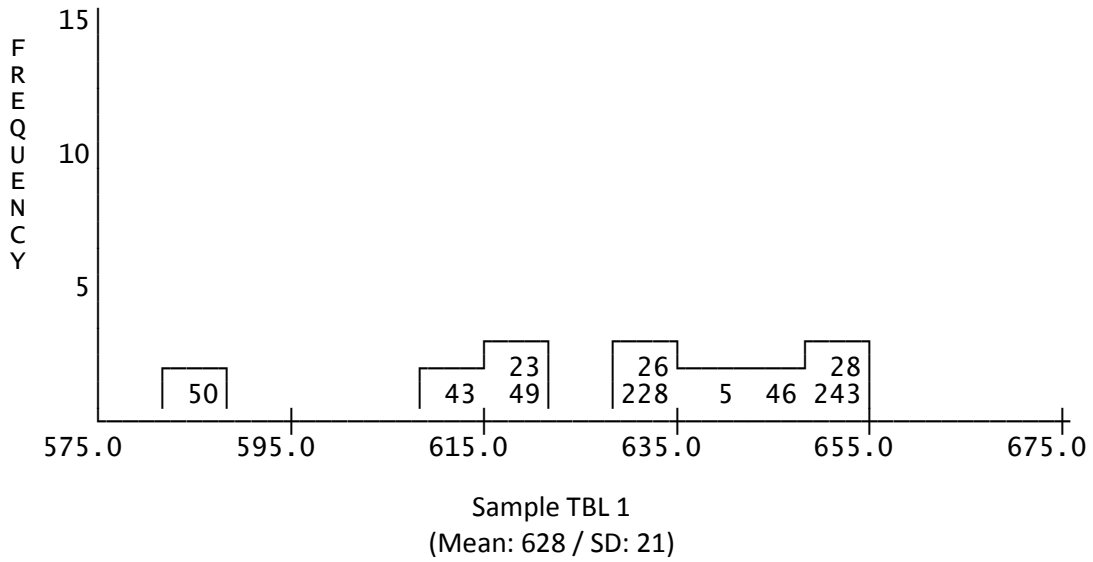
**PRECISION ACHIEVED (after removal of extreme results)**

Elongation at Break(%) - 4mm dumbbell

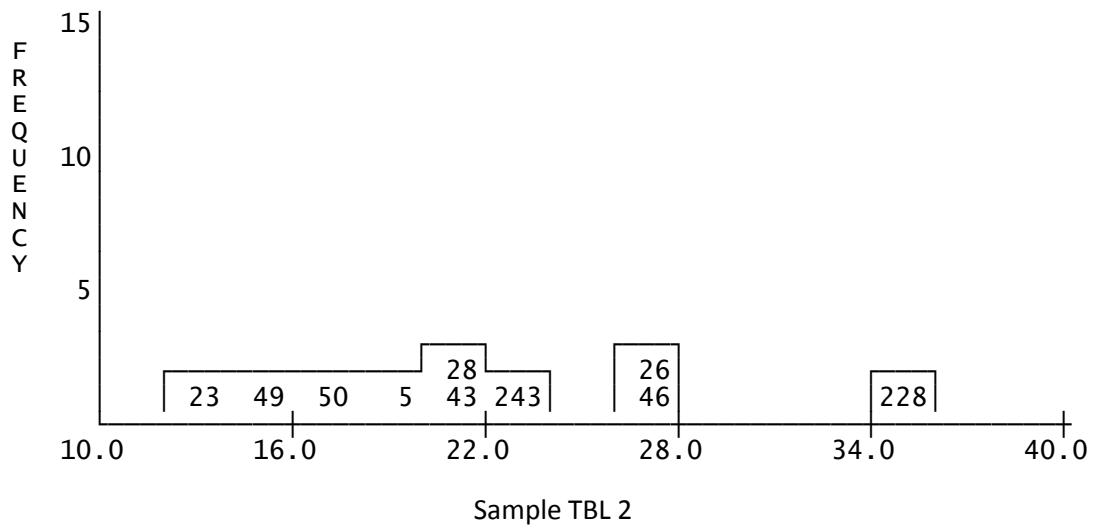
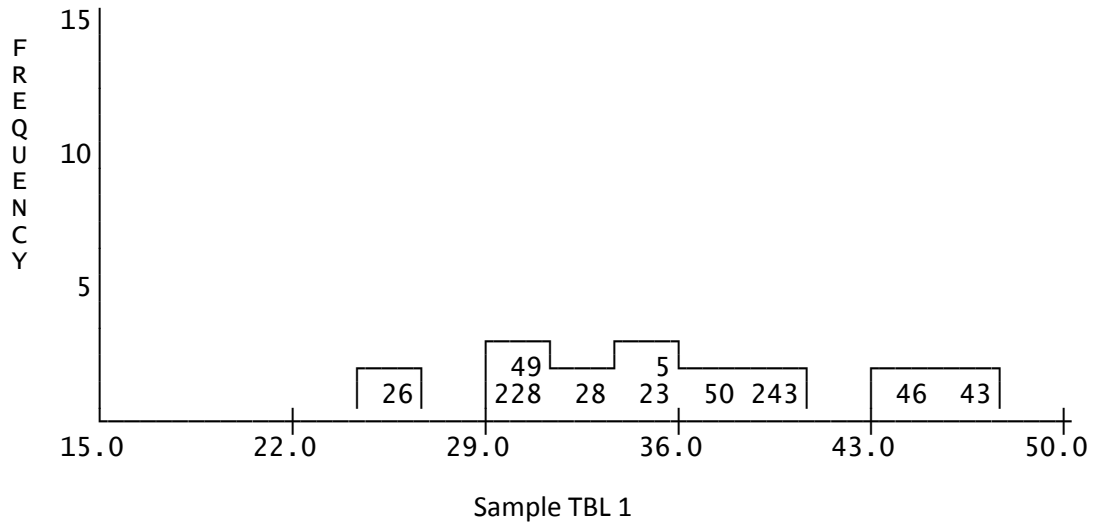
Sample : CETL 5  
 Number of Laboratories : 15  
 Consensus Mean : 606  
 Repeatability Estimate :  $96 \pm 18$   
 Reproducibility Estimate :  $125 \pm 35$

Sample : CLTE 6  
 Number of Laboratories : 16  
 Consensus Mean : 610  
 Repeatability Estimate :  $112 \pm 20$   
 Reproducibility Estimate :  $115 \pm 20$

**Elongation at Break (%) - 3mm Dumbbell - Laboratory Means**



**Elongation at Break (%) - 3mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Elongation at Break (%) - 3mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	10	10	Repeatability Outliers	None
Mean	628	628	Reproduc'tility Stragglers	None
Std Dev'n	21	21	Reproduc'tility Outliers	None
Std Error	7	7		
Coef Var'n	3	3		
Minimum	584	584		
Maximum	652	652		
Range	68	68		

**Sample TBL 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	10	10	Repeatability Outliers	None
Mean	394	394	Reproduc'tility Stragglers	None
Std Dev'n	47	47	Reproduc'tility Outliers	None
Std Error	15	15		
Coef Var'n	12	12		
Minimum	292	292		
Maximum	470	470		
Range	178	178		

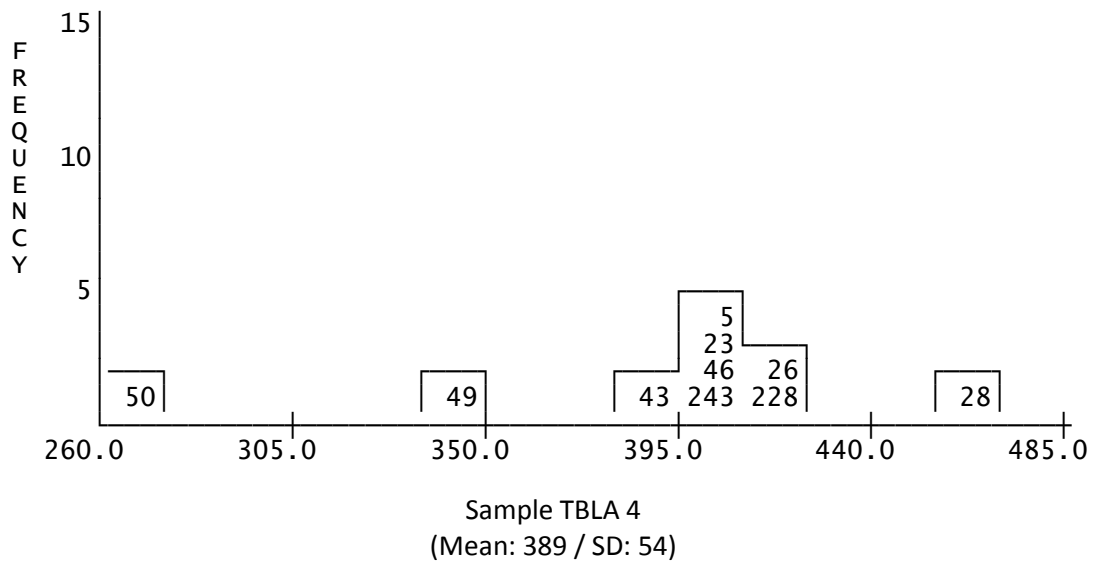
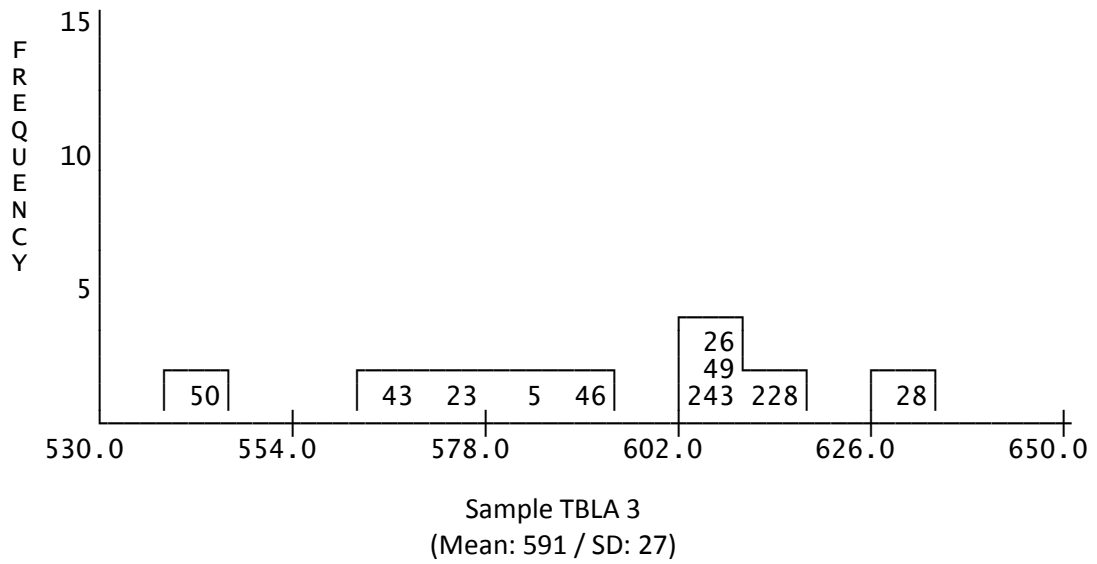
**PRECISION ACHIEVED (after removal of extreme results)**

Elongation at Break (%) - 3mm Dumbbell

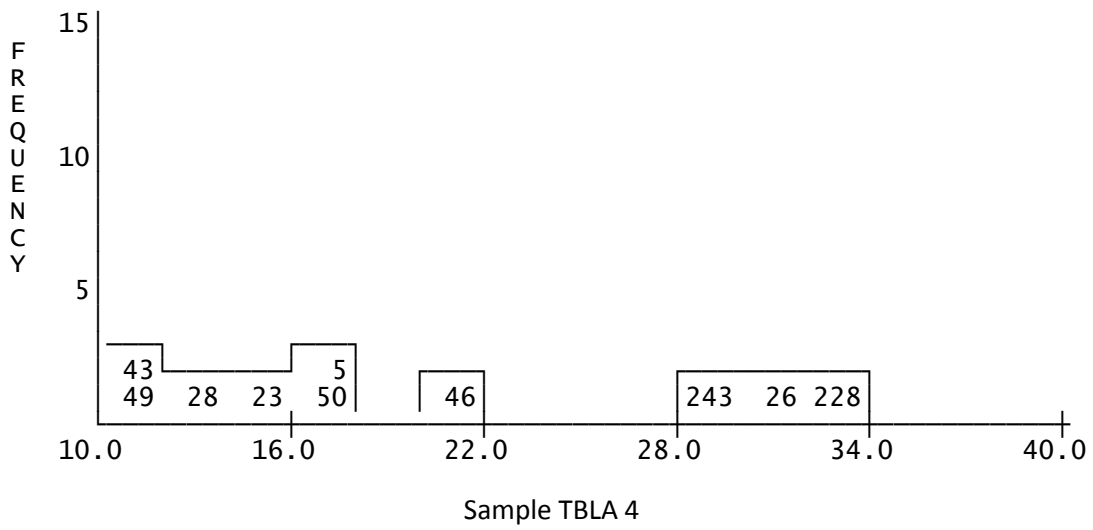
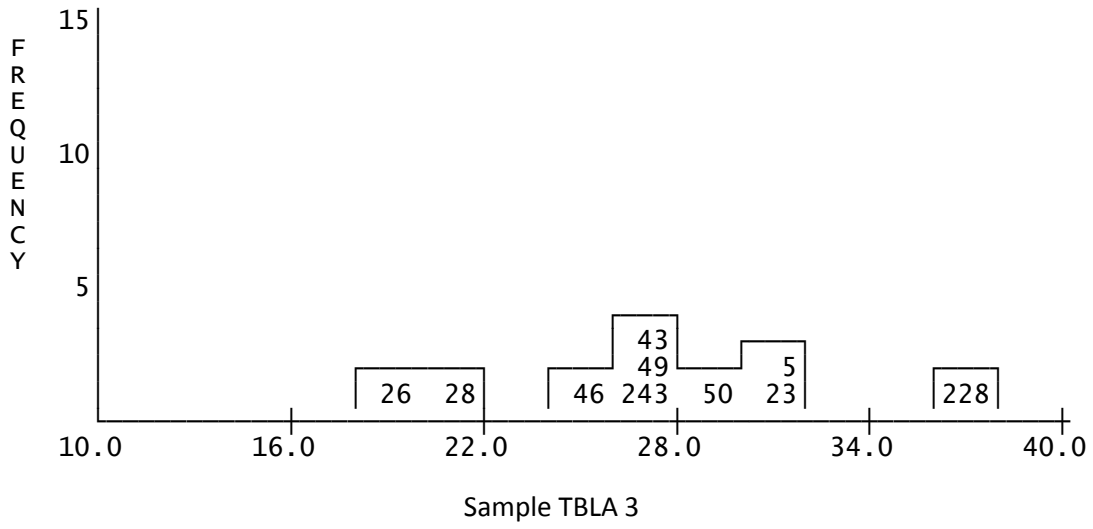
Sample : TBL 1  
 Number of Laboratories : 10  
 Consensus Mean : 628  
 Repeatability Estimate : 102 ± 23  
 Reproducibility Estimate : 114 ± 29

Sample : TBL 2  
 Number of Laboratories : 10  
 Consensus Mean : 394  
 Repeatability Estimate : 64 ± 14  
 Reproducibility Estimate : 145 ± 85

**Elongation at Break (Oven-Conditioned) (%) - 3mm Dumbbell - Laboratory Means**



**Elongation at Break (Oven-Conditioned) (%) - 3mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Elongation at Break (Oven-Conditioned) (%) - 3mm Dumbbell**

**Sample TBLA 3:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	10
Mean	591	591	Repeatability Outliers	None
Std Dev'n	27	27	Reproduc'ility Stragglers	None
Std Error	9	9	Reproduc'ility Outliers	None
Coef Var'n	5	5		
Minimum	538	538		
Maximum	633	633		
Range	95	95		

**Sample TBLA 4:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	10
Mean	389	389	Repeatability Outliers	None
Std Dev'n	54	54	Reproduc'ility Stragglers	None
Std Error	17	17	Reproduc'ility Outliers	None
Coef Var'n	14	14		
Minimum	262	262		
Maximum	465	465		
Range	203	203		

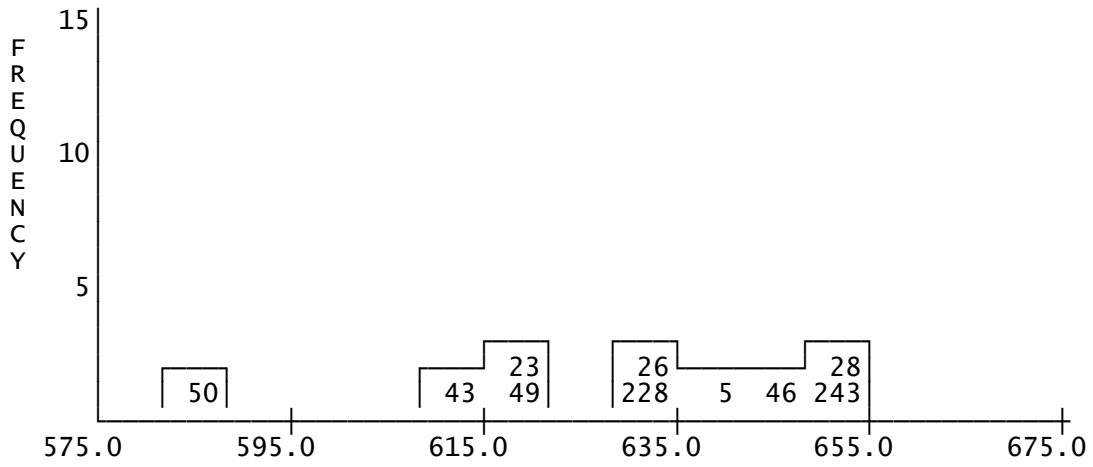
**PRECISION ACHIEVED (after removal of extreme results)**

Elongation at Break Oven Conditions (%) - 3mm dumbbell

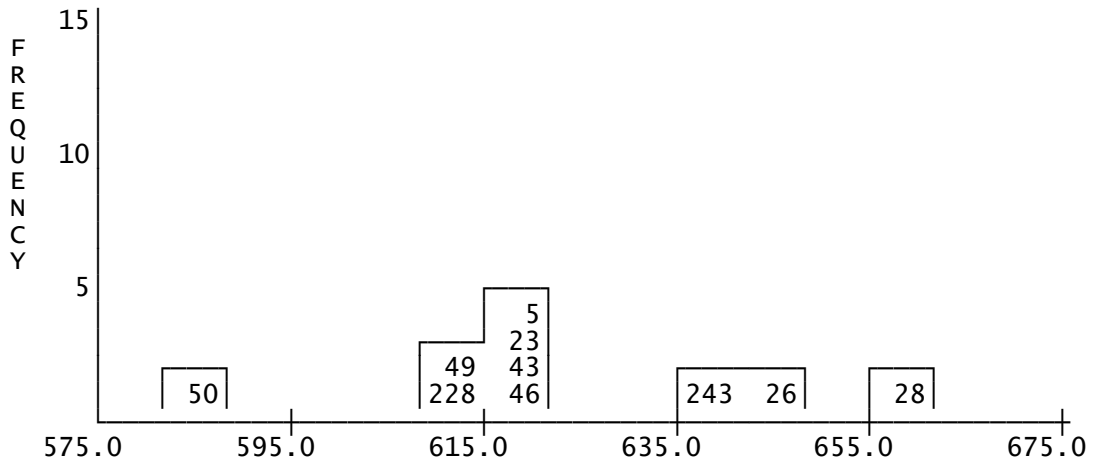
Sample : TBLA 3  
 Number of Laboratories : 10  
 Consensus Mean : 591  
 Repeatability Estimate : 78 ± 18  
 Reproducibility Estimate : 107 ± 41

Sample : TBLA 4  
 Number of Laboratories : 10  
 Consensus Mean : 389  
 Repeatability Estimate : 59 ± 13  
 Reproducibility Estimate : 162 ± 101

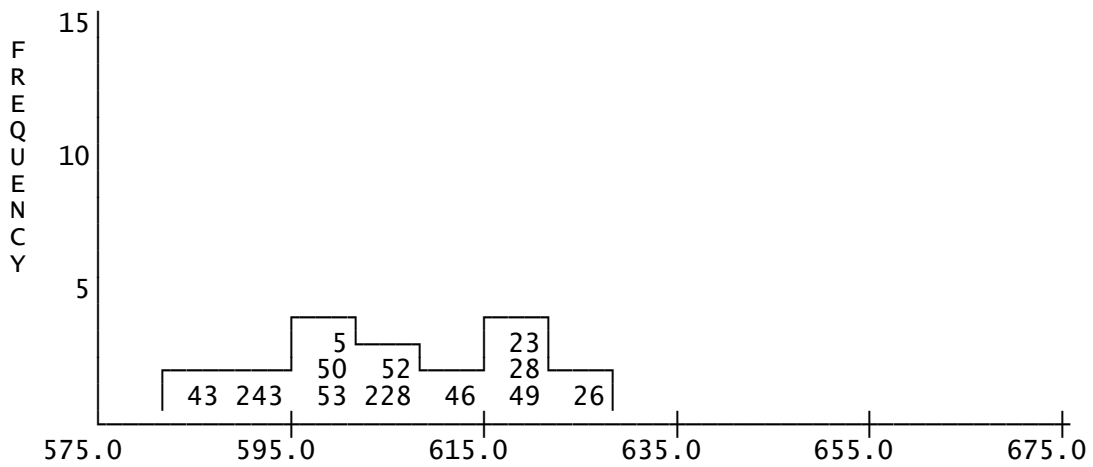
**Elongation at Break (%) - 3mm Dumbbell - Laboratory Means**



Sample TBL 1  
(Mean: 628 / SD: 21)

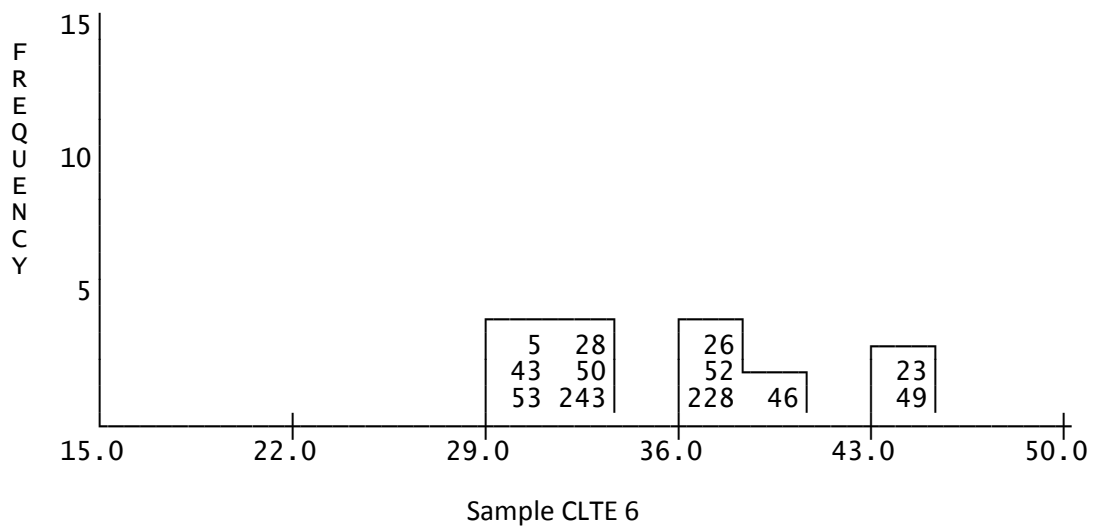
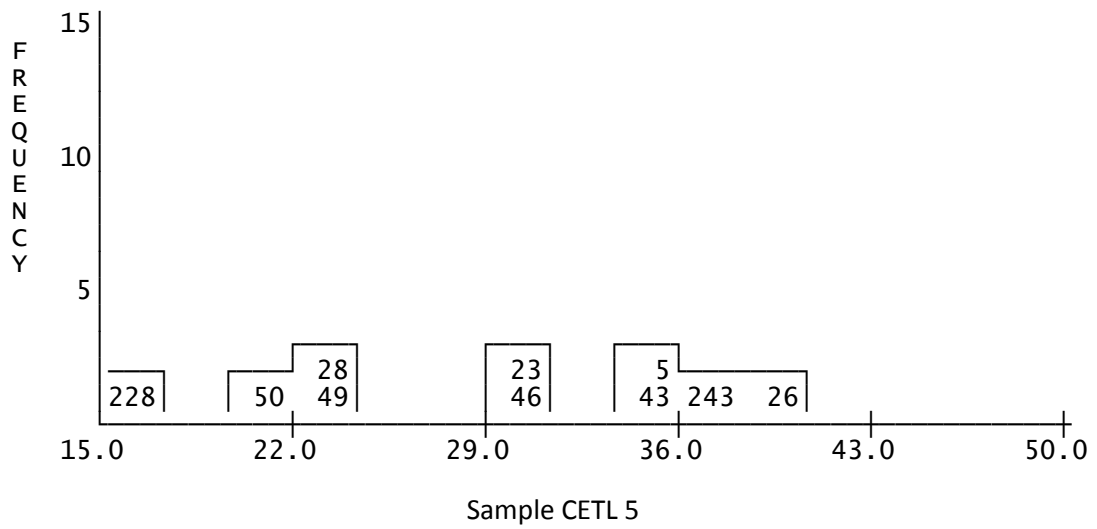
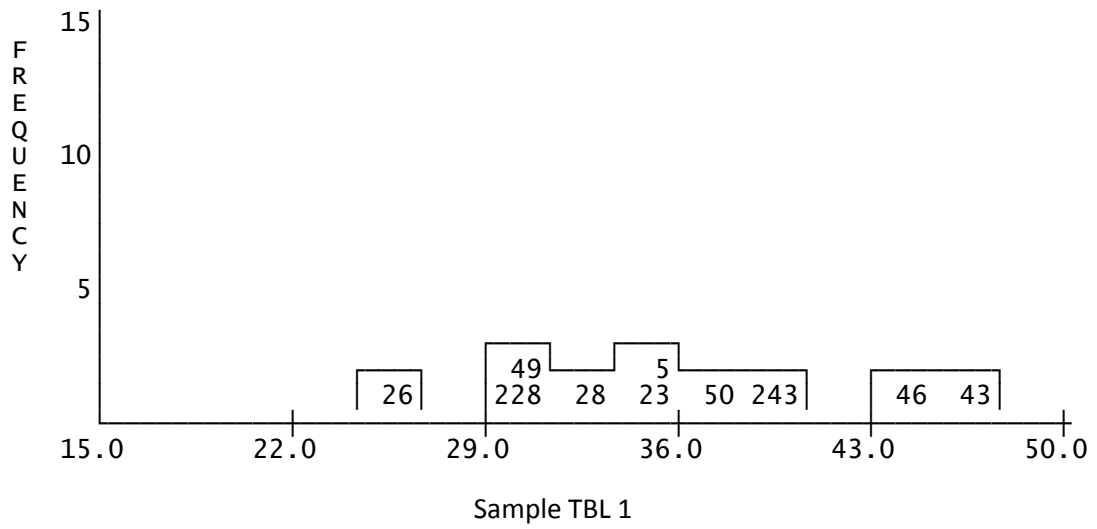


Sample CETL 5  
(Mean: 622 / SD: 22)



Sample CLTE 6  
(Mean: 606 / SD: 12)

**Elongation at Break (%) - 3mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Elongation at Break (%) - 3 mm dumbbell**

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	10	10	Repeatability Outliers	None
Mean	622	622	Reproduc'tility Stragglers	None
Std Dev'n	22	22	Reproduc'tility Outliers	None
Std Error	7	7		
Coef Var'n	4	4		
Minimum	582	582		
Maximum	660	660		
Range	78	78		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			Repeatability Stragglers	None
No. Labs	12	12	Repeatability Outliers	None
Mean	606	606	Reproduc'tility Stragglers	None
Std Dev'n	12	12	Reproduc'tility Outliers	None
Std Error	4	4		
Coef Var'n	2	2		
Minimum	587	587		
Maximum	628	628		
Range	41	41		

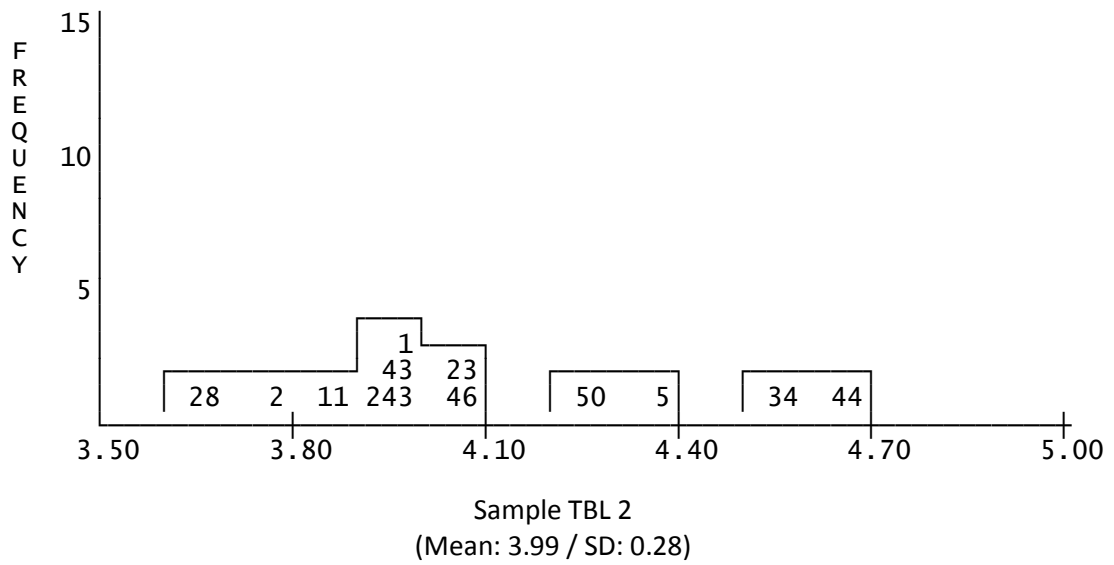
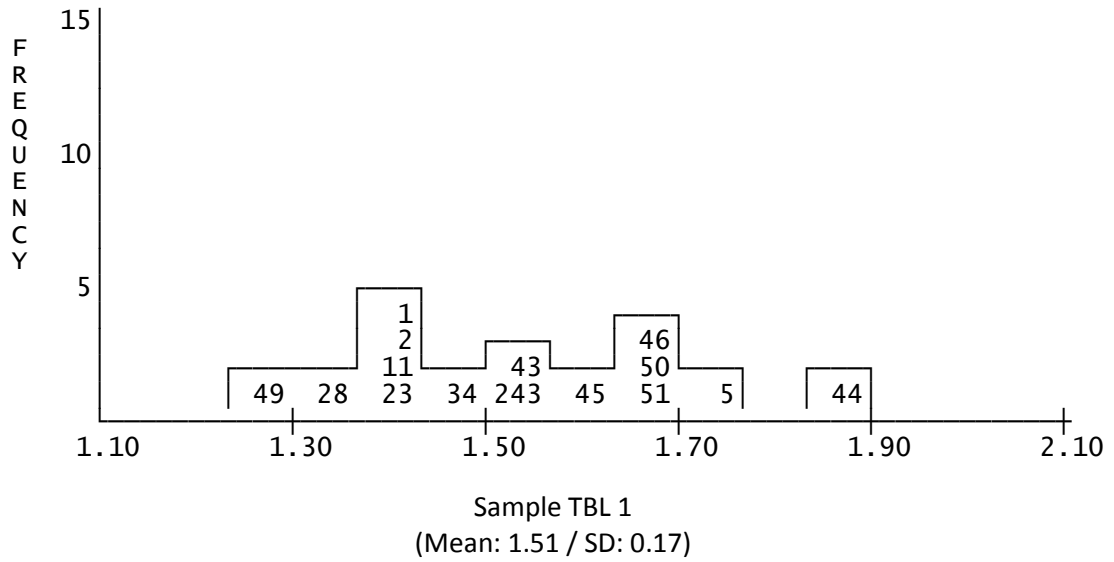
**PRECISION ACHIEVED (after removal of extreme results)**

Elongation at Break (%) - 3mm dumbbell

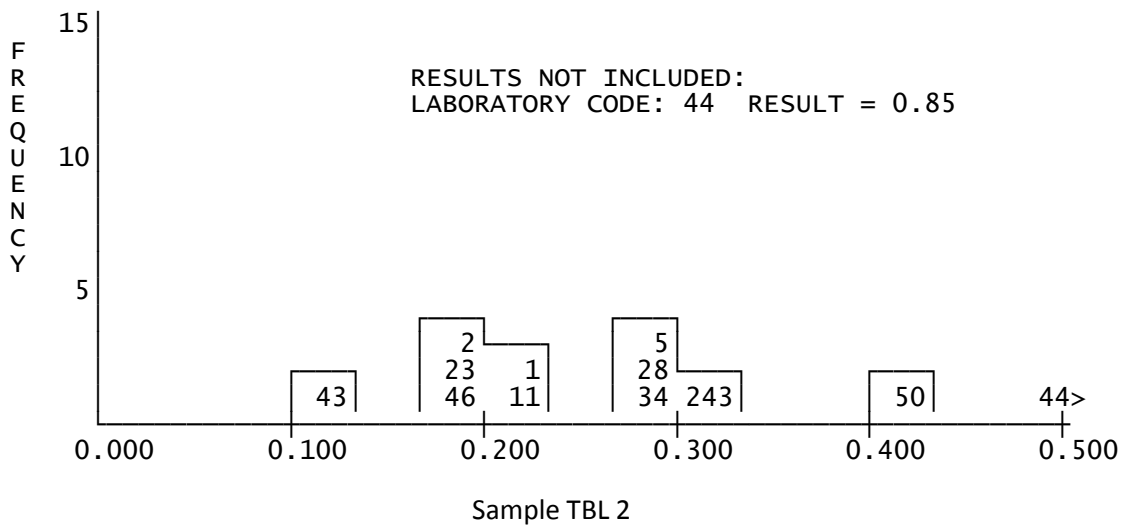
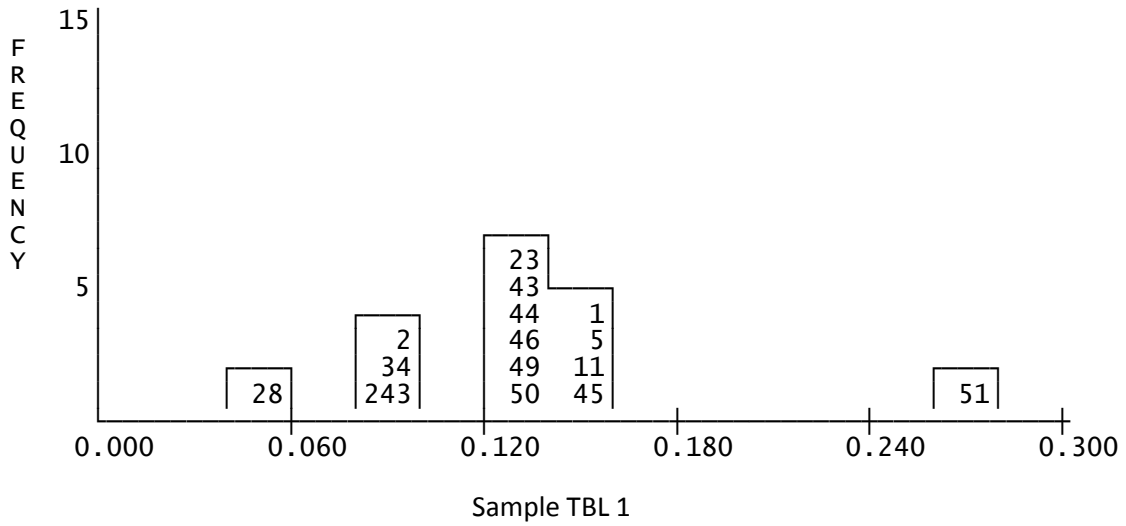
Sample : CETL 5  
 Number of Laboratories : 10  
 Consensus Mean : 622  
 Repeatability Estimate : 85 ± 19  
 Reproducibility Estimate : 102 ± 31

Sample : CLTE 6  
 Number of Laboratories : 12  
 Consensus Mean : 606  
 Repeatability Estimate : 101 ± 21  
 Reproducibility Estimate : 102 ± 20

**Force at 300% Elongation (N) - 4mm Dumbbell - Laboratory Means**



**Force at 300% Elongation (N) - 4mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Force at 300% Elongation (N) - 4mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	15
Mean	1.52	1.51	Repeatability Outliers	51
Std Dev'n	0.17	0.17	Reproduc'lity Stragglers	None
Std Error	0.04	0.05	Reproduc'lity Outliers	None
Coef Var'n	11.27	11.49		
Minimum	1.30	1.30		
Maximum	1.89	1.89		
Range	0.59	0.59		

**Sample TBL 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	12
Mean	4.07	3.99	Repeatability Outliers	44,50
Std Dev'n	0.33	0.28	Reproduc'lity Stragglers	None
Std Error	0.09	0.09	Reproduc'lity Outliers	None
Coef Var'n	8.02	6.90		
Minimum	3.63	3.63		
Maximum	4.69	4.57		
Range	1.06	0.94		

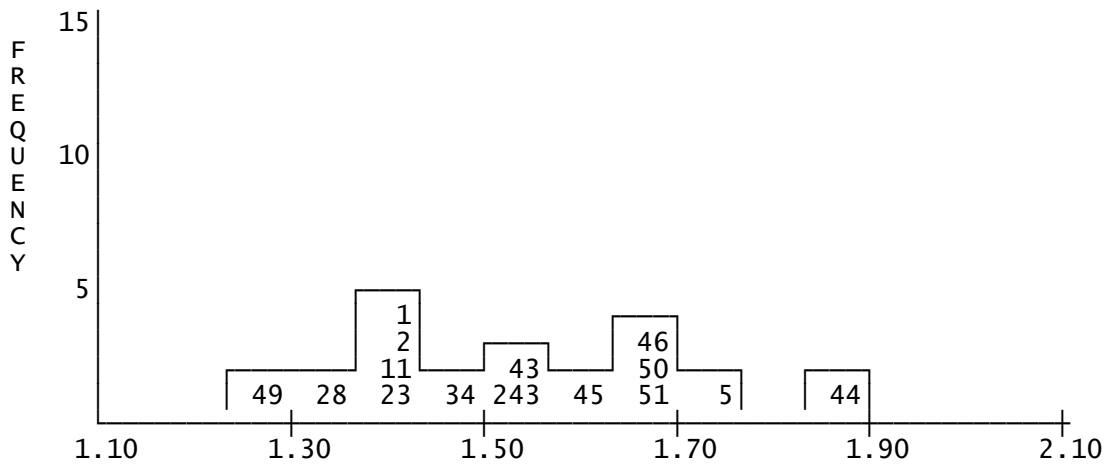
**PRECISION ACHIEVED (after removal of extreme results)**

Force at 300% elongation (N) - 4mm dumbbell

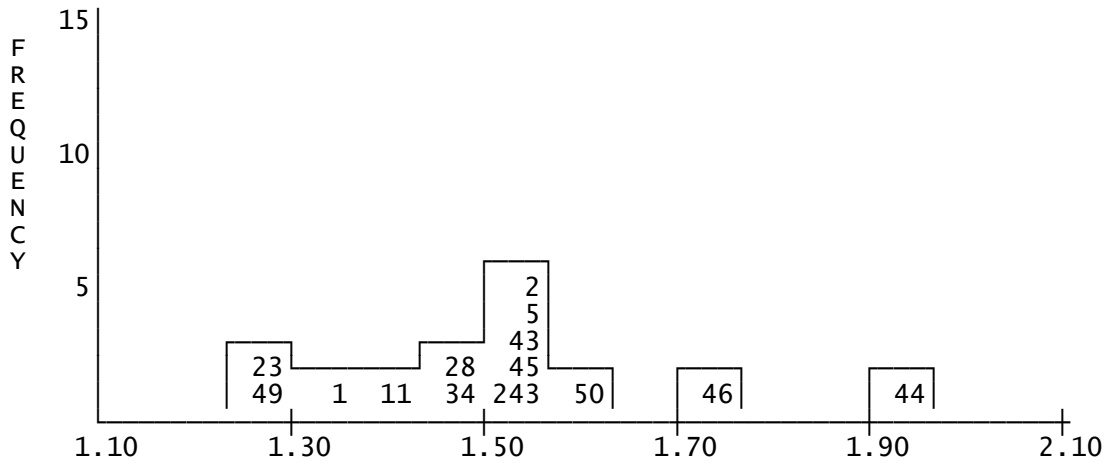
Sample : TBL 1  
 Number of Laboratories : 14  
 Consensus Mean : 1.51  
 Repeatability Estimate : 0.37 ± 0.07  
 Reproducibility Estimate : 0.60 ± 0.24

Sample : TBL 2  
 Number of Laboratories : 10  
 Consensus Mean : 3.99  
 Repeatability Estimate : 0.64 ± 0.14  
 Reproducibility Estimate : 0.99 ± 0.44

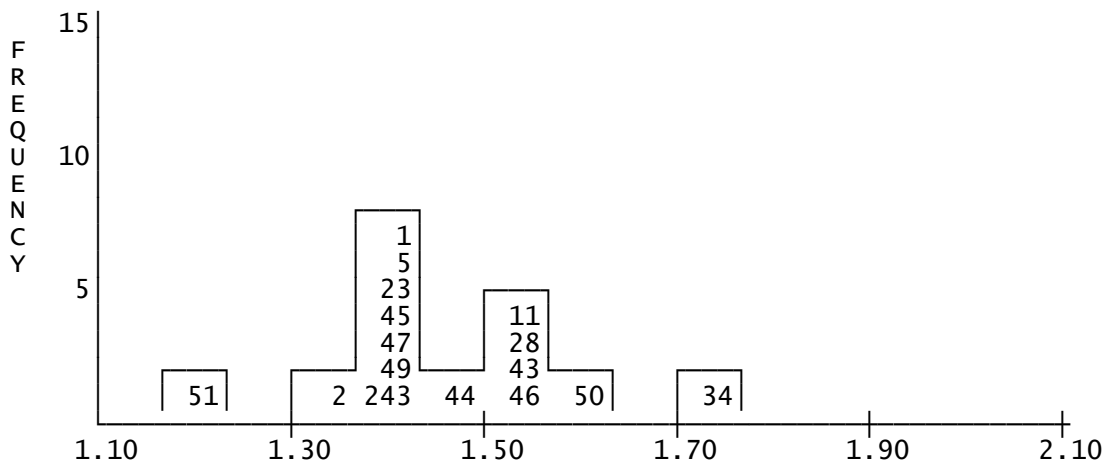
**Force at 300% Elongation (N) - 4mm Dumbbell - Laboratory Means**



Sample TBL 1  
(Mean: 1.51 / SD: 0.17)

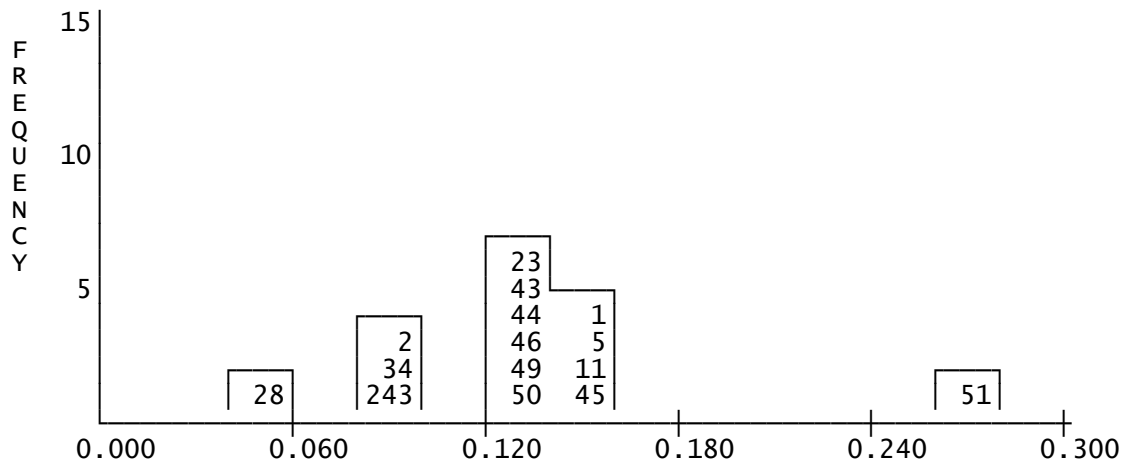


Sample CETL 5  
(Mean: 1.51 / SD: 0.19)

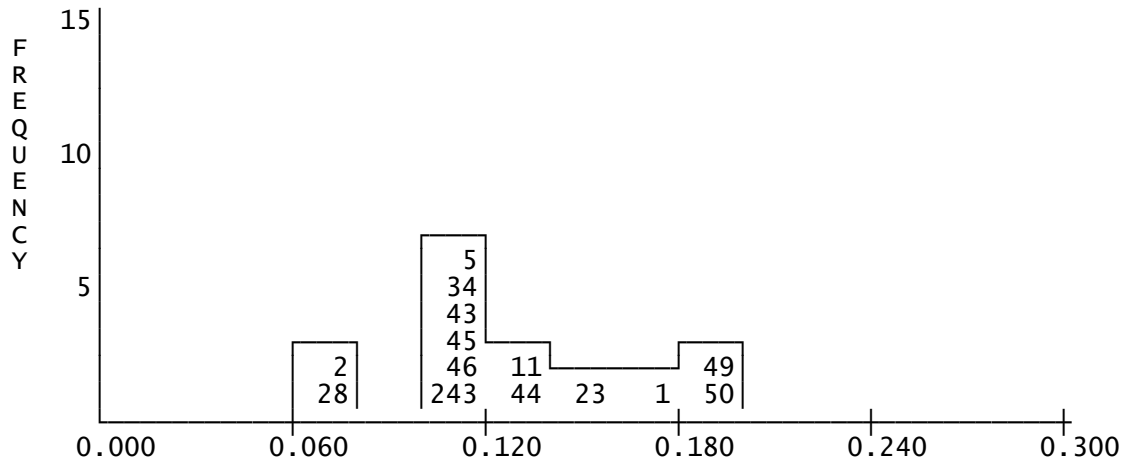


Sample CLTE 6  
(Mean: 1.48 / SD: 0.10)

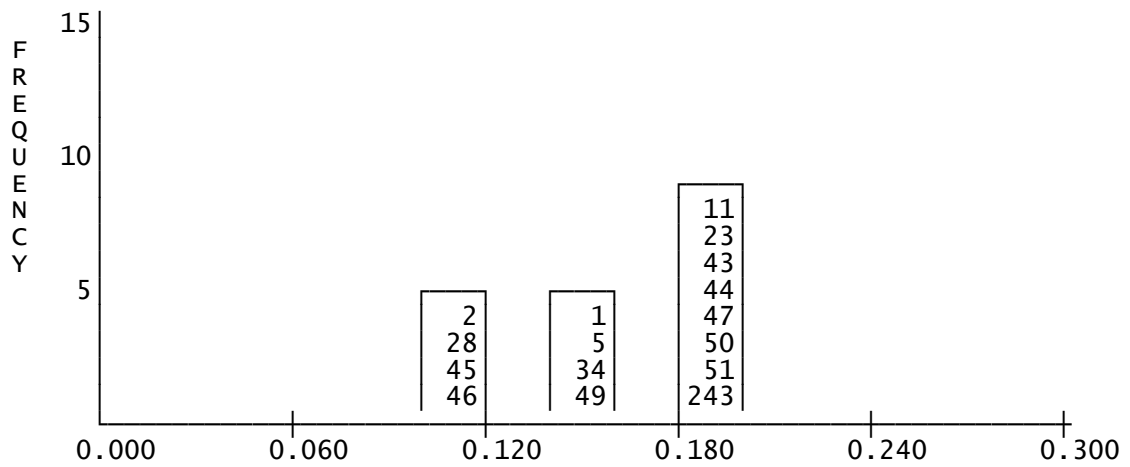
**Force at 300% elongation (N) - 4mm dumbbell - Laboratory Standard Deviations**



Sample TBL 1



Sample CETL 5



Sample CLTE 6

**SUMMARY STATISTICS for Force at 300% elongation (N) - 4mm dumbbell**

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	14
Mean	1.51	1.51	Repeatability Outliers	None
Std Dev'n	0.19	0.19	Reproduc'ility Stragglers	None
Std Error	0.05	0.05	Reproduc'ility Outliers	None
Coef Var'n	12.31	12.31		
Minimum	1.24	1.24		
Maximum	1.94	1.94		
Range	0.70	0.70		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	16
Mean	1.46	1.48	Repeatability Outliers	None
Std Dev'n	0.12	0.10	Reproduc'ility Stragglers	51
Std Error	0.03	0.03	Reproduc'ility Outliers	None
Coef Var'n	8.00	6.58		
Minimum	1.20	1.36		
Maximum	1.73	1.73		
Range	0.53	0.37		

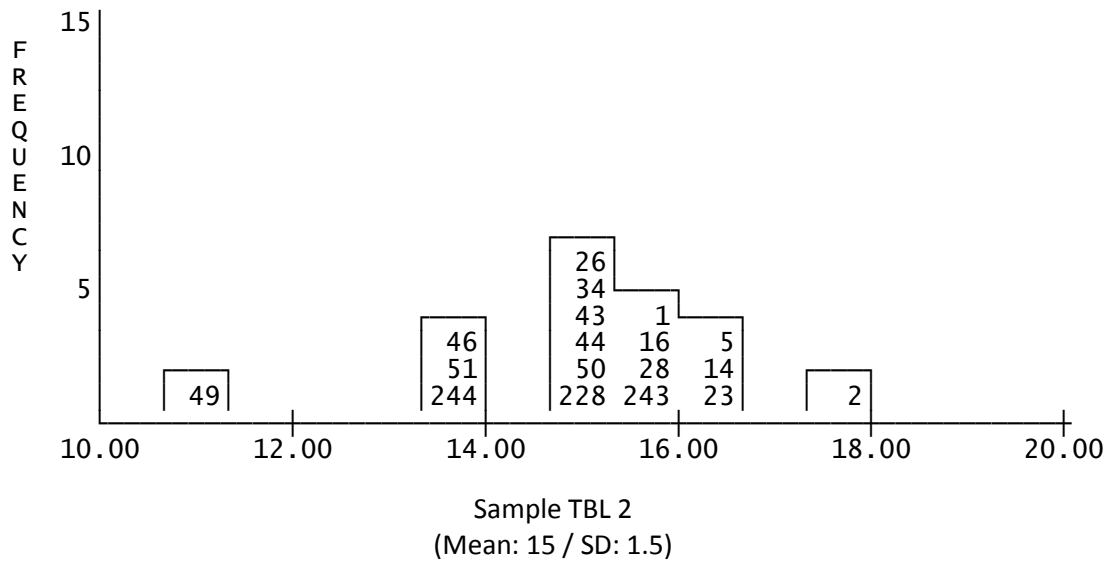
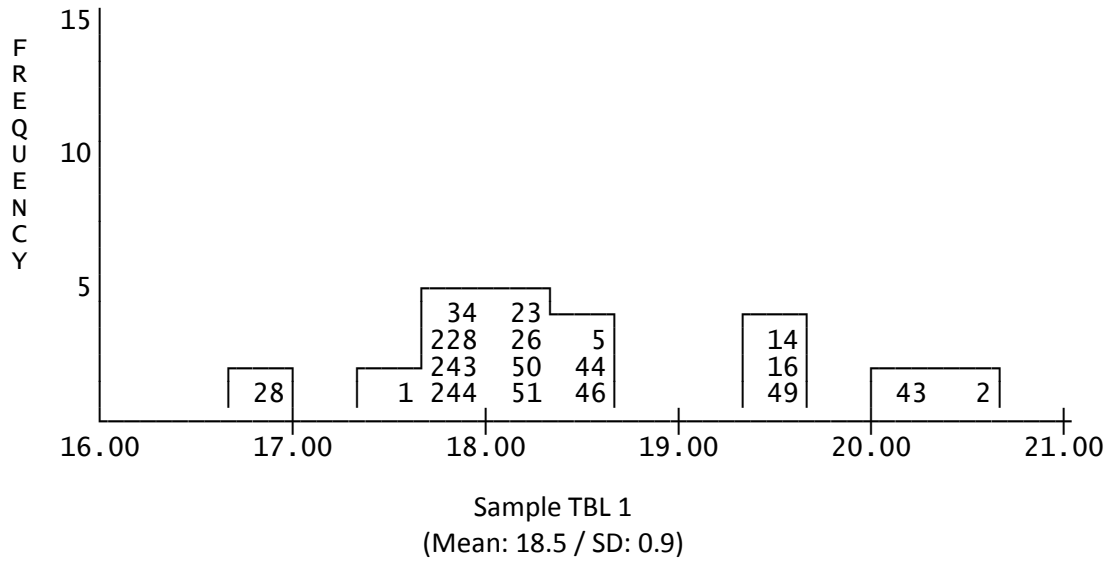
**PRECISION ACHIEVED (after removal of extreme results)**

Force at 300% elongation (N) - 4mm dumbbell

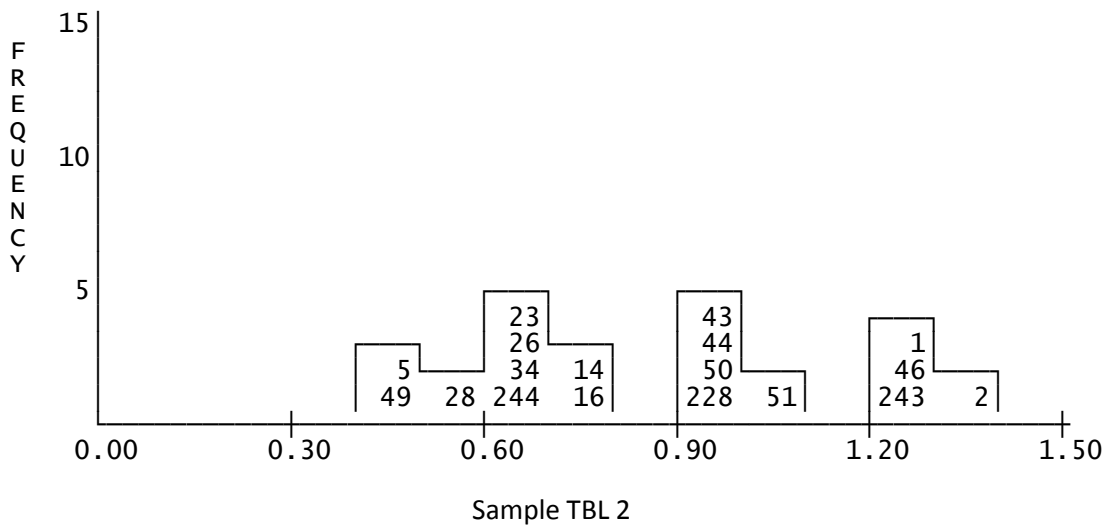
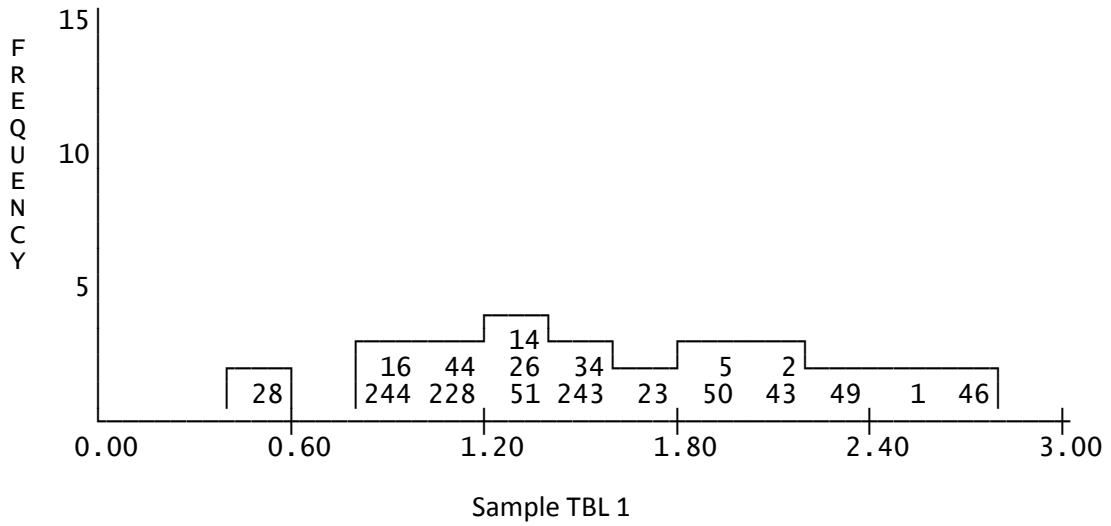
Sample : CETL 5  
 Number of Laboratories : 14  
 Consensus Mean : 1.51  
 Repeatability Estimate :  $0.38 \pm 0.07$   
 Reproducibility Estimate :  $0.64 \pm 0.26$

Sample : CLTE 6  
 Number of Laboratories : 15  
 Consensus Mean : 1.48  
 Repeatability Estimate :  $0.45 \pm 0.08$   
 Reproducibility Estimate :  $0.51 \pm 0.11$

**Tensile Strength at Break (MPa) - 6mm Dumbbell - Laboratory Means**



**Tensile Strength at Break (MPa) - 6mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Strength at Break (MPa) - 6mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	18.5	18.5	Repeatability Outliers	None
Std Dev'n	0.9	0.9	Reproduc'ility Stragglers	None
Std Error	0.2	0.2	Reproduc'ility Outliers	None
Coef Var'n	5.1	5.1		
Minimum	16.8	16.8		
Maximum	20.5	20.5		
Range	3.7	3.7		

**Sample TBL 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	15.0	15.0	Repeatability Outliers	None
Std Dev'n	1.5	1.5	Reproduc'ility Stragglers	None
Std Error	0.4	0.4	Reproduc'ility Outliers	None
Coef Var'n	10.2	10.2		
Minimum	10.7	10.7		
Maximum	17.9	17.9		
Range	7.1	7.2		

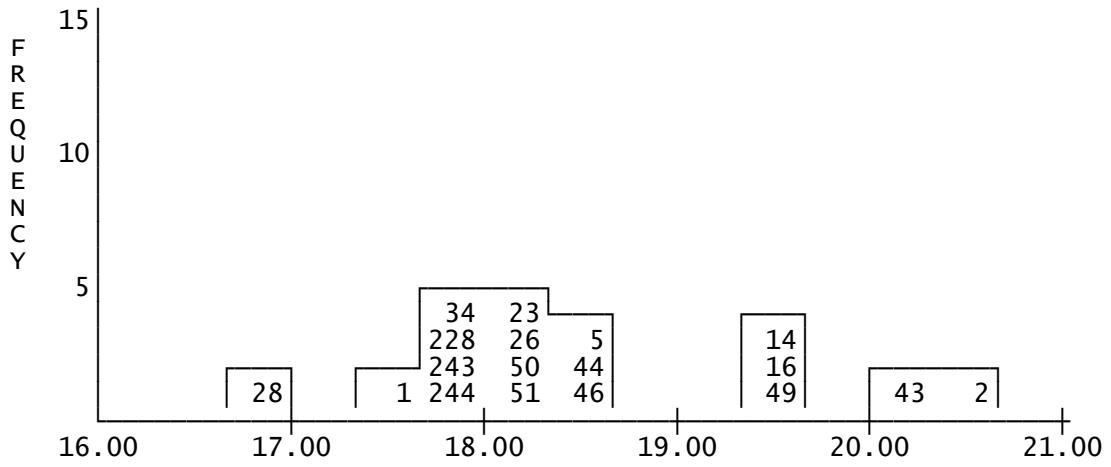
**PRECISION ACHIEVED (after removal of extreme results)**

Tensile Strength at Break (MPa) - 6mm Dumbbell

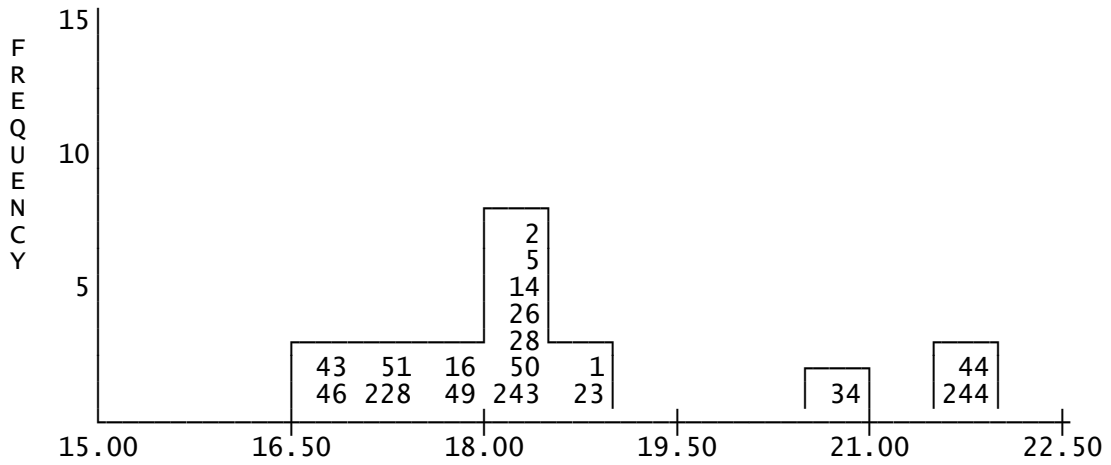
Sample : TBL 1  
 Number of Laboratories : 18  
 Consensus Mean : 18.5  
 Repeatability Estimate : 4.7 ± 0.8  
 Reproducibility Estimate : 5.2 ± 0.9

Sample : TBL 2  
 Number of Laboratories : 18  
 Consensus Mean : 15.0  
 Repeatability Estimate : 2.5 ± 0.4  
 Reproducibility Estimate : 4.9 ± 2.0

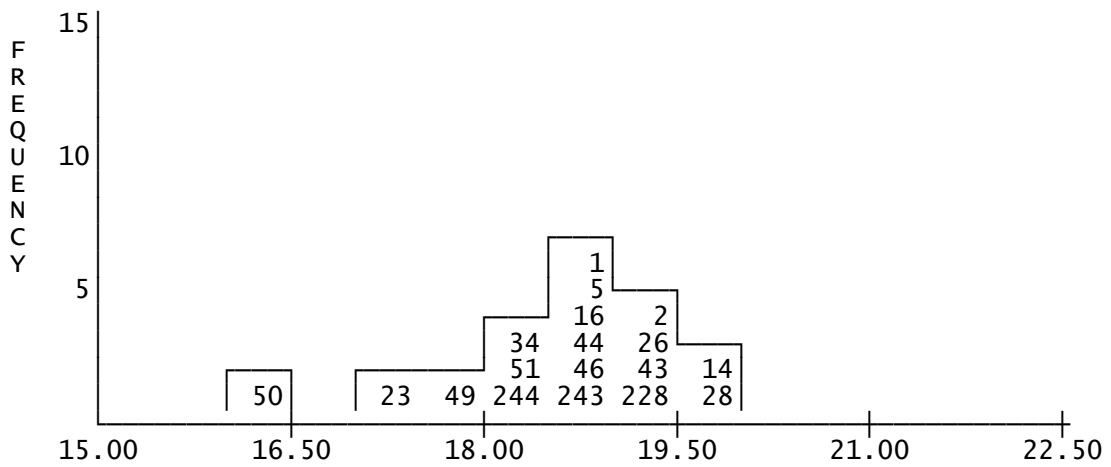
**Tensile Strength at Break (MPa) - 6mm Dumbbell - Laboratory Means**



Sample TBL 1  
(Mean: 18.5 / SD: 0.9)

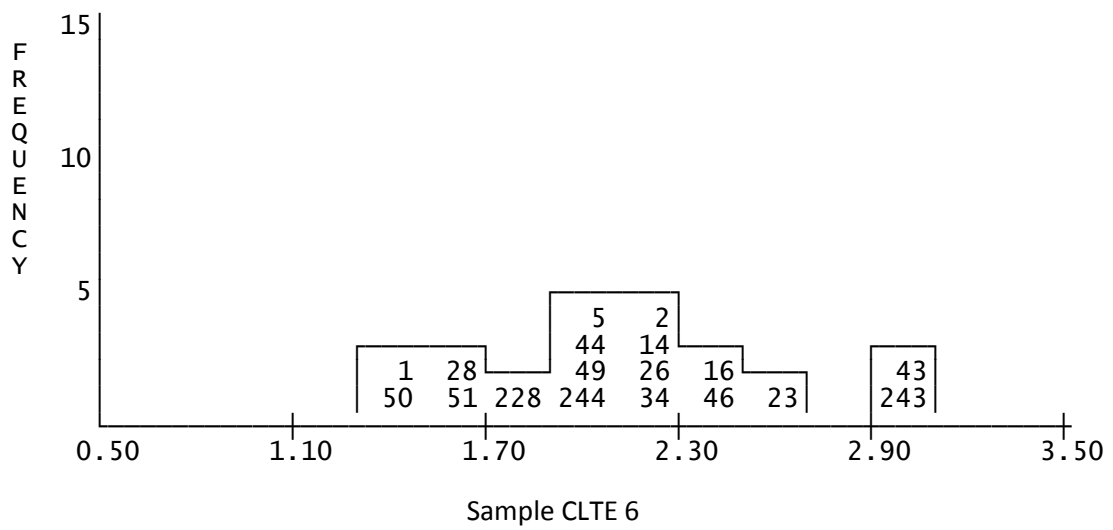
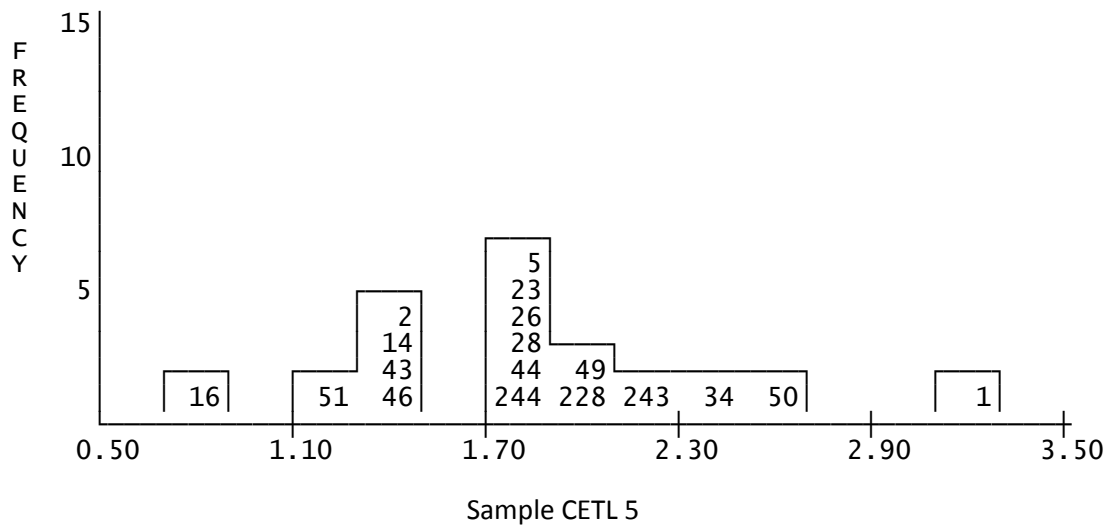
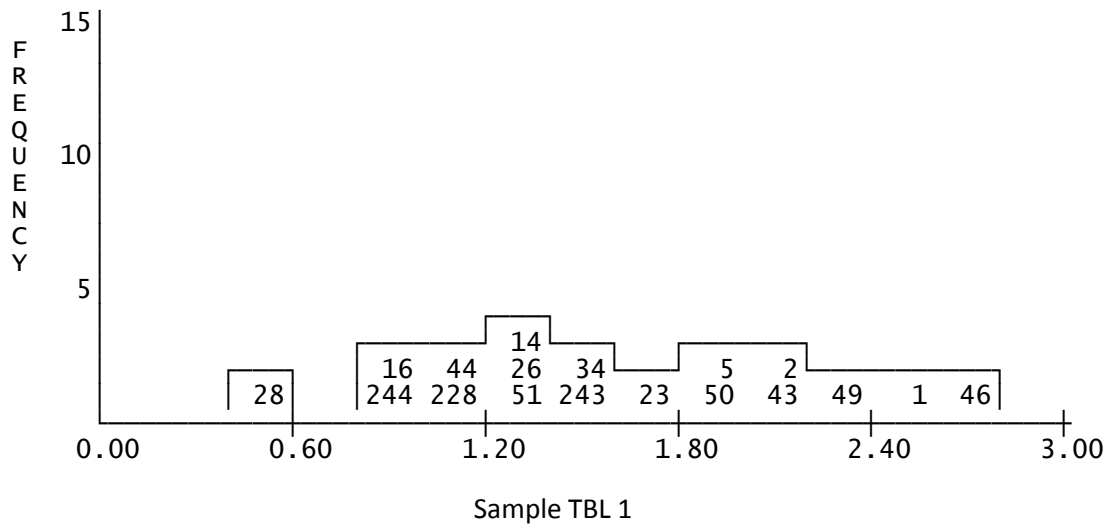


Sample CETL 5  
(Mean: 18.4 / SD: 1.6)



Sample CLTE 6  
(Mean: 18.5 / SD: 0.9)

**Tensile Strength at Break (MPa) - 6mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Strength at Break (MPa) - 6mm Dumbbell**

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	18.4	18.4	Repeatability Outliers	None
Std Dev'n	1.5	1.6	Reproduc'ility Stragglers	None
Std Error	0.4	0.4	Reproduc'ility Outliers	None
Coef Var'n	8.2	8.5		
Minimum	16.6	16.6		
Maximum	21.8	21.8		
Range	5.2	5.2		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	18.5	18.5	Repeatability Outliers	None
Std Dev'n	0.9	0.9	Reproduc'ility Stragglers	None
Std Error	0.2	0.2	Reproduc'ility Outliers	None
Coef Var'n	4.8	4.7		
Minimum	16.3	16.3		
Maximum	19.6	19.6		
Range	3.3	3.3		

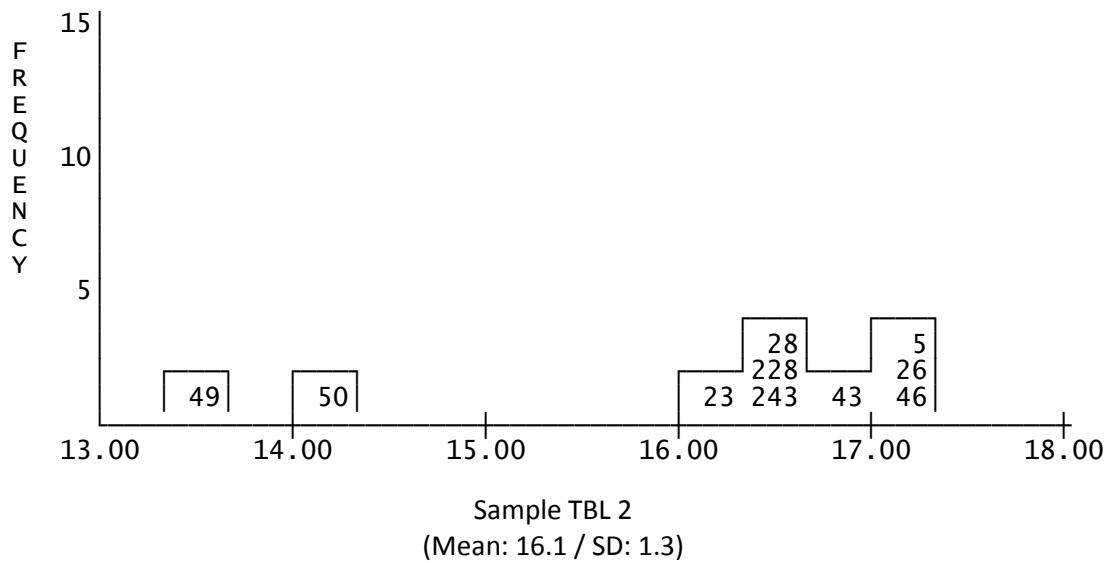
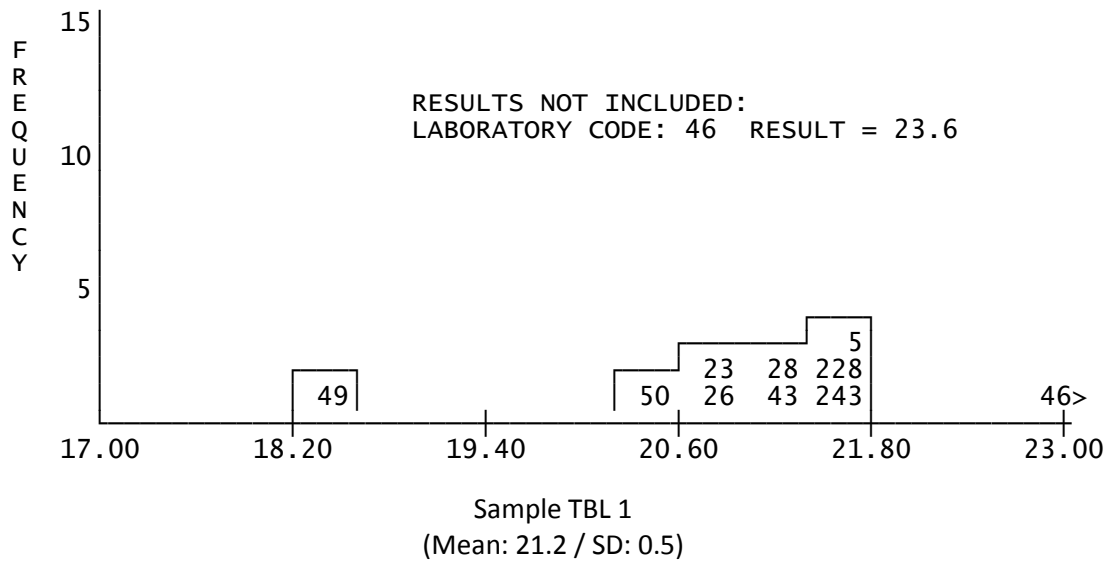
**PRECISION ACHIEVED (after removal of extreme results)**

Tensile Strength at Break (MPa) - 6mm Dumbbell

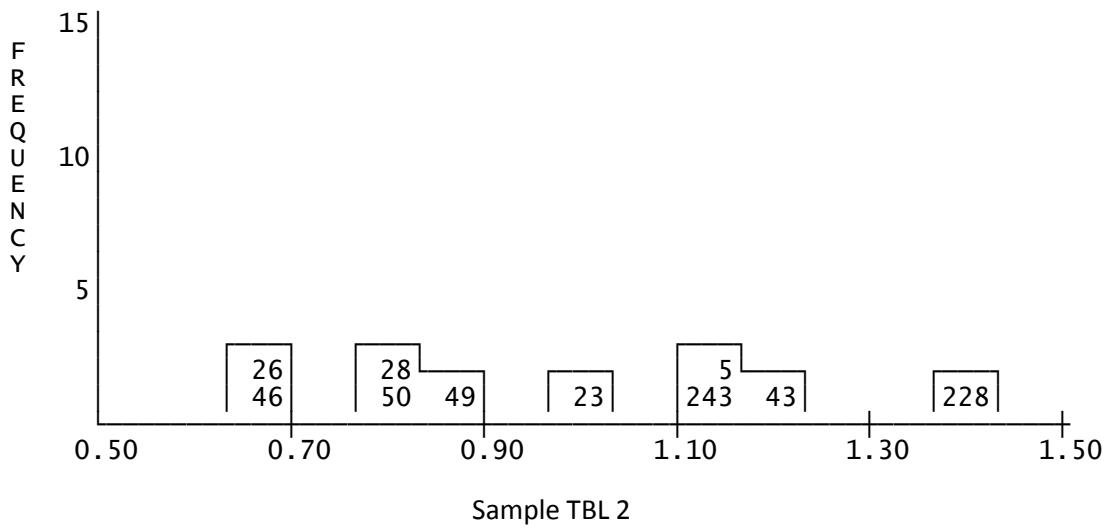
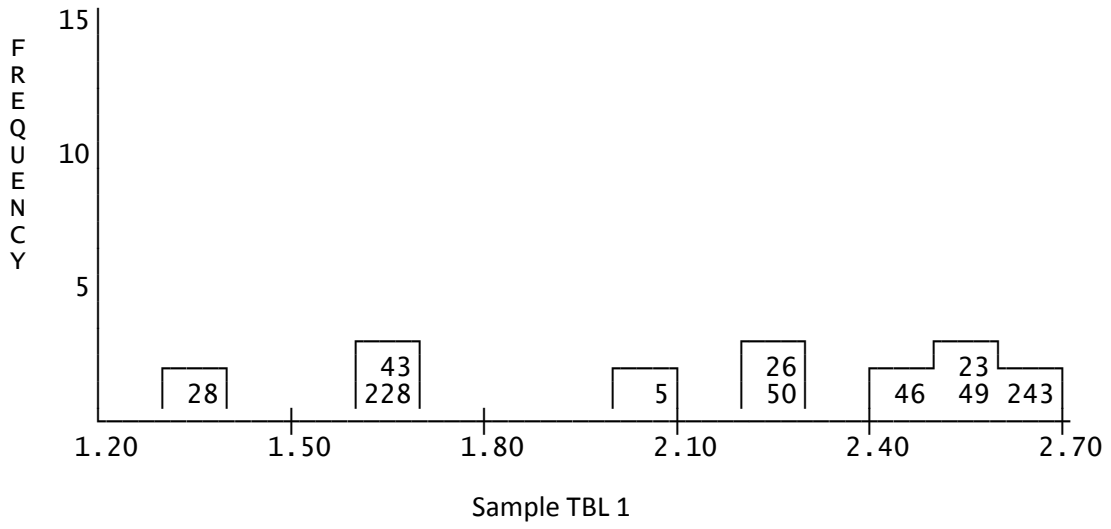
Sample : CETL 5  
 Number of Laboratories : 17  
 Consensus Mean : 18.4  
 Repeatability Estimate :  $4.9 \pm 0.8$   
 Reproducibility Estimate :  $6.5 \pm 1.7$

Sample : CLTE 6  
 Number of Laboratories : 18  
 Consensus Mean : 18.5  
 Repeatability Estimate :  $5.9 \pm 1.0$   
 Reproducibility Estimate :  $6.2 \pm 1.0$

**Tensile Strength at Break (MPa) - 3mm Dumbbell - Laboratory Means**



**Tensile Strength at Break (MPa) - 3mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Strength at Break (MPa) - 3mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	10
Mean	21.1	21.2	Repeatability Outliers	None
Std Dev'n	1.3	0.5	Reproduc'lity Stragglers	46,49
Std Error	0.4	0.2	Reproduc'lity Outliers	None
Coef Var'n	6.1	2.3		
Minimum	18.4	20.5		
Maximum	23.6	21.8		
Range	5.2	1.3		

**Sample TBL 2:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	10
Mean	16.1	16.1	Repeatability Outliers	None
Std Dev'n	1.3	1.3	Reproduc'lity Stragglers	None
Std Error	0.4	0.4	Reproduc'lity Outliers	None
Coef Var'n	8.3	8.2		
Minimum	13.4	13.4		
Maximum	17.3	17.3		
Range	3.9	3.9		

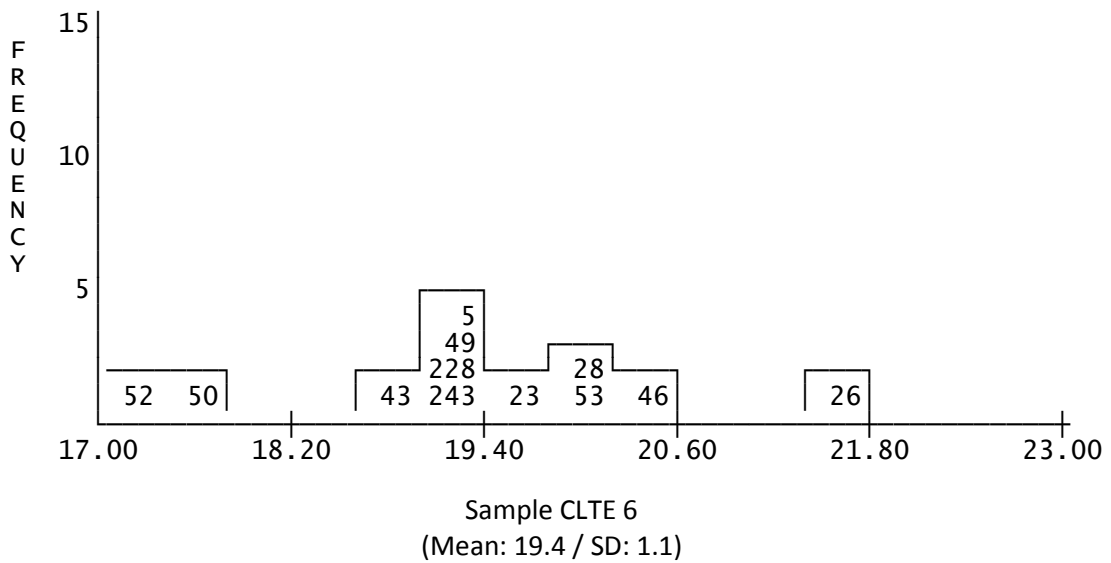
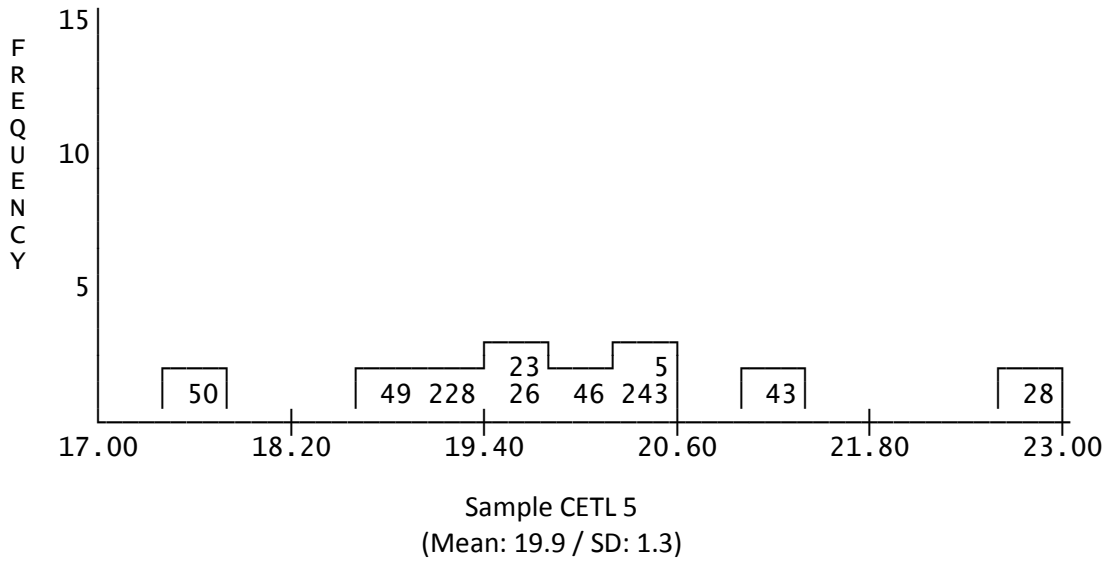
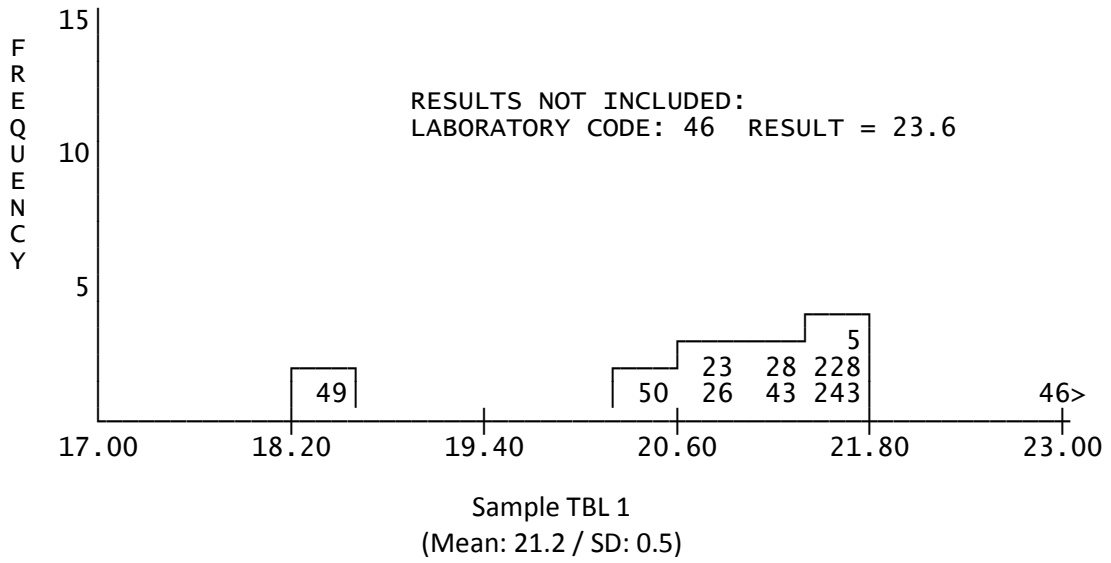
**PRECISION ACHIEVED (after removal of extreme results)**

Tensile Strength at Break (MPa) - 3mm Dumbbell

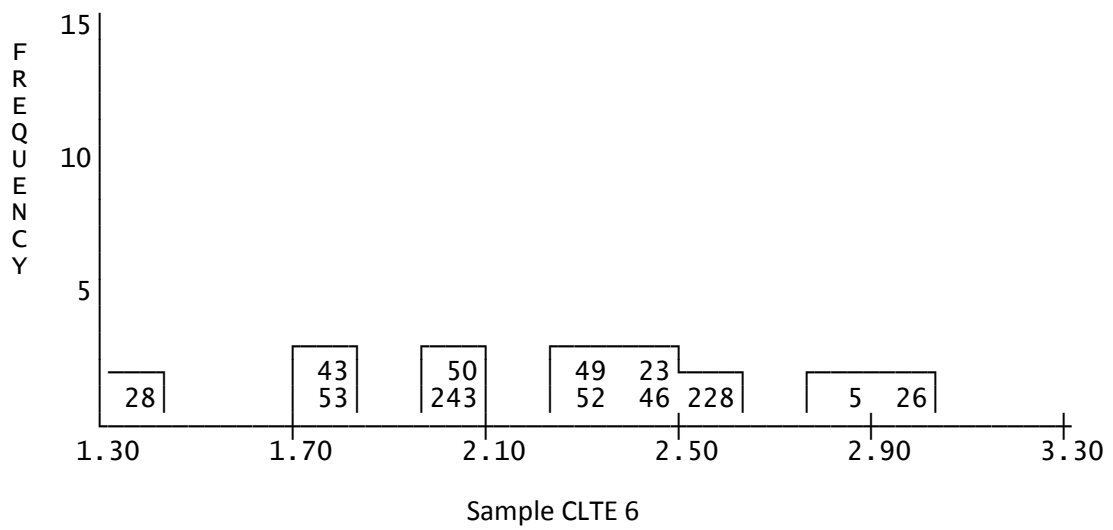
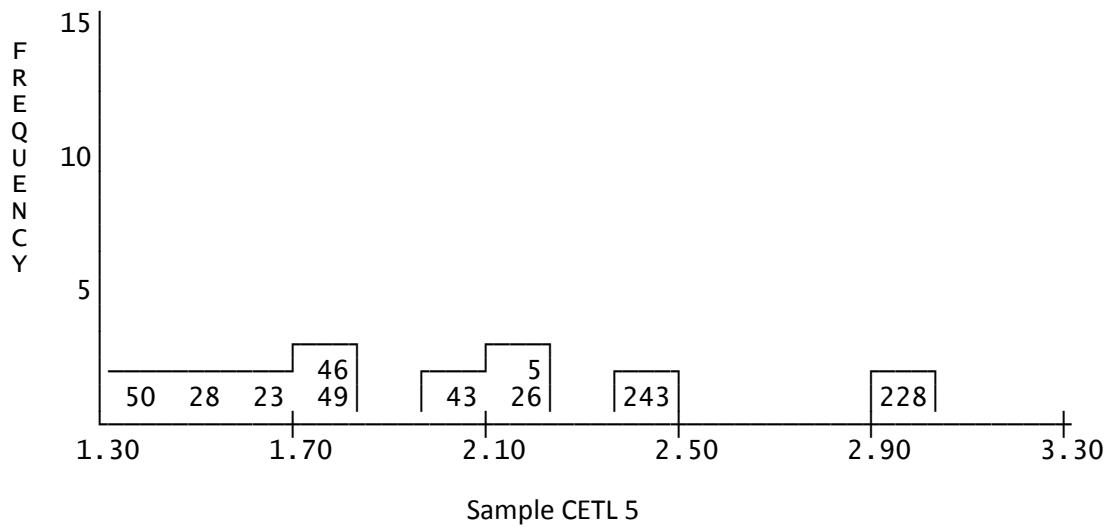
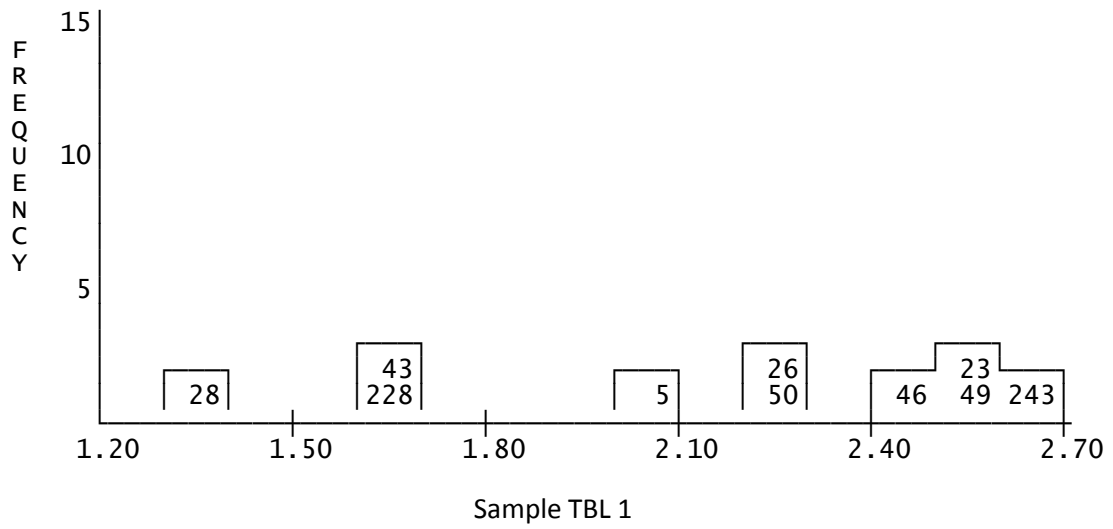
Sample : TBL 1  
 Number of Laboratories : 8  
 Consensus Mean : 21.2  
 Repeatability Estimate : 5.9 ± 1.5  
 Reproducibility Estimate : 5.9 ± 1.4

Sample : TBL 2  
 Number of Laboratories : 10  
 Consensus Mean : 16.1  
 Repeatability Estimate : 2.9 ± 0.6  
 Reproducibility Estimate : 4.6 ± 2.2

**Tensile Strength at Break (MPa) - 3mm Dumbbell - Laboratory Means**



**Tensile Strength at Break (MPa) - 3mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Strength at Break (MPa) - 3mm Dumbbell**

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	10
Mean	19.9	19.9	Repeatability Outliers	None
Std Dev'n	1.3	1.3	Reproduc'ility Stragglers	None
Std Error	0.4	0.4	Reproduc'ility Outliers	None
Coef Var'n	6.7	6.7		
Minimum	17.8	17.8		
Maximum	22.8	22.8		
Range	5.0	5.0		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	12
Mean	19.4	19.4	Repeatability Outliers	None
Std Dev'n	1.1	1.1	Reproduc'ility Stragglers	None
Std Error	0.3	0.3	Reproduc'ility Outliers	None
Coef Var'n	5.9	5.8		
Minimum	17.3	17.3		
Maximum	21.5	21.5		
Range	4.3	4.2		

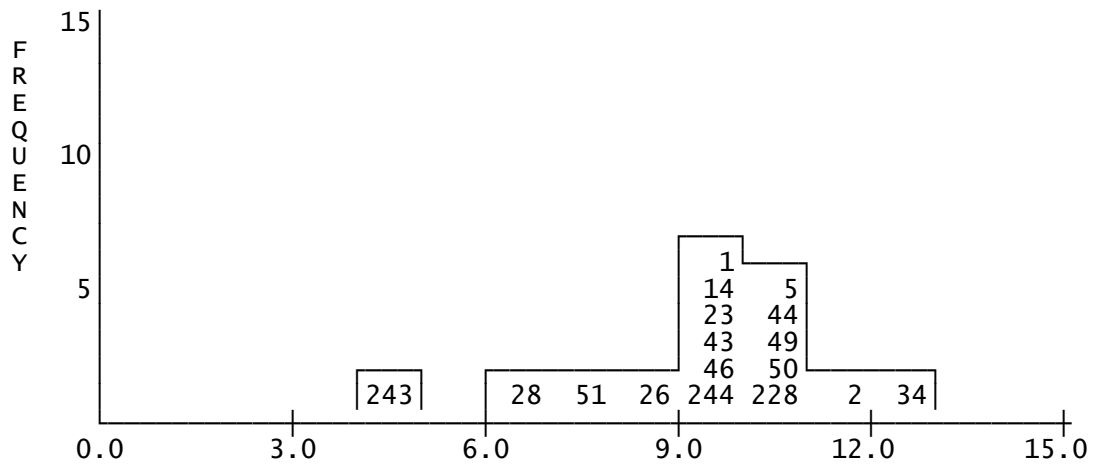
**PRECISION ACHIEVED (after removal of extreme results)**

Tensile Strength at Break (MPa) - 3mm Dumbbell

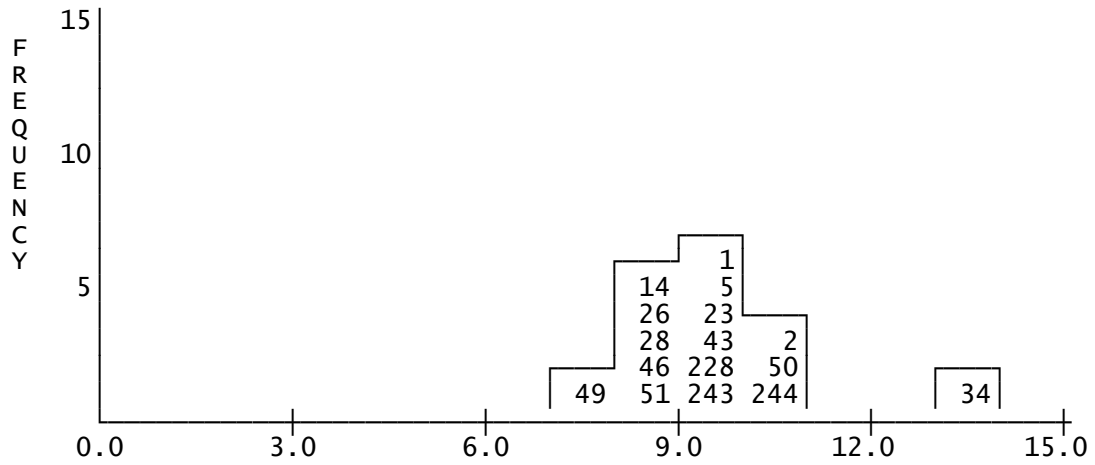
Sample : CETL 5  
 Number of Laboratories : 10  
 Consensus Mean : 19.9  
 Repeatability Estimate :  $5.7 \pm 1.3$   
 Reproducibility Estimate :  $6.6 \pm 1.8$

Sample : CLTE 6  
 Number of Laboratories : 12  
 Consensus Mean : 19.4  
 Repeatability Estimate :  $6.4 \pm 1.3$   
 Reproducibility Estimate :  $6.9 \pm 1.4$

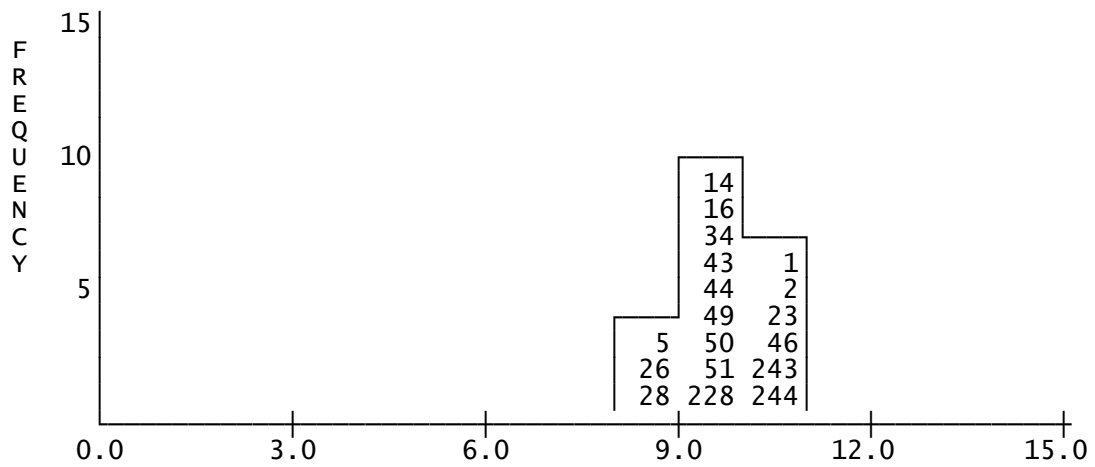
**Tensile Stress at 500% (MPa) - 6mm Dumbbell - Laboratory Means**



Sample TBL 1  
(Mean: 9.5 / SD: 1.8)

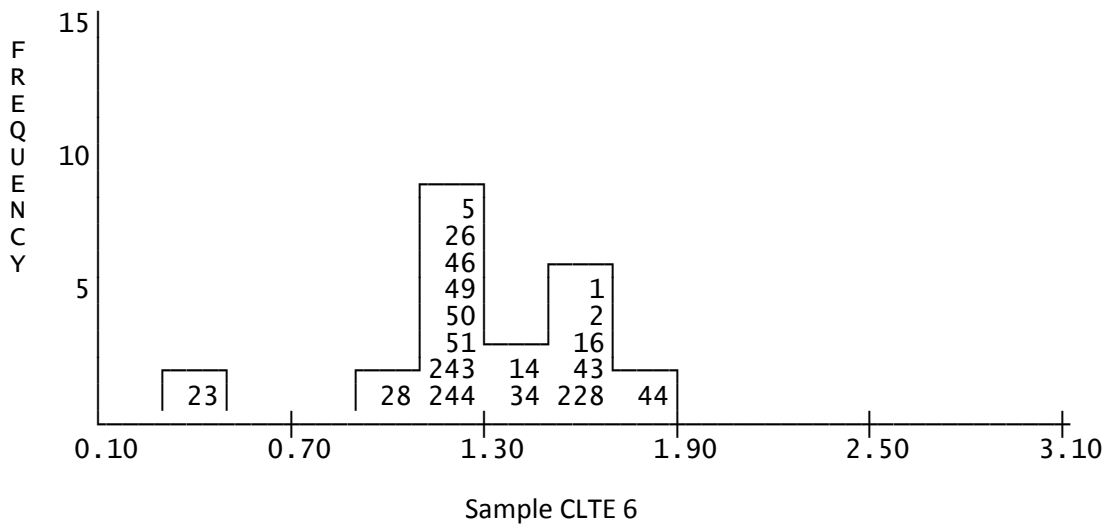
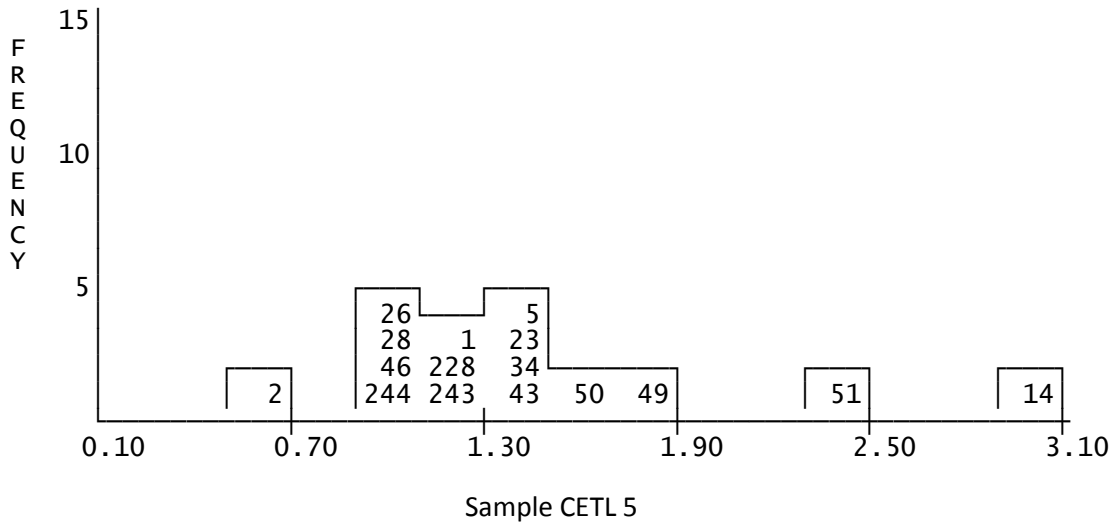
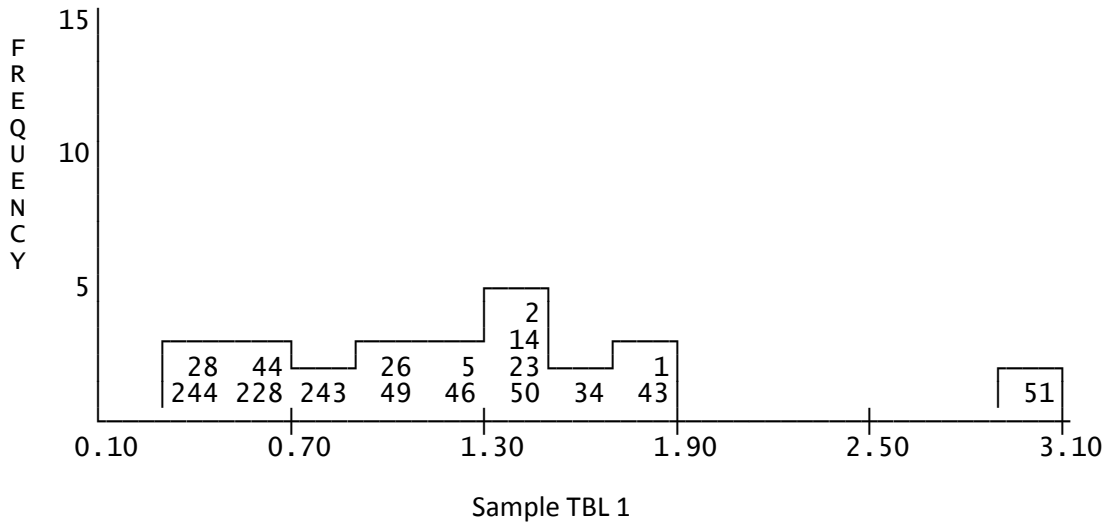


Sample CETL 5  
(Mean: 9.6 / SD: 1.4)



Sample CLTE 6  
(Mean: 9.6 / SD: 0.6)

**Stress at 500% (MPa) - 6mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Stress at 500% (MPa) - 6mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	17
Mean	9.4	9.5	Repeatability Outliers	51
Std Dev'n	1.8	1.8	Reproduc'lity Stragglers	None
Std Error	0.4	0.4	Reproduc'lity Outliers	None
Coef Var'n	19.1	18.5		
Minimum	4.5	4.5		
Maximum	12.0	12.0		
Range	7.5	7.5		

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	16
Mean	9.4	9.6	Repeatability Outliers	14,51
Std Dev'n	1.4	1.4	Reproduc'lity Stragglers	None
Std Error	0.3	0.4	Reproduc'lity Outliers	None
Coef Var'n	14.5	14.4		
Minimum	7.8	7.8		
Maximum	13.2	13.2		
Range	5.4	5.4		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	18
Mean	9.5	9.6	Repeatability Outliers	None
Std Dev'n	0.6	0.6	Reproduc'lity Stragglers	None
Std Error	0.1	0.1	Reproduc'lity Outliers	None
Coef Var'n	6.5	6.6		
Minimum	8.5	8.5		
Maximum	10.8	10.8		
Range	2.3	2.3		

**SUMMARY STATISTICS for Stress at 500% (MPa) - 6mm Dumbbell**

**PRECISION ACHIEVED (after removal of extreme results)**

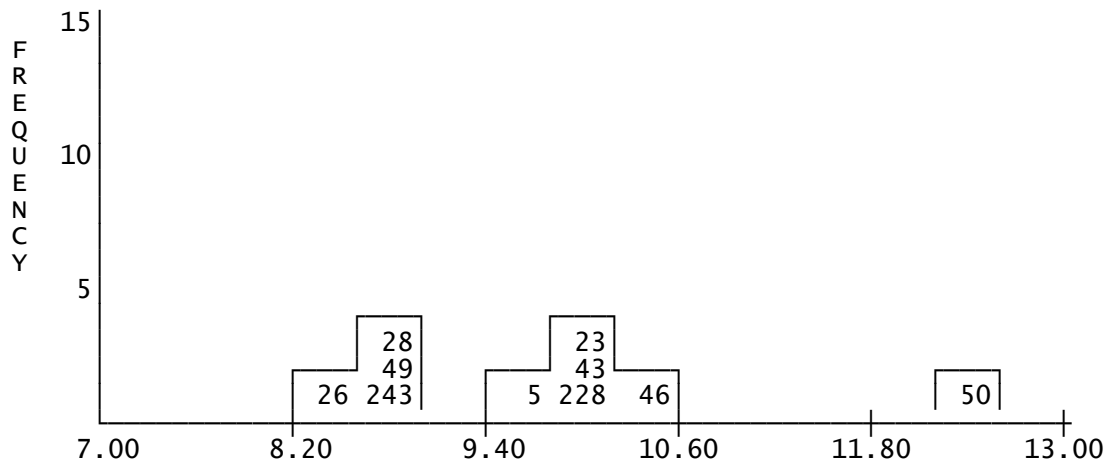
Tensile Stress at 500% (MPa) - 6mm Dumbbell

Sample : TBL 1  
Number of Laboratories : 16  
Consensus Mean : 9.5  
Repeatability Estimate :  $3.3 \pm 0.6$   
Reproducibility Estimate :  $5.9 \pm 2.3$

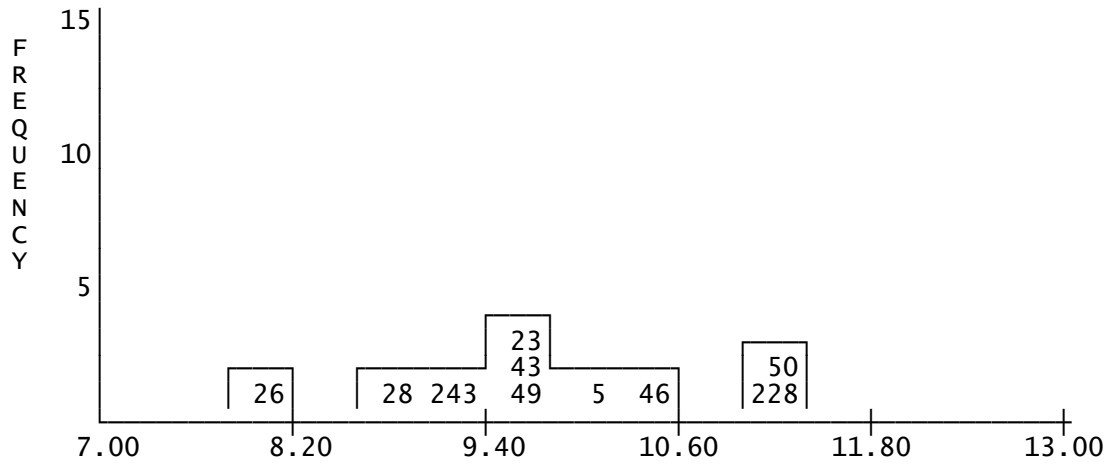
Sample : CETL 5  
Number of Laboratories : 14  
Consensus Mean : 9.6  
Repeatability Estimate :  $3.6 \pm 0.7$   
Reproducibility Estimate :  $5.2 \pm 1.8$

Sample : CLTE 6  
Number of Laboratories : 18  
Consensus Mean : 9.6  
Repeatability Estimate :  $3.8 \pm 0.6$   
Reproducibility Estimate :  $4.0 \pm 0.7$

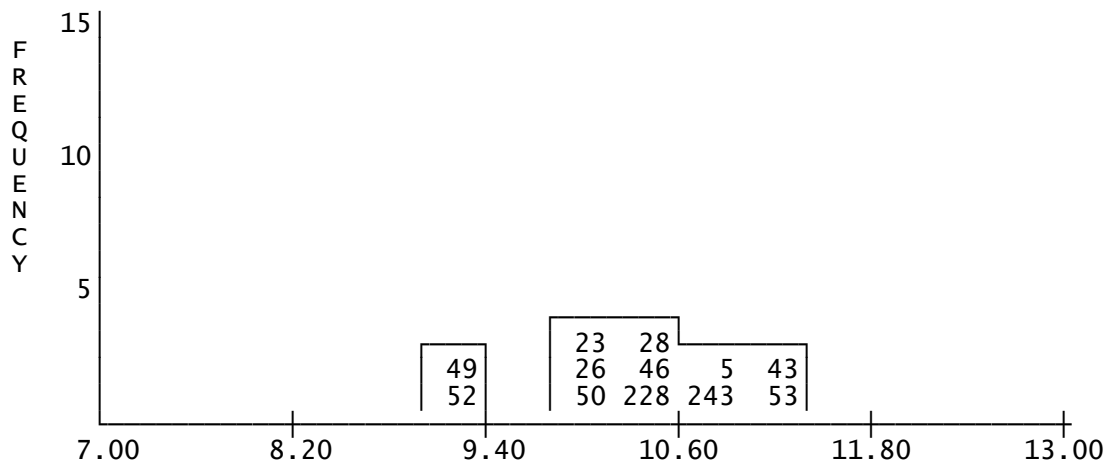
**Stress at 500% (MPa) - 3mm Dumbbell - Laboratory Means**



Sample TBL 1  
(Mean: 9.7 / SD: 1.1)

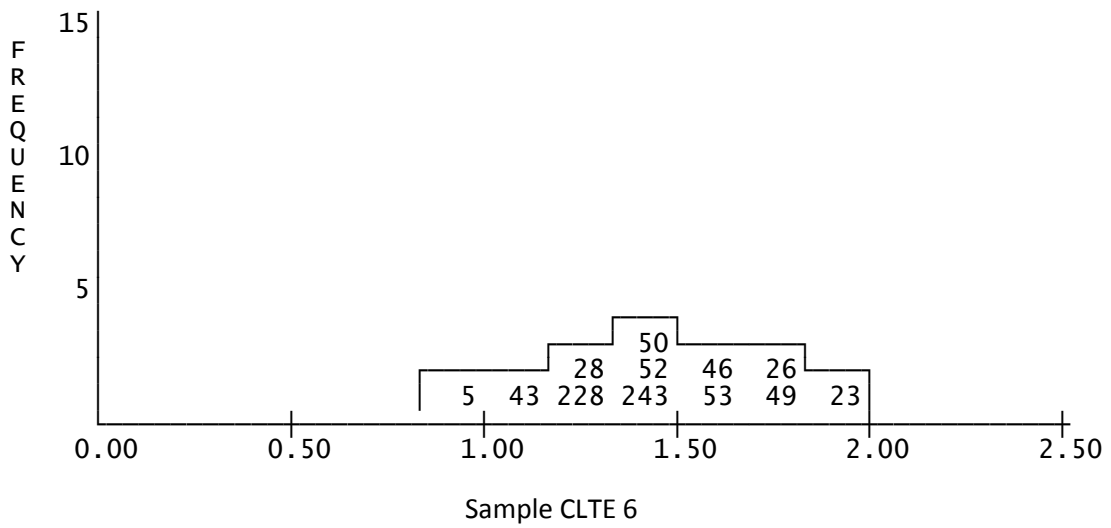
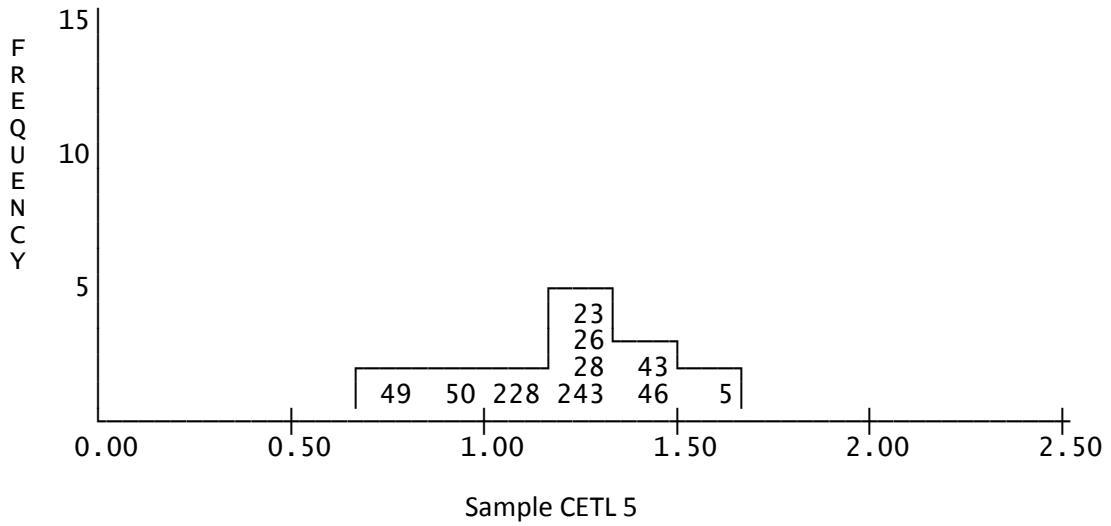
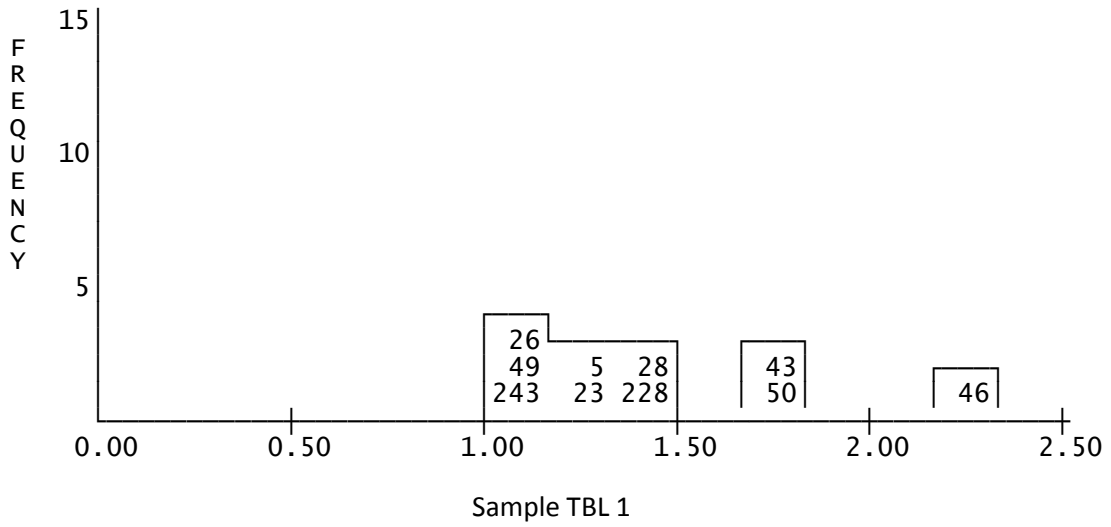


Sample CETL 5  
(Mean: 9.7 / SD: 1.0)



Sample CLTE 6  
(Mean: 10.3 / SD: 0.6)

**Stress at 500% (MPa) - 3mm Dumbbell - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Tensile Stress at 500% (MPa) - 3mm Dumbbell**

**Sample TBL 1:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	10
Mean	9.7	9.7	Repeatability Outliers	None
Std Dev'n	1.1	1.1	Reproduc'lity Stragglers	None
Std Error	0.4	0.4	Reproduc'lity Outliers	None
Coef Var'n	11.4	11.5		
Minimum	8.5	8.5		
Maximum	12.2	12.2		
Range	3.7	3.7		

**Sample CETL 5:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	10
Mean	9.7	9.7	Repeatability Outliers	None
Std Dev'n	1.0	1.0	Reproduc'lity Stragglers	None
Std Error	0.3	0.3	Reproduc'lity Outliers	None
Coef Var'n	9.8	9.9		
Minimum	8.0	8.0		
Maximum	11.1	11.1		
Range	3.1	3.1		

**Sample CLTE 6:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	12
Mean	10.3	10.3	Repeatability Outliers	None
Std Dev'n	0.6	0.6	Reproduc'lity Stragglers	None
Std Error	0.2	0.2	Reproduc'lity Outliers	None
Coef Var'n	6.2	6.2		
Minimum	9.3	9.3		
Maximum	11.3	11.3		
Range	2.0	2.0		

**SUMMARY STATISTICS for Tensile Stress at 500% (MPa) - 3mm Dumbbell**

**PRECISION ACHIEVED (after removal of extreme results)**

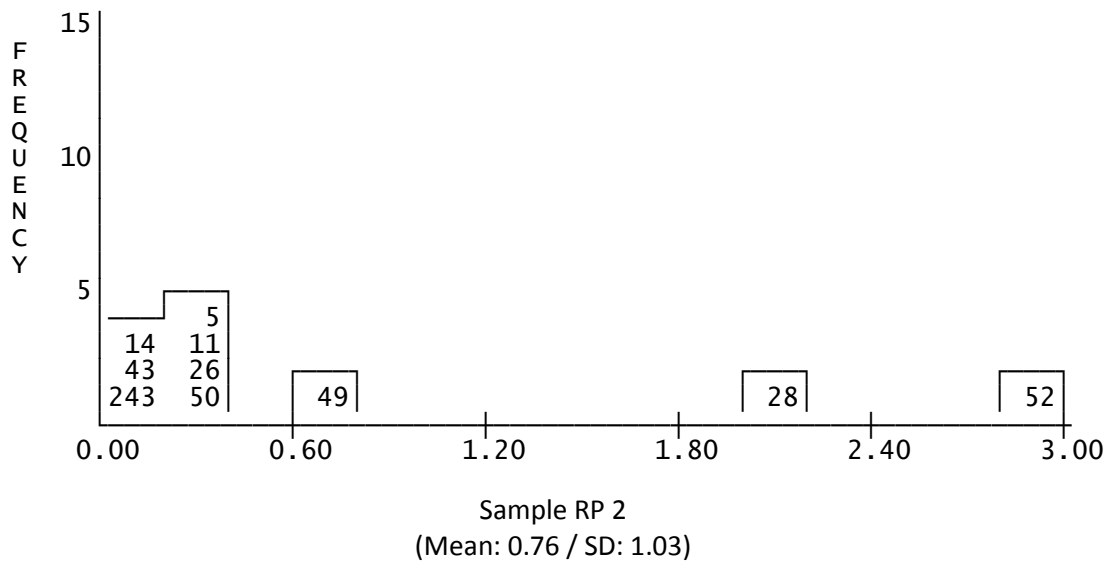
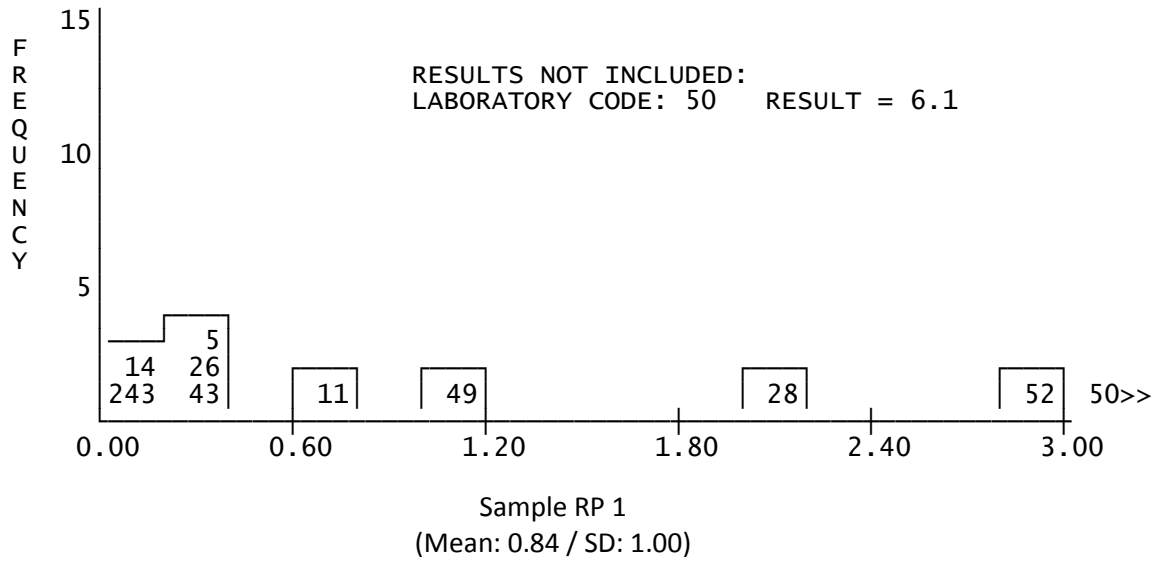
Tensile Stress at 500% (MPa) - 3mm Dumbbell

Sample : TBL 1  
Number of Laboratories : 10  
Consensus Mean : 9.7  
Repeatability Estimate :  $4.2 \pm 0.9$   
Reproducibility Estimate :  $5.1 \pm 1.5$

Sample : CETL 5  
Number of Laboratories : 10  
Consensus Mean : 9.7  
Repeatability Estimate :  $3.5 \pm 0.8$   
Reproducibility Estimate :  $4.3 \pm 1.3$

Sample : CLTE 6  
Number of Laboratories : 12  
Consensus Mean : 10.3  
Repeatability Estimate :  $4.1 \pm 0.8$   
Reproducibility Estimate :  $4.3 \pm 0.9$

**Powder Removal - Powder-Free (mg) - Laboratory Means**



**SUMMARY STATISTICS for Powder Removal - Powder-Free (mg)**

Sample RP 1			Sample RP 2		
Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results
No. Labs	10	9	No. Labs	10	9
Mean	1.36	0.84	Mean	0.72	0.76
Std Dev'n	1.91	1.00	Std Dev'n	0.98	1.03
Std Error	0.61	0.33	Std Error	0.31	0.34
Coeff Var'n	140.29	119.60	Coeff Var'n	136.12	135.66
Minimum	0.0	0.0	Minimum	0.0	0.0
Maximum	6.1	2.9	Maximum	2.9	2.9
Range	6.1	2.9	Range	2.9	2.9

Repeatability Extreme Results (for sample pair) : Outliers - 50

Reproducibility Extreme Results : Sample RP 1 - Stragglers - 50

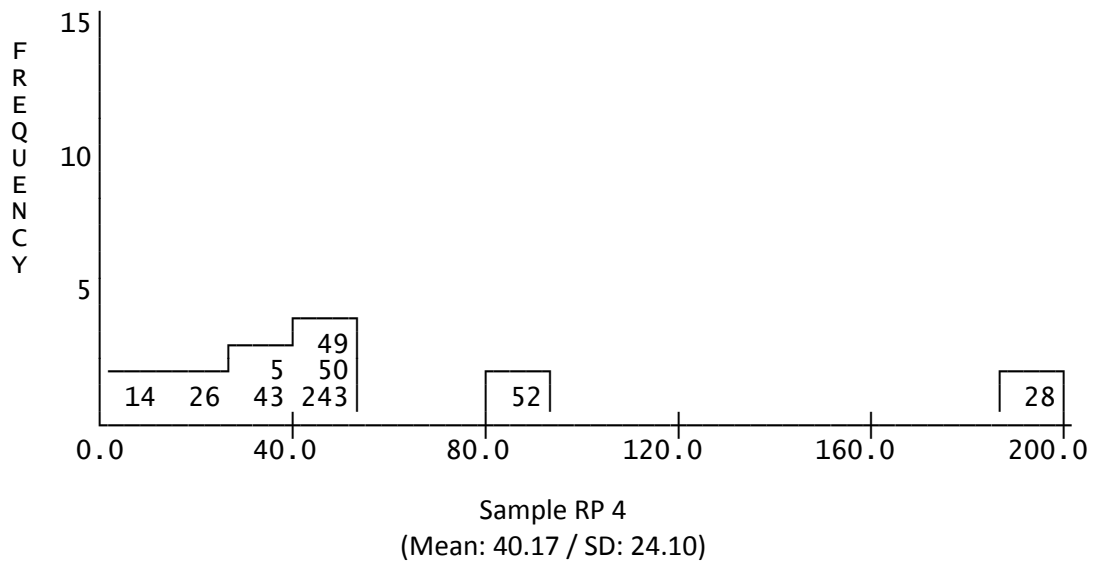
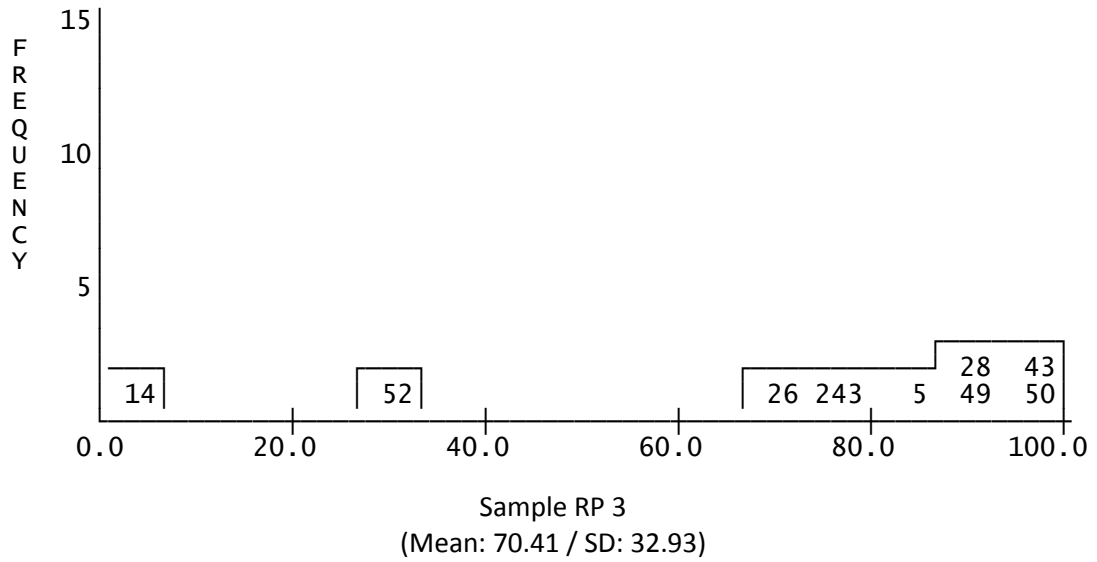
Reproducibility Extreme Results : Sample RP 2 - None

**PRECISION ACHIEVED FOR SAMPLE PAIR (after removing extreme results)**

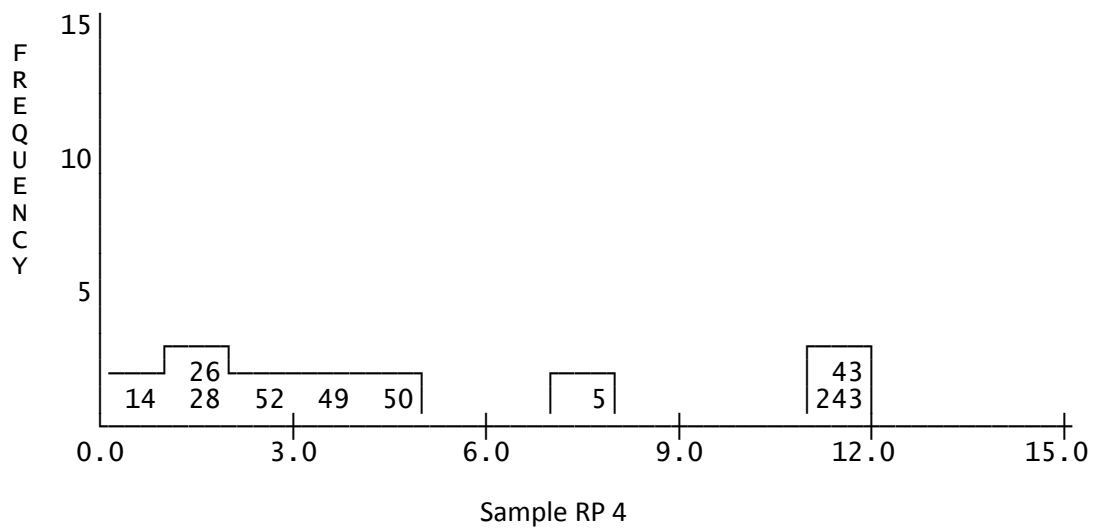
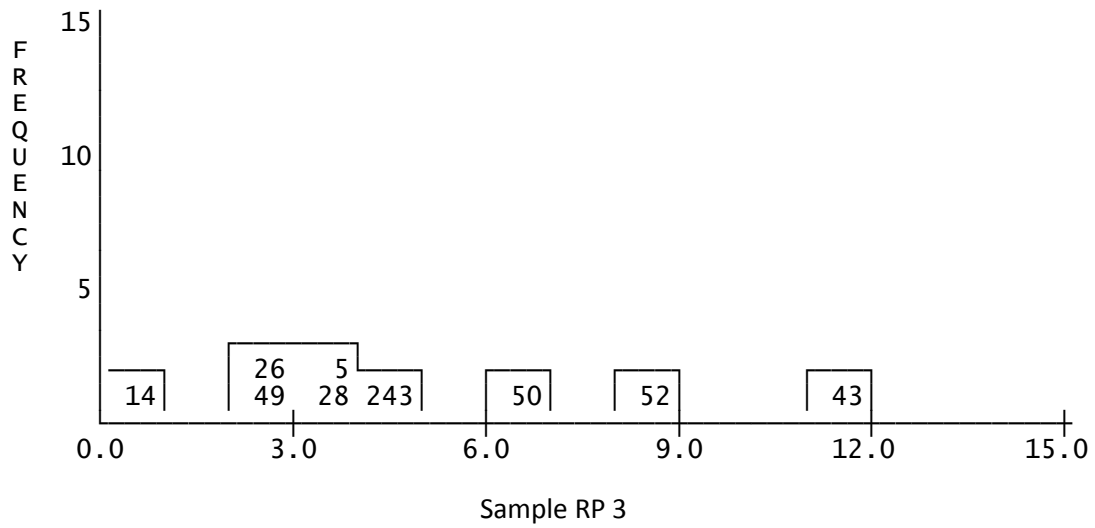
RESIDUAL POWDER - Powder-Free (mg)

1<sup>st</sup> Sample : Sample RP 1  
 2<sup>nd</sup> Sample : Sample RP 2  
 Number of Laboratories : 9  
 Consensus Mean – Sample 1 : 0.84  
 Consensus Mean – Sample 2 : 0.76  
 Repeatability Estimate : 0.25 ± 0.19  
 Reproducibility Estimate : 2.87 ± 2.15

**Powder Removal - Powdered (mg) - Laboratory Means**



**Powder Removal - Powdered (mg) - Laboratory Standard Deviations**



**SUMMARY STATISTICS for Powder Removal - Powdered (mg)**

**Sample RP 3:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	9
Mean	70.41	70.41	Repeatability Outliers	None
Std Dev'n	32.93	32.93	Reproduc'tility Stragglers	None
Std Error	10.98	10.98	Reproduc'tility Outliers	None
Coef Var'n	46.77	46.77		
Minimum	0.00	0.00		
Maximum	97.67	97.67		
Range	97.67	97.67		

**Sample RP 4:**

Statistical Parameters	Before Removing Extreme Results	After Removing Extreme Results	Extreme Results (Laboratory code no's)	
			No. Labs	9
Mean	56.93	40.17	Repeatability Outliers	None
Std Dev'n	55.10	24.10	Reproduc'tility Stragglers	28
Std Error	18.37	8.52	Reproduc'tility Outliers	None
Coef Var'n	96.80	60.01		
Minimum	0.00	0.00		
Maximum	191.00	85.33		
Range	191.00	85.33		

**PRECISION ACHIEVED (after removal of extreme results)**

RESIDUAL POWDER - Powdered (mg)

Sample : RP 3  
 Number of Laboratories : 9  
 Consensus Mean : 70.41  
 Repeatability Estimate : 15.97 ± 7.99  
 Reproducibility Estimate : 94.05 ± 69.18

Sample : RP 4  
 Number of Laboratories : 8  
 Consensus Mean : 40.17  
 Repeatability Estimate : 18.50 ± 9.81  
 Reproducibility Estimate : 69.83 ± 53.39

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