The 2012 CANADIAN ASPHALT MIX EXCHANGE PROGRAM (CAMEP)

2012 Detailed Report (July 2012)

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Alan Carter, P.Eng., Ph.D.
Professor
École de technologie supérieure

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ABSTRACT

Thirty seven Canadian engineering organizations participated in the 2012 CANADIAN ASPHALT MIX EXCHANGE PROGRAM. The exchange provides an opportunity for participants to compare their test results to those of other laboratories. It provides a mechanism for review and refinement of existing test methods and equipment. The exchange evaluates the volumetric and mechanical properties of an asphalt-aggregate mixture using Marshall mix design procedures, the gyratory compactor, and the ignition oven.

This report documents the test results for the year 2012 CANADIAN ASPHALT MIX EXCHANGE PROGRAM.

The complete report is available on the internet at the following address:
http://www.etsmtl.ca/Unites-de-recherche/LCMB/CAMEP-CAEP

1 INTRODUCTION

The Canadian Asphalt Mix Exchange Program (CAMEP) is part of the Canadian Asphalt and Mix Program (CAMP). The Asphalt Mix Exchange Program is operated by a steering committee under the umbrella of the Canadian User Producer Group for Asphalt (CUPGA).

In 2012, Thirty seven laboratories from across Canada obtained samples for the 2012 Canadian Asphalt and Mix Program. These laboratories represent 7 government/municipal agencies and 30 private/consulting firms.
There are three parts to the 2012 Canadian Asphalt Mix Exchange Program:

- Marshall Mix Design Procedures,
- SHRP Gyratory Compactor,
- Ignition Oven.

Thirty seven labs participated in the Marshall Mix Design Procedures (7 government/municipal and 30 private/consulting). Twenty one laboratories participated in the Gyratory Compactor part of the exchange program (6 government/municipal and 15 private/consulting). Thirty five laboratories participated in the Ignition Oven testing (6 government/municipal and 29 private/consulting).

Participation in the exchange program is voluntary. The results cannot be used for pre-qualification or specification purposes as previously indicated in this report. Laboratory results are confidential and are presented using a randomly assigned laboratory number that is known by the particular laboratory and the co-ordinating agency only. The order of the participating laboratories shown in Tables 12, 13, and 14 is not related to the laboratory numbers used in the other tables contained in this report.

The exchange program is operated on an annual basis. Samples are shipped to participants in March. Test results are returned to the co-ordinating agency in April and the final report is made available in July.

For 2012, each laboratory paid a participation fee of $420 for the first part and $125 for every part thereafter. The cost to participate in all three parts is $670. The participation fee is used to cover the costs associated with operating the asphalt mix exchange program. The participation fee is reviewed at the CAMP annual meeting that is held in conjunction with the Canadian Technical Asphalt Association annual conference. Mix exchange packages are shipped collect to the participating laboratories.

École de technologie supérieure is the co-ordinating agency for the mix exchange program. The responsibilities include:

- developing participant lists
- providing instructions for handling and testing of the materials
- supplying data collection forms
- arranging and co-ordinating material suppliers
- preparing, packaging and shipping aggregate and asphalt samples
- collecting and compiling the test data
- preparing a final report that is available to all participants
- preparing a final report for the CTAA (Canadian Technical Asphalt Association) Annual Proceedings.

2 INSTRUCTIONS TO PARTICIPANTS (MARSHALL MIX)

Each asphalt mix exchange participant package contains seventeen prepared aggregate samples and two litres of asphalt cement. The aggregate samples are prepared by splitting raw aggregate samples on each of the sieves shown in Table 1. The weight of each individual sieve size, to be combined for the exchange aggregate samples, is established through a trial and error process. Each aggregate test sample is prepared by weighing the individual size components and recombining them.

The following samples are distributed:

- Seventeen (17) aggregate samples
- Two (2) asphalt cement samples

The aggregate samples are to be used as follows:

- Eight (8) 1,200.0 gram samples for Marshall briquettes.
- Three (3) 2,000.0 gram samples for Asphalt Mix Maximum Theoretical Density.
- Three (3) 2,000.0 gram samples for Coarse Aggregate Relative Density.
- Three (3) 1,000.0 gram samples for Fine Aggregate Relative Density.

NOTE:

- **The filler relative density is 2.700.**
- **Asphalt Cement**
  Two litres of PG64-34 have been provided. To ensure consistency, the following values should be used:
  - Specific gravity 1.016
  - Mixing temperature 168^{o}C
  - Compaction temperature 152^{o}C

Aggregate samples are ready for use with the following exceptions:

a) The coarse aggregate relative density samples must be washed and sieved on the 5.0 mm sieve as specified by ASTM C127 Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.

b) The fine aggregate relative density samples shall be tested according to ASTM C128 Standard Test Method for Specific Gravity and Absorption of Fine Aggregate. They must be washed on the 75 μm sieve.

c) Aggregate Sieve Analysis.

Table 1: Aggregate Sieve Analysis

Sieve	Percent Passing
14.0 mm	**100.0**
10.0 mm	**94,5**
5.0 mm	**46**
2.5 mm	**36**
1.25 mm	**26,5**
630 μm	**20,5**
315 μm	**15**
160 μm	**10,5**
80μm	**7,4**

2.1 Aggregate Relative Density and Water Absorption

Three determinations are made on each of the individual pre-weighed coarse and fine aggregate samples. The coarse aggregate density is obtained by following ASTM C127 Standard Test Method for DENSITY, RELATIVE DENSITY (SPECIFIC GRAVITY), AND ABSORPTION OF COARSE AGGREGATE. The fine aggregate density is determined by following ASTM C128 Standard Test Method for DENSITY, RELATIVE DENSITY (SPECIFIC GRAVITY) AND ABSORPTION OF FINE AGGREGATE. Both aggregate densities are reported to four (4) significant figures.

The following interpretative revisions to ASTM C128 were agreed to at the 1989 Canadian Asphalt Mix Exchange meeting. All participants are to incorporate the following into their procedures:

1. The fine aggregate should again be washed after the 24 hour immersion period.
2. For the cone test, do not refill the cone after each tamping.

During the May 29, 1989 General Technical Meeting, most agencies indicated that a fan is used to dry aggregate when determining the aggregate specific gravity (as allowed by ASTM). This procedure is to be incorporated by all participants.

The water absorption for the two aggregates is determined during the aggregate relative density testing in accordance with the respective ASTM procedures. The combined percentage water absorption is based on a blend of 35.1 % of the average held on the 5.0 mm sieve and 64.9 % of the average passing the 5.0 mm sieve.

2.2 Maximum Theoretical Density

Aggregate for the eight Marshall compaction briquettes have been labelled, "Marshall Briquette"

The aggregate samples have been pre-weighed to 1,200.0 grams. 67.2 grams of asphalt cement will be added to the aggregate samples to prepare the Marshall compaction briquettes. (5.60% asphalt content based on dry weight of aggregate or 5.30% asphalt content on a total mix basis).

Aggregate for the Maximum Theoretical Density (MTD) samples has been pre-weighed to 2,000.0 grams to which 112.0 grams of asphalt cement will be added to achieve an asphalt content of 5.60% based on the dry weight of aggregate. The test for MTD shall follow AASHTO T 209 Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures. **The only deviations from AASHTO T 209 are:**

- the 2000 g aggregate samples provided shall be mixed at 168°C, and

- the mix samples shall be conditioned for four hours at the compaction temperature of 152°C.

  The results for this Theoretical Maximum Specific Gravity and Density test shall be used for determining the air voids of the Marshall briquettes and the percent asphalt absorption.

  NOTE:

- If for some reason the aggregate mass varies from that specified, the asphalt cement mass should be calculated based on the new aggregate mass to achieve an asphalt cement content of 5.60% by weight of dry aggregate.

2.3 Aggregate Relative Density and Water Absorption

Three determinations are to be made on each of the coarse and fine aggregates using the individual pre-weighed samples. The coarse relative density shall follow ASTM C127. The fine relative density shall follow ASTM C128. Aggregate relative density is to be reported to four (4) significant figures.

The following interpretative revisions to ASTM C128 were agreed to at the 1989 Asphalt Mix Exchange. All participants should incorporate the following into their procedures:

1. The fine aggregate should again be washed after the 24 hour immersion period.
2. For the Cone Test, do not refill the cone after each tamping.

NOTE:

- **During the May 29, 1989 General Technical Meeting, most agencies indicated that a fan is being used to dry aggregate for determining bulk specific gravity, as allowed by ASTM.**

The following interpretative revisions to ASTM C128 were agreed to at the 1989 Asphalt Mix Exchange. All participants should incorporate the following into their procedures:

- The water absorption for the two aggregates shall be determined during the relative density testing in accordance with the respective ASTM procedures and reported.
- The combined percentage water absorption is based on a blend of 54% of the average held on the 5.0 mm sieve and 46 % of the average passing the 5.00 mm sieve.

Asphalt absorption determination shall follow ASTM D4469 Standard Test Method for Calculating Percent Asphalt Absorption by the Aggregate in an Asphalt Pavement Mixture.

2.4 Asphalt Absorption

Asphalt absorption determination shall follow ASTM D4469 Standard Test Method for Calculating Percent Asphalt Absorption by the Aggregate in an Asphalt Pavement Mixture.

2.5 Asphalt Cement Content and Asphalt Mix Sample Preparation

Eight (8) briquettes with an asphalt cement content of 5.60% (by weight of dry aggregate basis) are to be prepared separately by adding 67 g of asphalt cement.

Three MTD samples with an asphalt cement content of 5.60% (by weight of dry aggregate basis) are to be prepared by adding 112.0 g of asphalt cement.

The following procedures are to be followed to ensure uniformity in preparation of the asphalt mix samples:

Mixing

1. Aggregates shall be heated for 12 hours minimum at a temperature of 110°C ± 5°C prior to adding asphalt.

2. Mixing should be done at 168°C using a "**buttered**" mixing pan. The mixing pan should not be totally clean but should contain the residue from previous mixing that is left after scraping with a spoon and/or spatula.
3. The asphalt cement added should be the percentage specified and no allowance should be made for asphalt cement that is left sticking to the sides of the mixing pan.
4. All mixing is to be done by hand using a spoon and a spatula.

Compaction

A total of eight (8) briquettes will be manufactured: four (4) by hand compaction and four by (4) mechanical compaction.

Hand compaction shall be **75 BLOWS** to each face at 152°C. Mechanical compaction should be based on the equivalent blow count to each face that your laboratory correlates to 75 blows of the hand hammer at 152°C.

1. The compaction pedestal shall follow specifications from AASHTO T245 Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus and shall be secured to a solid concrete slab.
2. For a bevelled compaction hammer, the thickest part of the compaction foot shall be placed toward the chain of the mechanical compactor at the start of compaction.
3. Briquettes are manufactured one at a time. Do not combine samples.
4. Manufactured briquettes will be air cooled for one hour before they are removed from the mould.
5. The briquettes shall not be removed from the mould by applying blows to the face but rather by a constant applied pressure.

Marshall Mix Design Characteristics

1. Bulk specific gravity and density determination for briquettes shall be as specified in ASTM D2726 Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
2. Marshall stability and flow determination for briquettes shall be as specified in AASHTO T245.
3. Bulk specific gravity, Marshall stability and flow testing shall be performed 24 hours after the briquettes have been compacted.

Flow shall be measured using flow meters on each guide rod. The average flow value is recorded if hand flow meters are used. Please specify if some other method is being used.

2.6 Calculated Data

For the four (4) hand compacted and four (4) mechanically compacted briquettes, each lab uses their determination of the aggregate bulk density, the bulk density of the compacted mixture and the maximum theoretical density of the asphalt-aggregate mixture to compute:

- percent voids in the mineral aggregate (*VMA*)
- percent air voids (*AV*)
- percent voids filled (*VF*)

The void characteristics are calculated using the following formulae:

Percent Voids in the Mineral Aggregate (*VMA)*

$$VMA = 100 - \left(\frac{G_{mb}}{G_{sb}} \times \frac{100}{100 + P_b} \right) \times 100$$

Percent Air Voids (*AV*)

$$AV = 100 \times \left(1 - \frac{G_{mb}}{G_{mm}} \right)$$

Percent Voids Filled with Asphalt (*VF*)

$$VF = \left(\frac{VMA - AV}{VMA} \right) \times 100$$

Percent Water Absorption (*WA*)

$$WA = \left(\frac{B - A}{A} \right) \times 100$$

Where:			Units
G_{mb}	=	bulk density of the compacted mixture	(g/cm^3)
G_{sb}	=	bulk density of the aggregate	(g/cm^3)
P_b	=	asphalt content of the mix (% by weight of dry aggregate)	(%)
G_{mm}	=	maximum theoretical density of the asphalt-aggregate mixture	(g/cm^3)
B	=	weight of saturated surface dry aggregate	(g)
A	=	dry weight of aggregate	(g)

2.7 Mechanical Compaction Equipment Data

Each laboratory must provide a description of the mechanical compaction equipment used. This required information includes:

- number of blows,
- mass of the compaction hammer (kg),
- drop of the hammer (mm),
- type of spring in the hammer,
- thickness of the compaction foot (mm),
- the high and low thickness (if the compaction foot is bevelled),
- type of base (rotating or stationary),
- type and trade name of the mechanical compactor (e.g., home-made, Soil test, Pine Instrument, double acting, etc.).

3 INSTRUCTIONS TO PARTICIPANTS (GYRATORY COMPACTOR)

Please note that at the November 2008 CAMP technical meeting, it was agreed that only the determination of the Bulk Density at N_{design} =75 gyrations **is required for this part of the proficiency exchange.**

3.1 Mix Ingredients

The mix, consisting of processed aggregates, is a standard surface mix for Transport Quebec. The aggregates and the asphalt cement were provided by Transport Quebec.

3.2 Guidelines for Gyratory Compaction

a) Mixing Temperature = 168°C

b) Compaction Temperature = 152°C

c) N_{Design} = 75 gyrations

d) Asphalt Content = 5.30% by total weight of mix (282 grams to be added to each sample)

e) If for some reason the aggregate mass varied from that specified, the labs are to adjust the asphalt mass so that the desired asphalt content is maintained.

3.3 Sample Container

Your Gyratory Compactor asphalt mix exchange participant package consists of the following materials:

- aggregate samples
- 1 asphalt cement sample

The aggregate samples are to be used as follows: Three (3) 5,037 gram samples for the Gyratory Compactor testing.

3.4 Preparation of Aggregate

Place the pan containing the aggregate in an oven set approximately 15°C higher than the mixing temperature. Two to four hours are required for the aggregate to reach the mixing temperature. While aggregate is heating, heat all mixing implements such as spatulas, mixing bowl and other tools.

Heat the asphalt binder to the desired mixing temperature. The time required for this step varies depending on the amount of asphalt and the heating method. Preheat a forced draft oven to 152°C to use for short term aging of the test specimens immediately after mixing.

3.5 Preparation of Mixture

Place the hot mixing bowl on a scale and zero the scale. Charge the mixing bowl with the heated aggregates and dry mix thoroughly.

Form a crater in the blended aggregate and weigh the required asphalt into the mixture to achieve the desired batch weight.

Remove the mixing bowl from the scale and mix the asphalt and aggregate. Mix the specimen until the aggregate is thoroughly coated. Place the mix in a flat shallow pan at an even thickness of 21 – 22 kg/m^2 and place the pan in the forced draft oven at 152°C. Short term age the specimen for 2 hours in accordance with AASHTO R30.

Repeat this procedure until the desired number of specimens is produced. Proper timing of the gyratory compaction steps can be achieved by spacing approximately 20 minutes between mixing each specimen and proceeding with compaction.

3.6 Compaction of Specimens

The compaction of the specimens and the determination of the bulk density will be conducted in accordance with AASHTO T312 and AASHTO R35.

3.7 Preparation Instructions

Complete instructions and a data sheet are included in the package to ensure uniformity between the labs. Three specimens are prepared and tested.

The following gyratory compaction guidelines are used:

1. Mixing Temperature = 145 °C
2. Compaction Temperature = 135 °C
3. N_{Design} = 75 gyrations
4. Asphalt Content: 5.39 % by total weight of mix (267.9 grams are added to each sample)
5. If for some reason the aggregate mass varies from that specified, the labs are to adjust the asphalt mass so that the desired asphalt content is maintained.

Aggregate Preparation

The following procedures are used to prepare the aggregate:

1. The aggregate is placed in a pan and heated in an oven for two to four hours until the mixing temperature is reached. The oven temperature is set approximately 15 °C higher than the mixing temperature. All the mixing implements are heated at the same time.
2. The asphalt binder is heated to the desired mixing temperature.
3. A forced draft mixing oven is preheated to 135 °C for use in short term aging of the test specimens.

Mixture Preparation

The following procedures are used to prepare the mixture:

1. Place the hot mixing bowl on a scale and zero the scale.
2. Charge the mixing bowl with the heated aggregates and dry mix thoroughly.
3. Form a crater in the blended aggregate and weigh the required asphalt into the mixture to achieve the desired batch weight.
4. Remove the mixing bowl from the scale and mix the asphalt and the aggregate until the aggregate is thoroughly coated.
5. Place the mixture in a flat shallow pan to an even thickness of 21-22 kg/m^2 and put the pan in the forced draft oven at 135 °C.
6. Short term age the specimen for 2 hours in accordance with AASHTO R30.
7. Repeat this process for each specimen.
8. Proper timing of the gyratory compaction steps can be achieved by spacing approximately 20 minutes between mixing each specimen and proceeding with compaction.

3.8 Compaction of Specimens

The compaction of the specimens and the determination of the bulk density will be conducted in accordance with AASHTO T312 and AASHTO R35.

3.9 Gyratory Compactor Characteristics

The bulk density at 75 gyrations is determined after the specimens are compacted with the gyratory compactor.

4 PARTICIPANT SAMPLE PACKAGES (IGNITION OVEN)

Each ignition oven participant package contains three 1,500 gram aggregate samples, three asphalt mix samples and one asphalt cement sample. The three aggregate samples are used to calibrate the ignition oven; the three asphalt mix samples are used for the ignition oven tests.

5 INSTRUCTIONS TO PARTICIPANTS (IGNITION OVEN)

5.1 Calibration

Calibration testing is to be completed on the three 1,500.0 gram samples supplied for the Ignition Oven calibration.

The aggregate samples have been pre-weighed to 1,500.0 grams. The Ignition Oven calibration testing is to be completed at an asphalt content of **5.2%** based on the dry weight of aggregate (4.94% asphalt content based on a total mix basis).

Three samples are to be prepared separately by adding 78.0 grams of asphalt to the aggregate in order to obtain the desired asphalt content of 5.2% based on the dry weight of the aggregate.

Three determinations will be made to establish a calibration factor.

Note:

- **If for some reason the aggregate mass varies from that specified, the asphalt cement mass should be calculated based on the new aggregate mass to achieve an asphalt cement content of 5.2% by weight of dry aggregate.**

Mixing

4. Aggregates shall be heated for 12 hours minimum at a temperature of 110°C ± 5°C prior to adding asphalt.
5. Mixing should be done at 145°C using a "**buttered**" mixing pan. The mixing pan should not be totally clean but should contain the residue from previous mixing that is left after scraping with a spoon and/or spatula.
6. The asphalt cement added should be the percentage specified and no allowance should be made for asphalt cement that is left sticking to the sides of the mixing pan.
7. All mixing is to be done by hand using a spoon and a spatula.
8. After the sample is mixed, record the mass of the total mixture to the nearest 0.1 gram as M_{PC1}.
9. Repeat the process for the other two samples and record the mass of the total mixture to the nearest 0.1 gram as M_{PC2} and M_{PC3}.

Testing

7. After the samples are prepared, the asphalt content should be determined using:

ASTM D6307 Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method.

8. After the asphalt is burned off in the ignition oven, determine the mass of the remaining sample to the nearest 0.1 gram and record it as M_{AC1}, M_{AC2} and M_{AC3}.

Note:

- **Ensure that the mass recorded as M_{AC1}, M_{AC2} and M_{AC3} are from the same samples as the masses recorded for M_{PC1}, M_{PC2} and M_{PC3} respectively.**

Calculations

10. Calculate the measured percent mass loss (C_{sx}) for each sample using the equation in ASTM D 6307:

$$C_{Sx} = (\frac{M_{PCx} - M_{ACx}}{M_{PCx}} \times 100) - \%AC$$

C_{Sx} = Measured mass loss of the calibration sample

x = Calibration sample number, where x = 1 or x = 2 or x = 3.

M_{PCx} = Total mass of the mixture calibration sample prior to ignition.

M_{ACx} = Total mass of the mixture calibration sample after ignition.

%AC = Percentage of the actual asphalt cement in the mix by **mass of the total mix** expressed as a percentage (e.g. 5%).

11. Record the measured mass loss of the calibration sample for each sample on the test result sheet, in the "Data Collection and Submission Forms" section of these instructions.
12. Calculate the average calibration factor (C_F) using the following equation:

$$C_F = \frac{C_{S1} + C_{S2} + C_{S3}}{3}$$

Where:

C_F = Average measured mass loss of the calibration samples expressed as a percentage

C_{S1} = Measured mass loss of calibration sample 1

C_{S2} = Measured mass loss of calibration sample 2

C_{S3} = Measured mass loss of calibration sample 3

13. Compute and record the average calibration factor on the test result sheet in the "Data Collection and Submission Forms" section of these instructions.

Testing

The following process was used to ensure uniformity in ignition oven testing:

1. After the samples are prepared, the asphalt content will be determined using:
   - ASTM D6307 STANDARD TEST METHOD FOR ASPHALT CONTENT OF HOT-MIX ASPHALT BY IGNITION METHOD.

2. After the asphalt is burned off in the ignition oven, determine the mass of the remaining sample to 0.1 gram and record it as M_{AC1}, M_{AC2}, and M_{AC3}. The masses recorded as M_{AC1}, M_{AC2}, and M_{AC3} should correspond to the samples that have masses of M_{PC1}, M_{PC2}, and M_{PC3} respectively.

Calculations

A correction factor for the calibration samples is determined.

1. Calculate the measured percent mass loss (C_{SX}) for each sample using the equation in ASTM D6307:

$$C_{Sx} = (\frac{M_{PCx} - M_{ACx}}{M_{PCx}} \times 100) - \%AC$$

Where: Units

C_{Sx}	=	Measured mass loss of the calibration sample.	(%)
x	=	Calibration sample number, where x = 1 or x = 2 or x = 3.	
M_{PCx}	=	Total mass of the mixture calibration sample prior to ignition.	(g)
M_{ACx}	=	Total mass of the mixture calibration sample after ignition.	(g)
$\%AC$	=	Percentage of the actual asphalt cement in the mix by mass of the total mix.	(%)

2. Calculate the average calibration factor (CF) using the following equation:

$$C_F = \frac{C_{S1} + C_{S2} + C_{S3}}{3}$$

Where: Units

C_F	=	Average measured mass loss of the calibration sample expressed as a (%) percentage.	
C_{S1}	=	Measured mass loss of calibration sample 1.	(%)
C_{S2}	=	Measured mass loss of calibration sample 2.	(%)
C_{S3}	=	Measured mass loss of calibration sample 3.	(%)

5.2 Testing of premixed asphalt samples

After the correction factor is determined, ignition oven testing is completed on the other three premixed asphalt mix samples. The asphalt mix samples have been pre-mixed with a predetermined amount of asphalt that is known only to the coordinating agency.

Preparation of asphalt mix samples

1. In accordance with AASHTO T308 or ASTM D6307, oven dry each hot mix sample at a temperature of 105°C ± 5°C to constant mass.
2. Record the mass of the total mixture to the nearest 0.1 gram as M_{PT1}.
3. Ensure the sample has been softened enough to distribute evenly in the sample basket.
4. Repeat the process for the other two samples and record the mass of the total mixture to the nearest 0.1 gram as of the total mixture to the nearest 0.1 gram as M_{PT2} and M_{PT3}.

Testing

The following process is used to ensure uniformity in the ignition oven testing:

1. After the samples are prepared, the asphalt content will be determined using AASHTO T308 or ASTM D6307.
2. After the asphalt is burned off in the ignition oven, determine the mass of the remaining samples to 0.1 gram and record it as M_{AT1}, M_{AT2}, and M_{AT3}. The masses recorded as M_{AT1}, M_{AT2}, and M_{AT3} should correspond to the samples that have masses of M_{PT1}, M_{PT2}, and M_{PT3} respectively.

Calculations

1. Calculate the corrected asphalt content ($\%AC_x$) using the equation in ASTM D6307:

$$\%AC_x = \left(\frac{M_{PTX} - M_{ATX}}{M_{PTX}} \times 100\right) - C_F$$

Where: Units

$\%AC_x$	=	Measured percent asphalt content by mass of the oven-dry. HMA sample.	(%)
C_F	=	Calibration factor as determined above, expressed as a percentage.	(%)
x	=	Testing sample number (1, 2 or 3).	
M_{PTx}	=	Total mass of the mixture testing sample prior to ignition.	(g)
M_{ATx}	=	Total mass of the aggregate remaining after ignition.	(g)

2. Calculate the asphalt content percent ($\%AC_x$) by mass of the oven dry HMA for each sample and record on the result sheet.
3. Compute and record the asphalt content ($\%AC_x$) by dry weight of aggregate for each sample and record on the test result sheet. Use the following equation:

$$\%AC_{DRY\ WEIGHT\ AGGREGATE} = \frac{\%AC_{OVEN\ DRY}}{1 - \left(\frac{\%AC_{OVEN\ DRY}}{100}\right)}$$

The results shown in Table 11.1 provide asphalt content by mass of oven-dry HMA samples.

6 SUMMARY OF TEST RESULTS

6.1 Background

The 2012 asphalt mix exchange test results are analysed using ASTM test procedure E691, Standard Practice for Conducting an Inter-laboratory Study to Determine the Precision of a Test Method.

The repeatability standard deviation, s_r, is a measure of the variability that can be expected within-laboratory under repeatability conditions. It usually refers to the single operator variability that can be expected when the operator, equipment, equipment calibration, and environment (temperature, humidity, etc.) have a minimal effect on the variability of test results within a lab.

The reproducibility standard deviation, s_R, is a measure of between-laboratory variability. It refers to the variability that can be expected when the operator, equipment, equipment calibration, and environment (temperature, humidity, etc.) have a significant effect on the variability of test results between different labs. The *k* consistency statistic is used to examine the consistency of test results within a laboratory. This value indicates how a lab's within-laboratory variability (under repeatability conditions on a particular material) compares with the within-laboratory variability of all the other laboratories combined. The *k* consistency statistic is calculated for each lab and then compared to a critical value, k_{crit}. If a lab's *k* consistency statistic exceeds the critical value, then it is likely that they are having problems repeating test results in their laboratory. The critical value is determined using a statistical calculation based on an F-Test at a 0.5% level of significance. The critical value is a function of the level of significance, the number of labs involved in the testing and the number of replicate samples.

The h consistency statistic is used to examine the consistency of test results between laboratories. This value indicates how a lab's average test result (under repeatability conditions on a particular material) compares to the average obtained by all of the other laboratories involved in the testing program. The h consistency statistic is calculated for each lab and compared to a critical value, h_{crit}. If a lab's h consistency statistics exceeds the critical value, then it is likely that they are having problems correlating test results with other laboratories. The critical value is determined using a statistical calculation based on a Student's t-Test at a 0.5% level of significance. The critical value is a function of the level of significance and the number of labs involved in the testing.

The level of significance is the probability of incorrectly deciding that two data sets are different when in fact they are the same. At a 0.5% level of significance, only 1 in every 200 times will a lab be identified as having some type of testing problem; when in fact they do not. ASTM E691 Standard Practice for Conducting an Inter-laboratory Study to Determine the Precision of a Test Method suggests that a 0.5% level of significance is appropriate for this type of analysis.

6.2 Test Results

A summary of the results for each test procedure used in the Marshall Mix, Gyratory Compactor, and Ignition Oven parts of the exchange is presented in Table 15. The following information is provided:

- The average value
- The repeatability and reproducibility standard deviations
- The 95% confidence limits for repeatability and reproducibility
- The labs that exceed or are close to the critical *h* or *k* statistics.

As an example, for the Bulk Density of the Coarse Aggregate in Table 15, the average value reported by all of the laboratories is 2.8434. The repeatability standard deviation, s_r, is 0.0058 and reproducibility standard deviation, s_R, is 0.0153.

The 95% confidence limit for repeatability is computed with the following equation:

$$95\% \text{ Repeatability Confidence Limit} = 1.96 * \sqrt{2} * s_r$$

The 95% confidence limit for repeatability means that approximately 95% of all pairs of test results on a given material from within a laboratory can be expected to differ in absolute value by $1.96 * \sqrt{2} * s_r$. For example, the Bulk Density of the Coarse Aggregate 95% Confidence Limit for Repeatability is computed to be $1.96 * \sqrt{2} * 0.0058 = 0.0162$. This means that approximately 95% of all pairs of test results on a given

material from within a laboratory can be expected to differ in absolute value by 0.0162. In other words, two test results from the same lab on the same material will be considered suspect if they differ in absolute value by more than 0.0162.

The 95% confidence limit for reproducibility is computed with the following equation:

$$95\% \text{ Reproducibility Confidence Limit} = 1.96 * \sqrt{2} * s_R$$

The 95% confidence limit for reproducibility means that approximately 95% of all pairs of test results on a given material from between laboratories can be expected to differ in absolute value by $1.96 * \sqrt{2} * s_R$. For example, the Bulk Density of the Coarse Aggregate 95% Confidence Limit for Reproducibility is computed to be $1.96 * \sqrt{2} * 0.0153 = 0.0424$. This means that approximately 95% of all pairs of test results on a given material from between two laboratories can be expected to differ in absolute value by 0.0424. In other words, two test results from different labs on the same material will be considered suspect if they differ in absolute value by more than 0.0424.

Table 15 indicates which labs have between-laboratory consistency statistics (*h* consistency statistic) that exceed (Labs Out *h*-stat) or are close (Labs Close *h*-stat) to the critical between-laboratory consistency statistic, h_{crit}. This table also shows the laboratories that have within-laboratory consistency statistics (*k* consistency statistic) that exceed (Labs Out *k*-stat) or are close (Labs Close *k*-stat) to the critical within-laboratory consistency statistic, k_{crit}.

If a lab has a between-laboratory consistency statistic (*h* consistency statistic) that exceeds the critical between-laboratory consistency statistic, h_{crit}, then its average test result is significantly different from the average obtained by the other laboratories. It may have difficulty correlating to other laboratories and should investigate its testing equipment and procedures.

Using Bulk Density of Coarse Aggregate from Table 1.2 as an example, lab 10 has a between-laboratory consistency statistics (*h* consistency statistic) that exceeds the critical consistency statistic, h_{crit}. The laboratory average test results are significantly different from the average obtained by the other laboratories. They may have difficulty correlating to other laboratories and should investigate their testing equipment and procedures.

If a lab has a between-laboratory consistency statistic (*h* consistency statistic) that is close to the critical between-laboratory consistency statistic, h_{crit}, then its average test result is not significantly different from the average obtained by the other laboratories. However, the lab may want to consider taking precautions to ensure that there are not any problems with its testing procedures and equipment.

If a lab has a within-laboratory consistency statistic (*k* consistency statistic) that exceeds the critical within-laboratory consistency statistic, k_{crit}, then its within-laboratory standard deviation is significantly different from that obtained by all of the laboratories combined. The laboratory is having problems repeating test results in its own laboratory and should investigate its testing procedures and equipment.

Using Bulk Density of Fine Aggregate from Table 1.1 as an example, lab 29 has a within-laboratory consistency statistic (*k* consistency statistic) that exceeds the critical consistency statistic, k_{crit}. The within-laboratory standard deviation is significantly different from that obtained by all of the laboratories combined. They may have problems repeating the test results in their own lab and should investigate their testing procedures and equipment.

If a lab has a within-laboratory consistency statistic (*k* consistency statistic) that is close to the critical within-laboratory consistency statistic, k_{crit} , then its within-laboratory standard deviation is not significantly different from that obtained by all of the laboratories combined. However, the lab may want to consider taking precautions to ensure that there are not any problems with its testing procedures and equipment.

7 ADDITIONAL INFORMATION

The complete set of test results is presented in Appendix A (Tables 1.1 – 11.1). Graphs representing the k-consistency statistic, for within laboratory variability, and the h-consistency statistic, for between laboratory variability, are also included in Appendix A.

The definitions and formulae for the statistical equations used in the analysis of the test results are included in Appendix B. Additional elaboration on the statistical analysis can be found in ASTM E691 Standard Practice for Conducting an Inter-laboratory Study to Determine the Precision of a Test Method.

The entire report is available for viewing and/ or printing from the following Internet address:
http://www.etsmtl.ca/Unites-de-recherche/LCMB/CAMEP-CAEP

Questions pertaining to the Canadian Asphalt Mix Exchange Program can be directed to:

Alan Carter, P.Eng., Ph.D.
Professor
École de technologie supérieure
1100, Notre-Dame Ouest
Montreal, Quebec
Fax: (514) 396-8584
E-mail: alan.carter@etsmtl.ca

Appendix A

Table 1.1 Fine Aggregate Bulk Density

100 - Bulk Density of Aggregates
102 - Fine Aggregate (g/cm3)
2012

Data							
n =	3	$(X_{ave})_{ave}$ =	2,7234	s_r =	0,0097	Check s_{Xave} =	0,0304
p =	37	s_{Xave} =	0,0304	s_{R*} =	0,0314	$r = 2.8\ s_r$ =	0,0269
Significance Level =		0,5%		s_R =	0,0314	$R = 2.8\ s_R$ =	0,0870

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	2,7371	2,7403	2,7500		2,7425	0,0067	0,0191	0,0000	0,63	0,69	2,67	-2,67	2,25
Lab 2	2,7310	2,7280	2,7310		2,7300	0,0017	0,0066	0,0000	0,22	0,18	2,67	-2,67	2,25
Lab 3	2,7290	2,7100	2,7120		2,7170	0,0104	-0,0064	0,0001	-0,21	1,08	2,67	-2,67	2,25
Lab 4	2,7379	2,7395	2,7381		2,7385	0,0009	0,0151	0,0000	0,50	0,09	2,67	-2,67	2,25
Lab 5	2,7193	2,7231	2,7161		2,7195	0,0035	-0,0039	0,0000	-0,13	0,36	2,67	-2,67	2,25
Lab 6	2,7370	2,7380	2,7380		2,7377	0,0006	0,0143	0,0000	0,47	0,06	2,67	-2,67	2,25
Lab 7	2,7240	2,7350	2,7040		2,7210	0,0157	-0,0024	0,0002	-0,08	1,62	2,67	-2,67	2,25
Lab 8	2,7240	2,7360	2,7400		2,7333	0,0083	0,0100	0,0001	0,33	0,86	2,67	-2,67	2,25
Lab 9	2,7411	2,7523	2,7358		2,7431	0,0084	0,0197	0,0001	0,65	0,87	2,67	-2,67	2,25
Lab 10	2,7290	2,7040	2,7070		2,7133	0,0137	-0,0100	0,0002	-0,33	1,41	2,67	-2,67	2,25
Lab 11	2,7440	2,7340	2,7290		2,7357	0,0076	0,0123	0,0001	0,41	0,79	2,67	-2,67	2,25
Lab 12	2,7400	2,7330	2,7260		2,7330	0,0070	0,0096	0,0000	0,32	0,72	2,67	-2,67	2,25
Lab 13	2,6470	2,6210	2,6490		2,6390	0,0156	-0,0844	0,0002	-2,78	1,61	2,67	-2,67	2,25
Lab 14	2,7260	2,7290	2,7340		2,7297	0,0040	0,0063	0,0000	0,21	0,42	2,67	-2,67	2,25
Lab 15	2,7222	2,7178	2,7232		2,7211	0,0029	-0,0023	0,0000	-0,08	0,30	2,67	-2,67	2,25
Lab 16	2,7230	2,7330	2,7340		2,7300	0,0061	0,0066	0,0000	0,22	0,63	2,67	-2,67	2,25
Lab 17	2,7310	2,7240	2,7240		2,7263	0,0040	0,0030	0,0000	0,10	0,42	2,67	-2,67	2,25
Lab 18	2,7470	2,7430	2,7390		2,7430	0,0040	0,0196	0,0000	0,65	0,41	2,67	-2,67	2,25
Lab 19	2,7480	2,7490	2,7410		2,7460	0,0044	0,0226	0,0000	0,75	0,45	2,67	-2,67	2,25
Lab 20	2,6720	2,6560	2,6630		2,6637	0,0080	-0,0597	0,0001	-1,97	0,83	2,67	-2,67	2,25
Lab 21	2,6200	2,6170	2,6210		2,6193	0,0021	-0,1040	0,0000	-3,42	0,21	2,67	-2,67	2,25
Lab 22	2,7250	2,7610	2,7460		2,7440	0,0181	0,0206	0,0003	0,68	1,86	2,67	-2,67	2,25
Lab 23	2,7350	2,7420	2,7370		2,7380	0,0036	0,0146	0,0000	0,48	0,37	2,67	-2,67	2,25
Lab 24	2,7270	2,7360	2,7230		2,7287	0,0067	0,0053	0,0000	0,17	0,69	2,67	-2,67	2,25
Lab 25	2,7430	2,7320	2,7320		2,7357	0,0064	0,0123	0,0000	0,41	0,65	2,67	-2,67	2,25
Lab 26	2,7070	2,7090	2,7210		2,7123	0,0076	-0,0110	0,0001	-0,36	0,78	2,67	-2,67	2,25
Lab 27	2,6820	2,6560	2,6750		2,6710	0,0135	-0,0524	0,0002	-1,72	1,39	2,67	-2,67	2,25
Lab 28	2,7670	2,7410	2,7530		2,7537	0,0130	0,0303	0,0002	1,00	1,34	2,67	-2,67	2,25
Lab 29	2,7687	2,7564	2,7112		2,7454	0,0303	0,0221	0,0009	0,73	3,12	2,67	-2,67	2,25
Lab 30	2,7730	2,7690	2,7750		2,7723	0,0031	0,0490	0,0000	1,61	0,31	2,67	-2,67	2,25
Lab 31	2,6936	2,6976	2,6901		2,6938	0,0038	-0,0296	0,0000	-0,97	0,39	2,67	-2,67	2,25
Lab 32	2,7220	2,7300	2,7310		2,7277	0,0049	0,0043	0,0000	0,14	0,51	2,67	-2,67	2,25
Lab 33	2,7400	2,7360	2,7390		2,7383	0,0021	0,0150	0,0000	0,49	0,21	2,67	-2,67	2,25
Lab 34	2,7160	2,7230	2,7390		2,7260	0,0118	0,0026	0,0001	0,09	1,22	2,67	-2,67	2,25
Lab 35	2,7350	2,7330	2,7330		2,7337	0,0012	0,0103	0,0000	0,34	0,12	2,67	-2,67	2,25
Lab 36	2,7380	2,7400	2,7400		2,7393	0,0012	0,0160	0,0000	0,53	0,12	2,67	-2,67	2,25
Lab 37	2,7310	2,7030	2,7310		2,7217	0,0162	-0,0017	0,0003	-0,06	1,67	2,67	-2,67	2,25
											2,67	-2,67	2,25
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											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25

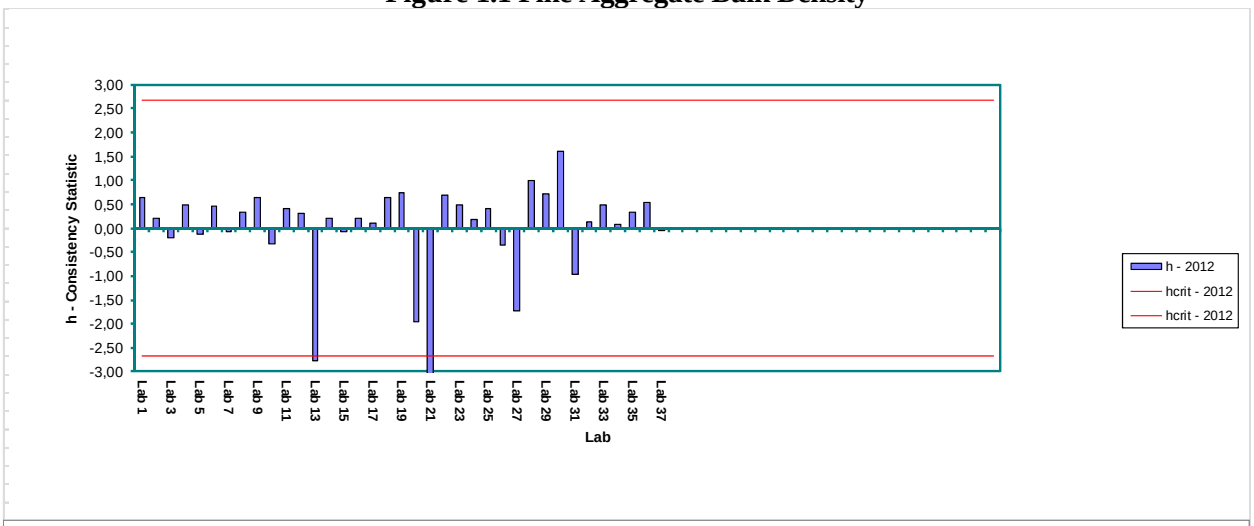
Additional Statistics					
Minimum X_{ave}	2,6193	$r = 2.8\ s_r$ =	0,0269	h_{crit} =	2,67
Maximum X_{ave}	2,7723	$R = 2.8\ s_R$ =	0,0870	h_{crit} =	-2,67
Check s_{Xave} =	0,0304			k_{crit} =	2,25

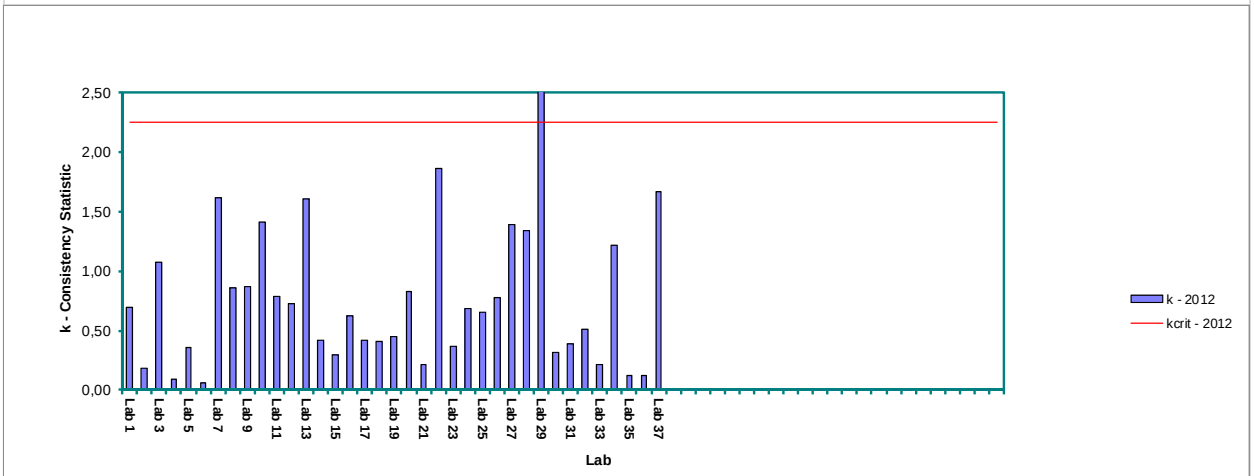
Where:		Where:	
$x_1....x_n$ =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 1.1 Fine Aggregate Bulk Density





Where:	$x_1 ... x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 1.2 Coarse Aggregate Bulk Density

100 - Bulk Density of Aggregates
101 - Coarse Aggregate (g/cm3)
2012

Data			
n = 3	$(X_{ave})_{ave}$ = 2,8434	s_r = 0,0058	Check s_{Xave} = 0,0145
p = 37	s_{Xave} = 0,0145	s_{R*} = 0,0153	$r = 2.8\, s_r$ = 0,0162
Significance Level = 0,5%		s_R = 0,0153	$R = 2.8\, s_R$ = 0,0424

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	2,8383	2,8467	2,8388		2,8413	0,0047	-0,0022	0,0000	-0,15	0,81	2,67	-2,67	2,25
Lab 2	2,8270	2,8270	2,8240		2,8260	0,0017	-0,0174	0,0000	-1,20	0,30	2,67	-2,67	2,25
Lab 3	2,8310	2,8370	2,8480		2,8387	0,0086	-0,0048	0,0001	-0,33	1,48	2,67	-2,67	2,25
Lab 4	2,8302	2,8316	2,8292		2,8303	0,0012	-0,0131	0,0000	-0,90	0,21	2,67	-2,67	2,25
Lab 5	2,8438	2,8406	2,8305		2,8383	0,0069	-0,0051	0,0000	-0,35	1,19	2,67	-2,67	2,25
Lab 6	2,8400	2,8440	2,8390		2,8410	0,0026	-0,0024	0,0000	-0,17	0,45	2,67	-2,67	2,25
Lab 7	2,8420	2,8440	2,8320		2,8393	0,0064	-0,0041	0,0000	-0,28	1,10	2,67	-2,67	2,25
Lab 8	2,8290	2,8300	2,8250		2,8280	0,0026	-0,0154	0,0000	-1,06	0,45	2,67	-2,67	2,25
Lab 9	2,8307	2,8280	2,8268		2,8285	0,0020	-0,0149	0,0000	-1,03	0,34	2,67	-2,67	2,25
Lab 10	2,8820	2,8880	2,8890		2,8863	0,0038	0,0429	0,0000	2,95	0,65	2,67	-2,67	2,25
Lab 11	2,8650	2,8600	2,8590		2,8613	0,0032	0,0179	0,0000	1,23	0,55	2,67	-2,67	2,25
Lab 12	2,8130	2,8140	2,8210		2,8160	0,0044	-0,0274	0,0000	-1,89	0,75	2,67	-2,67	2,25
Lab 13	2,8450	2,8320	2,8310		2,8360	0,0078	-0,0074	0,0001	-0,51	1,34	2,67	-2,67	2,25
Lab 14	2,8500	2,8430	2,8440		2,8457	0,0038	0,0022	0,0000	0,15	0,65	2,67	-2,67	2,25
Lab 15	2,8364	2,8327	2,8334		2,8342	0,0020	-0,0093	0,0000	-0,64	0,34	2,67	-2,67	2,25
Lab 16	2,8600	2,8500	2,8610		2,8570	0,0061	0,0136	0,0000	0,93	1,04	2,67	-2,67	2,25
Lab 17	2,8410	2,8440	2,8410		2,8420	0,0017	-0,0014	0,0000	-0,10	0,30	2,67	-2,67	2,25
Lab 18	2,8490	2,8430	2,8420		2,8447	0,0038	0,0012	0,0000	0,09	0,65	2,67	-2,67	2,25
Lab 19	2,8430	2,8470	2,8460		2,8453	0,0021	0,0019	0,0000	0,13	0,36	2,67	-2,67	2,25
Lab 20	2,8380	2,8390	2,8380		2,8383	0,0006	-0,0051	0,0000	-0,35	0,10	2,67	-2,67	2,25
Lab 21	2,8290	2,8230	2,8240		2,8253	0,0032	-0,0181	0,0000	-1,25	0,55	2,67	-2,67	2,25
Lab 22	2,8420	2,8060	2,8450		2,8310	0,0217	-0,0124	0,0005	-0,86	3,72	2,67	-2,67	2,25
Lab 23	2,8580	2,8610	2,8590		2,8593	0,0015	0,0159	0,0000	1,09	0,26	2,67	-2,67	2,25
Lab 24	2,8580	2,8550	2,8520		2,8550	0,0030	0,0116	0,0000	0,80	0,51	2,67	-2,67	2,25
Lab 25	2,8490	2,8420	2,8430		2,8447	0,0038	0,0012	0,0000	0,09	0,65	2,67	-2,67	2,25
Lab 26	2,8480	2,8500	2,8660		2,8547	0,0099	0,0112	0,0001	0,77	1,69	2,67	-2,67	2,25
Lab 27	2,8710	2,8820	2,8760		2,8763	0,0055	0,0329	0,0000	2,26	0,94	2,67	-2,67	2,25
Lab 28	2,8610	2,8720	2,8730		2,8687	0,0067	0,0252	0,0000	1,74	1,14	2,67	-2,67	2,25
Lab 29	2,8335	2,8238	2,8267		2,8280	0,0050	-0,0154	0,0000	-1,06	0,85	2,67	-2,67	2,25
Lab 30	2,8260	2,8240	2,8350		2,8283	0,0059	-0,0151	0,0000	-1,04	1,00	2,67	-2,67	2,25
Lab 31	2,8539	2,8495	2,8475		2,8503	0,0033	0,0069	0,0000	0,47	0,56	2,67	-2,67	2,25
Lab 32	2,8430	2,8410	2,8380		2,8407	0,0025	-0,0028	0,0000	-0,19	0,43	2,67	-2,67	2,25
Lab 33	2,8470	2,8390	2,8370		2,8410	0,0053	-0,0024	0,0000	-0,17	0,91	2,67	-2,67	2,25
Lab 34	2,8540	2,8440	2,8560		2,8513	0,0064	0,0079	0,0000	0,54	1,10	2,67	-2,67	2,25
Lab 35	2,8440	2,8470	2,8480		2,8463	0,0021	0,0029	0,0000	0,20	0,36	2,67	-2,67	2,25
Lab 36	2,8470	2,8400	2,8420		2,8430	0,0036	-0,0004	0,0000	-0,03	0,62	2,67	-2,67	2,25
Lab 37	2,8500	2,8450	2,8390		2,8447	0,0055	0,0012	0,0000	0,09	0,94	2,67	-2,67	2,25
											2,67	-2,67	2,25
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											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25

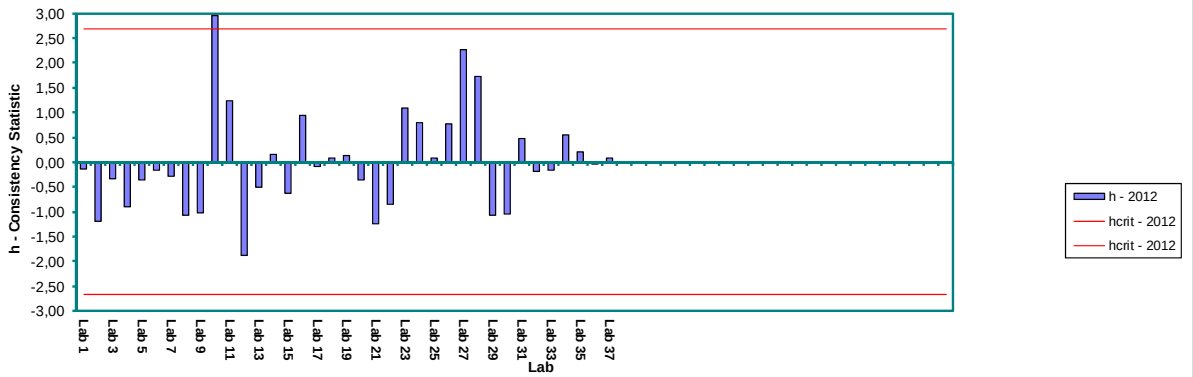
Additional Statistics					
Minimum X_{ave}	2,8160	$r = 2.8\, s_r$ =	0,0162	h_{crit} =	2,67
Maximum X_{ave}	2,8863	$R = 2.8\, s_R$ =	0,0424	h_{crit} =	-2,67
Check s_{Xave} =	0,0145			k_{crit} =	2,25

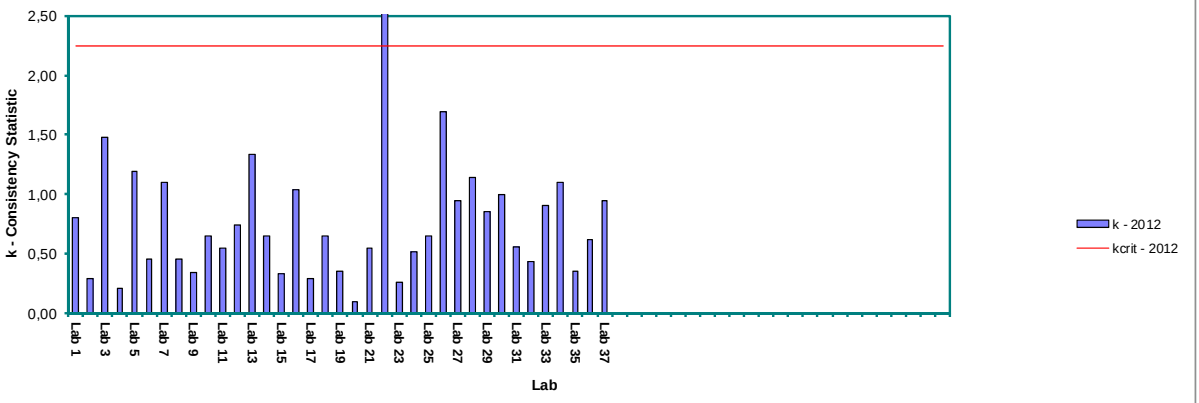
Where:		Where:	
$x_1 .... x_n$ =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n = FAUX	$(X_{ave})_{ave}$ = #DIV/0!	s_r = 0,0000	Check s_{Xave} = 0,0000

Figure 1.2 Coarse Aggregate Bulk Density





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 2.1 Fine Aggregate Water Absorption

200 - Water Absorption
201 - Absorption Fine Aggregate (%)
2012

Data						
n = 3	$(X_{ave})_{ave}$ =	1,3955	s_r =	0,1715	Check s_{Xave} =	0,4236
p = 37	s_{Xave} =	0,4236	s_{R*} =	0,4462	$r = 2.8\ s_r$ =	0,4755
Significance Level =	0,5%		s_R =	0,4462	$R = 2.8\ s_R$ =	1,2367

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	1,5960	1,5880	1,5150		1,5663	0,0446	0,1709	0,0020	0,40	0,26	2,67	-2,67	2,25
Lab 2	1,3050	1,4220	1,3950		1,3740	0,0613	-0,0215	0,0038	-0,05	0,36	2,67	-2,67	2,25
Lab 3	1,5840	1,6250	1,6470		1,6187	0,0320	0,2232	0,0010	0,53	0,19	2,67	-2,67	2,25
Lab 4	1,4875	1,5030	1,4954		1,4953	0,0078	0,0998	0,0001	0,24	0,05	2,67	-2,67	2,25
Lab 5	1,4620	1,4050	1,5240		1,4637	0,0595	0,0682	0,0035	0,16	0,35	2,67	-2,67	2,25
Lab 6	1,3160	1,2960	1,2140		1,2753	0,0540	-0,1201	0,0029	-0,28	0,32	2,67	-2,67	2,25
Lab 7	1,2970	1,2550	1,2760		1,2760	0,0210	-0,1195	0,0004	-0,28	0,12	2,67	-2,67	2,25
Lab 8	1,4910	1,3580	1,3110		1,3867	0,0934	-0,0088	0,0087	-0,02	0,54	2,67	-2,67	2,25
Lab 9	1,0960	1,0320	1,0920		1,0733	0,0359	-0,3221	0,0013	-0,76	0,21	2,67	-2,67	2,25
Lab 10	1,3500	1,5800	1,4600		1,4633	0,1150	0,0679	0,0132	0,16	0,67	2,67	-2,67	2,25
Lab 11	1,1100	1,1900	1,2800		1,1933	0,0850	-0,2021	0,0072	-0,48	0,50	2,67	-2,67	2,25
Lab 12	1,3980	1,4800	1,5630		1,4803	0,0825	0,0849	0,0068	0,20	0,48	2,67	-2,67	2,25
Lab 13	2,5420	2,9620	1,1630		2,2223	0,9411	0,8269	0,8857	1,95	5,49	2,67	-2,67	2,25
Lab 14	1,4500	1,5600	1,4600		1,4900	0,0608	0,0945	0,0037	0,22	0,35	2,67	-2,67	2,25
Lab 15	1,1436	1,1193	1,1536		1,1388	0,0176	-0,2566	0,0003	-0,61	0,10	2,67	-2,67	2,25
Lab 16	1,4400	1,3800	1,3400		1,3867	0,0503	-0,0088	0,0025	-0,02	0,29	2,67	-2,67	2,25
Lab 17	1,3300	1,3600	1,4500		1,3800	0,0624	-0,0155	0,0039	-0,04	0,36	2,67	-2,67	2,25
Lab 18	1,5640	1,6470	1,7090		1,6400	0,0728	0,2445	0,0053	0,58	0,42	2,67	-2,67	2,25
Lab 19	1,1100	1,1200	1,2000		1,1433	0,0493	-0,2521	0,0024	-0,60	0,29	2,67	-2,67	2,25
Lab 20	1,7730	1,7850	1,7790		1,7790	0,0060	0,3835	0,0000	0,91	0,03	2,67	-2,67	2,25
Lab 21	1,3540	1,3370	1,3770		1,3560	0,0201	-0,0395	0,0004	-0,09	0,12	2,67	-2,67	2,25
Lab 22	1,1530	0,9880	0,9680		1,0363	0,1015	-0,3591	0,0103	-0,85	0,59	2,67	-2,67	2,25
Lab 23	1,2690	1,2750	1,2530		1,2657	0,0114	-0,1298	0,0001	-0,31	0,07	2,67	-2,67	2,25
Lab 24	1,5520	1,4200	1,4360		1,4693	0,0720	0,0739	0,0052	0,17	0,42	2,67	-2,67	2,25
Lab 25	1,1000	1,3000	1,2000		1,2000	0,1000	-0,1955	0,0100	-0,46	0,58	2,67	-2,67	2,25
Lab 26	1,0410	1,2160	1,0340		1,0970	0,1031	-0,2985	0,0106	-0,70	0,60	2,67	-2,67	2,25
Lab 27	3,6100	3,4800	3,2400		3,4433	0,1877	2,0479	0,0352	4,83	1,09	2,67	-2,67	2,25
Lab 28	0,8460	0,9820	0,9690		0,9323	0,0750	-0,4631	0,0056	-1,09	0,44	2,67	-2,67	2,25
Lab 29	1,3600	1,2400	1,0600		1,2200	0,1510	-0,1755	0,0228	-0,41	0,88	2,67	-2,67	2,25
Lab 30	1,3600	1,3000	1,3400		1,3333	0,0306	-0,0621	0,0009	-0,15	0,18	2,67	-2,67	2,25
Lab 31	1,3800	1,3400	1,4000		1,3733	0,0306	-0,0221	0,0009	-0,05	0,18	2,67	-2,67	2,25
Lab 32	1,0300	1,0500	1,0100		1,0300	0,0200	-0,3655	0,0004	-0,86	0,12	2,67	-2,67	2,25
Lab 33	1,2750	1,2950	1,1320		1,2340	0,0889	-0,1615	0,0079	-0,38	0,52	2,67	-2,67	2,25
Lab 34	1,4240	1,4910	1,2610		1,3920	0,1183	-0,0035	0,0140	-0,01	0,69	2,67	-2,67	2,25
Lab 35	1,2100	1,0610	1,1300		1,1337	0,0746	-0,2618	0,0056	-0,62	0,43	2,67	-2,67	2,25
Lab 36	0,9700	0,9500	0,9500		0,9567	0,0115	-0,4388	0,0001	-1,04	0,07	2,67	-2,67	2,25
Lab 37	1,2880	1,3800	1,2690		1,3123	0,0594	-0,0831	0,0035	-0,20	0,35	2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
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											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25

Additional Statistics						
Minimum X_{ave}	0,9323	$r = 2.8\ s_r$ =	0,4755	h_{crit} =	2,67
Maximum X_{ave}	3,4433	$R = 2.8\ s_R$ =	1,2367	h_{crit} =	-2,67
Check s_{Xave} =	0,4236			k_{crit} =	2,25

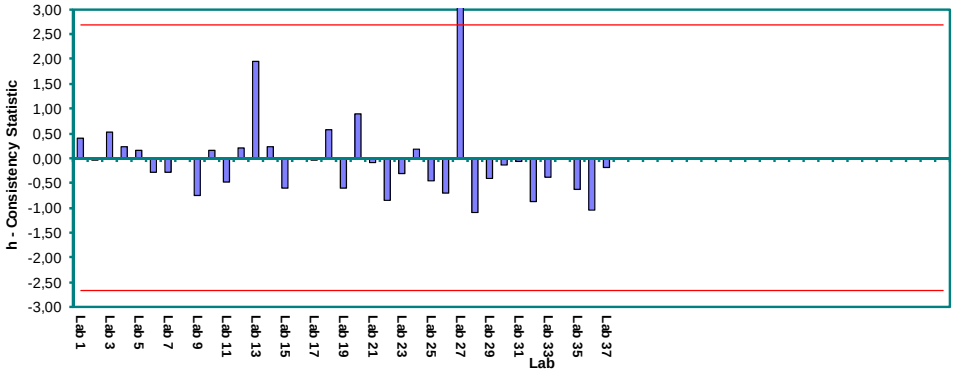
Where:
- $x_1....x_n$ = Individual Test Result
- X_{ave} = Cell Average
- n = Number of Test Results per Cell
- s = Cell Standard Deviation
- d = Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)
- s^2 = Cell Variation
- p = Number of Laboratories

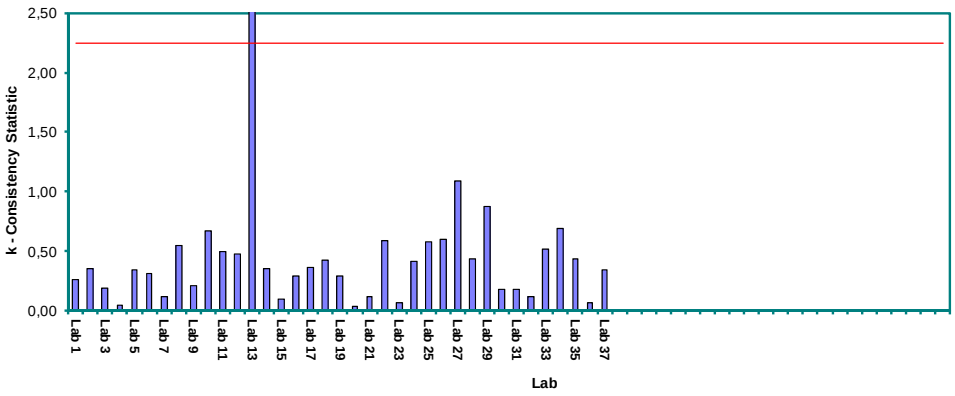
Where:
- $(X_{ave})_{ave}$ = Average of Cell Averages
- s_{Xave} = Standard Deviation of Cell Averages
- s_r = Repeatability Standard Deviation
- s_{R*} = Interim Reproducibility Standard Deviation
- s_R = Reproducibility Standard Deviation (Larger of s_r and s_{R*})
- h = Betw een Laboratory Consistency Statistic
- k = Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} = 0,0000

Figure 2.1 Fine Aggregate Water Absorption





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 2.2 Coarse Aggregate Water Absorption

200 - Water Absorption
202 - Absorption Coarse Aggregate (%)
2012

Data													
					n =	3	$(X_{ave})_{ave}$ =	1,3472	s_r =	0,0507	Check s_{Xave} =	0,1842	
					p =	37	s_{Xave} =	0,1842	s_{R*} =	0,1888	$r = 2.8\ s_r$ =	0,1404	
					Significance Level =		0,5%		s_R =	0,1888	$R = 2.8\ s_R$ =	0,5234	
Lab #	**x_1**	**x_2**	**x_3**	**x_4**	**X_{ave}**	**s**	**d**	**s^2**	**h - 2012**	**k - 2012**	**hcrit - 2012**	**hcrit - 2012**	**kcrit - 2012**
Lab 1	1,5110	1,3990	1,4540		1,4547	0,0560	0,1075	0,0031	0,58	1,11	2,67	-2,67	2,25
Lab 2	1,4220	1,4620	1,4660		1,4500	0,0243	0,1028	0,0006	0,56	0,48	2,67	-2,67	2,25
Lab 3	1,4690	1,2290	1,1630		1,2870	0,1610	-0,0602	0,0259	-0,33	3,18	2,67	-2,67	2,25
Lab 4	1,4585	1,4438	1,4863		1,4629	0,0216	0,1157	0,0005	0,63	0,43	2,67	-2,67	2,25
Lab 5	1,3840	1,3240	1,5090		1,4057	0,0944	0,0585	0,0089	0,32	1,86	2,67	-2,67	2,25
Lab 6	1,4050	1,3640	1,3770		1,3820	0,0210	0,0348	0,0004	0,19	0,41	2,67	-2,67	2,25
Lab 7	1,4530	1,4700	1,4700		1,4643	0,0098	0,1171	0,0001	0,64	0,19	2,67	-2,67	2,25
Lab 8	1,0290	1,0290	1,0290		1,0290	0,0000	-0,3182	0,0000	-1,73	0,00	2,67	-2,67	2,25
Lab 9	1,6020	1,4880	1,6650		1,5850	0,0897	0,2378	0,0080	1,29	1,77	2,67	-2,67	2,25
Lab 10	1,4200	1,4000	1,3900		1,4033	0,0153	0,0561	0,0002	0,30	0,30	2,67	-2,67	2,25
Lab 11	0,9000	0,9100	0,9800		0,9300	0,0436	-0,4172	0,0019	-2,26	0,86	2,67	-2,67	2,25
Lab 12	1,6860	1,6500	1,6770		1,6710	0,0187	0,3238	0,0004	1,76	0,37	2,67	-2,67	2,25
Lab 13	1,4193	1,4102	1,3808		1,4034	0,0201	0,0562	0,0004	0,31	0,40	2,67	-2,67	2,25
Lab 14	1,3400	1,3300	1,3100		1,3267	0,0153	-0,0205	0,0002	-0,11	0,30	2,67	-2,67	2,25
Lab 15	1,5607	1,6171	1,6157		1,5978	0,0322	0,2506	0,0010	1,36	0,64	2,67	-2,67	2,25
Lab 16	1,2500	1,2300	1,1700		1,2167	0,0416	-0,1305	0,0017	-0,71	0,82	2,67	-2,67	2,25
Lab 17	1,2600	1,2200	1,2400		1,2400	0,0200	-0,1072	0,0004	-0,58	0,39	2,67	-2,67	2,25
Lab 18	1,3630	1,3950	1,4200		1,3927	0,0286	0,0455	0,0008	0,25	0,56	2,67	-2,67	2,25
Lab 19	1,3900	1,3400	1,3500		1,3600	0,0265	0,0128	0,0007	0,07	0,52	2,67	-2,67	2,25
Lab 20	1,4790	1,5220	1,5360		1,5123	0,0297	0,1651	0,0009	0,90	0,59	2,67	-2,67	2,25
Lab 21	1,4610	1,4520	1,4980		1,4703	0,0244	0,1231	0,0006	0,67	0,48	2,67	-2,67	2,25
Lab 22	1,2440	1,0940	1,0560		1,1313	0,0994	-0,2159	0,0099	-1,17	1,96	2,67	-2,67	2,25
Lab 23	1,1940	1,1910	1,2290		1,2047	0,0211	-0,1425	0,0004	-0,77	0,42	2,67	-2,67	2,25
Lab 24	1,3260	1,2620	1,2320		1,2733	0,0480	-0,0739	0,0023	-0,40	0,95	2,67	-2,67	2,25
Lab 25	1,4000	1,5000	1,5000		1,4667	0,0577	0,1195	0,0033	0,65	1,14	2,67	-2,67	2,25
Lab 26	1,0940	1,0420			1,0680	0,0368	-0,2792	0,0014	-1,52	0,73	2,67	-2,67	2,25
Lab 27	1,7100	1,5800	1,5500		1,6133	0,0850	0,2661	0,0072	1,44	1,68	2,67	-2,67	2,25
Lab 28	1,0100	0,9120	0,9300		0,9507	0,0522	-0,3965	0,0027	-2,15	1,03	2,67	-2,67	2,25
Lab 29	1,5300	1,5900	1,5800		1,5667	0,0321	0,2195	0,0010	1,19	0,63	2,67	-2,67	2,25
Lab 30	1,4300	1,4200	1,5100		1,4533	0,0493	0,1061	0,0024	0,58	0,97	2,67	-2,67	2,25
Lab 31	1,4100	1,3400	1,3600		1,3700	0,0361	0,0228	0,0013	0,12	0,71	2,67	-2,67	2,25
Lab 32	1,0800	1,0400	1,0300		1,0500	0,0265	-0,2972	0,0007	-1,61	0,52	2,67	-2,67	2,25
Lab 33	1,4380	1,4910	1,5120		1,4803	0,0381	0,1331	0,0015	0,72	0,75	2,67	-2,67	2,25
Lab 34	1,2330	1,2720	1,1720		1,2257	0,0504	-0,1215	0,0025	-0,66	1,00	2,67	-2,67	2,25
Lab 35	1,3590	1,3400	1,3340		1,3443	0,0131	-0,0029	0,0002	-0,02	0,26	2,67	-2,67	2,25
Lab 36	1,3400	1,3800	1,3700		1,3633	0,0208	0,0161	0,0004	0,09	0,41	2,67	-2,67	2,25
Lab 37	1,2110	1,2470	1,2620		1,2400	0,0262	-0,1072	0,0007	-0,58	0,52	2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
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											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25

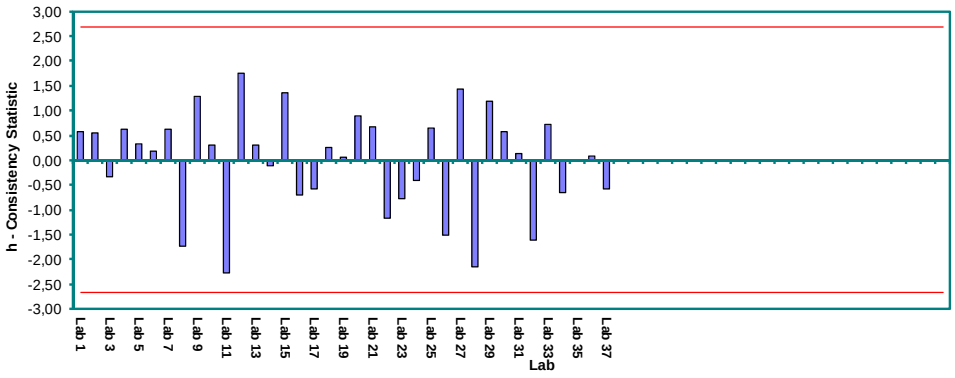
Additional Statistics	Minimum X_{ave}	0,9300	$r = 2.8\ s_r$ =	0,1404	h_{crit} =	2,67
	Maximum X_{ave}	1,6710	$R = 2.8\ s_R$ =	0,5234	h_{crit} =	-2,67
	Check s_{Xave} =	0,1842			k_{crit} =	2,25

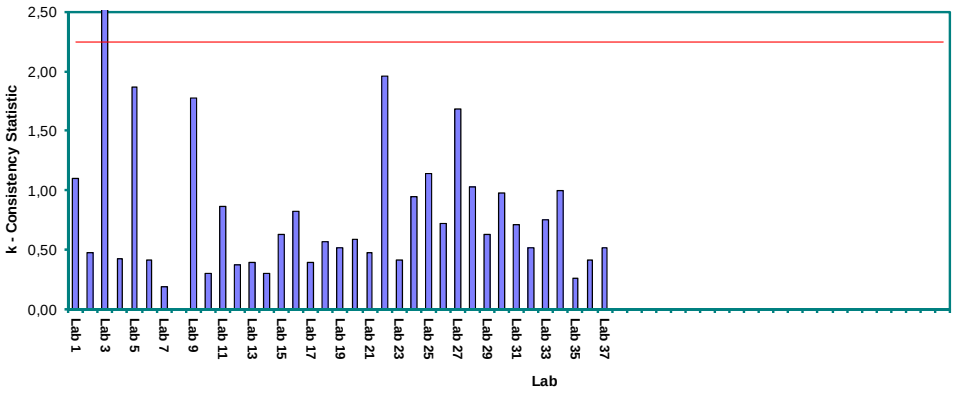
Where: $x_1....x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation		s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000	

Figure 2.2 Coarse Aggregate Water Absorption





Where:	$x_1 ... x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 3.1 Theoretical Maximum Specific Gravity – Modified Rice

300 - Theoretical Max. Specific Gravity and Density Test
302 - Modified Rice (g/cm3)
2012

Data										
n =	3	$(X_{ave})_{ave}$ =	2,6079	s_r =	0,0053	Check s_{Xave} =	0,0096
p =	37	s_{Xave} =	0,0096	s_{R*} =	0,0106	r = 2.8 s_r =	0,0148
Significance Level =		0,5%		s_R =	0,0106	R = 2.8 s_R =	0,0293

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	2,5972	2,5965	2,5899		2,5945	0,0040	-0,0134	0,0000	-1,39	0,75	2,67	-2,67	2,25
Lab 2	2,6090	2,6070	2,6090		2,6083	0,0012	0,0004	0,0000	0,04	0,22	2,67	-2,67	2,25
Lab 3	2,6030	2,5960	2,5980		2,5990	0,0036	-0,0089	0,0000	-0,93	0,67	2,67	-2,67	2,25
Lab 4	2,6077	2,6074	2,6065		2,6072	0,0006	-0,0007	0,0000	-0,08	0,12	2,67	-2,67	2,25
Lab 5	2,6133	2,6176	2,6091		2,6133	0,0043	0,0054	0,0000	0,56	0,79	2,67	-2,67	2,25
Lab 6	2,6070	2,6140	2,6110		2,6107	0,0035	0,0027	0,0000	0,28	0,66	2,67	-2,67	2,25
Lab 7	2,5930	2,5980	2,5960		2,5957	0,0025	-0,0123	0,0000	-1,28	0,47	2,67	-2,67	2,25
Lab 8	2,6100	2,6060	2,6070		2,6077	0,0021	-0,0003	0,0000	-0,03	0,39	2,67	-2,67	2,25
Lab 9	2,6110	2,6320	2,6360		2,6263	0,0134	0,0184	0,0002	1,91	2,51	2,67	-2,67	2,25
Lab 10	2,6130	2,6100	2,6090		2,6107	0,0021	0,0027	0,0000	0,28	0,39	2,67	-2,67	2,25
Lab 11	2,6120	2,6020	2,6010		2,6050	0,0061	-0,0029	0,0000	-0,31	1,14	2,67	-2,67	2,25
Lab 12	2,5920	2,5950	2,5990		2,5953	0,0035	-0,0126	0,0000	-1,31	0,66	2,67	-2,67	2,25
Lab 13	2,6200	2,6230	2,6220		2,6217	0,0015	0,0137	0,0000	1,43	0,29	2,67	-2,67	2,25
Lab 14	2,6030	2,6060	2,5980		2,6023	0,0040	-0,0056	0,0000	-0,58	0,76	2,67	-2,67	2,25
Lab 15	2,6067	2,6121	2,6104		2,6097	0,0028	0,0018	0,0000	0,19	0,52	2,67	-2,67	2,25
Lab 16	2,6090	2,6180	2,6180		2,6150	0,0052	0,0071	0,0000	0,73	0,97	2,67	-2,67	2,25
Lab 17	2,6170	2,6140	2,6150		2,6153	0,0015	0,0074	0,0000	0,77	0,29	2,67	-2,67	2,25
Lab 18	2,6150	2,6190	2,6220		2,6187	0,0035	0,0107	0,0000	1,11	0,66	2,67	-2,67	2,25
Lab 19	2,6130	2,6150	2,6110		2,6130	0,0020	0,0051	0,0000	0,53	0,37	2,67	-2,67	2,25
Lab 20	2,6090	2,6190	2,6050		2,6110	0,0072	0,0031	0,0001	0,32	1,35	2,67	-2,67	2,25
Lab 21	2,6200	2,6170	2,6210		2,6193	0,0021	0,0114	0,0000	1,18	0,39	2,67	-2,67	2,25
Lab 22	2,6440	2,6180	2,6080		2,6233	0,0186	0,0154	0,0003	1,60	3,48	2,67	-2,67	2,25
Lab 23	2,5910	2,5950	2,5890		2,5917	0,0031	-0,0163	0,0000	-1,69	0,57	2,67	-2,67	2,25
Lab 24	2,5970	2,5970	2,5940		2,5960	0,0017	-0,0119	0,0000	-1,24	0,32	2,67	-2,67	2,25
Lab 25	2,6100	2,6120	2,6100		2,6107	0,0012	0,0027	0,0000	0,28	0,22	2,67	-2,67	2,25
Lab 26	2,6020	2,6070	2,5980		2,6023	0,0045	-0,0056	0,0000	-0,58	0,84	2,67	-2,67	2,25
Lab 27	2,6130	2,6200	2,6110		2,6147	0,0047	0,0067	0,0000	0,70	0,88	2,67	-2,67	2,25
Lab 28	2,5970	2,6050	2,6020		2,6013	0,0040	-0,0066	0,0000	-0,69	0,76	2,67	-2,67	2,25
Lab 29	2,6064	2,6050	2,6037		2,6050	0,0014	-0,0029	0,0000	-0,30	0,25	2,67	-2,67	2,25
Lab 30	2,6090	2,6140	2,6200		2,6143	0,0055	0,0064	0,0000	0,66	1,03	2,67	-2,67	2,25
Lab 31	2,6121	2,6132	2,6008		2,6087	0,0069	0,0008	0,0000	0,08	1,28	2,67	-2,67	2,25
Lab 32	2,5950	2,5950	2,5970		2,5957	0,0012	-0,0123	0,0000	-1,28	0,22	2,67	-2,67	2,25
Lab 33	2,5870	2,5920	2,6050		2,5947	0,0093	-0,0133	0,0001	-1,38	1,74	2,67	-2,67	2,25
Lab 34	2,6220	2,6300	2,6290		2,6270	0,0044	0,0191	0,0000	1,98	0,82	2,67	-2,67	2,25
Lab 35	2,5920	2,5920	2,5955		2,5932	0,0020	-0,0148	0,0000	-1,54	0,38	2,67	-2,67	2,25
Lab 36	2,6120	2,6110	2,6130		2,6120	0,0010	0,0041	0,0000	0,42	0,19	2,67	-2,67	2,25
Lab 37	2,6010	2,6080	2,6020		2,6037	0,0038	-0,0043	0,0000	-0,44	0,71	2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
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											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25

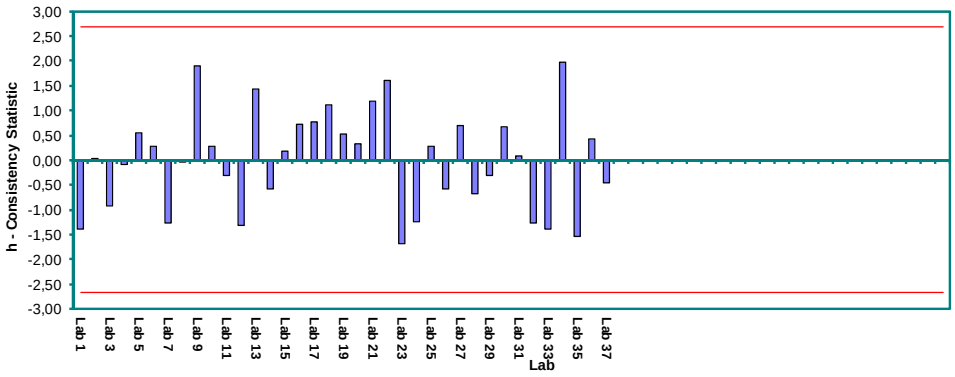
Additional Statistics						
	Minimum X_{ave}	2,5917	r = 2.8 s_r =	0,0148	h_{crit} =	2,67
	Maximum X_{ave}	2,6270	R = 2.8 s_R =	0,0293	h_{crit} =	-2,67
	Check s_{Xave} =	0,0096			k_{crit} =	2,25

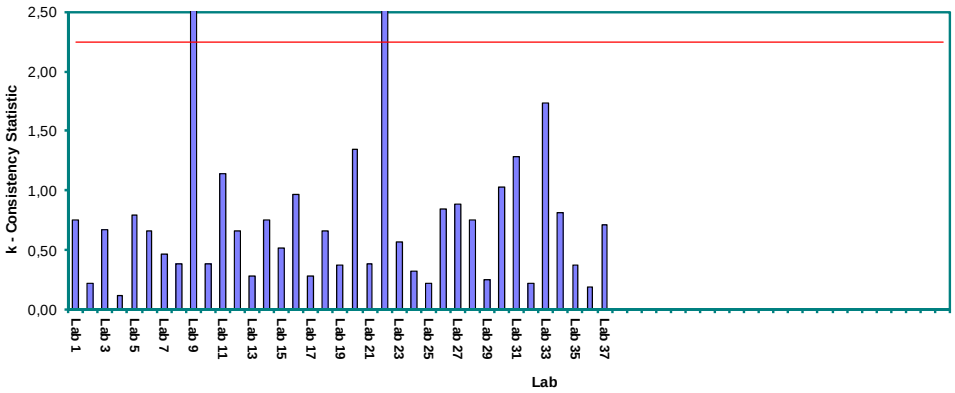
Where:		Where:	
x_1....x_n =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 3.1 Theoretical Maximum Specific Gravity – Modified Rice





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 4.1 Bulk Density Hand Compaction

400 - Hand Compaction
401 - Bulk Density (g/cm3)
2012

Data					
n =	4	$(X_{ave})_{ave}$ =	2,5435	s_r =	0,0078
p =	35	s_{Xave} =	0,0181	s_{R*} =	0,0194
Significance Level =		0,5%		s_R =	0,0194

Check s_{Xave} =	0,0184
r = 2.8 s_r =	0,0215
R = 2.8 s_R =	0,0536

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	2,5530	2,5530	2,5580	2,5590	2,5558	0,0032	0,0122	0,0000	0,67	0,41	2,67	-2,67	2,03
Lab 2	2,5560	2,5500	2,5570	2,5430	2,5515	0,0065	0,0080	0,0000	0,44	0,83	2,67	-2,67	2,03
Lab 3	2,5320	2,5280	2,5290	2,5220	2,5278	0,0042	-0,0158	0,0000	-0,87	0,54	2,67	-2,67	2,03
Lab 4	2,5520	2.547	2,5440	2,5460	2,5473	0,0042	0,0038	0,0000	0,21	0,54	2,67	-2,67	2,03
Lab 5	2,5670	2,5630	2,5580	2,5640	2,5630	0,0037	0,0195	0,0000	1,07	0,48	2,67	-2,67	2,03
Lab 6	2,5570	2,5580	2,5550	2,5530	2,5558	0,0022	0,0122	0,0000	0,67	0,29	2,67	-2,67	2,03
Lab 7	2,5310	2,5180	2,4980	2,5250	2,5180	0,0144	-0,0255	0,0002	-1,41	1,85	2,67	-2,67	2,03
Lab 8											2,67	-2,67	2,03
Lab 9	2,5486	2,5534	2,5523	2,5655	2,5550	0,0073	0,0114	0,0001	0,63	0,94	2,67	-2,67	2,03
Lab 10	2,5110	2,5080	2,5250	2,5360	2,5200	0,0130	-0,0235	0,0002	-1,30	1,67	2,67	-2,67	2,03
Lab 11	2,5560	2,5560	2,5510	2,5660	2,5573	0,0063	0,0137	0,0000	0,76	0,81	2,67	-2,67	2,03
Lab 12	2,5170	2,5020	2,4770	2,5100	2,5015	0,0174	-0,0420	0,0003	-2,32	2,24	2,67	-2,67	2,03
Lab 13	2,5440	2,5460	2,5450	2,5410	2,5440	0,0022	0,0005	0,0000	0,03	0,28	2,67	-2,67	2,03
Lab 14	2,5410	2,5430	2,5420	2,5410	2,5418	0,0010	-0,0018	0,0000	-0,10	0,12	2,67	-2,67	2,03
Lab 15	2,5539	2,5453	2,5461	2,5410	2,5466	0,0054	0,0031	0,0000	0,17	0,69	2,67	-2,67	2,03
Lab 16	2,5540	2,5550	2,5580	2,5560	2,5558	0,0017	0,0122	0,0000	0,67	0,22	2,67	-2,67	2,03
Lab 17	2,5560	2,5540	2,5580	2,5570	2,5563	0,0017	0,0127	0,0000	0,70	0,22	2,67	-2,67	2,03
Lab 18	2,5350	2,5390	2,5420	2,5360	2,5380	0,0032	-0,0055	0,0000	-0,30	0,41	2,67	-2,67	2,03
Lab 19	2,5410	2,5510	2,5530	2,5530	2,5495	0,0057	0,0060	0,0000	0,33	0,74	2,67	-2,67	2,03
Lab 20	2,5440	2,5330	2,5110	2,5200	2,5270	0,0145	-0,0165	0,0002	-0,91	1,86	2,67	-2,67	2,03
Lab 21	2,5570	2,5630	2,5610	2,5640	2,5613	0,0031	0,0177	0,0000	0,98	0,40	2,67	-2,67	2,03
Lab 22	2,4950	2,4930	2,4950	2,4950	2,4945	0,0010	-0,0490	0,0000	-2,70	0,13	2,67	-2,67	2,03
Lab 23	2,5580	2,5500	2,5540	2,5530	2,5538	0,0033	0,0102	0,0000	0,56	0,42	2,67	-2,67	2,03
Lab 24	2,5490	2,5500	2,5500	2,5520	2,5503	0,0013	0,0067	0,0000	0,37	0,16	2,67	-2,67	2,03
Lab 25	2,5310	2,5340	2,5300	2,5270	2,5305	0,0029	-0,0130	0,0000	-0,72	0,37	2,67	-2,67	2,03
Lab 26	2,5430	2,5340	2,5270	2,5420	2,5365	0,0075	-0,0070	0,0001	-0,39	0,97	2,67	-2,67	2,03
Lab 27	2,5560	2,5550	2,5480	2,5500	2,5523	0,0039	0,0087	0,0000	0,48	0,50	2,67	-2,67	2,03
Lab 28	2,5500	2,5560	2,5480	2,5530	2,5518	0,0035	0,0082	0,0000	0,45	0,45	2,67	-2,67	2,03
Lab 29	2,5607	2,5738	2,5546	2,5519	2,5603	0,0098	0,0167	0,0001	0,92	1,25	2,67	-2,67	2,03
Lab 30	2,5500	2,5480	2,5540	2,5470	2,5498	0,0031	0,0062	0,0000	0,34	0,40	2,67	-2,67	2,03
Lab 31	2,5227	2,5263	2,5188	2,5163	2,5210	0,0044	-0,0225	0,0000	-1,24	0,57	2,67	-2,67	2,03
Lab 32	2,5400	2,5300	2,5380	2,5340	2,5355	0,0044	-0,0080	0,0000	-0,44	0,57	2,67	-2,67	2,03
Lab 33	2,5540	2,5480	2,5590	2,5620	2,5558	0,0061	0,0122	0,0000	0,67	0,79	2,67	-2,67	2,03
Lab 34	2,5230	2,4800	2,5230	2,5380	2,5160	0,0250	-0,0275	0,0006	-1,52	3,22	2,67	-2,67	2,03
Lab 35	2,5740	2,5720	2,5700	2,5660	2,5705	0,0034	0,0270	0,0000	1,49	0,44	2,67	-2,67	2,03
Lab 36	2,5690	2,5740	2,5740	2,5710	2,5720	0,0024	0,0285	0,0000	1,57	0,32	2,67	-2,67	2,03
Lab 37	2,5430	2,5460	2,5440	2,5410	2,5435	0,0021	0,0000	0,0000	0,00	0,27	2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
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											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03

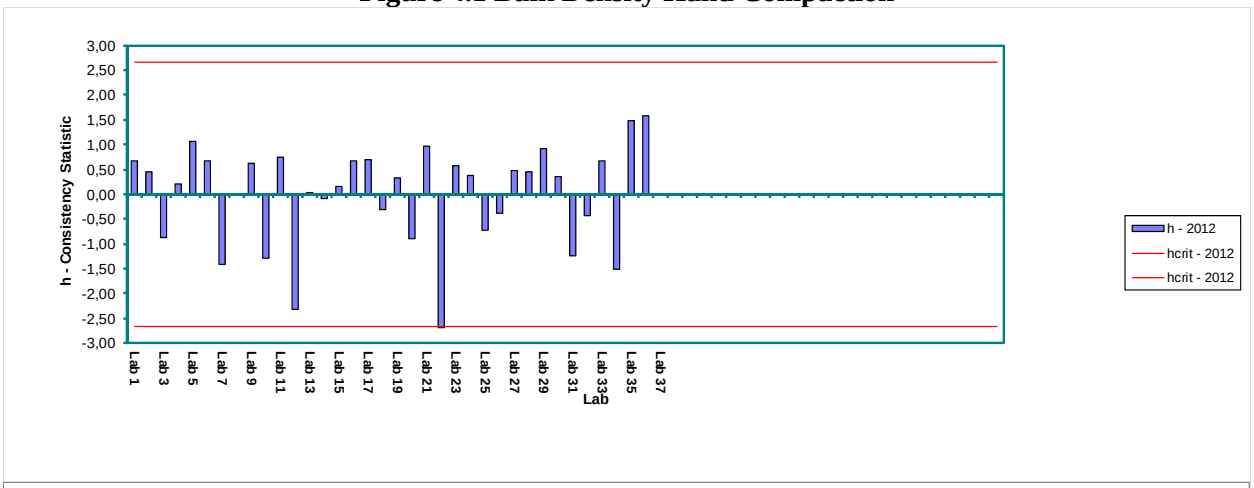
Additional Statistics						
	Minimum X_{ave}	2,4945	r = 2.8 s_r =	0,0215	h_{crit} =	2,67
	Maximum X_{ave}	2,5720	R = 2.8 s_R =	0,0536	h_{crit} =	-2,67
	Check s_{Xave} =	0,0184			k_{crit} =	2,03

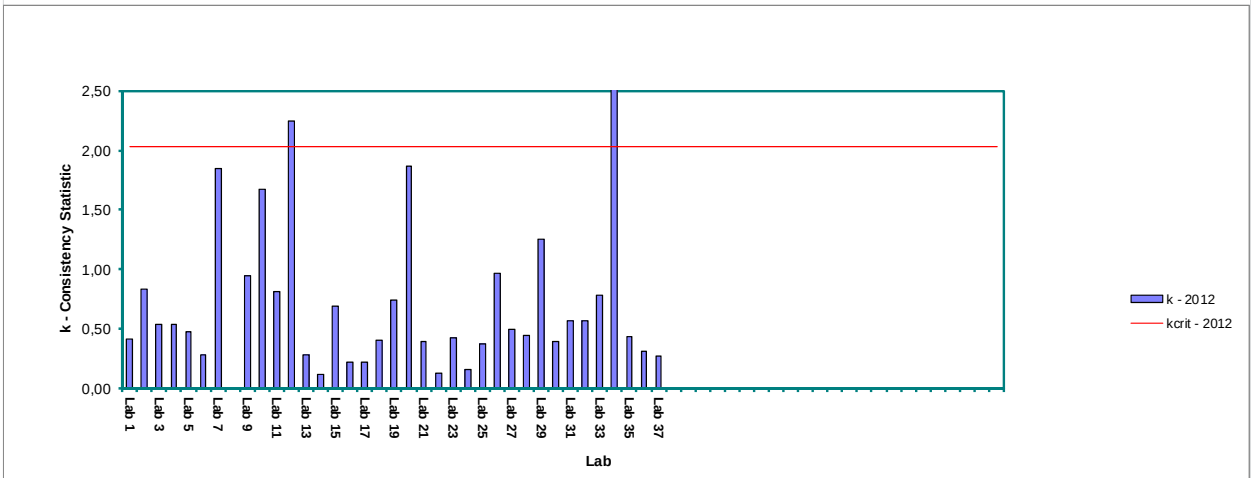
Where:			Where:		
	$x_1....x_n$ =	Individual Test Result		$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 4.1 Bulk Density Hand Compaction





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 4.2 Bulk Density Mechanical Compaction

500 - Mechanical Compaction
501 - Bulk Density (g/cm3)
2012

Data				
n = 4	$(X_{ave})_{ave}$ = 2,5430	s_r = 0,0063	Check s_{Xave} = 0,0173
p = 24	s_{Xave} = 0,0173	s_{R*} = 0,0181	r = 2.8 s_r = 0,0174
Significance Level = 0,5%		s_R = 0,0181	R = 2.8 s_R = 0,0503

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	2,5560	2,5530	2,5530	2,5600	2,5555	0,0033	0,0125	0,0000	0,72	0,53	2,60	-2,60	2,01
Lab 2	2,5280	2,5280	2,5290	2,5310	2,5290	0,0014	-0,0140	0,0000	-0,81	0,23	2,60	-2,60	2,01
Lab 3	2,5220	2,5290	2,5320	2,5270	2,5275	0,0042	-0,0155	0,0000	-0,90	0,67	2,60	-2,60	2,01
Lab 4	2,5430	2,5520	2,5450	2,5440	2,5460	0,0041	0,0030	0,0000	0,17	0,65	2,60	-2,60	2,01
Lab 5	2,5590	2,5660	2,5580	2,5600	2,5608	0,0036	0,0177	0,0000	1,02	0,57	2,60	-2,60	2,01
Lab 6	2,5500	2,5490	2,5560	2,5580	2,5533	0,0044	0,0102	0,0000	0,59	0,71	2,60	-2,60	2,01
Lab 7	2,4980	2,5240	2,5440	2,5150	2,5203	0,0192	-0,0228	0,0004	-1,32	3,06	2,60	-2,60	2,01
Lab 8	2,5510	2,5460	2,5420	2,5500	2,5473	0,0041	0,0042	0,0000	0,24	0,66	2,60	-2,60	2,01
Lab 9	2,5460	2,5464	2,5531	2,5613	2,5517	0,0072	0,0087	0,0001	0,50	1,15	2,60	-2,60	2,01
Lab 10	2,5120	2,5120	2,5100	2,5180	2,5130	0,0035	-0,0300	0,0000	-1,74	0,55	2,60	-2,60	2,01
Lab 11											2,60	-2,60	2,01
Lab 12											2,60	-2,60	2,01
Lab 13	2,5420	2,5400	2,5410	2,5430	2,5415	0,0013	-0,0015	0,0000	-0,09	0,21	2,60	-2,60	2,01
Lab 14	2,5430	2,5490	2,5460		2,5460	0,0030	0,0030	0,0000	0,17	0,48	2,60	-2,60	2,01
Lab 15											2,60	-2,60	2,01
Lab 16	2,5600	2,5520	2,5600	2,5550	2,5568	0,0039	0,0137	0,0000	0,79	0,63	2,60	-2,60	2,01
Lab 17	2,5650	2,5650	2,5660	2,5640	2,5650	0,0008	0,0220	0,0000	1,27	0,13	2,60	-2,60	2,01
Lab 18											2,60	-2,60	2,01
Lab 19	2,5380	2,5600	2,5600	2,5570	2,5538	0,0106	0,0107	0,0001	0,62	1,69	2,60	-2,60	2,01
Lab 20											2,60	-2,60	2,01
Lab 21	2,5590	2,5550	2,5570	2,5570	2,5570	0,0016	0,0140	0,0000	0,81	0,26	2,60	-2,60	2,01
Lab 22											2,60	-2,60	2,01
Lab 23	2,5670	2,5490	2,5610	2,5550	2,5580	0,0077	0,0150	0,0001	0,86	1,24	2,60	-2,60	2,01
Lab 24											2,60	-2,60	2,01
Lab 25											2,60	-2,60	2,01
Lab 26											2,60	-2,60	2,01
Lab 27	2,4900	2,4880	2,4950	2,5000	2,4933	0,0054	-0,0498	0,0000	-2,88	0,86	2,60	-2,60	2,01
Lab 28	2,5430	2,5570	2,5430	2,5470	2,5475	0,0066	0,0045	0,0000	0,26	1,06	2,60	-2,60	2,01
Lab 29	2,5446	2,5466	2,5453	2,5469	2,5459	0,0011	0,0028	0,0000	0,16	0,17	2,60	-2,60	2,01
Lab 30	2,5500	2,5470	2,5450	2,5430	2,5463	0,0030	0,0032	0,0000	0,19	0,48	2,60	-2,60	2,01
Lab 31											2,60	-2,60	2,01
Lab 32	2,5330	2,5350	2,5250	2,5240	2,5293	0,0056	-0,0138	0,0000	-0,80	0,89	2,60	-2,60	2,01
Lab 33	2,5540	2,5690	2,5550	2,5580	2,5590	0,0069	0,0160	0,0000	0,92	1,10	2,60	-2,60	2,01
Lab 34											2,60	-2,60	2,01
Lab 35											2,60	-2,60	2,01
Lab 36											2,60	-2,60	2,01
Lab 37	2,5200	2,5340	2,5290	2,5360	2,5298	0,0071	-0,0133	0,0001	-0,77	1,14	2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
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											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01

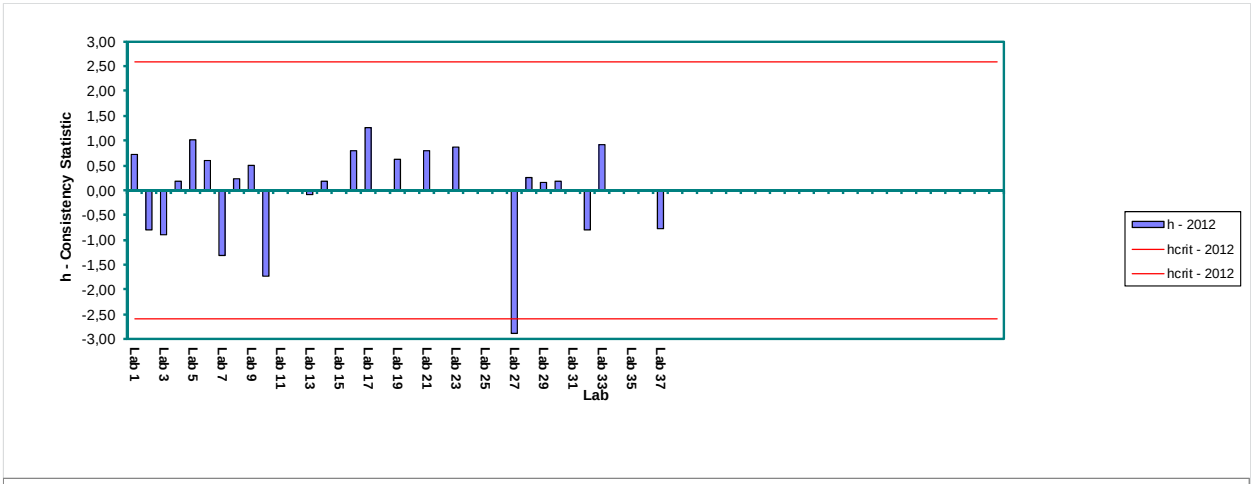
Additional Statistics						
	Minimum X_{ave}	2,4933	r = 2.8 s_r =	0,0174	h_{crit} =	2,60
	Maximum X_{ave}	2,5650	R = 2.8 s_R =	0,0503	h_{crit} =	-2,60
	Check s_{Xave} =	0,0173			k_{crit} =	2,01

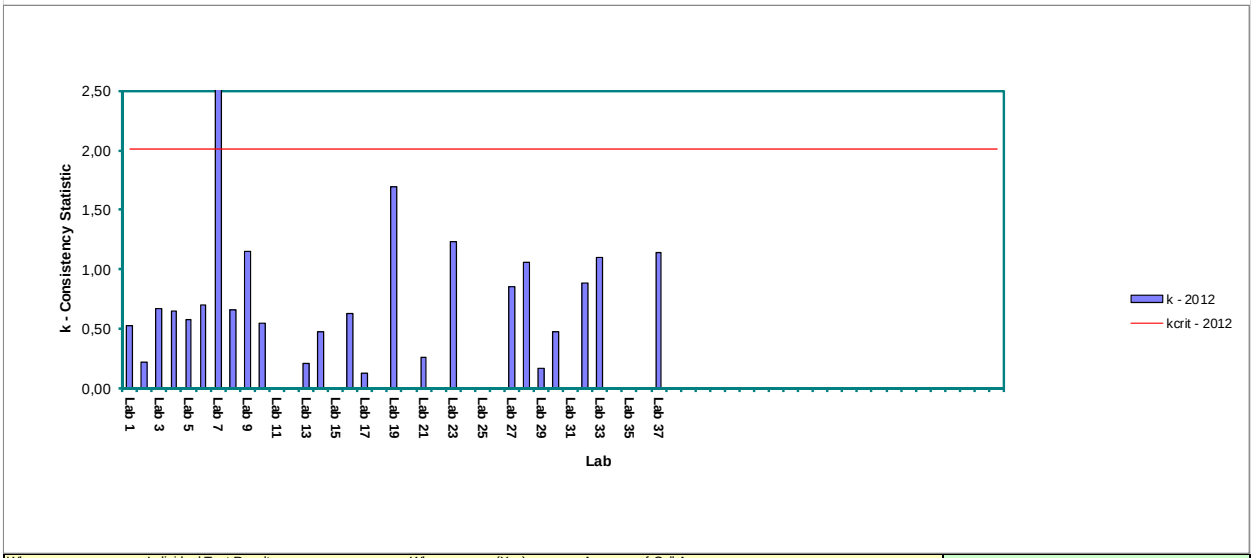
Where:		Where:	
$x_1....x_n$ =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n = FAUX	$(X_{ave})_{ave}$ = #DIV/0!	s_r = 0,0000	Check s_{Xave} = 0,0000

Figure 4.2 Bulk Density Mechanical Compaction





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 5.1 Marshall Stability Hand Compaction

400 - Hand Compaction
402 - Marshall Stability (kN)
2012

Data													
					n =	4	$(X_{ave})_{ave}$ =	15,5891	s_r =	0,9482	Check s_{Xave} =	2,0004	
					p =	36	s_{Xave} =	2,0004	s_{R*} =	2,1624	r = 2.8 s_r =	2,6282	
					Significance Level =		0,5%		s_R =	2,1624	R = 2.8 s_R =	5,9939	
Lab #	**x_1**	**x_2**	**x_3**	**x_4**	**X_{ave}**	**s**	**d**	**s^2**	**h - 2012**	**k - 2012**	**hcrit - 2012**	**hcrit - 2012**	**kcrit - 2012**
Lab 1	14,1000	14,3000	16,7000	16,4000	15,3750	1,3647	-0,2141	1,8625	-0,11	1,44	2,67	-2,67	2,03
Lab 2	16,7880	14,8420	15,0850	15,5710	15,5715	0,8658	-0,0176	0,7496	-0,01	0,91	2,67	-2,67	2,03
Lab 3	12,1240	12,4420	11,8070	11,8070	12,0450	0,3039	-3,5441	0,0924	-1,77	0,32	2,67	-2,67	2,03
Lab 4	14,7850	15,2030	14,7250	14,9940	14,9268	0,2173	-0,6624	0,0472	-0,33	0,23	2,67	-2,67	2,03
Lab 5	16,4150	16,1850	15,4000	17,2650	16,3163	0,7674	0,7271	0,5889	0,36	0,81	2,67	-2,67	2,03
Lab 6	16,3630	16,0650	16,3630	16,3630	16,2885	0,1490	0,6994	0,0222	0,35	0,16	2,67	-2,67	2,03
Lab 7	16,1200	14,8720	16,6400	16,4320	16,0160	0,7920	0,4269	0,6273	0,21	0,84	2,67	-2,67	2,03
Lab 8											2,67	-2,67	2,03
Lab 9	17,2700	16,1300	15,4200	17,7600	16,6450	1,0645	1,0559	1,1332	0,53	1,12	2,67	-2,67	2,03
Lab 10	14,7500	14,5000	14,0000	12,7500	14,0000	0,8898	-1,5891	0,7917	-0,79	0,94	2,67	-2,67	2,03
Lab 11	17,8000	16,9000	17,2000	17,6000	17,3750	0,4031	1,7859	0,1625	0,89	0,43	2,67	-2,67	2,03
Lab 12	14,7000	14,7000	15,2000	17,2000	15,4500	1,1902	-0,1391	1,4167	-0,07	1,26	2,67	-2,67	2,03
Lab 13	12,4800	12,7230	12,4800	12,3580	12,5103	0,1530	-3,0789	0,0234	-1,54	0,16	2,67	-2,67	2,03
Lab 14	12,2800	12,5000	12,3700	12,8900	12,5100	0,2689	-3,0791	0,0723	-1,54	0,28	2,67	-2,67	2,03
Lab 15	17,5980	15,3060	15,5560	14,8420	15,8255	1,2181	0,2364	1,4838	0,12	1,28	2,67	-2,67	2,03
Lab 16	16,7500	16,6500	16,6300	15,5700	16,4000	0,5558	0,8109	0,3089	0,41	0,59	2,67	-2,67	2,03
Lab 17	14,0890	14,8270	15,4010	13,7750	14,5230	0,7328	-1,0661	0,5371	-0,53	0,77	2,67	-2,67	2,03
Lab 18	15,2160	16,3510	16,2820	14,4560	15,5763	0,9098	-0,0129	0,8277	-0,01	0,96	2,67	-2,67	2,03
Lab 19	11,5900	13,2400	13,6000	12,8700	12,8250	0,8756	-2,7641	0,7667	-1,38	0,92	2,67	-2,67	2,03
Lab 20	24,2160	19,9020	17,5090	18,2540	19,9703	3,0019	4,3811	9,0114	2,19	3,17	2,67	-2,67	2,03
Lab 21	15,1000	15,9000	15,2000	16,0000	15,5500	0,4655	-0,0391	0,2167	-0,02	0,49	2,67	-2,67	2,03
Lab 22	14,0700	16,1100	17,6000	16,7700	16,1375	1,5071	0,5484	2,2714	0,27	1,59	2,67	-2,67	2,03
Lab 23	15,0640	16,7520	14,9280	16,6580	15,8505	0,9890	0,2614	0,9781	0,13	1,04	2,67	-2,67	2,03
Lab 24	13,5750	13,0180	12,6060	14,1090	13,3270	0,6553	-2,2621	0,4295	-1,13	0,69	2,67	-2,67	2,03
Lab 25	16,3000	16,6000	17,9000	16,8000	16,9000	0,6976	1,3109	0,4867	0,66	0,74	2,67	-2,67	2,03
Lab 26	17,4000	16,7000	16,7000	16,0000	16,7000	0,5715	1,1109	0,3267	0,56	0,60	2,67	-2,67	2,03
Lab 27	14,6090	14,4820	14,1830	14,9500	14,5560	0,3176	-1,0331	0,1009	-0,52	0,33	2,67	-2,67	2,03
Lab 28	15,5000	15,5000	15,0000	15,8000	15,4500	0,3317	-0,1391	0,1100	-0,07	0,35	2,67	-2,67	2,03
Lab 29	15,9493	14,2016	14,2842	13,5407	14,4940	1,0257	-1,0952	1,0521	-0,55	1,08	2,67	-2,67	2,03
Lab 30	14,4000	14,0000	15,1000	14,0000	14,3750	0,5188	-1,2141	0,2692	-0,61	0,55	2,67	-2,67	2,03
Lab 31	18,5000	19,2000	18,0000	17,3000	18,2500	0,8021	2,6609	0,6433	1,33	0,85	2,67	-2,67	2,03
Lab 32	17,7000	18,7000	17,8000	17,1000	17,8250	0,6602	2,2359	0,4358	1,12	0,70	2,67	-2,67	2,03
Lab 33	12,5000	12,0000	13,9000	12,2000	12,6500	0,8583	-2,9391	0,7367	-1,47	0,91	2,67	-2,67	2,03
Lab 34	13,4000	12,4000	14,7000	13,6000	13,5250	0,9430	-2,0641	0,8892	-1,03	0,99	2,67	-2,67	2,03
Lab 35	20,6170	19,4900	21,4630	21,6310	20,8003	0,9797	5,2111	0,9599	2,61	1,03	2,67	-2,67	2,03
Lab 36	17,7100	17,3000	17,6000	19,4000	18,0025	0,9476	2,4134	0,8980	1,21	1,00	2,67	-2,67	2,03
Lab 37	18,1260	15,8150	16,1800	16,5450	16,6665	1,0176	1,0774	1,0355	0,54	1,07	2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
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											2,67	-2,67	2,03
											2,67	-2,67	2,03
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											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03

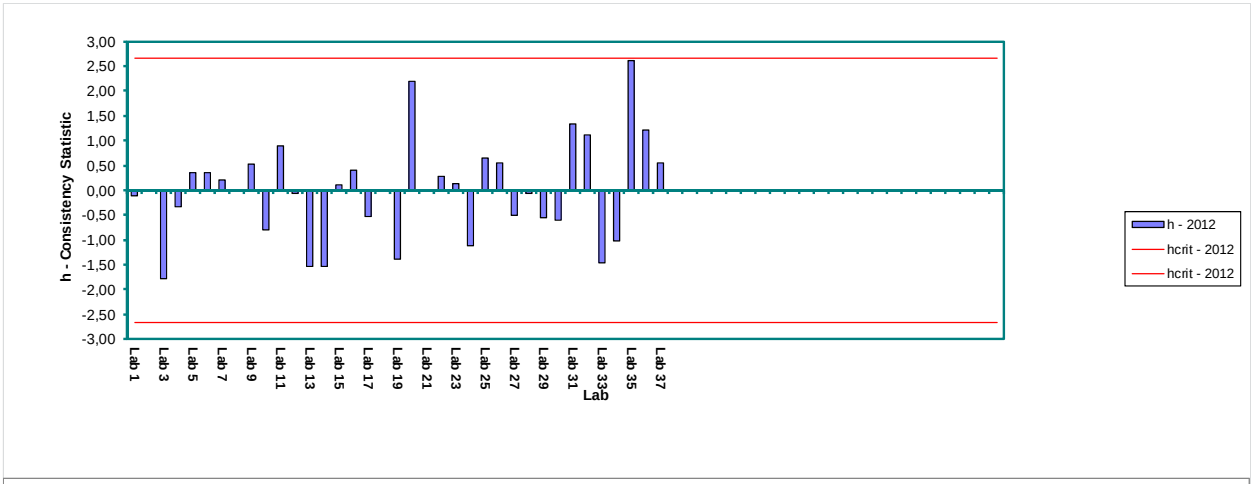
Additional Statistics	Minimum X_{ave}	12,0450	r = 2.8 s_r =	2,6282	h_{crit} =	2,67	
	Maximum X_{ave}	20,8003	R = 2.8 s_R =	5,9939	h_{crit} =	-2,67	
	Check s_{Xave} =	2,0004			k_{crit} =	2,03	

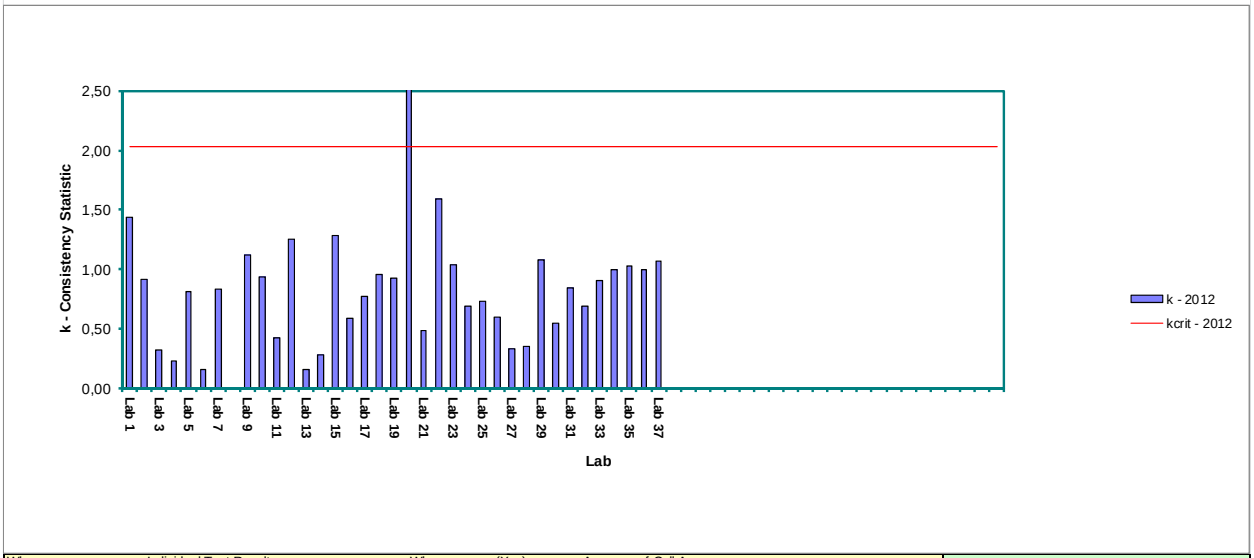
Where: $x_1....x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation		s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation		h =	Betw een Laboratory Consistency Statistic
p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 5.1 Marshall Stability Hand Compaction





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 5.2 Marshall Stability Mechanical Compaction

500 - Mechanical Compaction
502 - Marshall Stability (kN)
2012

Data							
n =	4	$(X_{ave})_{ave}$ =	14,4578	s_r =	0,9429	Check s_{Xave} =	1,5530
p =	24	s_{Xave} =	1,5530	s_{R*} =	1,7546	$r = 2.8\ s_r$ =	2,6136
Significance Level =		0,5%		s_R =	1,7546	$R = 2.8\ s_R$ =	4,8635

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	14,6000	16,1000	15,0000	15,5000	15,3000	0,6481	0,8422	0,4200	0,54	0,69	2,60	-2,60	2,01
Lab 2	16,2500	15,9020	16,1340	16,1340	16,1050	0,1460	1,6472	0,0213	1,06	0,15	2,60	-2,60	2,01
Lab 3	11,4900	12,1240	11,8070	11,1730	11,6485	0,4092	-2,8093	0,1675	-1,81	0,43	2,60	-2,60	2,01
Lab 4	14,6060	14,7850	15,0460	14,6650	14,7755	0,1951	0,3177	0,0381	0,20	0,21	2,60	-2,60	2,01
Lab 5	15,6000	14,4200	15,5100	15,4350	15,2413	0,5516	0,7835	0,3043	0,50	0,59	2,60	-2,60	2,01
Lab 6	16,3030	16,3030	16,0650	16,3630	16,2585	0,1321	1,8007	0,0174	1,16	0,14	2,60	-2,60	2,01
Lab 7	13,5200	14,5600	15,7040	13,0000	14,1960	1,1964	-0,2618	1,4313	-0,17	1,27	2,60	-2,60	2,01
Lab 8	14,2000	13,7000	14,5000	13,9000	14,0750	0,3500	-0,3828	0,1225	-0,25	0,37	2,60	-2,60	2,01
Lab 9	14,7400	13,9300	15,6800	16,1300	15,1200	0,9822	0,6622	0,9647	0,43	1,04	2,60	-2,60	2,01
Lab 10	12,6300	13,7500	12,0000	13,5000	12,9700	0,8054	-1,4878	0,6486	-0,96	0,85	2,60	-2,60	2,01
Lab 11											2,60	-2,60	2,01
Lab 12											2,60	-2,60	2,01
Lab 13	13,4520	13,3300	13,0870	13,2090	13,2695	0,1570	-1,1883	0,0246	-0,77	0,17	2,60	-2,60	2,01
Lab 14	11,4600	13,0700	12,9800		12,5033	0,9047	-1,9544	0,8184	-1,26	0,96	2,60	-2,60	2,01
Lab 15											2,60	-2,60	2,01
Lab 16	14,3100	14,9000	16,7900	15,3300	15,3325	1,0578	0,8747	1,1190	0,56	1,12	2,60	-2,60	2,01
Lab 17	16,8880	15,1810	11,6020	15,1270	14,6995	2,2210	0,2417	4,9329	0,16	2,36	2,60	-2,60	2,01
Lab 18											2,60	-2,60	2,01
Lab 19	10,8200	12,5100	13,7900	13,0600	12,5450	1,2639	-1,9128	1,5974	-1,23	1,34	2,60	-2,60	2,01
Lab 20											2,60	-2,60	2,01
Lab 21	15,0000	15,4000	15,9000	15,7000	15,5000	0,3916	1,0422	0,1533	0,67	0,42	2,60	-2,60	2,01
Lab 22											2,60	-2,60	2,01
Lab 23	18,4900	16,1080	15,9720	15,2920	16,4655	1,3961	2,0077	1,9490	1,29	1,48	2,60	-2,60	2,01
Lab 24											2,60	-2,60	2,01
Lab 25											2,60	-2,60	2,01
Lab 26											2,60	-2,60	2,01
Lab 27	11,2840	12,4840	11,2840	11,6700	11,6805	0,5657	-2,7773	0,3200	-1,79	0,60	2,60	-2,60	2,01
Lab 28	14,2000	14,8000	14,8000	15,0000	14,7000	0,3464	0,2422	0,1200	0,16	0,37	2,60	-2,60	2,01
Lab 29	13,8711	14,4494	14,2016	15,3597	14,4705	0,6384	0,0127	0,4076	0,01	0,68	2,60	-2,60	2,01
Lab 30	14,0000	14,4000	13,9000	14,0000	14,0750	0,2217	-0,3828	0,0492	-0,25	0,24	2,60	-2,60	2,01
Lab 31											2,60	-2,60	2,01
Lab 32	18,6000	17,5000	17,9000	17,9000	17,9750	0,4573	3,5172	0,2092	2,26	0,49	2,60	-2,60	2,01
Lab 33	11,0000	16,3000	13,1000	11,9000	13,0750	2,3157	-1,3828	5,3625	-0,89	2,46	2,60	-2,60	2,01
Lab 34											2,60	-2,60	2,01
Lab 35											2,60	-2,60	2,01
Lab 36											2,60	-2,60	2,01
Lab 37	14,6250	14,7480	15,3210	15,3280	15,0055	0,3718	0,5477	0,1382	0,35	0,39	2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
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											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01

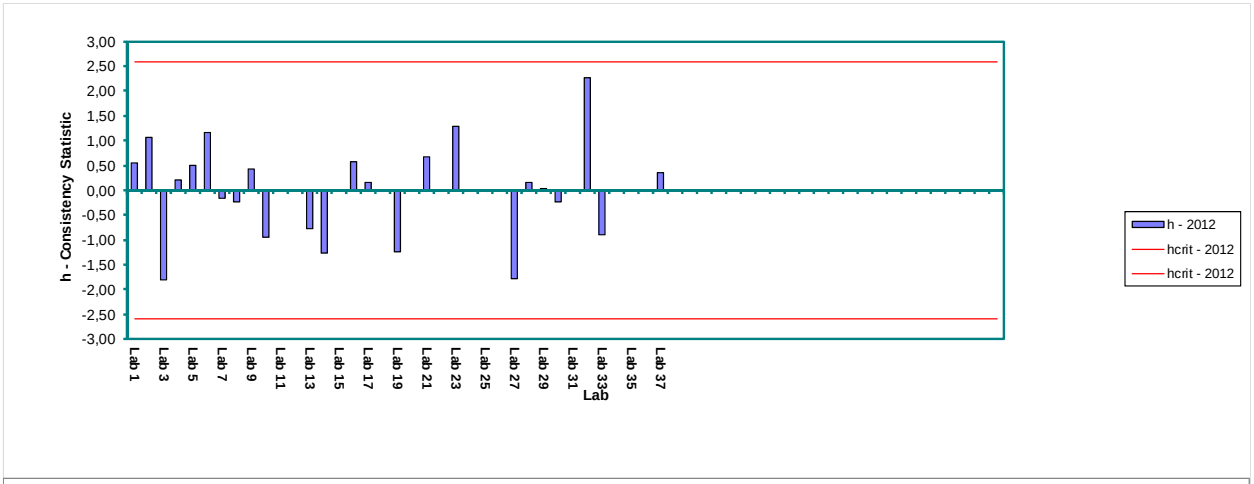
Additional Statistics						
Minimum X_{ave}	11,6485	$r = 2.8\ s_r$ =	2,6136	h_{crit} =	2,60
Maximum X_{ave}	17,9750	$R = 2.8\ s_R$ =	4,8635	h_{crit} =	-2,60
Check s_{Xave} =	1,5530			k_{crit} =	2,01

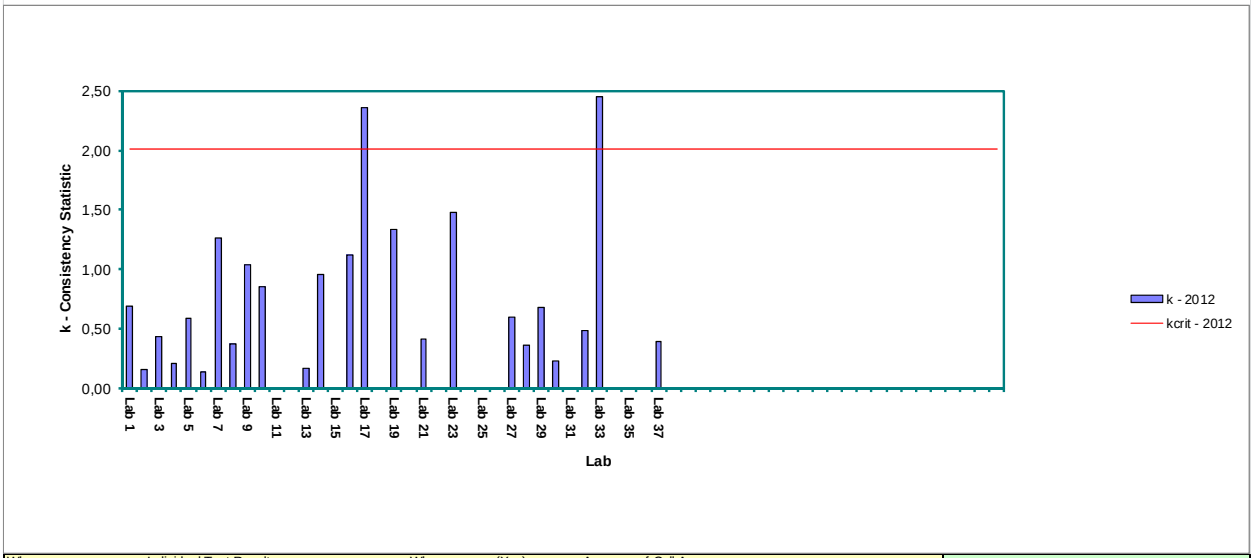
Where:		Where:	
$x_1....x_n$ =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 5.2 Marshall Stability Mechanical Compaction





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 6.1 Flow Hand Compaction

400 - Hand Compaction 403 - Flow (mm) 2012													
Data					n =	4	$(X_{ave})_{ave}$ =	4,5119	s_r =	0,3861	Check s_{Xave} =	1,1528	
					p =	35	s_{Xave} =	1,1528	s_{R*} =	1,2003	r = 2.8 s_r =	1,0703	
					Significance Level =		0,5%		s_R =	1,2003	R = 2.8 s_R =	3,3270	
Lab #	**x_1**	**x_2**	**x_3**	**x_4**	**X_{ave}**	**s**	**d**	**s^2**	**h - 2012**	**k - 2012**	**hcrit - 2012**	**hcrit - 2012**	**kcrit - 2012**
Lab 1	5,1000	5,8000	4,5000	5,0000	5,1000	0,5354	0,5881	0,2867	0,51	1,39	2,67	-2,67	2,03
Lab 2	3,7500	3,7500	3,7500	3,7500	3,7500	0,0000	-0,7619	0,0000	-0,66	0,00	2,67	-2,67	2,03
Lab 3	3,2500	3,2500	3,2500	3,2500	3,2500	0,0000	-1,2619	0,0000	-1,09	0,00	2,67	-2,67	2,03
Lab 4	4,6000	4,7000	4,9000	4,7000	4,7250	0,1258	0,2131	0,0158	0,18	0,33	2,67	-2,67	2,03
Lab 5	5,2100	5,7000	5,7700	4,7700	5,3625	0,4670	0,8506	0,2181	0,74	1,21	2,67	-2,67	2,03
Lab 6	3,5000	3,6000	3,6000	3,4000	3,5250	0,0957	-0,9869	0,0092	-0,86	0,25	2,67	-2,67	2,03
Lab 7	5,3000	5,0000	5,5000	5,5000	5,3250	0,2363	0,8131	0,0558	0,71	0,61	2,67	-2,67	2,03
Lab 8											2,67	-2,67	2,03
Lab 9	3,7000	4,3000	3,2000	5,0000	4,0500	0,7767	-0,4619	0,6033	-0,40	2,01	2,67	-2,67	2,03
Lab 10	5,5000	4,8800	4,5000	4,8100	4,9225	0,4189	0,4106	0,1755	0,36	1,08	2,67	-2,67	2,03
Lab 11	4,0000	4,5000	4,0000	4,5000	4,2500	0,2887	-0,2619	0,0833	-0,23	0,75	2,67	-2,67	2,03
Lab 12	3,5000	4,0000	3,2500	4,2500	3,7500	0,4564	-0,7619	0,2083	-0,66	1,18	2,67	-2,67	2,03
Lab 13	2,9000	2,9000	3,0000	2,9000	2,9250	0,0500	-1,5869	0,0025	-1,38	0,13	2,67	-2,67	2,03
Lab 14	3,5600	3,5600	3,8100	3,8100	3,6850	0,1443	-0,8269	0,0208	-0,72	0,37	2,67	-2,67	2,03
Lab 15	3,8100	3,8100	4,0640	3,5560	3,8100	0,2074	-0,7019	0,0430	-0,61	0,54	2,67	-2,67	2,03
Lab 16	5,1000	5,0000	5,0000	5,0000	5,0250	0,0500	0,5131	0,0025	0,45	0,13	2,67	-2,67	2,03
Lab 17	3,8000	3,3000	3,6000	4,1000	3,7000	0,3367	-0,8119	0,1133	-0,70	0,87	2,67	-2,67	2,03
Lab 18	3,9750	4,9560	4,4410	4,4150	4,4468	0,4012	-0,0652	0,1610	-0,06	1,04	2,67	-2,67	2,03
Lab 19	3,7000	3,9500	3,8000	3,8000	3,8125	0,1031	-0,6994	0,0106	-0,61	0,27	2,67	-2,67	2,03
Lab 20	2,1000	2,8000	2,5000	3,7000	2,7750	0,6801	-1,7369	0,4625	-1,51	1,76	2,67	-2,67	2,03
Lab 21	3,8100	3,5100	3,4100	3,3700	3,5250	0,1989	-0,9869	0,0396	-0,86	0,52	2,67	-2,67	2,03
Lab 22	6,3500	7,3700	6,8900	7,6200	7,0575	0,5606	2,5456	0,3142	2,21	1,45	2,67	-2,67	2,03
Lab 23	4,3050	5,3210	4,5960	5,3810	4,9008	0,5339	0,3888	0,2850	0,34	1,38	2,67	-2,67	2,03
Lab 24	7,3000	8,3000	7,9000	8,3000	7,9500	0,4726	3,4381	0,2233	2,98	1,22	2,67	-2,67	2,03
Lab 25	4,4000	4,4000	5,3000	5,0000	4,7750	0,4500	0,2631	0,2025	0,23	1,17	2,67	-2,67	2,03
Lab 26	3,0000	3,0000	2,7500	3,7500	3,1250	0,4330	-1,3869	0,1875	-1,20	1,12	2,67	-2,67	2,03
Lab 27	5,5000	5,8000	4,2000	5,0000	5,1250	0,6994	0,6131	0,4892	0,53	1,81	2,67	-2,67	2,03
Lab 28	4,2000	4,6000	4,8000	5,3000	4,7250	0,4573	0,2131	0,2092	0,18	1,18	2,67	-2,67	2,03
Lab 29											2,67	-2,67	2,03
Lab 30	2,9000	3,1000	3,2000	2,8000	3,0000	0,1826	-1,5119	0,0333	-1,31	0,47	2,67	-2,67	2,03
Lab 31	3,7500	3,5000	3,7500	4,0000	3,7500	0,2041	-0,7619	0,0417	-0,66	0,53	2,67	-2,67	2,03
Lab 32	4,2000	4,5000	3,8000	3,6000	4,0250	0,4031	-0,4869	0,1625	-0,42	1,04	2,67	-2,67	2,03
Lab 33	5,5000	5,5000	5,3700	5,1300	5,3750	0,1745	0,8631	0,0304	0,75	0,45	2,67	-2,67	2,03
Lab 34	5,7500	6,0000	5,9000	5,7500	5,8500	0,1225	1,3381	0,0150	1,16	0,32	2,67	-2,67	2,03
Lab 35	6,3500	5,5900	5,8420	5,8420	5,9060	0,3189	1,3941	0,1017	1,21	0,83	2,67	-2,67	2,03
Lab 36	4,7676	5,3975	4,3586	5,0190	4,8857	0,4365	0,3738	0,1905	0,32	1,13	2,67	-2,67	2,03
Lab 37	5,6300	6,3800	5,7500	5,2500	5,7525	0,4695	1,2406	0,2204	1,08	1,22	2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
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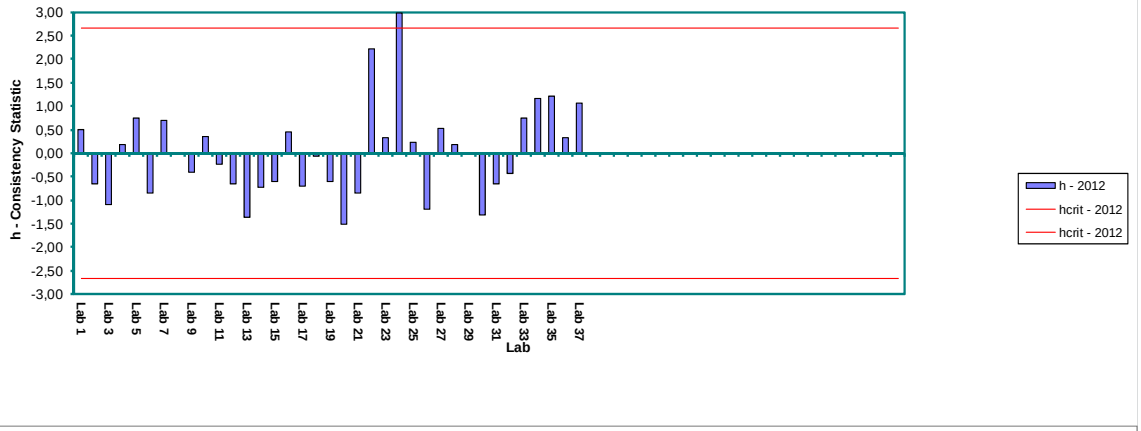
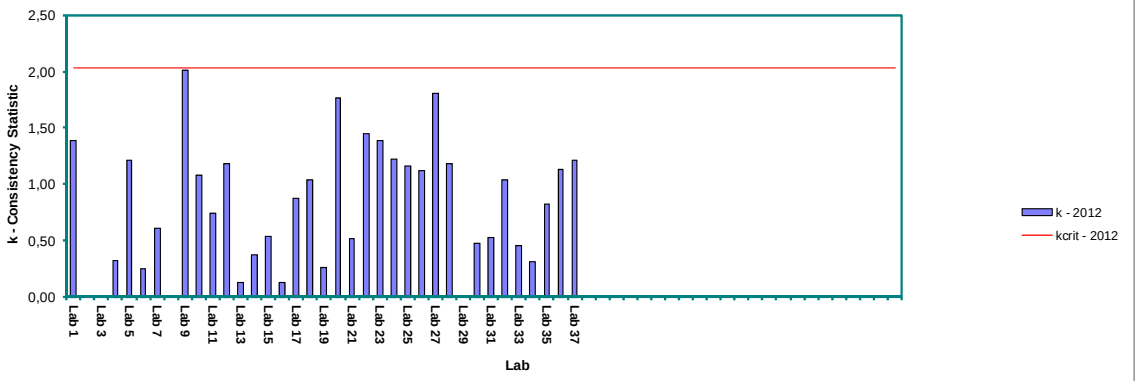
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
Additional Statistics			Minimum X_{ave}		2,7750	r = 2.8 s_r =	1,0703		h_{crit} =	2,67			
			Maximum X_{ave}		7,9500	R = 2.8 s_R =	3,3270		h_{crit} =	-2,67			
			Check s_{Xave} =		1,1528				k_{crit} =	2,03			
Where: $x_1 \ldots x_n$ =	Individual Test Result				Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages						
X_{ave} =	Cell Average					s_{Xave} =	Standard Deviation of Cell Averages						
n =	Number of Test Results per Cell					s_r =	Repeatability Standard Deviation						
s =	Cell Standard Deviation					s_{R*} =	Interim Reproducibility Standard Deviation						
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)					s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})						
s^2 =	Cell Variation					h =	Between Laboratory Consistency Statistic						
p =	Number of Laboratories					k =	Within Laboratory Consistency Statistic						
0,0000													
					n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000	

Figure 6.1 Flow Hand Compaction





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 6.2 Flow Mechanical Compaction

500 - Mechanical Compaction
503 - Flow (mm)
2012

Data						
n =	4	$(X_{ave})_{ave}$ =	4,2546	s_r =	0,5097	Check s_{Xave} = 0,7872
p =	23	s_{Xave} =	0,7872	s_{R*} =	0,9025	$r = 2.8\ s_r$ = 1,4128
Significance Level =		0,5%		s_R =	0,9025	$R = 2.8\ s_R$ = 2,5015

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	4,9000	5,8000	5,8000	5,2000	5,4250	0,4500	1,1704	0,2025	1,49	0,88	2,59	-2,59	2,01
Lab 2	5,0000	3,7500	3,7500	3,7500	4,0625	0,6250	-0,1921	0,3906	-0,24	1,23	2,59	-2,59	2,01
Lab 3	3,0000	3,2500	3,2500	3,0000	3,1250	0,1443	-1,1296	0,0208	-1,43	0,28	2,59	-2,59	2,01
Lab 4	4,8000	4,8000	4,7000	4,7000	4,7500	0,0577	0,4954	0,0033	0,63	0,11	2,59	-2,59	2,01
Lab 5	5,3300	4,5600	5,0200	4,3300	4,8100	0,4500	0,5554	0,2025	0,71	0,88	2,59	-2,59	2,01
Lab 6	3,6000	3,6000	3,5000	3,6000	3,5750	0,0500	-0,6796	0,0025	-0,86	0,10	2,59	-2,59	2,01
Lab 7	3,7000	3,8000	4,7000	4,6000	4,2000	0,5228	-0,0546	0,2733	-0,07	1,03	2,59	-2,59	2,01
Lab 8	4,8000	4,8000	4,0000	4,9000	4,6250	0,4193	0,3704	0,1758	0,47	0,82	2,59	-2,59	2,01
Lab 9	4,5000	3,5000	3,9000	4,0000	3,9750	0,4113	-0,2796	0,1692	-0,36	0,81	2,59	-2,59	2,01
Lab 10	3,5000	5,0000	3,9000	4,7500	4,2875	0,7052	0,0329	0,4973	0,04	1,38	2,59	-2,59	2,01
Lab 11											2,59	-2,59	2,01
Lab 12											2,59	-2,59	2,01
Lab 13	2,7000	2,8000	3,0000	2,9000	2,8500	0,1291	-1,4046	0,0167	-1,78	0,25	2,59	-2,59	2,01
Lab 14	3,5600	4,0600	3,5600		3,7267	0,2887	-0,5279	0,0833	-0,67	0,57	2,59	-2,59	2,01
Lab 15											2,59	-2,59	2,01
Lab 16	3,9000	3,4000	5,1000	4,1000	4,1250	0,7136	-0,1296	0,5092	-0,16	1,40	2,59	-2,59	2,01
Lab 17	4,1000	4,1000	4,3000	4,1000	4,1500	0,1000	-0,1046	0,0100	-0,13	0,20	2,59	-2,59	2,01
Lab 18											2,59	-2,59	2,01
Lab 19	3,9500	4,6000	5,3400	4,8400	4,6825	0,5775	0,4279	0,3335	0,54	1,13	2,59	-2,59	2,01
Lab 20											2,59	-2,59	2,01
Lab 21	3,5600	3,0500	3,3000	3,3200	3,3075	0,2084	-0,9471	0,0434	-1,20	0,41	2,59	-2,59	2,01
Lab 22											2,59	-2,59	2,01
Lab 23	5,0680	4,1180	4,9550	3,4930	4,4085	0,7430	0,1539	0,5520	0,20	1,46	2,59	-2,59	2,01
Lab 24											2,59	-2,59	2,01
Lab 25											2,59	-2,59	2,01
Lab 26											2,59	-2,59	2,01
Lab 27	6,0000	5,3000	6,3000	5,1000	5,6750	0,5679	1,4204	0,3225	1,80	1,11	2,59	-2,59	2,01
Lab 28	4,3000	4,6000	5,3000	5,4000	4,9000	0,5354	0,6454	0,2867	0,82	1,05	2,59	-2,59	2,01
Lab 29											2,59	-2,59	2,01
Lab 30	2,6000	2,9000	3,1000	2,8000	2,8500	0,2082	-1,4046	0,0433	-1,78	0,41	2,59	-2,59	2,01
Lab 31											2,59	-2,59	2,01
Lab 32	3,9000	4,6000	3,9000	3,6000	4,0000	0,4243	-0,2546	0,1800	-0,32	0,83	2,59	-2,59	2,01
Lab 33	4,2500	6,7500	5,0000	5,8700	5,4675	1,0813	1,2129	1,1692	1,54	2,12	2,59	-2,59	2,01
Lab 34											2,59	-2,59	2,01
Lab 35											2,59	-2,59	2,01
Lab 36											2,59	-2,59	2,01
Lab 37	5,1300	3,8800	5,5000	5,0000	4,8775	0,6979	0,6229	0,4871	0,79	1,37	2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01

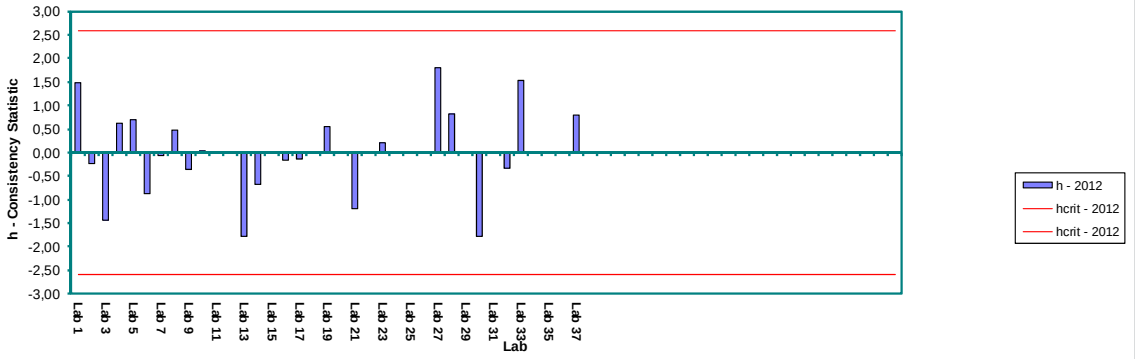
Additional Statistics						
	Minimum X_{ave}	2,8500	$r = 2.8\ s_r$ =	1,4128	h_{crit} =	2,59
	Maximum X_{ave}	5,6750	$R = 2.8\ s_R$ =	2,5015	h_{crit} =	-2,59
	Check s_{Xave} =	0,7872			k_{crit} =	2,01

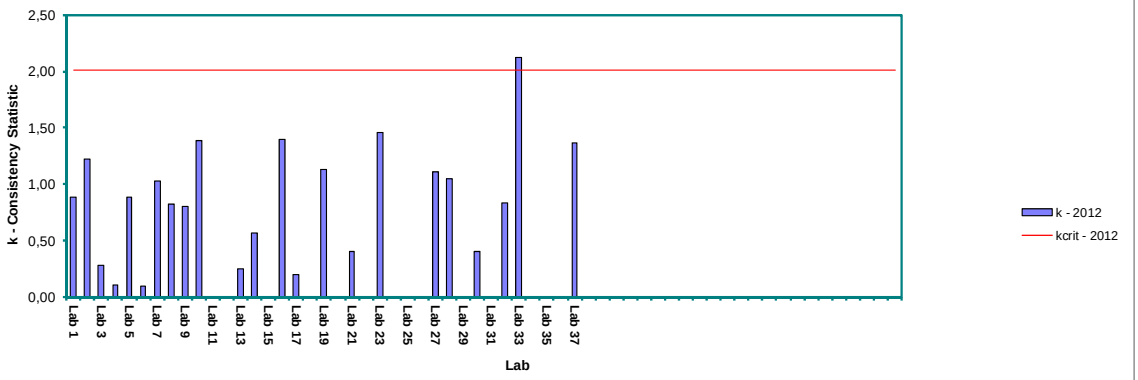
Where:		Where:	
$x_1 \ldots x_n$ =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} = 0,0000

Figure 6.2 Flow Mechanical Compaction





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		$s_{R'}$ =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and $s_{R'}$)
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 7.1 VMA Hand Compaction

400 - Hand Compaction
404 - VMA (%)
2012

Data					
n =	4	$(X_{ave})_{ave}$ =	13,5529	s_r =	0,2796	Check s_{Xave} =	0,6999
p =	35	s_{Xave} =	0,6999	s_{R*} =	0,7405	r = 2.8 s_r =	0,7749
Significance Level =		0,5%		s_R =	0,7405	R = 2.8 s_R =	2,0527

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	13,4372	13,4372	13,2676	13,2337	13,3439	0,1086	-0,2090	0,0118	-0,30	0,39	2,67	-2,67	2,03
Lab 2	13,0000	13,2000	12,9000	13,4000	13,1250	0,2217	-0,4279	0,0492	-0,61	0,79	2,67	-2,67	2,03
Lab 3	13,8000	13,9000	13,9000	14,1000	13,9250	0,1258	0,3721	0,0158	0,53	0,45	2,67	-2,67	2,03
Lab 4	13,3000	13,4000	13,5000	13,4000	13,4000	0,0816	-0,1529	0,0067	-0,22	0,29	2,67	-2,67	2,03
Lab 5	12,5900	12,7200	12,8900	12,6900	12,7225	0,1247	-0,8304	0,0156	-1,19	0,45	2,67	-2,67	2,03
Lab 6	13,2000	13,2000	13,3000	13,3000	13,2500	0,0577	-0,3029	0,0033	-0,43	0,21	2,67	-2,67	2,03
Lab 7	13,8000	14,3000	15,0000	14,0000	14,2750	0,5252	0,7221	0,2758	1,03	1,88	2,67	-2,67	2,03
Lab 8											2,67	-2,67	2,03
Lab 9	13,3817	13,2185	13,2559	12,8073	13,1659	0,2490	-0,3870	0,0620	-0,55	0,89	2,67	-2,67	2,03
Lab 10	15,2000	15,3000	14,7000	14,3000	14,8750	0,4646	1,3221	0,2158	1,89	1,66	2,67	-2,67	2,03
Lab 11	13,6000	13,6000	13,6000	13,3000	13,5250	0,1500	-0,0279	0,0225	-0,04	0,54	2,67	-2,67	2,03
Lab 12	14,2000	14,7000	15,6000	14,7000	14,8000	0,5831	1,2471	0,3400	1,78	2,09	2,67	-2,67	2,03
Lab 13	12,1000	12,0000	12,0000	12,2000	12,0750	0,0957	-1,4779	0,0092	-2,11	0,34	2,67	-2,67	2,03
Lab 14	13,7300	13,6600	13,7000	13,7300	13,7050	0,0332	0,1521	0,0011	0,22	0,12	2,67	-2,67	2,03
Lab 15	13,0275	13,3211	13,2927	13,4631	13,2761	0,1817	-0,2768	0,0330	-0,40	0,65	2,67	-2,67	2,03
Lab 16	13,5000	13,5000	13,4000	13,5000	13,4750	0,0500	-0,0779	0,0025	-0,11	0,18	2,67	-2,67	2,03
Lab 17	13,1500	13,2200	13,0800	13,1200	13,1425	0,0591	-0,4104	0,0035	-0,59	0,21	2,67	-2,67	2,03
Lab 18	14,1100	13,9700	13,8700	14,0800	14,0075	0,1097	0,4546	0,0120	0,65	0,39	2,67	-2,67	2,03
Lab 19	13,9000	13,6000	13,5000	13,5000	13,6250	0,1893	0,0721	0,0358	0,10	0,68	2,67	-2,67	2,03
Lab 20	12,7000	13,0000	13,8000	13,5000	13,2500	0,4933	-0,3029	0,2433	-0,43	1,76	2,67	-2,67	2,03
Lab 21	13,0000	12,8000	12,9000	12,8000	12,8750	0,0957	-0,6779	0,0092	-0,97	0,34	2,67	-2,67	2,03
Lab 22	15,3000	15,3000	15,3000	15,3000	15,3000	0,0000	1,7471	0,0000	2,50	0,00	2,67	-2,67	2,03
Lab 23	13,4560	13,7260	13,5910	13,6250	13,5995	0,1115	0,0466	0,0124	0,07	0,40	2,67	-2,67	2,03
Lab 24	13,6400	13,6000	13,6000	13,5400	13,5950	0,0412	0,0421	0,0017	0,06	0,15	2,67	-2,67	2,03
Lab 25	14,1000	14,0000	14,2000	14,3000	14,1500	0,1291	0,5971	0,0167	0,85	0,46	2,67	-2,67	2,03
Lab 26	13,6000	13,9000	14,2000	13,6000	13,8250	0,2872	0,2721	0,0825	0,39	1,03	2,67	-2,67	2,03
Lab 27	12,7000	12,7000	13,2000	12,9000	12,8750	0,2363	-0,6779	0,0558	-0,97	0,85	2,67	-2,67	2,03
Lab 28	14,1000	13,9000	14,2000	14,0000	14,0500	0,1291	0,4971	0,0167	0,71	0,46	2,67	-2,67	2,03
Lab 29	13,0300	12,5800	13,2400	13,3300	13,0450	0,3345	-0,5079	0,1119	-0,73	1,20	2,67	-2,67	2,03
Lab 30	13,7000	13,7000	13,5000	13,8000	13,6750	0,1258	0,1221	0,0158	0,17	0,45	2,67	-2,67	2,03
Lab 31	14,0000	13,8000	14,1000	14,2000	14,0250	0,1708	0,4721	0,0292	0,67	0,61	2,67	-2,67	2,03
Lab 32											2,67	-2,67	2,03
Lab 33	13,5000	13,5000	12,6000	12,6000	13,0500	0,5196	-0,5029	0,2700	-0,72	1,86	2,67	-2,67	2,03
Lab 34	14,3900	15,8600	14,3900	13,8900	14,6325	0,8516	1,0796	0,7252	1,54	3,05	2,67	-2,67	2,03
Lab 35	12,6970	12,7650	12,8330	12,9680	12,8158	0,1157	-0,7371	0,0134	-1,05	0,41	2,67	-2,67	2,03
Lab 36	12,4000	12,2000	12,2000	12,3000	12,2750	0,0957	-1,2779	0,0092	-1,83	0,34	2,67	-2,67	2,03
Lab 37	13,6000	13,5000	13,6000	13,7000	13,6000	0,0816	0,0471	0,0067	0,07	0,29	2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03

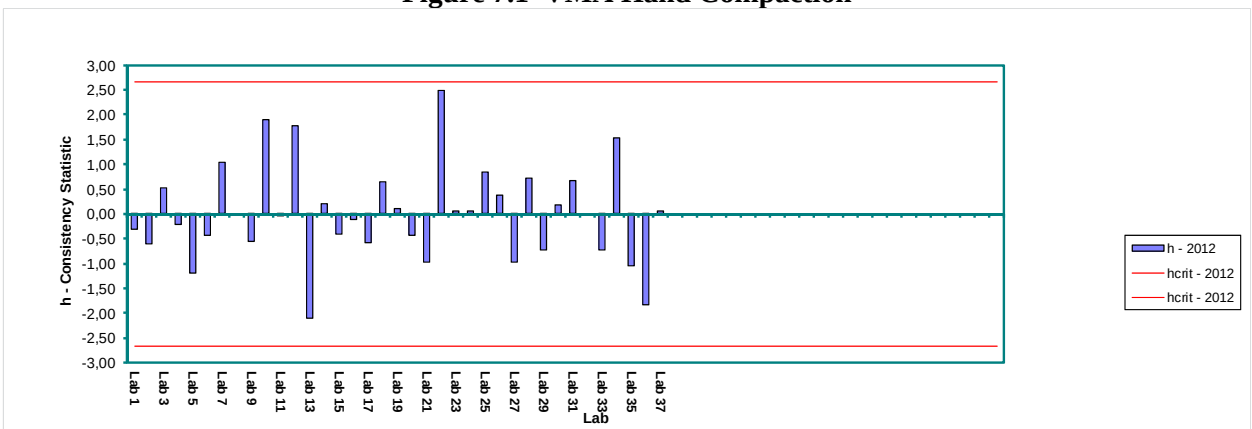
Additional Statistics						
	Minimum X_{ave}	12,0750	r = 2.8 s_r =	0,7749	h_{crit} =	2,67
	Maximum X_{ave}	15,3000	R = 2.8 s_R =	2,0527	h_{crit} =	-2,67
	Check s_{Xave} =	0,6999			k_{crit} =	2,03

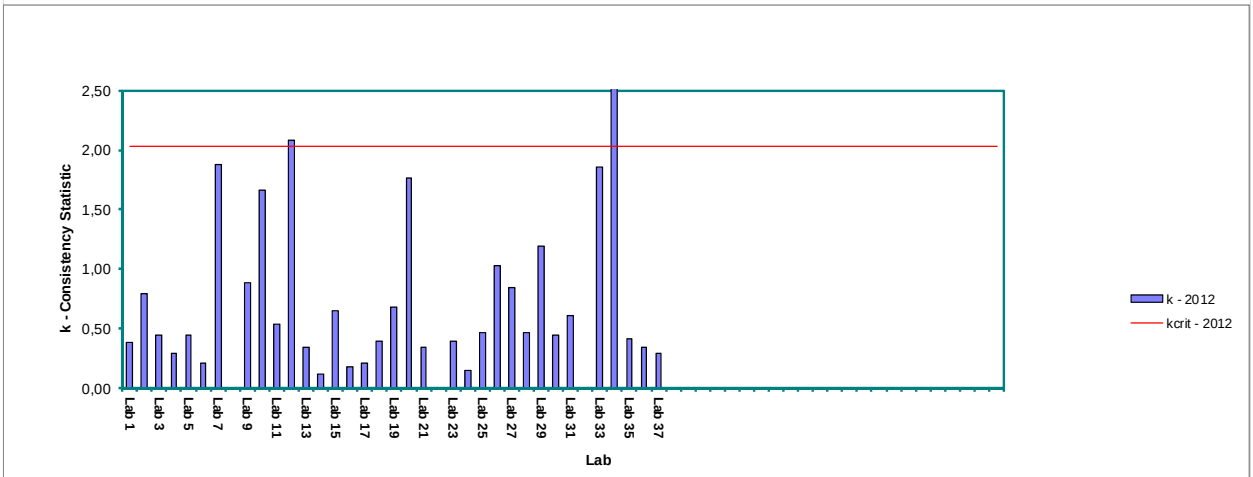
Where:		Where:	
$x_1 .... x_n$ =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,6999

Figure 7.1 VMA Hand Compaction





Where:	$x_1 ... x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 7.2 VMA Mechanical Compaction

500 - Mechanical Compaction
504 - VMA (%)
2012

Data								
n =	4	$(X_{ave})_{ave}$ =	13,5902	s_r =	0,2842	Check s_{Xave} =	0,6815	
p =	23	s_{Xave} =	0,6815	s_{R*} =	0,7246	$r = 2.8\ s_r$ =	0,7878	
Significance Level =		0,5%		s_R =	0,7246	$R = 2.8\ s_R$ =	2,0084	

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	13,3354	13,9372	13,4372	13,1998	13,4774	0,3216	-0,1128	0,1034	-0,17	1,13	2,59	-2,59	2,01
Lab 2	13,9000	13,9000	13,9000	13,8000	13,8750	0,0500	0,2848	0,0025	0,42	0,18	2,59	-2,59	2,01
Lab 3	14,1000	13,9000	13,8000	14,0000	13,9500	0,1291	0,3598	0,0167	0,53	0,45	2,59	-2,59	2,01
Lab 4	13,5000	13,2000	13,5000	13,5000	13,4250	0,1500	-0,1652	0,0225	-0,24	0,53	2,59	-2,59	2,01
Lab 5	12,8600	12,6200	12,8900	12,8200	12,7975	0,1218	-0,7927	0,0148	-1,16	0,43	2,59	-2,59	2,01
Lab 6	13,4000	13,5000	13,3000	13,2000	13,3500	0,1291	-0,2402	0,0167	-0,35	0,45	2,59	-2,59	2,01
Lab 7	15,0000	14,1000	13,4000	14,4000	14,2250	0,6652	0,6348	0,4425	0,93	2,34	2,59	-2,59	2,01
Lab 8	13,1000	13,3000	13,5000	13,2000	13,2750	0,1708	-0,3152	0,0292	-0,46	0,60	2,59	-2,59	2,01
Lab 9	13,4700	13,4564	13,2287	12,9500	13,2763	0,2441	-0,3139	0,0596	-0,46	0,86	2,59	-2,59	2,01
Lab 10	15,1000	15,1000	15,2000	14,9000	15,0750	0,1258	1,4848	0,0158	2,18	0,44	2,59	-2,59	2,01
Lab 11											2,59	-2,59	2,01
Lab 12											2,59	-2,59	2,01
Lab 13	12,1000	12,2000	12,2000	12,1000	12,1500	0,0577	-1,4402	0,0033	-2,11	0,20	2,59	-2,59	2,01
Lab 14	13,6600	13,4600	13,5600		13,5600	0,1000	-0,0302	0,0100	-0,04	0,35	2,59	-2,59	2,01
Lab 15											2,59	-2,59	2,01
Lab 16	13,3000	13,6000	13,3000	13,5000	13,4250	0,1500	-0,1652	0,0225	-0,24	0,53	2,59	-2,59	2,01
Lab 17	12,8500	12,8500	12,8100	12,8800	12,8475	0,0287	-0,7427	0,0008	-1,09	0,10	2,59	-2,59	2,01
Lab 18											2,59	-2,59	2,01
Lab 19	14,0000	13,3000	13,3000	13,4000	13,5000	0,3367	-0,0902	0,1133	-0,13	1,18	2,59	-2,59	2,01
Lab 20											2,59	-2,59	2,01
Lab 21	13,0000	13,1000	13,0000	13,0000	13,0250	0,0500	-0,5652	0,0025	-0,83	0,18	2,59	-2,59	2,01
Lab 22											2,59	-2,59	2,01
Lab 23	13,1510	13,7600	13,3540	13,5570	13,4555	0,2621	-0,1347	0,0687	-0,20	0,92	2,59	-2,59	2,01
Lab 24											2,59	-2,59	2,01
Lab 25											2,59	-2,59	2,01
Lab 26											2,59	-2,59	2,01
Lab 27	16,2000	15,0000	14,8000	14,6000	15,1500	0,7188	1,5598	0,5167	2,29	2,53	2,59	-2,59	2,01
Lab 28	14,4000	13,9000	14,4000	14,4000	14,2750	0,2500	0,6848	0,0625	1,00	0,88	2,59	-2,59	2,01
Lab 29	13,5800	13,5100	13,5500	13,5000	13,5350	0,0370	-0,0552	0,0014	-0,08	0,13	2,59	-2,59	2,01
Lab 30	13,7000	13,8000	13,8000	13,9000	13,8000	0,0816	0,2098	0,0067	0,31	0,29	2,59	-2,59	2,01
Lab 31											2,59	-2,59	2,01
Lab 32											2,59	-2,59	2,01
Lab 33	13,5000	12,6000	13,5000	12,6000	13,0500	0,5196	-0,5402	0,2700	-0,79	1,83	2,59	-2,59	2,01
Lab 34											2,59	-2,59	2,01
Lab 35											2,59	-2,59	2,01
Lab 36											2,59	-2,59	2,01
Lab 37	14,4000	13,9000	14,1000	13,9000	14,0750	0,2363	0,4848	0,0558	0,71	0,83	2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01

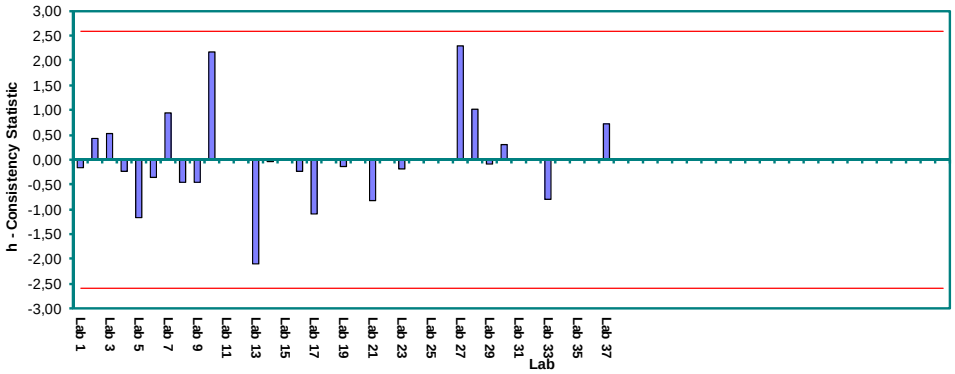
Additional Statistics						
	Minimum X_{ave}	12,1500	$r = 2.8\ s_r$ =	0,7878	h_{crit} =	2,59
	Maximum X_{ave}	15,1500	$R = 2.8\ s_R$ =	2,0084	h_{crit} =	-2,59
	Check s_{Xave} =	0,6815			k_{crit} =	2,01

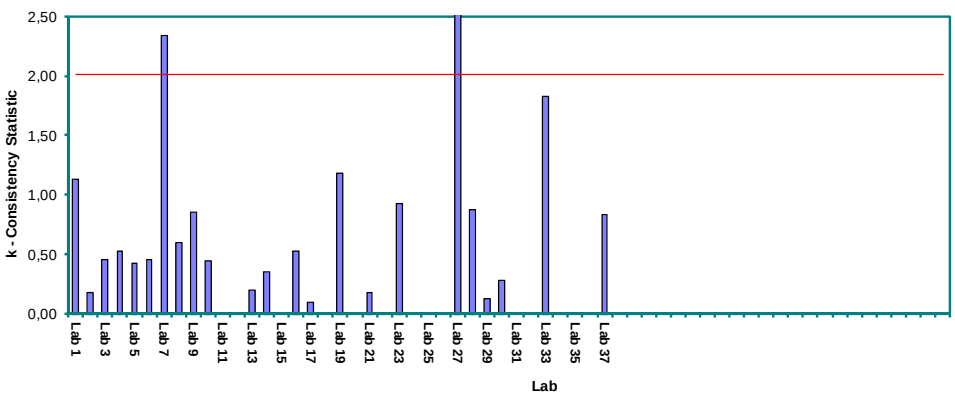
Where:			Where:		
	x_1....x_n =	Individual Test Result		$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 7.2 VMA Mechanical Compaction





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 8.1 Air Voids Hand Compaction

400 - Hand Compaction
405 - Air Voids (%)
2012

Data													
					n =	4	$(X_{ave})_{ave}$ =	2,4694	s_r =	0,2900	Check s_{Xave} =	0,8125	
					p =	36	s_{Xave} =	0,8125	s_{R*} =	0,8504	$r = 2.8\ s_r$ =	0,8038	
					Significance Level =		0,5%		s_R =	0,8504	$R = 2.8\ s_R$ =	2,3572	
Lab #	**x_1**	**x_2**	**x_3**	**x_4**	**X_{ave}**	**s**	**d**	**s^2**	**h - 2012**	**k - 2012**	**hcrit - 2012**	**hcrit - 2012**	**kcrit - 2012**
Lab 1	1,5995	1,5995	1,4068	1,3683	1,4935	0,1234	-0,9758	0,0152	-1,20	0,43	2,67	-2,67	2,03
Lab 2	2,0000	2,2000	2,0000	2,5000	2,1750	0,2363	-0,2944	0,0558	-0,36	0,81	2,67	-2,67	2,03
Lab 3	2,5800	2,7300	2,6900	2,9600	2,7400	0,1598	0,2706	0,0255	0,33	0,55	2,67	-2,67	2,03
Lab 4	2,1000	2,3000	2,4000	2,3000	2,2750	0,1258	-0,1944	0,0158	-0,24	0,43	2,67	-2,67	2,03
Lab 5	1,7300	1,8900	2,0800	1,8500	1,8875	0,1452	-0,5819	0,0211	-0,72	0,50	2,67	-2,67	2,03
Lab 6	2,1000	2,0000	2,1000	2,2000	2,1000	0,0816	-0,3694	0,0067	-0,45	0,28	2,67	-2,67	2,03
Lab 7	2,5000	3,0000	3,8000	2,7000	3,0000	0,5715	0,5306	0,3267	0,65	1,97	2,67	-2,67	2,03
Lab 8											2,67	-2,67	2,03
Lab 9	2,9470	2,7650	2,8070	2,3040	2,7058	0,2789	0,2364	0,0778	0,29	0,96	2,67	-2,67	2,03
Lab 10	3,8000	3,9000	3,3000	2,9000	3,4750	0,4646	1,0056	0,2158	1,24	1,60	2,67	-2,67	2,03
Lab 11	1,9000	1,9000	2,1000	1,5000	1,8500	0,2517	-0,6194	0,0633	-0,76	0,87	2,67	-2,67	2,03
Lab 12	3,0000	3,6000	4,5000	3,3000	3,6000	0,6481	1,1306	0,4200	1,39	2,23	2,67	-2,67	2,03
Lab 13	3,0000	2,9000	2,9000	3,1000	2,9750	0,0957	0,5056	0,0092	0,62	0,33	2,67	-2,67	2,03
Lab 14	2,3400	2,2700	2,3100	2,3400	2,3150	0,0332	-0,1544	0,0011	-0,19	0,11	2,67	-2,67	2,03
Lab 15	2,1382	2,4677	2,4371	2,6325	2,4189	0,2059	-0,0505	0,0424	-0,06	0,71	2,67	-2,67	2,03
Lab 16	2,3000	2,3000	2,2000	2,3000	2,2750	0,0500	-0,1944	0,0025	-0,24	0,17	2,67	-2,67	2,03
Lab 17	2,2600	2,3300	2,1800	2,2200	2,2475	0,0640	-0,2219	0,0041	-0,27	0,22	2,67	-2,67	2,03
Lab 18	3,2100	3,0500	2,9400	3,1700	3,0925	0,1223	0,6231	0,0150	0,77	0,42	2,67	-2,67	2,03
Lab 19	2,8000	2,4000	2,3000	2,3000	2,4500	0,2380	-0,0194	0,0567	-0,02	0,82	2,67	-2,67	2,03
Lab 20	2,6000	3,0000	3,8000	3,5000	3,2250	0,5315	0,7556	0,2825	0,93	1,83	2,67	-2,67	2,03
Lab 21	2,4000	2,2000	2,2000	2,1000	2,2250	0,1258	-0,2444	0,0158	-0,30	0,43	2,67	-2,67	2,03
Lab 22	4,9000	5,0000	4,9000	4,9000	4,9250	0,0500	2,4556	0,0025	3,02	0,17	2,67	-2,67	2,03
Lab 23	1,3120	1,6200	1,4660	1,5050	1,4758	0,1272	-0,9936	0,0162	-1,22	0,44	2,67	-2,67	2,03
Lab 24	1,8000	1,8000	1,8000	1,7000	1,7750	0,0500	-0,6944	0,0025	-0,85	0,17	2,67	-2,67	2,03
Lab 25	3,1000	3,0000	3,1000	3,2000	3,1000	0,0816	0,6306	0,0067	0,78	0,28	2,67	-2,67	2,03
Lab 26	2,3000	2,6000	2,9000	2,3000	2,5250	0,2872	0,0556	0,0825	0,07	0,99	2,67	-2,67	2,03
Lab 27	2,3000	2,3000	2,6000	2,5000	2,4250	0,1500	-0,0444	0,0225	-0,05	0,52	2,67	-2,67	2,03
Lab 28	2,0000	1,7000	2,0000	1,8000	1,8750	0,1500	-0,5944	0,0225	-0,73	0,52	2,67	-2,67	2,03
Lab 29	1,7000	1,2000	1,9300	2,0400	1,7175	0,3729	-0,7519	0,1391	-0,93	1,29	2,67	-2,67	2,03
Lab 30	2,4000	2,5000	2,3000	2,6000	2,4500	0,1291	-0,0194	0,0167	-0,02	0,45	2,67	-2,67	2,03
Lab 31	3,3000	3,2000	3,4000	3,5000	3,3500	0,1291	0,8806	0,0167	1,08	0,45	2,67	-2,67	2,03
Lab 32	2,1000	2,5000	2,2000	2,4000	2,3000	0,1826	-0,1694	0,0333	-0,21	0,63	2,67	-2,67	2,03
Lab 33	1,6000	1,8000	1,4000	1,3000	1,5250	0,2217	-0,9444	0,0492	-1,16	0,76	2,67	-2,67	2,03
Lab 34	3,9600	5,6000	3,9600	3,3900	4,2275	0,9536	1,7581	0,9094	2,16	3,29	2,67	-2,67	2,03
Lab 35	0,7330	0,8100	0,8870	1,0410	0,8678	0,1315	-1,6016	0,0173	-1,97	0,45	2,67	-2,67	2,03
Lab 36	1,6600	1,4500	1,4500	1,5700	1,5325	0,1021	-0,9369	0,0104	-1,15	0,35	2,67	-2,67	2,03
Lab 37	2,3000	2,2000	2,3000	2,4000	2,3000	0,0816	-0,1694	0,0067	-0,21	0,28	2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
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											2,67	-2,67	2,03
											2,67	-2,67	2,03
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											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03

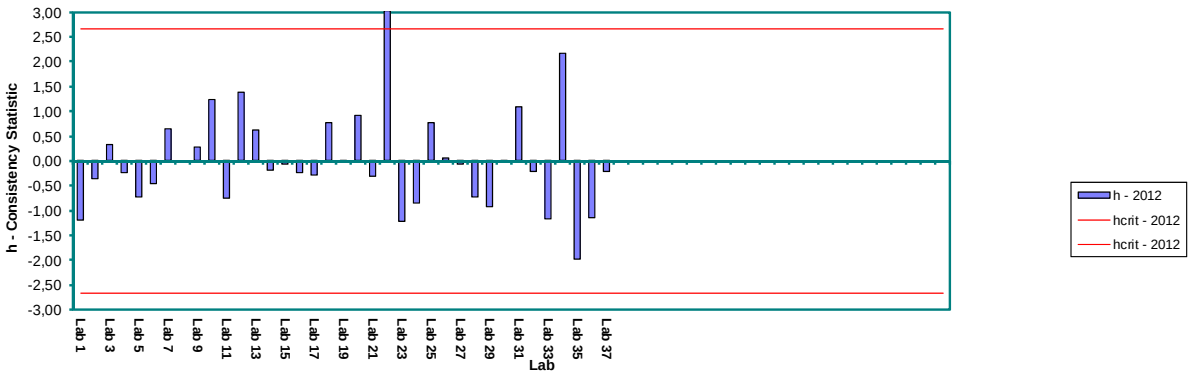
Additional Statistics						
	Minimum X_{ave}	0,8678	$r = 2.8\ s_r$ =	0,8038	h_{crit} =	2,67
	Maximum X_{ave}	4,9250	$R = 2.8\ s_R$ =	2,3572	h_{crit} =	-2,67
	Check s_{Xave} =	0,8125			k_{crit} =	2,03

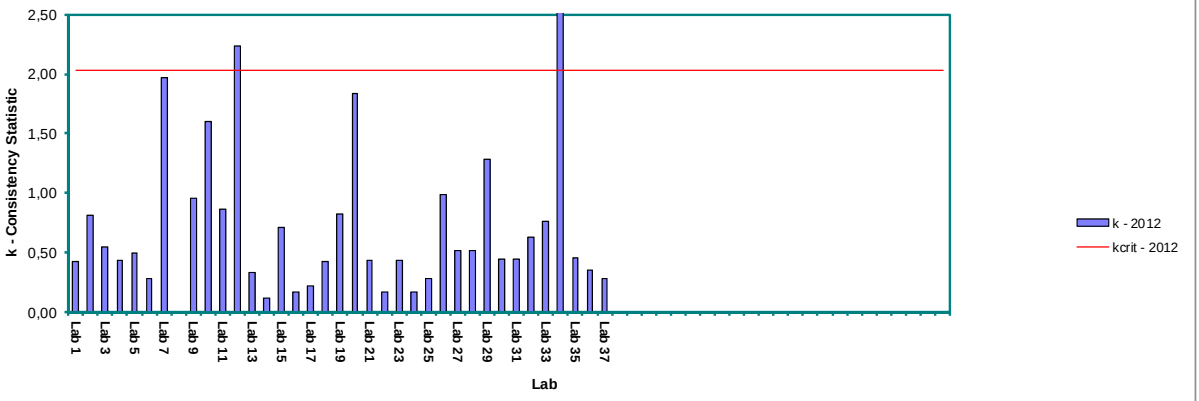
Where: $x_1....x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation		s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 8.1 Air Voids Hand Compaction





Where:	$x_1 ... x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 8.2 Air Voids Mechanical Compaction

500 - Mechanical Compaction
505 - Air Voids (%)
2012

Data					
n = 4	$(X_{ave})_{ave}$ = 2,4770	s_r = 0,2367	Check s_{Xave} = 0,7198		
p = 24	s_{Xave} = 0,7198	s_{R^*} = 0,7484	r = 2.8 s_r = 0,6561		
Significance Level = 0,5%		s_R = 0,7484	R = 2.8 s_R = 2,0746		

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	1,4839	1,5995	1,5995	1,3297	1,5032	0,1278	-0,9738	0,0163	-1,35	0,54	2,60	-2,60	2,01
Lab 2	3,1000	3,1000	3,0000	3,0000	3,0500	0,0577	0,5730	0,0033	0,80	0,24	2,60	-2,60	2,01
Lab 3	2,9600	2,6900	2,5800	2,7700	2,7500	0,1602	0,2730	0,0257	0,38	0,68	2,60	-2,60	2,01
Lab 4	2,5000	2,1000	2,4000	2,4000	2,3500	0,1732	-0,1270	0,0300	-0,18	0,73	2,60	-2,60	2,01
Lab 5	2,0400	1,7700	2,0800	2,0000	1,9725	0,1389	-0,5045	0,0193	-0,70	0,59	2,60	-2,60	2,01
Lab 6	2,3000	2,4000	2,1000	2,0000	2,2000	0,1826	-0,2770	0,0333	-0,38	0,77	2,60	-2,60	2,01
Lab 7	3,8000	2,8000	2,0000	3,1000	2,9250	0,7455	0,4480	0,5558	0,62	3,15	2,60	-2,60	2,01
Lab 8	2,2000	2,4000	2,5000	2,2000	2,3250	0,1500	-0,1520	0,0225	-0,21	0,63	2,60	-2,60	2,01
Lab 9	3,0460	3,0310	2,7761	2,4640	2,8293	0,2732	0,3523	0,0746	0,49	1,15	2,60	-2,60	2,01
Lab 10	3,8000	3,8000	3,8000	3,5000	3,7250	0,1500	1,2480	0,0225	1,73	0,63	2,60	-2,60	2,01
Lab 11											2,60	-2,60	2,01
Lab 12											2,60	-2,60	2,01
Lab 13	3,1000	3,1000	3,1000	3,0000	3,0750	0,0500	0,5980	0,0025	0,83	0,21	2,60	-2,60	2,01
Lab 14	2,2700	2,0400	2,1500		2,1533	0,1150	-0,3236	0,0132	-0,45	0,49	2,60	-2,60	2,01
Lab 15											2,60	-2,60	2,01
Lab 16	2,1000	2,4000	2,1000	2,3000	2,2250	0,1500	-0,2520	0,0225	-0,35	0,63	2,60	-2,60	2,01
Lab 17	1,9100	1,9100	1,8700	1,9500	1,9100	0,0327	-0,5670	0,0011	-0,79	0,14	2,60	-2,60	2,01
Lab 18											2,60	-2,60	2,01
Lab 19	2,9000	2,0000	2,0000	2,1000	2,2500	0,4359	-0,2270	0,1900	-0,32	1,84	2,60	-2,60	2,01
Lab 20											2,60	-2,60	2,01
Lab 21	2,3000	2,5000	2,4000	2,4000	2,4000	0,0816	-0,0770	0,0067	-0,11	0,34	2,60	-2,60	2,01
Lab 22											2,60	-2,60	2,01
Lab 23	1,4820	1,4870	1,4820	1,4840	1,4838	0,0024	-0,9932	0,0000	-1,38	0,01	2,60	-2,60	2,01
Lab 24											2,60	-2,60	2,01
Lab 25											2,60	-2,60	2,01
Lab 26											2,60	-2,60	2,01
Lab 27	4,8000	4,9000	4,6000	4,4000	4,6750	0,2217	2,1980	0,0492	3,05	0,94	2,60	-2,60	2,01
Lab 28	2,2000	1,7000	2,2000	2,1000	2,0500	0,2380	-0,4270	0,0567	-0,59	1,01	2,60	-2,60	2,01
Lab 29	2,3200	2,2400	2,2900	2,2300	2,2700	0,0424	-0,2070	0,0018	-0,29	0,18	2,60	-2,60	2,01
Lab 30	2,4000	2,6000	2,6000	2,7000	2,5750	0,1258	0,0980	0,0158	0,14	0,53	2,60	-2,60	2,01
Lab 31											2,60	-2,60	2,01
Lab 32	2,4000	2,3000	2,7000	2,7000	2,5250	0,2062	0,0480	0,0425	0,07	0,87	2,60	-2,60	2,01
Lab 33	1,6000	1,0000	1,5000	1,4000	1,3750	0,2630	-1,1020	0,0692	-1,53	1,11	2,60	-2,60	2,01
Lab 34											2,60	-2,60	2,01
Lab 35											2,60	-2,60	2,01
Lab 36											2,60	-2,60	2,01
Lab 37	3,2000	2,7000	2,9000	2,6000	2,8500	0,2646	0,3730	0,0700	0,52	1,12	2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01
											2,60	-2,60	2,01

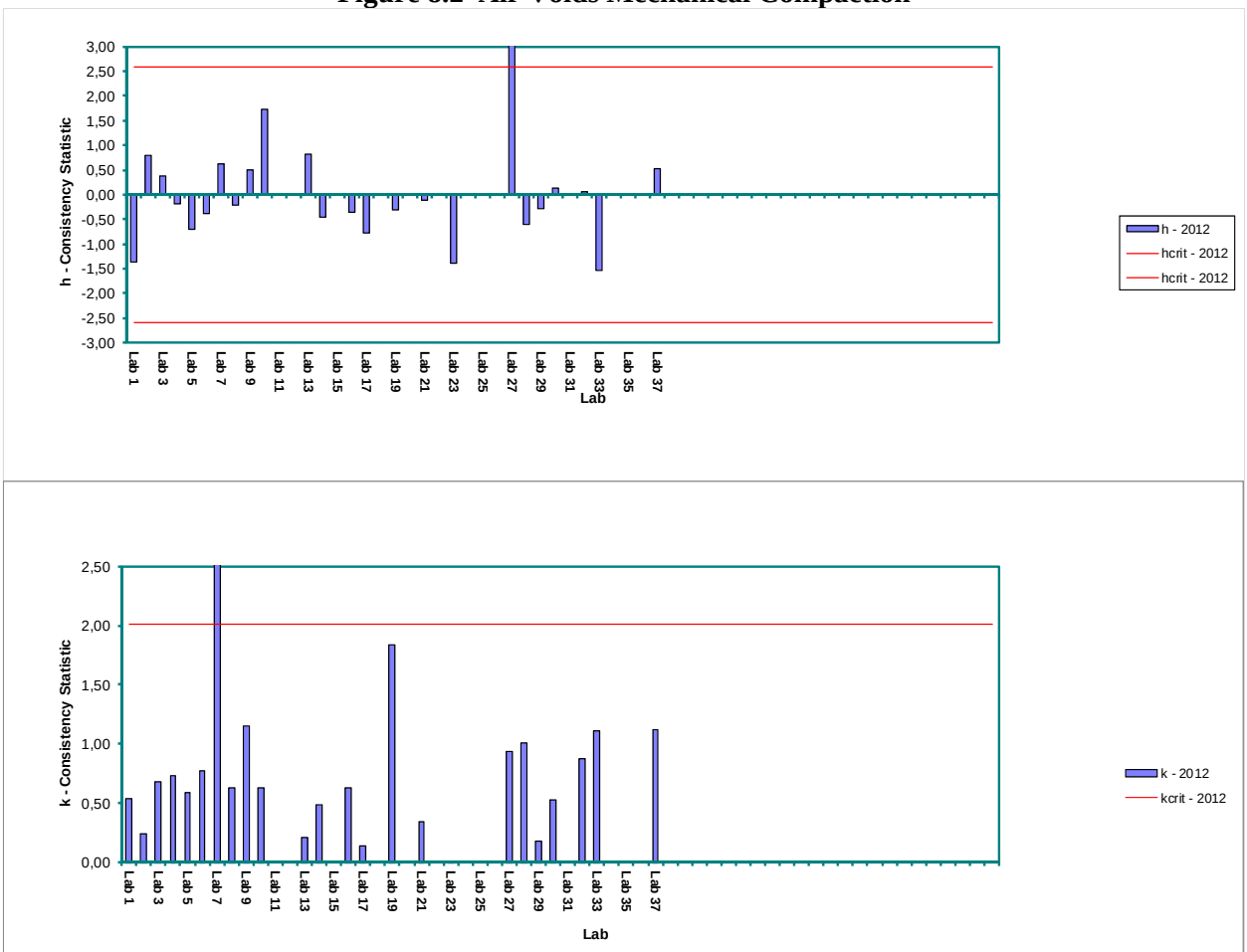
Additional Statistics					
Minimum X_{ave}	1,3750	r = 2.8 s_r =	0,6561	h_{crit} =	2,60
Maximum X_{ave}	4,6750	R = 2.8 s_R =	2,0746	h_{crit} =	-2,60
Check s_{Xave} =	0,7198			k_{crit} =	2,01

Where:		Where:	
x_1....x_n =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R^*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n = FAUX	$(X_{ave})_{ave}$ = #DIV/0!	s_r = 0,0000	Check s_{Xave} = 0,0000

Figure 8.2 Air Voids Mechanical Compaction



Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 9.1 Voids Filled with Asphalt Hand Compaction

400 - Hand Compaction
406 - Voids Filled with Asphalt (%)
2012

Data			
n =	4	$(X_{ave})_{ave}$ =	81,9199
p =	35	s_{Xave} =	5,3082
Significance Level =		0,5%	
s_r =	1,6660	Check s_{Xave} =	5,3082
s_{R*} =	5,5008	$r = 2.8\ s_r$ =	4,6178
s_R =	5,5008	$R = 2.8\ s_R$ =	15,2474

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	88,0962	88,0962	89,3966	89,6607	88,8124	0,8340	6,8925	0,6956	1,30	0,50	2,67	-2,67	2,03
Lab 2	84,4000	83,1000	84,8000	81,2000	83,3750	1,6215	1,4551	2,6292	0,27	0,97	2,67	-2,67	2,03
Lab 3	81,3000	80,3000	80,6000	79,0000	80,3000	0,9626	-1,6199	0,9267	-0,31	0,58	2,67	-2,67	2,03
Lab 4	83,9000	82,7000	82,1000	82,6000	82,8250	0,7632	0,9051	0,5825	0,17	0,46	2,67	-2,67	2,03
Lab 5	86,2500	85,1900	83,9000	85,4500	85,1975	0,9755	3,2776	0,9517	0,62	0,59	2,67	-2,67	2,03
Lab 6	84,3000	84,6000	83,8000	83,4000	84,0250	0,5315	2,1051	0,2825	0,40	0,32	2,67	-2,67	2,03
Lab 7	81,9000	79,0000	74,7000	80,7000	79,0750	3,1500	-2,8449	9,9225	-0,54	1,89	2,67	-2,67	2,03
Lab 8											2,67	-2,67	2,03
Lab 9	77,9774	79,0823	78,8245	82,0103	79,4736	1,7557	-2,4463	3,0826	-0,46	1,05	2,67	-2,67	2,03
Lab 10	74,8000	74,2000	77,7000	80,0000	76,6750	2,6924	-5,2449	7,2492	-0,99	1,62	2,67	-2,67	2,03
Lab 11	86,0000	86,0000	84,6000	88,7000	86,3250	1,7154	4,4051	2,9425	0,83	1,03	2,67	-2,67	2,03
Lab 12	78,9000	75,5000	71,2000	77,6000	75,8000	3,3714	-6,1199	11,3667	-1,15	2,02	2,67	-2,67	2,03
Lab 13	75,2000	75,8000	75,8000	74,6000	75,3500	0,5745	-6,5699	0,3300	-1,24	0,34	2,67	-2,67	2,03
Lab 14	82,9300	83,4000	83,1600	82,9300	83,1050	0,2246	1,1851	0,0504	0,22	0,13	2,67	-2,67	2,03
Lab 15	83,5870	81,4753	81,6659	82,0331	82,1903	0,9595	0,2704	0,9206	0,05	0,58	2,67	-2,67	2,03
Lab 16	83,0000	83,0000	83,6000	83,0000	83,1500	0,3000	1,2301	0,0900	0,23	0,18	2,67	-2,67	2,03
Lab 17	82,8100	82,3800	83,3300	83,0800	82,9000	0,4065	0,9801	0,1653	0,18	0,24	2,67	-2,67	2,03
Lab 18	77,2500	78,1700	78,8000	77,4900	77,9275	0,7001	-3,9924	0,4902	-0,75	0,42	2,67	-2,67	2,03
Lab 19	79,9000	82,4000	83,0000	83,0000	82,0750	1,4773	0,1551	2,1825	0,03	0,89	2,67	-2,67	2,03
Lab 20	79,6000	77,0000	72,2000	74,0000	75,7000	3,2680	-6,2199	10,6800	-1,17	1,96	2,67	-2,67	2,03
Lab 21	81,8000	83,2000	82,7000	83,5000	82,8000	0,7439	0,8801	0,5533	0,17	0,45	2,67	-2,67	2,03
Lab 22	67,9700	67,3200	67,9700	67,9700	67,8075	0,3250	-14,1124	0,1056	-2,66	0,20	2,67	-2,67	2,03
Lab 23	90,2510	88,1950	89,2130	88,9570	89,1540	0,8496	7,2341	0,7218	1,36	0,51	2,67	-2,67	2,03
Lab 24	86,7000	87,0000	87,0000	87,5000	87,0500	0,3317	5,1301	0,1100	0,97	0,20	2,67	-2,67	2,03
Lab 25	78,2000	78,9000	78,1000	77,5000	78,1750	0,5737	-3,7449	0,3292	-0,71	0,34	2,67	-2,67	2,03
Lab 26	83,4000	81,3000	79,7000	83,1000	81,8750	1,7212	-0,0449	2,9625	-0,01	1,03	2,67	-2,67	2,03
Lab 27	82,3000	82,1000	78,6000	80,9000	80,9750	1,6998	-0,9449	2,8892	-0,18	1,02	2,67	-2,67	2,03
Lab 28	85,8000	87,8000	85,9000	87,1000	86,6500	0,9678	4,7301	0,9367	0,89	0,58	2,67	-2,67	2,03
Lab 29	86,9500	90,4600	85,4200	84,7000	86,8825	2,5629	4,9626	6,5684	0,93	1,54	2,67	-2,67	2,03
Lab 30	82,1000	81,7000	83,1000	81,4000	82,0750	0,7411	0,1551	0,5492	0,03	0,44	2,67	-2,67	2,03
Lab 31	76,4000	77,2000	75,6000	75,0000	76,0500	0,9574	-5,8699	0,9167	-1,11	0,57	2,67	-2,67	2,03
Lab 32											2,67	-2,67	2,03
Lab 33	88,1000	86,7000	88,9000	89,7000	88,3500	1,2793	6,4301	1,6367	1,21	0,77	2,67	-2,67	2,03
Lab 34	72,4800	64,6900	72,4800	75,5900	71,3100	4,6505	-10,6099	21,6269	-2,00	2,79	2,67	-2,67	2,03
Lab 35	94,2300	93,6600	93,0900	91,9700	93,2375	0,9647	11,3176	0,9306	2,13	0,58	2,67	-2,67	2,03
Lab 36	86,6000	88,1000	88,1000	87,3000	87,5250	0,7228	5,6051	0,5225	1,06	0,43	2,67	-2,67	2,03
Lab 37	83,0000	83,6000	83,0000	82,4000	83,0000	0,4899	1,0801	0,2400	0,20	0,29	2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
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											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03
											2,67	-2,67	2,03

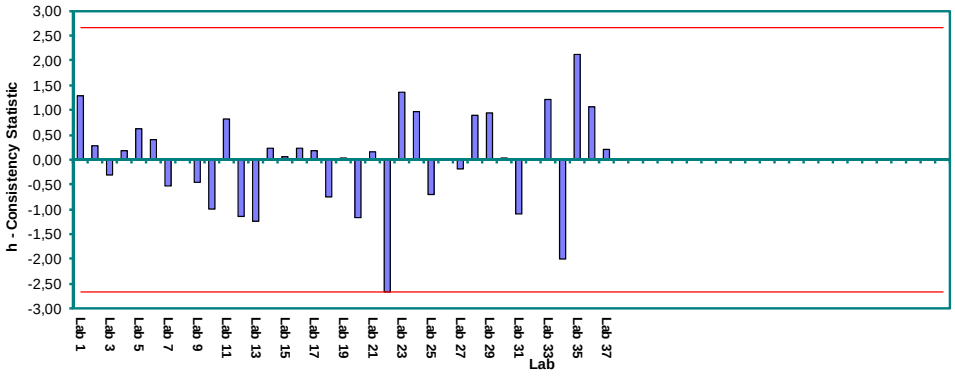
Additional Statistics						
Minimum X_{ave}	67,8075	$r = 2.8\ s_r$ =	4,6178	h_{crit} =	2,67
Maximum X_{ave}	93,2375	$R = 2.8\ s_R$ =	15,2474	h_{crit} =	-2,67
Check s_{Xave} =	5,3082			k_{crit} =	2,03

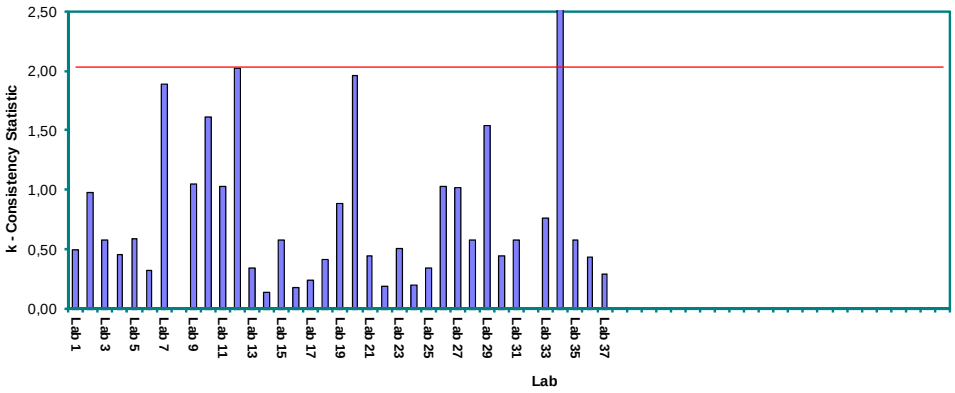
Where:		Where:	
$x_1 \ldots x_n$ =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 9.1 Voids Filled with Asphalt Hand Compaction





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 9.2 Voids Filled with Asphalt Mechanical Compaction

500 - Mechanical Compaction
506 - Voids Filled with Asphalt (%)
2012

Data							
n =	4	$(X_{ave})_{ave}$ =	81,8104	s_r =	1,5796	Check s_{Xave} =	4,9988
p =	23	s_{Xave} =	4,9988	s_{R*} =	5,1826	$r = 2.8\ s_r$ =	4,3784
Significance Level =		0,5%		s_R =	5,1826	$R = 2.8\ s_R$ =	14,3654

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	88,8724	88,0962	88,0962	89,9261	88,7477	0,8666	6,9374	0,7510	1,39	0,55	2,59	-2,59	2,01
Lab 2	77,9000	77,8000	78,1000	78,5000	78,0750	0,3096	-3,7354	0,0958	-0,75	0,20	2,59	-2,59	2,01
Lab 3	79,0000	80,6000	81,3000	80,2000	80,2750	0,9639	-1,5354	0,9292	-0,31	0,61	2,59	-2,59	2,01
Lab 4	81,8000	84,1000	82,2000	82,1000	82,5500	1,0472	0,7396	1,0967	0,15	0,66	2,59	-2,59	2,01
Lab 5	84,1500	85,9800	83,9000	84,4100	84,6100	0,9368	2,7996	0,8775	0,56	0,59	2,59	-2,59	2,01
Lab 6	82,6000	82,4000	83,4000	84,6000	83,2500	0,9983	1,4396	0,9967	0,29	0,63	2,59	-2,59	2,01
Lab 7	74,7000	80,1000	85,1000	78,5000	79,6000	4,3097	-2,2104	18,5733	-0,44	2,73	2,59	-2,59	2,01
Lab 8	83,3000	82,1000	81,2000	83,2000	82,4500	0,9950	0,6396	0,9900	0,13	0,63	2,59	-2,59	2,01
Lab 9	77,3868	77,4754	79,0146	80,9730	78,7125	1,6822	-3,0979	2,8297	-0,62	1,06	2,59	-2,59	2,01
Lab 10	75,0000	75,0000	74,8000	76,2000	75,2500	0,6403	-6,5604	0,4100	-1,31	0,41	2,59	-2,59	2,01
Lab 11											2,59	-2,59	2,01
Lab 12											2,59	-2,59	2,01
Lab 13	74,4000	74,6000	74,6000	75,2000	74,7000	0,3464	-7,1104	0,1200	-1,42	0,22	2,59	-2,59	2,01
Lab 14	83,4000	84,8700	84,1300		84,1333	0,7350	2,3230	0,5402	0,46	0,47	2,59	-2,59	2,01
Lab 15											2,59	-2,59	2,01
Lab 16	84,2000	82,4000	84,2000	83,0000	83,4500	0,9000	1,6396	0,8100	0,33	0,57	2,59	-2,59	2,01
Lab 17	85,1400	85,1400	85,4000	84,8600	85,1350	0,2205	3,3246	0,0486	0,67	0,14	2,59	-2,59	2,01
Lab 18											2,59	-2,59	2,01
Lab 19	79,3000	85,0000	85,0000	84,3000	83,4000	2,7532	1,5896	7,5800	0,32	1,74	2,59	-2,59	2,01
Lab 20											2,59	-2,59	2,01
Lab 21	82,2000	81,3000	81,8000	81,8000	81,7750	0,3686	-0,0354	0,1358	-0,01	0,23	2,59	-2,59	2,01
Lab 22											2,59	-2,59	2,01
Lab 23	88,7300	89,1900	88,9040	89,0550	88,9698	0,1980	7,1594	0,0392	1,43	0,13	2,59	-2,59	2,01
Lab 24											2,59	-2,59	2,01
Lab 25											2,59	-2,59	2,01
Lab 26											2,59	-2,59	2,01
Lab 27	62,1000	67,8000	68,9000	70,0000	67,2000	3,5166	-14,6104	12,3667	-2,92	2,23	2,59	-2,59	2,01
Lab 28	84,7000	87,8000	84,7000	85,2000	85,6000	1,4855	3,7896	2,2067	0,76	0,94	2,59	-2,59	2,01
Lab 29	82,9200	83,4200	83,1000	83,4800	83,2300	0,2656	1,4196	0,0705	0,28	0,17	2,59	-2,59	2,01
Lab 30	82,1000	81,4000	81,0000	80,5000	81,2500	0,6758	-0,5604	0,4567	-0,11	0,43	2,59	-2,59	2,01
Lab 31											2,59	-2,59	2,01
Lab 32											2,59	-2,59	2,01
Lab 33	88,1000	92,1000	88,9000	88,9000	89,5000	1,7739	7,6896	3,1467	1,54	1,12	2,59	-2,59	2,01
Lab 34											2,59	-2,59	2,01
Lab 35											2,59	-2,59	2,01
Lab 36											2,59	-2,59	2,01
Lab 37	77,7000	80,7000	79,6000	81,1000	79,7750	1,5218	-2,0354	2,3158	-0,41	0,96	2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
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											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01
											2,59	-2,59	2,01

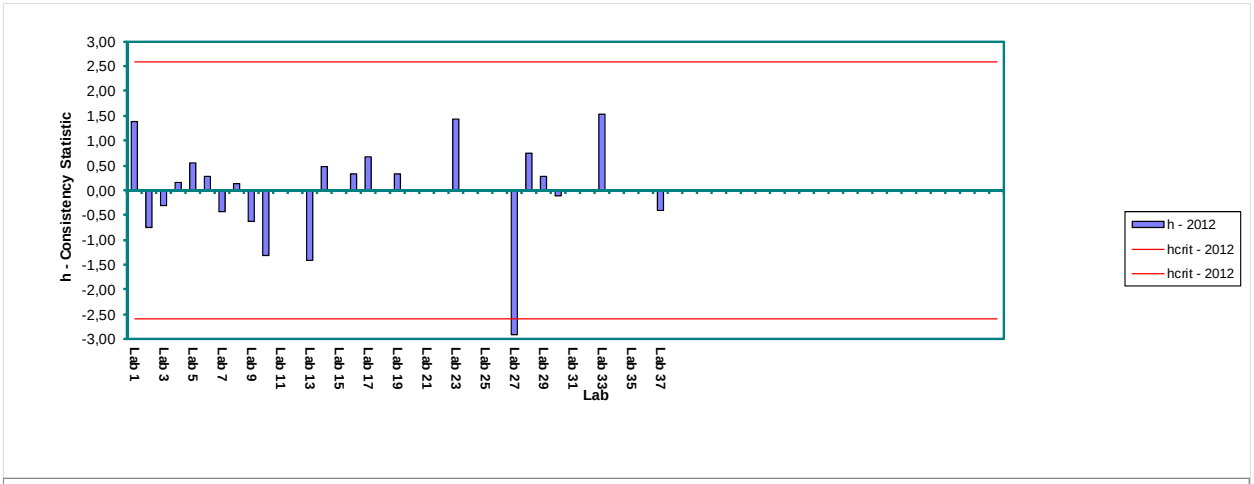
Additional Statistics					
Minimum X_{ave}	67,2000	$r = 2.8\ s_r$ =	4,3784	h_{crit} =	2,59
Maximum X_{ave}	89,5000	$R = 2.8\ s_R$ =	14,3654	h_{crit} =	-2,59
Check s_{Xave} =	4,9988			k_{crit} =	2,01

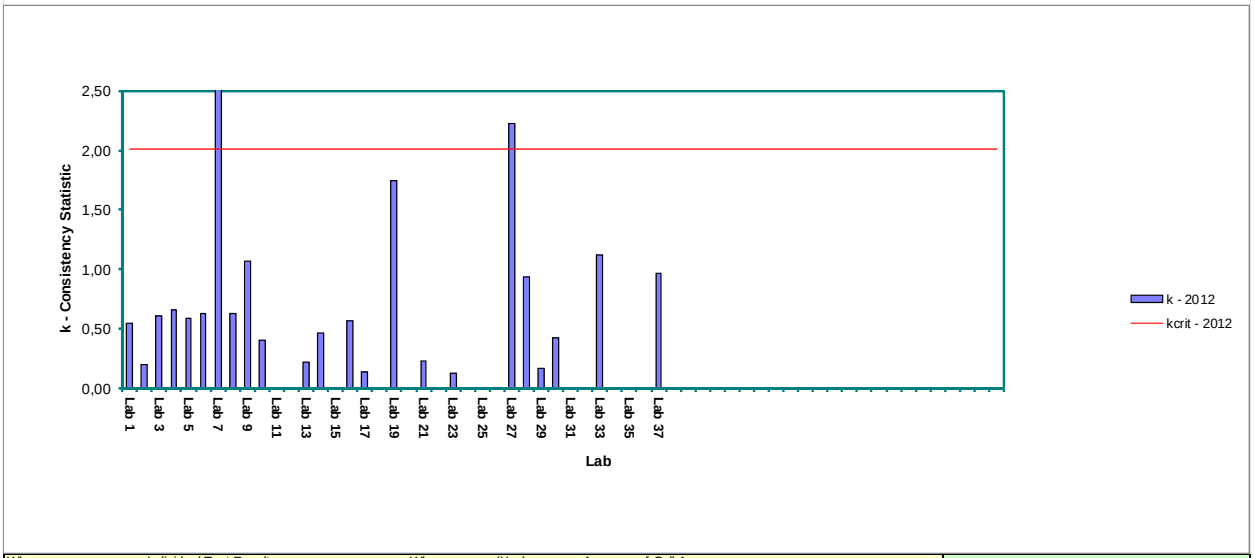
Where:		Where:	
x_1....x_n =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 9.2 Voids Filled with Asphalt Mechanical Compaction





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 10.1 Bulk Density 75 Gyrations

600 - Gyratory Compaction
602 - Bulk Density 75 Gyrations (g/cm3)
2012

Data						
n = 3	$(X_{ave})_{ave}$ =	2,5326	s_r =	0,0057	Check s_{Xave} =	0,0145
p = 21	s_{Xave} =	0,0145	s_{R*} =	0,0152	$r = 2.8\ s_r$ =	0,0158
Significance Level = 0,5%			s_R =	0,0152	$R = 2.8\ s_R$ =	0,0422

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1											2,57	-2,57	2,21
Lab 2											2,57	-2,57	2,21
Lab 3	2,5400	2,5510	2,5450		2,5453	0,0055	0,0128	0,0000	0,88	0,97	2,57	-2,57	2,21
Lab 4											2,57	-2,57	2,21
Lab 5	2,5300	2,5300	2,5300		2,5300	0,0000	-0,0026	0,0000	-0,18	0,00	2,57	-2,57	2,21
Lab 6	2,5480	2,5420	2,5450		2,5450	0,0030	0,0124	0,0000	0,86	0,53	2,57	-2,57	2,21
Lab 7	2,5430	2,5330	2,5230		2,5330	0,0100	0,0004	0,0001	0,03	1,76	2,57	-2,57	2,21
Lab 8	2,5080	2,5080	2,5160		2,5107	0,0046	-0,0219	0,0000	-1,51	0,81	2,57	-2,57	2,21
Lab 9											2,57	-2,57	2,21
Lab 10	2,5540	2,5440	2,5510		2,5497	0,0051	0,0171	0,0000	1,18	0,90	2,57	-2,57	2,21
Lab 11											2,57	-2,57	2,21
Lab 12											2,57	-2,57	2,21
Lab 13											2,57	-2,57	2,21
Lab 14	2,5240	2,5230	2,5180		2,5217	0,0032	-0,0109	0,0000	-0,75	0,56	2,57	-2,57	2,21
Lab 15	2,5540	2,5630	2,5490		2,5553	0,0071	0,0228	0,0001	1,57	1,25	2,57	-2,57	2,21
Lab 16	2,5510	2,5500	2,5380		2,5463	0,0072	0,0138	0,0001	0,95	1,27	2,57	-2,57	2,21
Lab 17	2,5480	2,5450	2,5570		2,5500	0,0062	0,0174	0,0000	1,20	1,10	2,57	-2,57	2,21
Lab 18											2,57	-2,57	2,21
Lab 19		2,5410	2,5330		2,5370	0,0057	0,0044	0,0000	0,31	0,99	2,57	-2,57	2,21
Lab 20											2,57	-2,57	2,21
Lab 21											2,57	-2,57	2,21
Lab 22											2,57	-2,57	2,21
Lab 23	2,5270	2,5230	2,5170		2,5223	0,0050	-0,0102	0,0000	-0,71	0,88	2,57	-2,57	2,21
Lab 24	2,5270	2,5240	2,5270		2,5260	0,0017	-0,0066	0,0000	-0,45	0,30	2,57	-2,57	2,21
Lab 25	2,5320	2,5230	2,5300		2,5283	0,0047	-0,0042	0,0000	-0,29	0,83	2,57	-2,57	2,21
Lab 26	2,5130	2,5200	2,5130		2,5153	0,0040	-0,0172	0,0000	-1,19	0,71	2,57	-2,57	2,21
Lab 27											2,57	-2,57	2,21
Lab 28	2,5430	2,5390	2,5510		2,5443	0,0061	0,0118	0,0000	0,81	1,07	2,57	-2,57	2,21
Lab 29											2,57	-2,57	2,21
Lab 30	2,5370	2,5390	2,5420		2,5393	0,0025	0,0068	0,0000	0,47	0,44	2,57	-2,57	2,21
Lab 31	2,5187	2,5168	2,5203		2,5186	0,0018	-0,0140	0,0000	-0,96	0,31	2,57	-2,57	2,21
Lab 32											2,57	-2,57	2,21
Lab 33	2,5210	2,5390	2,5420		2,5340	0,0114	0,0014	0,0001	0,10	1,99	2,57	-2,57	2,21
Lab 34	2,5070	2,4910	2,5000		2,4993	0,0080	-0,0332	0,0001	-2,29	1,41	2,57	-2,57	2,21
Lab 35											2,57	-2,57	2,21
Lab 36											2,57	-2,57	2,21
Lab 37	2,5300	2,5330	2,5330		2,5320	0,0017	-0,0006	0,0000	-0,04	0,30	2,57	-2,57	2,21
											2,57	-2,57	2,21
											2,57	-2,57	2,21
											2,57	-2,57	2,21
											2,57	-2,57	2,21
											2,57	-2,57	2,21
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											2,57	-2,57	2,21
											2,57	-2,57	2,21
											2,57	-2,57	2,21
											2,57	-2,57	2,21
											2,57	-2,57	2,21
											2,57	-2,57	2,21

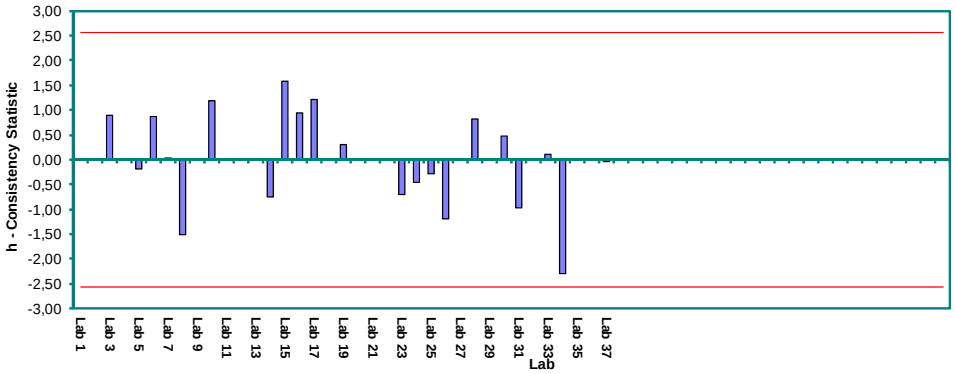
Additional Statistics						
Minimum X_{ave}	2,4993	$r = 2.8\ s_r$ =	0,0158	h_{crit} =	2,57
Maximum X_{ave}	2,5553	$R = 2.8\ s_R$ =	0,0422	h_{crit} =	-2,57
Check s_{Xave} =	0,0145			k_{crit} =	2,21

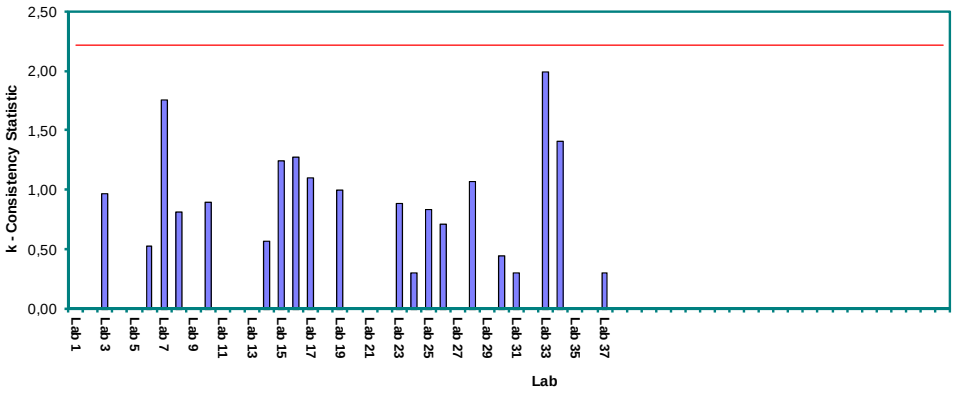
Where:		Where:	
$x_1....x_n$ =	Individual Test Result	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average	s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell	s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation	s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)	s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation	h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories	k =	Within Laboratory Consistency Statistic

0,0000

n = FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 10.1 Bulk Density 75 Gyrations





Where:	$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
	X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
	n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
	s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
	d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
	s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
	p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
	h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
	k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 11.1 Asphalt Content by Ignition Oven

700 - Ignition Oven
701 - Asphalt Content by Ignition Oven oven dry HMA (%)
2012

Data					
n =	3	$(X_{ave})_{ave}$ =	5,1992	s_r =	0,1420
p =	35	s_{Xave} =	0,3332	s_{R*} =	0,3528
Significance Level =	0,5%			s_R =	0,3528

Check s_{Xave} =	0,3332
r = 2.8 s_r =	0,3936
R = 2.8 s_R =	0,9779

Lab #	x_1	x_2	x_3	x_4	X_{ave}	s	d	s^2	h - 2012	k - 2012	hcrit - 2012	hcrit - 2012	kcrit - 2012
Lab 1	4,9100	5,1700	5,1700		5,0833	0,1501	-0,1159	0,0225	-0,35	1,06	2,67	-2,67	2,25
Lab 2	5,3200	4,9800	4,9300		5,0767	0,2122	-0,1226	0,0450	-0,37	1,49	2,67	-2,67	2,25
Lab 3	5,2500	5,0800	5,1500		5,1600	0,0854	-0,0392	0,0073	-0,12	0,60	2,67	-2,67	2,25
Lab 4	5,0000	5,3700	5,1900		5,1867	0,1850	-0,0126	0,0342	-0,04	1,30	2,67	-2,67	2,25
Lab 5	5,2000	4,9000	4,8500		4,9833	0,1893	-0,2159	0,0358	-0,65	1,33	2,67	-2,67	2,25
Lab 6	5,3300	5,3300	5,3200		5,3267	0,0058	0,1274	0,0000	0,38	0,04	2,67	-2,67	2,25
Lab 7	4,9200	5,0900	5,3500		5,1200	0,2166	-0,0792	0,0469	-0,24	1,53	2,67	-2,67	2,25
Lab 8	5,0300	5,1100	5,0200		5,0533	0,0493	-0,1459	0,0024	-0,44	0,35	2,67	-2,67	2,25
Lab 9	5,0800	4,9800	4,9300		4,9967	0,0764	-0,2026	0,0058	-0,61	0,54	2,67	-2,67	2,25
Lab 10	5,4500	5,4100	5,3000		5,3867	0,0777	0,1874	0,0060	0,56	0,55	2,67	-2,67	2,25
Lab 11	5,0600	4,9100	5,0100		4,9933	0,0764	-0,2059	0,0058	-0,62	0,54	2,67	-2,67	2,25
Lab 12	5,7700	5,8300	5,6500		5,7500	0,0917	0,5508	0,0084	1,65	0,65	2,67	-2,67	2,25
Lab 13	5,0530	4,9380	4,9850		4,9920	0,0578	-0,2072	0,0033	-0,62	0,41	2,67	-2,67	2,25
Lab 14	4,9100	4,8900	4,9500		4,9167	0,0306	-0,2826	0,0009	-0,85	0,22	2,67	-2,67	2,25
Lab 15	5,1715	5,0071	4,8833		5,0206	0,1446	-0,1786	0,0209	-0,54	1,02	2,67	-2,67	2,25
Lab 16	5,1900	5,2400	5,2200		5,2167	0,0252	0,0174	0,0006	0,05	0,18	2,67	-2,67	2,25
Lab 17	5,0700	5,1700	5,1600		5,1333	0,0551	-0,0659	0,0030	-0,20	0,39	2,67	-2,67	2,25
Lab 18	5,1600	5,0900	5,2400		5,1633	0,0751	-0,0359	0,0056	-0,11	0,53	2,67	-2,67	2,25
Lab 19											2,67	-2,67	2,25
Lab 20	5,2100	5,4300	4,9900		5,2100	0,2200	0,0108	0,0484	0,03	1,55	2,67	-2,67	2,25
Lab 21	5,0700	5,0500	5,0600		5,0600	0,0100	-0,1392	0,0001	-0,42	0,07	2,67	-2,67	2,25
Lab 22	6,9500	6,6900	6,6000		6,7467	0,1818	1,5474	0,0330	4,64	1,28	2,67	-2,67	2,25
Lab 23	5,4970	5,1640	5,2030		5,2880	0,1820	0,0888	0,0331	0,27	1,28	2,67	-2,67	2,25
Lab 24	5,1300	5,2500	5,4600		5,2800	0,1670	0,0808	0,0279	0,24	1,18	2,67	-2,67	2,25
Lab 25											2,67	-2,67	2,25
Lab 26	5,3300	5,2200	5,2100		5,2533	0,0666	0,0541	0,0044	0,16	0,47	2,67	-2,67	2,25
Lab 27	5,0100	4,9500	5,0100		4,9900	0,0346	-0,2092	0,0012	-0,63	0,24	2,67	-2,67	2,25
Lab 28	4,9400	4,7800	5,4500		5,0567	0,3499	-0,1426	0,1224	-0,43	2,46	2,67	-2,67	2,25
Lab 29	4,5900	4,8900	4,9600		4,8133	0,1966	-0,3859	0,0386	-1,16	1,38	2,67	-2,67	2,25
Lab 30	4,9700	5,0700	5,0500		5,0300	0,0529	-0,1692	0,0028	-0,51	0,37	2,67	-2,67	2,25
Lab 31	5,7900	5,7800	5,6700		5,7467	0,0666	0,5474	0,0044	1,64	0,47	2,67	-2,67	2,25
Lab 32	4,8900	5,0700	5,2200		5,0600	0,1652	-0,1392	0,0273	-0,42	1,16	2,67	-2,67	2,25
Lab 33	4,9600	5,3400	5,1600		5,1533	0,1901	-0,0459	0,0361	-0,14	1,34	2,67	-2,67	2,25
Lab 34	5,0900	5,0600	4,9900		5,0467	0,0513	-0,1526	0,0026	-0,46	0,36	2,67	-2,67	2,25
Lab 35	5,4900	5,3400	5,3680		5,3993	0,0798	0,2001	0,0064	0,60	0,56	2,67	-2,67	2,25
Lab 36	5,2800	5,2000	5,1200		5,2000	0,0800	0,0008	0,0064	0,00	0,56	2,67	-2,67	2,25
Lab 37	5,2800	4,8200	5,1400		5,0800	0,2358	-0,1192	0,0556	-0,36	1,66	2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
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											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25
											2,67	-2,67	2,25

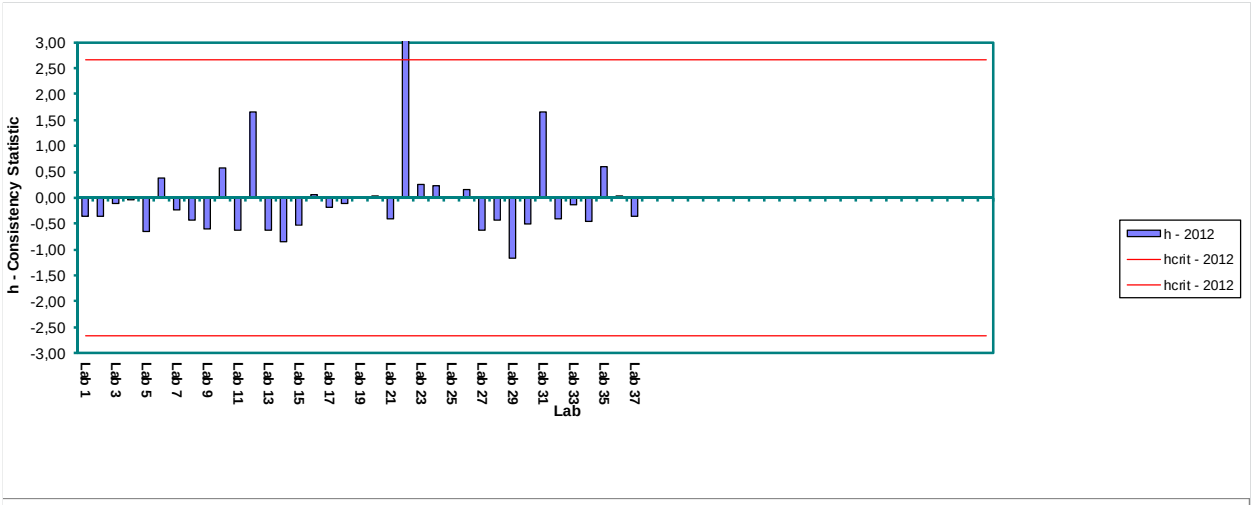
Additional Statistics						
	Minimum X_{ave}	4,8133	r = 2.8 s_r =	0,3936	h_{crit} =	2,67
	Maximum X_{ave}	6,7467	R = 2.8 s_R =	0,9779	h_{crit} =	-2,67
	Check s_{Xave} =	0,3332			k_{crit} =	2,25

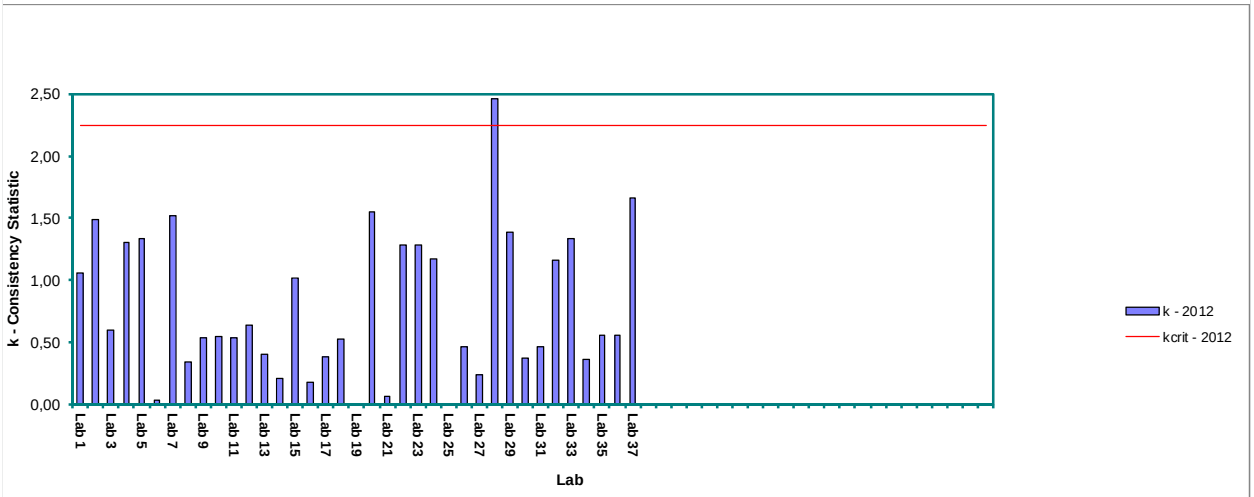
Where:			Where:		
x_1....x_n =	Individual Test Result		$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation		s_{R*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R*})
s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic

0,0000

n =	FAUX	$(X_{ave})_{ave}$ =	#DIV/0!	s_r =	0,0000	Check s_{Xave} =	0,0000

Figure 11.1 Asphalt Content by Ignition Oven





$x_1 \ldots x_n$ =	Individual Test Result	Where:	$(X_{ave})_{ave}$ =	Average of Cell Averages
X_{ave} =	Cell Average		s_{Xave} =	Standard Deviation of Cell Averages
n =	Number of Test Results per Cell		s_r =	Repeatability Standard Deviation
s =	Cell Standard Deviation		s_{R^*} =	Interim Reproducibility Standard Deviation
d =	Cell Deviation (X_{ave} - $(X_{ave})_{ave}$)		s_R =	Reproducibility Standard Deviation (Larger of s_r and s_{R^*})
s^2 =	Cell Variation		h =	Between Laboratory Consistency Statistic
p =	Number of Laboratories		k =	Within Laboratory Consistency Statistic
h_{crit} =	Critical Between Laboratory Consistency Statistic		r =	95% Confidence Limit for Repeatability
k_{crit} =	Critical Within Laboratory Consistency Statistic		R =	95% Confidence Limit for Reproducibility

Table 12 Participating Labs
CAMEP 2012 (Marshall Mix)

Aecon Materials Engineering (AME) main lab	Caledon, ON	Golder Associates Ltd	Whitby, ON
Almor Testing Services Ltd	Calgary, AB	Government of Newfoundland and Labrador, Transportation and Works	St John's, NL
AMEC Environment and Infrastructure	Saskatoon, SK	Hub City Paving - Division of Lafarge Canada	Nanaimo, BC
AMEC Environment and Infrastructure	Dartmouth, NS	Lafarge Canada, Bow River lab	Calgary, AB
AMEC Environment and Infrastructure	Edmonton, AB	Lafarge Canada, Saskatoon lab	Saskatoon, SK
AMEC Environment and Infrastructure	Regina, SK	Levelton Consultants Ltd	Nanaimo, BC
Clifton Associates Ltd	Calgary, AB	Levelton Consultants Ltd	Surrey, BC
Clifton Associates Ltd	Lloydminster, AB	LVM	Toronto, ON
Clifton Associates Ltd	Regina, SK	M&B Technical Testing Services Ltd	Calgary, AB
Clifton Associates Ltd, Saskatoon Lab	Saskatoon, SK	Manitoba Infrastructure and Transportation, Materials Engineering Branch - Central lab	Winnipeg, MB
DBA Engineering Ltd, Main lab	Vaughan, ON	Manitoba Infrstructure and Transportation	Brandon, MB
EBA Engineering Consultants Ltd	Nanaimo, BC	Maritime Testing (1985) Ltd	Dartmouth, NS
EBA, A Tetra Tech Company	Calgary, AB	MTQ	Québec, QC
EXP Services Inc	Saint John, NB	MTQ Laboratoire des chaussées	Québec, QC
Exp Services Inc	Moncton, NB	MTQ Service des matériaux d'infrastructure	Montreal, QC
Gecan	Acheson, AB	PEI Department of Transportation and Infrastructure Renewal	Mount Stewart, P.E.I.
Gemtec Ltd	Fredericton, NB	Peto MacCallum Ltd	Toronto, ON
General Liquids Canada	Bedford, NS	Thurber Engineering Ltd	Edmonton, AB
Genivar	Red Deer, AB		

Table 13 Participating Labs
CAMEP 2012 (Gyratory Compactor)

Aecon Materials Engineering (AME) main lab	Caledon, ON	Government of Newfoundland and Labrador, Transportation and Works	St John's, NL
DBA Engineering Ltd, Main lab	Vaughan, ON	Levelton Consultants Ltd	Surrey, BC
EBA, A Tetra Tech Company	Calgary, AB	LVM	Toronto, ON
EXP Services Inc	Saint John, NB	M&B Technical Testing Services Ltd	Calgary, AB
Exp Services Inc	Moncton, NB	Manitoba Infrastructure and Transportation, Materials Engineering Branch - Central lab	Winnipeg, MB
Gecan	Acheson, AB	Maritime Testing (1985) Ltd	Dartmouth, NS
Gemtec Ltd	Fredericton, NB	MTQ	Québec, QC
General Liquids Canada	Bedford, NS	MTQ Laboratoire des chaussées	Québec, QC
Genivar	Red Deer, AB	MTQ Service des matériaux d'infrastructure	Montreal, QC
Golder Associates Ltd	Whitby, ON	PEI Department of Transportation and Infrastructure Renewal	Mount Stewart, P.E.I.
		Peto MacCallum Ltd	Toronto, ON

Table 14 Participating Labs
CAMEP 2012 (Ignition Oven)

Aecon Materials Engineering (AME) main lab	Caledon, ON	Golder Associates Ltd	Whitby, ON
Almor Testing Services Ltd	Calgary, AB	Government of Newfoundland and Labrador, Transportation and Works	St John's, NL
AMEC Environment and Infrastructure	Saskatoon, SK	Hub City Paving - Division of Lafarge Canada	Nanaimo, BC
AMEC Environment and Infrastructure	Dartmouth, NS	Lafarge Canada, Bow River lab	Calgary, AB
AMEC Environment and Infrastructure	Edmonton, AB	Lafarge Canada, Saskatoon lab	Saskatoon, SK
AMEC Environment and Infrastructure	Regina, SK	Levelton Consultants Ltd	Nanaimo, BC
Clifton Associates Ltd	Calgary, AB	Levelton Consultants Ltd	Surrey, BC
Clifton Associates Ltd	Lloydminster, AB	LVM	Toronto, ON
Clifton Associates Ltd	Regina, SK	M&B Technical Testing Services Ltd	Calgary, AB
Clifton Associates Ltd, Saskatoon Lab	Saskatoon, SK	Manitoba Infrastructure and Transportation, Materials Engineering Branch - Central lab	Winnipeg, MB
DBA Engineering Ltd, Main lab	Vaughan, ON	Manitoba Infrstructure and Transportation	Brandon, MB
EBA Engineering Consultants Ltd	Nanaimo, BC	Maritime Testing (1985) Ltd	Dartmouth, NS
EXP Services Inc	Saint John, NB	MTQ	Québec, QC
Exp Services Inc	Moncton, NB	MTQ Service des matériaux d'infrastructure	Montreal, QC
Gecan	Acheson, AB	PEI Department of Transportation and Infrastructure Renewal	Mount Stewart, P.E.I.
Gemtec Ltd	Fredericton, NB	Peto MacCallum Ltd	Toronto, ON
General Liquids Canada	Bedford, NS	Thurber Engineering Ltd	Edmonton, AB
Genivar	Red Deer, AB		

Table 15 Summary of 2012 CAMEP Report

Test		Average	S_x	S_r	S_R	$2.77S_r$	$2.77S_R$	Labs Out h-stat	Labs Out k-stat	Labs Close h-stat	Labs Close k-stat
Marshall Mix											
Bulk Density of	Coarse Aggregate	2,8434	0,0145	0,0058	0,0153	0,0162	0,0424	10	22		
Aggregates (g/cm^3)	Fine Aggregate	2,7234	0,0304	0,0097	0,0314	0,0269	0,0870	13, 21	29		
Water Absorption	Coarse Aggregate	1,347	0,184	0,057	0,189	0,140	0,523		3		
(%)	Fine Aggregate	1,396	0,424	0,172	0,424	0,476	1,237	27	13		
Theor. Max. Specific Gravity & Density	Modified Rice	2,608	0,0096	0,0053	0,0160	0,0148	0,0293		9, 22		
Bulk Density	Hand Compaction	2,544	0,018	0,0078	0,019	0,022	0,054		12, 34	22	
(g/cm^3)	Mech. Compaction	2,543	0,017	0,006	0,018	0,017	0,050	27	7		
Marshall Stability	Hand Compaction	15,589	2,00	0,95	2,16	2,63	5,99		20	35	
(kN)	Mech. Compaction	14,458	1,55	0,94	1,75	2,61	4,86		17, 33		
Flow (mm)	Hand Compaction	4,5	1,15	0,39	1,20	1,07	3,33	24			9
	Mech. Compaction	4,3	0,79	0,51	0,90	1,41	2,50		33		
VMA (%)	Hand Compaction	13,6	0,70	0,28	0,74	0,77	2,05		12, 34		
	Mech. Compaction	13,6	0,68	0,28	0,72	0,79	2,01		7, 27		
Air Voids (%)	Hand Compaction	2,5	0,81	0,29	0,85	0,80	2,36	22	12, 34		
	Mech. Compaction	2,5	0,72	0,24	0,75	0,66	2,07	27	7		
Voids Filled	Hand Compaction	81,9	5,3	1,7	5,5	4,6	15,2		34		12
With Asphalt (%)	Mech. Compaction	81,8	5,0	1,6	5,2	4,4	14,4	27	7, 27		
Gyratory Compaction											
Bulk Density (g/cm^3)	75 Gyrations	2,533	0,015	0,0057	0,015	0,016	0,042				
Ignition Oven											
Asphalt Content (%)	By Mass of Oven-Dry	5,2	0,333	0,142	0,353	0,394	0,978	22	28		

Legend:

s_x = Standard Deviation

s_r = Repeatability Standard Deviation

s_R = Reproducibility Standard Deviation

$2.77s_r$ = 95% Confidence Limits for Repeatability (k-stat)

$2.77s_R$ = 95% Confidence Limits for Reproducibility (h-stat)

CAMEP = Canadian Asphalt Mix Exchange Program

VMA = Voids in Mineral Aggregate

MTD = Maximum Theoretical Density

Appendix B

Formulas Used in Calculating Precision Results

x = Individual test result

n = Number of test results per lab

p = Number of laboratories

$\bar{x}$ = Lab Average = $\frac{\sum_{1}^{n} x}{n}$

x_a = Average of lab averages = $\frac{\sum_{1}^{p} \bar{x}}{p}$

s = Lab standard deviation = $\sqrt{\frac{\sum_{1}^{n} (x - \bar{x})^2}{(n-1)}}$

d = Lab standard deviation = $\bar{x} - x_a$

s_{Xave} = Standard deviation of lab averages = $\sqrt{\frac{\sum_{1}^{p} d^2}{(p-1)}}$

s_r = Repeatability standard deviation = $\sqrt{\frac{\sum_{1}^{p} s^2}{p}}$

s_R = Reproducibility standard Deviation

= the larger of s_r and $\sqrt{\left(s_{Xave}\right)^2 + \left(s_r\right)^2 \times \frac{(n-1)}{n}}$

h = The between-laboratory consistency statistic = $\frac{d}{s_{Xave}}$

k = The within-laboratory consistency statistic = $\frac{s}{s_r}$

Reference: ASTM E691, Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method.