

APPENDICES

For

PRECISION ESTIMATES OF AASHTO T 304, AASHTO T 96, and AASHTO T 11 AND INVESTIGATION OF THE EFFECT OF MANUAL AND MECHANICAL METHOD OF WASHING ON SIEVE ANALYSIS OF AGGREGATES

FINAL Report

Prepared for
National Cooperative Highway Research Program
Transportation Research Board
National Research Council

TRANSPORTATION RESEARCH BOARD

NAS-NRC

PRIVILEGED DOCUMENT

This report, not released for publication, is furnished only for review to members of or participants in the work of the National Cooperative Highway Research Program (NCHRP). It is to be regarded as fully privileged, and dissemination of information included herein must be approved by the NCHRP.

Haleh Azari, Ph.D.
AASHTO Advanced Pavement Research Program
National Institute of Standards and Technology
Gaithersburg, Maryland

November 2013

TABLE OF CONTENT

TABLE OF CONTENT	2
APPENDIX A –PROFICIENCY SAMPLE DATA SHEETS AND INSTRUCTIONS	4
APPENDIX B - T 96 COARSE AGGREGATE GRAPHS.....	13
APPENDIX C - T 304 FINE AGGREGATE GRAPHS	17
APPENDIX D - T 11 COARSE AND FINE AGGREGATE GRAPHS	21
APPENDIX E - PRECISION STATMENTS FOR T 96, T 304 AND T 11.....	26
APPENDIX F - COARSE AGGREGATE- WASHING METHOD TABLES AND GRAPHS	30
Total Material Passing Scatter Plot Graphs	31
Percent Passing Bar Graphs	34
Summaries of Statistics	37
Statistical Tests of Significance	40
APPENDIX G - FINE AGGREGATE- WASHING METHOD TABLES AND GRAPHS	43
Total Material Passing Scatter Plot Graphs	44
Summaries of Statistics	53
Statistical Tests of Significance	56
APPENDIX H - HOT MIX ASPHALT IGNITION OVEN- WASHING METHOD TABLES AND GRAPHS.....	59
Total Material Passing Scatter Plot Graphs	60
Percent Passing Bar Graphs	66
Summaries of Statistics	72
Statistical Tests of Significance	80

APPENDIX I - HOT MIX ASPHALT SOLVENT EXTRACTION- WASHING METHOD	
TABLES AND GRAPHS.....	88
Total Material Passing Scatter Plot Graphs	89
Percent Passing Bar Graphs	93
Summaries of Statistics	99
Statistical Tests of Significance	105

APPENDIX A –PROFICIENCY SAMPLE DATA SHEETS AND INSTRUCTIONS

AGC Sample Instructions for AGC 169-170

Instructions for Testing and Reporting Coarse Aggregate Proficiency Samples No. 169 And No. 170 Closing Date: October 28, 2010

All tests should be conducted on each of the two samples according to the AASHTO or ASTM Standard Test Methods indicated. To permit an estimate of single-operator precision, the same operator should conduct an individual test on both samples. It is not necessary for all tests to be performed by the same person. Please use the same set of sieves for both samples. Report the results of a single determination only, not the average of two or more. For any tests you choose not to perform, leave the appropriate spaces blank on the data sheet.

Note: Please note that samples 169 and 170 are not identical. The program is designed to obtain two independent test results, one for each numbered sample, for each test method that the laboratory chooses to perform.

Note also that the coarse aggregate for this round of testing (Samples #169 and #170) contains particles of various compositions. Some particles are rather fragile, especially when wet. The samples are to be evaluated as being obtained from a single source. Laboratories should take appropriate steps to prevent excessive degradation of the samples during testing.

Directions for the individual tests on Samples No. 169 and No. 170 are as follows:

NOTE: The following steps should be taken in handling the samples if a full series of tests is to be performed on the material provided:

1. Oven-dry the material at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) before testing is begun.
2. Perform T11/C117 and T27/C136 on the entire sample.
3. Recombine all the plus 4.75-mm material and then select a representative test sample for T85/C127.
4. Recombine the material from T85/C127 with the remaining material from Step 3.
4. Oven-dry the recombined material at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$). Then, separate the material into size fractions by sieving, and obtain test samples for T96/C131 and T104/C88 in accordance with those test methods.

Materials Finer Than 75- μm Sieve in Mineral Aggregates by Washing, AASHTO T11-05 (Procedure A) or ASTM C117-04 (Procedure A): After oven drying, wash the entire sample in plain water. (Do not use a wetting agent.) Report the percentage finer than the 75- μm (No. 200) sieve to the nearest 0.01 percent. Upon completion of this test, the total oven dry sample mass determined before washing is to be used for the sieve analysis (T27/C136).

Sieve Analysis of Fine and Coarse Aggregates, AASHTO T27-06 or ASTM C136-06: Report, to the nearest 0.1 percent, the total material *passing* each of the following sieves: 25.0, 19.0, 12.5, 9.5, and 4.75 mm. Calculate percentages passing on the basis of the total mass of the initial dry sample. If T11 or C117 was performed, include the mass of the material finer than the 75- μm (No. 200) sieve by washing in the sieve analysis calculation; in other words, use the total oven dry sample mass that was determined prior to washing in T11 or C117 as the basis for calculating all the percentages. Use the same set of sieves for both samples.

Specific Gravity and Absorption of Coarse Aggregate, AASHTO T85-10 or Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate, ASTM C127-07: Oven-dry the samples at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) and determine the bulk, the bulk (SSD) and the apparent specific gravities. [ASTM C127 refers to these results as Relative Density (OD), Relative Density (SSD), and Apparent Relative Density, respectively.] Report these to the nearest 0.001 units. Determine the absorption and report it to the nearest 0.01 percent.

Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine, AASHTO T96-02 or ASTM C131-06: Perform the B grading using 11 steel spheres. In determining the loss, wash the material retained on the 1.70-mm (No. 12) sieve and oven-dry at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) to a constant mass. Report the percentage of loss by abrasion and impact to the nearest 0.01 percent.

Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate, AASHTO T104-99 or ASTM C88-05: The test may be performed using sodium or magnesium sulfate, or both solutions if desired. Perform five cycles on the following size fractions: passing the 19.0-mm and retained on the 9.5-mm sieve; passing the 9.5-mm and retained on the 4.75-mm sieve. For each size fraction, report the material finer than the designated sieve, expressed to the nearest 0.01 percent of the original weight of the fraction. Do NOT compute the weighted average or weighted percentage loss.

AGC Sample Data Sheet for AGC 169-170

AASHTO MATERIALS REFERENCE LABORATORY (AMRL) Coarse Aggregate Proficiency Sample Data Sheet

Closing Date: October 28, 2010

We encourage you to use the online data entry system. Or, you may fax (301) 975-8208 or mail your data sheet to: Ron Holsinger, AMRL / NIST, 100 Bureau Dr., Stop 8619, Gaithersburg, MD 20899-8619. If your laboratory is not registered to submit results online, or if there are questions, contact AMRL at psp@amrl.net or call 301-975-5450.

Enter Test Results in Rows (1) to (15) Below

Materials Finer Than 75-µm (No. 200) Sieve by Washing: T11 or C117	Sample 169	Sample 170
Mark the Box at the Right to Show the Method Used – T11 <input type="checkbox"/> , C117 <input type="checkbox"/>		
Washing Method? Manual <input type="checkbox"/> , Mechanical Washing Apparatus <input type="checkbox"/> If Mechanical, Time for Wash? _____ (minutes)		
Percentage of material finer than the 75-µm sieve by washing (nearest 0.01 percent) (1)		
Sieve Analysis: T27 or C136 (Report the total material PASSING each sieve.)		
Mark the Box at the Right to Show the Method Used – T27 <input type="checkbox"/> , C136 <input type="checkbox"/>		
Total Material Passing the 25.0-mm (1-in.) Sieve (nearest 0.1 percent) (2)		
Total Material Passing the 19.0-mm (3/4-in.) Sieve (nearest 0.1 percent) (3)		
Total Material Passing the 12.5-mm (1/2-in.) Sieve (nearest 0.1 percent) (4)		
Total Material Passing the 9.5-mm (3/8-in.) Sieve (nearest 0.1 percent) (5)		
Total Material Passing the 4.75-mm (No. 4) Sieve (nearest 0.1 percent) (6)		
Specific Gravity (or Relative Density) and Absorption: T85 or C127		
Mark the Box at the Right to Show the Method Used – T85 <input type="checkbox"/> , C127 <input type="checkbox"/>		
Bulk Specific Gravity [or Relative Density, OD for C127] (nearest 0.001) (7)		
Bulk Specific Gravity, SSD [or Relative Density, SSD for C127] (nearest 0.001) (8)		
Apparent Specific Gravity [or Apparent Relative Density for C127] (nearest 0.001) (9)		
Absorption (nearest 0.01 percent) (10)		
Los Angeles Abrasion: T96 or C131		
Mark the Box at the Right to Show the Method Used – T96 <input type="checkbox"/> , C131 <input type="checkbox"/>		
Percentage of Loss by Abrasion and Impact, B Grading (nearest 0.01 percent) (11)		
Sulfate Soundness Test: T104 or C88		
Mark the Box at the Right to Show the Method Used – T104 <input type="checkbox"/>, C88 <input type="checkbox"/>		
Enter results for SODIUM SULFATE testing in rows (12) and (13)		
Percentage of 19.0 to 9.5-mm fraction passing 8.0-mm sieve (nearest 0.01 percent) (12)		
Percentage of 9.5 to 4.75-mm fraction passing 4.0-mm sieve (nearest 0.01 percent) (13)		
Enter results for MAGNESIUM SULFATE testing in rows (14) and (15)		
Percentage of 19.0 to 9.5-mm fraction passing 8.0-mm sieve (nearest 0.01 percent) (14)		
Percentage of 9.5 to 4.75-mm fraction passing 4.0-mm sieve (nearest 0.01 percent) (15)		

Please complete the information below to identify your laboratory.

Lab Name:		Lab Number:	
City, State:			
Tested By:			
Lab Phone:			

Comments:

AGF Sample Instructions for AGF 171-172

Instructions for Testing and Reporting Fine Aggregate Proficiency Samples No. 171 and No. 172 Closing Date: March 10, 2011

All tests should be conducted on each of the two samples according to the AASHTO or ASTM Standard Test Methods indicated. To permit an estimate of single-operator precision, each individual test should be performed on both samples by the same person, but it is not necessary that all tests be performed by the same person. Please use the same set of sieves for both samples. Report the results of a single determination only, not the average of two or more, except in cases where an average is called for in the method. For any tests you do not choose to perform, leave the appropriate spaces on the data sheet blank.

Note: Please note that samples 171 and 172 are not identical. The program is designed to obtain two independent test results, one for each numbered sample, for each test method that the laboratory chooses to perform. Also, the samples for sieve testing are provided in small plastic bags (each weighing approximately 500 g) and were processed differently. Sieving sample 171 is air-dried and sample 172 is wet. Please remember to oven dry both samples before testing.

PLEASE USE THE SAMPLES IN THE SMALL PLASTIC BAGS FOR T11/C117 AND T27/C136.

Materials Finer Than 75- μ m Sieve by Washing (Procedure B using a wetting agent), AASHTO T11-05 or ASTM C117-04:

Oven dry the gradation sample (in the small bag), weigh it, place it in the container, add water and wetting agent, and wash it over the 75- μ m (No. 200) sieve (as directed by T11/C117, Procedure B). Determine the amount of material finer than the 75- μ m sieve by washing. Report the percentage finer than the 75- μ m (No. 200) sieve to the nearest 0.01 percent.

Sieve Analysis, AASHTO T27-06 or ASTM C136-06:

Oven dry the remaining gradation material again (after the wash) and sieve it (as directed by T27/C136). Report to the nearest 0.1 percent the total material **passing** each of the following sieves: 4.75-mm, 2.36-mm, 1.18-mm, 600- μ m, 300- μ m, and 150- μ m. Report the percentage passing the 75- μ m sieve to the nearest 0.01 percent. Calculate the percents based on the total original oven dry mass before the gradation sample was washed. (*The intent is to follow the test methods exactly as written.*) **Use the same set of sieves for both samples.**

PLEASE USE THE LARGE SAMPLES FOR THE REMAINDER OF THE TESTS BELOW.

Specific Gravity (Relative Density) and Absorption of Fine Aggregate, AASHTO T84-10 or ASTM C128-07a:

Oven dry the sample at $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$) and determine the bulk specific gravity, the bulk specific gravity (SSD) and the apparent specific gravity [or relative density (OD), relative density (SSD), and apparent relative density for C128]. Report these to the nearest 0.001 units. Determine the absorption and report it to the nearest 0.01 percent.

Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test, AASHTO T176-08 or ASTM D2419-09:

Report the average of the three sand equivalent determinations. ***Special Instructions: After test specimens are obtained (Specimens may be obtained using either the Air Dry or Pre-Wet method according to AASHTO Alternate Method No.1 or No.2, or ASTM Procedure A or B), dry each test specimen to constant mass at $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$) and cool to room temperature before testing. (Moist test specimens produce lower sand equivalent values than corresponding oven dry specimens. We are asking laboratories to oven dry the prepared test specimens before pouring them into the plastic cylinder in order to obtain more consistent results for between laboratory comparisons.)***

Sulfate Soundness by Use of Sodium Sulfate or Magnesium Sulfate, AASHTO T104-99 or ASTM C88-05:

The test may be performed using sodium or magnesium sulfate, or both solutions if desired. Perform five cycles on the following sizes: passing the 2.36-mm and retained on the 1.18-mm sieve; passing the 1.18-mm and retained on the 600- μ m sieve; passing the 600- μ m and retained on the 300- μ m sieve. For each size fraction, report the amount of material finer than the designated sieve as a percentage of the original mass of the fraction to the nearest 0.01 percent. **Do NOT compute the weighted, or weighted average, loss.**

Uncompacted Void Content, AASHTO T304-08 or ASTM C1252-06:

Perform Method A on both samples and complete two test runs on each sample. Calculate the uncompacted voids for each test run and record each result to the nearest 0.01 percent. Calculate the average uncompacted voids of the two test runs and report the average to the nearest 0.01 percent.

AGF Sample Data Sheet for AGF 171-172

Contact AMRL at psp@amrl.net or call 301-975-5450 if there are questions.

Fine Aggregate Proficiency Sample Data Sheet

Closing Date: **March 10, 2011**

We encourage you to use the online data entry system. Online data entry enables you to submit data, revise data, and receive confirmation. Please check the confirmation page to be sure that the results are entered correctly. Or, you may fax (301) 975-8208 or mail your data sheet to: ron holsinger, amrl / nist, 100 bureau dr., stop 8619, gaithersburg, md 20899-8619. Contact amrl at psp@amrl.net or call 301-975-5450 if there are questions.

Enter results in rows (1) to (23) below

	Sample 171	Sample 172
Materials Finer Than 75-μm (No. 200) Sieve by Washing: Method Used? – T11 <input type="checkbox"/>, C117 <input type="checkbox"/>		
<i>(Use the approximately 500-g sample in the small plastic bag.)</i>		
Washing Procedure? Manual <input type="checkbox"/> , Mechanical Washing Apparatus <input type="checkbox"/> If Mechanical, Time for Wash? _____ (minutes)		
Total Oven Dry Mass of Specimen Before Washing (nearest 0.1 g) (1)		
Percentage Finer Than the 75-μm Sieve by Washing (nearest 0.01 percent) (2)		
Sieve Analysis: Method Used? – T27 <input type="checkbox"/>, C136 <input type="checkbox"/>		
<i>(Use the approx. 500-g sample in the small plastic bag and report the total material PASSING each sieve.)</i>		
Total Material Passing the 4.75-mm (No. 4) Sieve (nearest 0.1 percent) (3)		
Total Material Passing the 2.36-mm (No. 8) Sieve (nearest 0.1 percent) (4)		
Total Material Passing the 1.18-mm (No. 16) Sieve (nearest 0.1 percent) (5)		
Total Material Passing the 600-μm (No. 30) Sieve (nearest 0.1 percent) (6)		
Total Material Passing the 300-μm (No. 50) Sieve (nearest 0.1 percent) (7)		
Total Material Passing the 150-μm (No. 100) Sieve (nearest 0.1 percent) (8)		
Total Material Passing the 75-μm (No. 200) Sieve (nearest 0.01 percent) (9)		
Specific Gravity (Relative Density) and Absorption: Method Used? – T84 <input type="checkbox"/>, C128 <input type="checkbox"/>		
Procedure Used? Gravimetric (Pycnometer) <input type="checkbox"/> , Volumetric (Le Chatlier Flask) <input type="checkbox"/>		
Bulk Specific Gravity [or Relative Density, Oven Dry for C128] (nearest 0.001) (10)		
Bulk Specific Gravity, SSD [or Relative Density, SSD for C128] (nearest 0.001) (11)		
Apparent Specific Gravity [or Apparent Relative Density for C128] (nearest 0.001) (12)		
Absorption (nearest 0.01 percent) (13)		
Sand Equivalent: Method Used? – T176 <input type="checkbox"/>, D2419 <input type="checkbox"/>		
<i>(See Special Instructions for Testing and Reporting)</i>		
Sand Equivalent Value (whole number) (14)		
Sulfate Soundness Test: Method Used? – T104 <input type="checkbox"/>, C88 <input type="checkbox"/>		
SODIUM		
Material Finer Than the 1.18-mm Sieve, Na (nearest 0.01 percent) (15)		
Material Finer Than the 600-μm Sieve, Na (nearest 0.01 percent) (16)		
Material Finer Than the 300-μm Sieve, Na (nearest 0.01 percent) (17)		
MAGNESIUM		
Material Finer Than the 1.18-mm Sieve, Mg (nearest 0.01 percent) (18)		
Material Finer Than the 600-μm Sieve, Mg (nearest 0.01 percent) (19)		
Material Finer Than the 300-μm Sieve, Mg (nearest 0.01 percent) (20)		
Uncompacted Void Content: Method Used? – T304, Method A <input type="checkbox"/>, C1252, Method A <input type="checkbox"/>		
Uncompacted Voids, Test Run # 1 (nearest 0.01 percent) (21)		
Uncompacted Voids, Test Run # 2 (nearest 0.01 percent) (22)		
Uncompacted Voids, Average of Two Runs (nearest 0.01 percent) (23)		

Please complete the information below to identify your laboratory.

Lab Name:	Lab Number:
City, State:	
Country:	
Tested By:	
Lab Phone:	

HMAIO Sample Instructions for HMAIO 19-20

Instructions for Testing and Reporting

Hot Mix Asphalt Ignition Oven Proficiency Samples No. 19 and No. 20

All tests should be conducted on each of the two samples according to the AASHTO or ASTM Standard Methods indicated. Report the results of a single determination only, not the average of two or more, except in cases where an average is called for in the method. For any tests that you do not perform, leave the appropriate spaces on the data sheet blank.

Directions for the individual tests on Samples No. 19 and No. 20 follow:

Note: Please note that samples 19 and 20 are not identical. The percentages of asphalt and the aggregate gradations are different. The program is designed to obtain two independent test results, one for each numbered sample, for each test method that the laboratory chooses to perform.

Determining the Ignition Oven Correction (or Calibration) Factor for Asphalt Binder Content, T308-09:

Determine the correction factor according to the procedure described in AASHTO T308. For this round of testing, determination of the correction factor for the asphalt binder content requires testing two correction-factor specimens. The average of the two tests is the correction factor to be applied to both samples, No. 19 and No. 20. Do not determine an aggregate gradation correction factor for this round of testing.

For the convection-type furnace, perform testing on correction-factor specimens and on samples No. 19 and No. 20 at a temperature of 538°C (1000°F). Follow the manufacturer's instructions when using the direct IR irradiation-type furnace. Prepare three batches using the aggregate and asphalt provided. Prepare the three batches by first oven drying the aggregate provided. Then, combine the materials provided in the proportions described in the table below and mix at a temperature of 153 to 160°C (307 to 320°F). Make all necessary weighings to the nearest 0.1 g. One of the batches is to be used as a butter mix. The remaining two batches are the correction-factor specimens. Mix and discard the butter mix prior to mixing any of the correction-factor specimens.

Mix Formula for Correction Factor Specimens	Specimen Mass	
	Individual Mass (g)	Cumulative Mass (g)
1. 12.5 mm (½ in.)	78.0	78.0
2. 9.5 mm (¾ in.)	153.0	231.0
3. 4.75 mm (No. 4)	299.0	530.0
4. 2.36 mm (No. 8)	345.0	875.0
5. Fine Aggregate (-2.36 mm (-No. 8))	590.0	1465.0
6. Mineral Filler	67.0	1532.0
7. Asphalt	80.0	1612.0

Test the two correction-factor specimens. The average of the two tests is the correction factor to be applied to both samples, No. 19 and No. 20. Report the correction factor to the nearest 0.01 percent.

Determining the Asphalt Binder Content of Hot-Mix Asphalt by the Ignition Method, T308-09 or D6307-05:

Assume the AMRL pre-mixed hot mix asphalt samples provided, No. 19 and No. 20, are moisture free. Record the initial (as received) masses of the AMRL pre-mixed hot mix asphalt samples No. 19 and No. 20 to the nearest 0.1 g. Test hot mix asphalt samples No. 19 and No. 20 in accordance with the test method and report the correction (or calibration) factor determined above. Use the same correction factor for both samples, No. 19 and No. 20. Calculate and report the corrected asphalt binder content to the nearest 0.01 percent.

Mechanical Analysis of Extracted Aggregate, T30-08 or D5444-08:

Determine the mass of material removed by washing over the 75-µm (No. 200) sieve and report the result to the nearest 0.1 gram. Report, to the nearest 0.1 percent, the total material passing each of the following sieves, as percentages of the total mass of aggregate in the bituminous mixture: 12.5-mm, 9.5-mm, 4.75-mm, 2.36-mm, 1.18-mm, 600-µm, 300-µm and 150-µm. Report the total material passing the 75-µm sieve to the nearest 0.01 percent. The total material passing the 75-µm sieve shall include the material removed by washing and the material in the pan after dry sieving. Do not use an aggregate gradation correction factor for this round of testing.

HMAIO Sample Data Sheet for HMAIO 19-20

AASHTO MATERIALS REFERENCE LABORATORY (AMRL) Hot Mix Asphalt Ignition Oven Proficiency Sample Data Sheet

Closing Date: January 28, 2010

We encourage you to use the online data entry system. Or, you may fax (301) 975-8208 or mail your data sheet to: Ron Holsinger, AMRL/NIST, 100 Bureau Dr., Stop 8619, Gaithersburg, MD 20899-8619. If your laboratory is not registered to enter your results online, or if there are questions, contact AMRL at psp@amrl.net or call 301-975-5450.

Enter Test Results in Rows (1) to (13) Below

ASPHALT CONTENT BY IGNITION METHOD: Method Used? T308 <input type="checkbox"/> , D6307 <input type="checkbox"/>		Sample 19	Sample 20
Initial (as received) Mass of AMRL Pre-Mixed HMA Sample (nearest 0.1 g): <i>(for information only)</i> (1) <small>Assume the pre-mixed samples are moisture free.</small>			
Correction Factor for Asphalt Binder Content: <i>(for informational purposes only)</i> (2) <small>Determine the correction factor using the procedure described in the instructions. Use the same factor for both samples.</small>			
Corrected Asphalt Binder Content (nearest 0.01 percent) (3)			

MECHANICAL ANALYSIS: Method Used? T30 <input type="checkbox"/> , D5444 <input type="checkbox"/>		Sample 19	Sample 20
Mass removed by washing over the 75- μ m (No. 200) sieve (nearest 0.1 g): <i>(for information only)</i> (4) Method Used for Washing? Manual <input type="checkbox"/> , Mechanical Washing Apparatus <input type="checkbox"/>			
REPORT THE TOTAL PERCENT PASSING EACH SIEVE			
Total material passing the 12.5-mm (1/2 in.) sieve (nearest 0.1 percent) (5)			
Total material passing the 9.5-mm (3/8 in.) sieve (nearest 0.1 percent) (6)			
Total material passing the 4.75-mm (No. 4) sieve (nearest 0.1 percent) (7)			
Total material passing the 2.36-mm (No. 8) sieve (nearest 0.1 percent) (8)			
Total material passing the 1.18-mm (No. 16) sieve (nearest 0.1 percent) (9)			
Total material passing the 600- μ m (No. 30) sieve (nearest 0.1 percent) (10)			
Total material passing the 300- μ m (No. 50) sieve (nearest 0.1 percent) (11)			
Total material passing the 150- μ m (No. 100) sieve (nearest 0.1 percent) (12)			
Total material passing the 75- μ m (No. 200) sieve (nearest 0.01 percent) (13)			

Please complete the information below to identify your laboratory.

Lab Name:	Lab Number:
City, State:	
Country:	
Tested By:	
Lab Phone:	
Comments:	

HMASE Sample Instructions for HMASE 73-74

Instructions for Testing and Reporting Hot Mix Asphalt Solvent Extraction Proficiency Samples No. 73 and 74 Closing Date: January 6, 2011

All tests should be conducted on each of the two samples according to the AASHTO or ASTM Standard Methods indicated. Report the results of a single determination only, not the average of two or more, except in cases where an average is called for in the method. For any tests that you do not perform, leave the appropriate spaces on the data sheet blank.

Directions for the individual tests on Samples No. 73 and No. 74 follow:

Note: Please note that samples 73 and 74 are not identical. The percentages of asphalt and the aggregate gradations are different. The program is designed to obtain two independent test results, one for each numbered sample, for each test method that the laboratory chooses to perform.

Quantitative Extraction of Bitumen from Bituminous Paving Mixtures, T164-10, D2172-05, or T319-08:

Assume the sample is moisture free. Report the mass of the sample used to the nearest 0.1 g. Calculate and report the percentage of extracted asphalt to the nearest 0.01 percent.

Mechanical Analysis of Extracted Aggregate, T30-10 or D5444-08:

Determine the mass of material removed by washing over the 75- μ m sieve. Report the mass of material removed by washing over the 75- μ m sieve to the nearest 0.1 g. Report to the nearest 0.1 percent the total material passing each of the following sieves, as percentages of the total mass of aggregate in the bituminous mixture: 12.5-mm, 9.5-mm, 4.75-mm, 2.36-mm, 1.18-mm, 600- μ m, 300- μ m and 150- μ m. Report the total percentage passing the 75- μ m sieve to the nearest 0.01 percent; the **total** percent passing the 75- μ m sieve shall include the mass removed by washing, material in the pan, mineral matter in the extracted asphalt, and increase in mass of the filter.

Recovery and Testing of Asphalt Residue, T170-09 / D1856-09 or D5404-03 or T319-08:

Recover the asphalt using the Abson or Rotavapor Method. Use only the specified solvent.

Penetration of the Residue, T49-07 or D5-06el:

Report to the nearest whole unit the average of three penetrations at 25°C, 100 g, 5 seconds.

Kinematic Viscosity of the Residue, T201-10 or D2170-10:

Report the kinematic viscosity at 135°C in mm²/s (cSt) to four significant figures.

Viscosity of the Residue at 60°C, T202-10 or D2171-10:

Report the viscosity, at 60° C and 300 mm Hg vacuum, in Pa·s to four significant figures. (1 Pa·s is equivalent to 10 poise)

Dynamic Shear Rheometer (DSR), AASHTO Standard T315-10 or D7175-08:

Determine high temperature stiffness ($G^*/\sin \delta$) at 64°C, using a frequency of 10 rad/s, a 25 mm plate, a 1 mm gap and the strain or stress values specified in the method for tests on original binder. Report $G^*/\sin \delta$ to the nearest 0.01 kPa.

Please contact AMRL at psp@amrl.net or call 301-975-5450 if there are questions.

HMASE Sample Data Sheet for HMASE 73-74

AASHTO MATERIALS REFERENCE LABORATORY (AMRL)

Hot Mix Asphalt Solvent Extraction Proficiency Sample Data Sheet

Closing Date: January 6, 2011

We encourage you to use the online data entry system. Or, you may fax (301) 975-8208 or mail your data sheet to: Ron Holsinger, AMRL/NIST, 100 Bureau Dr., Stop 8619, Gaithersburg, MD 20899-8619. If your laboratory is not registered to enter your results online, or if there are questions, contact AMRL at psp@amrl.net or call 301-975-5450.

Enter Test Results in Rows (1) to (20) Below

ASPHALT CONTENT: <i>Select the Box to show the Method Used- T164 <input type="checkbox"/>, D2172 <input type="checkbox"/>, T319 <input type="checkbox"/></i>	Sample 73	Sample 74
Sample Mass, assume moisture free (nearest 0.1 g): <i>for informational purposes only</i>(1)		
Percent Asphalt (nearest 0.01 percent):(2)		

MECHANICAL ANALYSIS: <i>Select the Box to Show Method Used- T30 <input type="checkbox"/>, D5444 <input type="checkbox"/></i>	Sample 73	Sample 74
Washing Method? Manual <input type="checkbox"/> , Mechanical Washing Apparatus <input type="checkbox"/> If Mechanical, Time for Wash? _____ (minutes)		
Mass removed by washing over 75- μ m (No. 200) sieve (nearest 0.1 g): <i>for informational purposes only</i>(3)		
REPORT THE TOTAL PERCENT PASSING EACH SIEVE:		
Total material passing the 12.5-mm (1/2 in.) sieve (nearest 0.1 percent)(4)		
Total material passing the 9.5-mm (3/8 in.) sieve (nearest 0.1 percent)(5)		
Total material passing the 4.75-mm (No. 4) sieve (nearest 0.1 percent)(6)		
Total material passing the 2.36-mm (No. 8) sieve (nearest 0.1 percent)(7)		
Total material passing the 1.18-mm (No. 16) sieve (nearest 0.1 percent)(8)		
Total material passing the 600- μ m (No. 30) sieve (nearest 0.1 percent)(9)		
Total material passing the 300- μ m (No. 50) sieve (nearest 0.1 percent)(10)		
Total material passing the 150- μ m (No. 100) sieve (nearest 0.1 percent)(11)		
Total material passing the 75- μ m (No. 200) sieve (nearest 0.01 percent)(12) (Item #12 includes: Mass removed by washing + Material in pan + Mineral matter + Increase in mass of filter)		

RECOVERY AND TESTING OF ASPHALT RESIDUE	Sample 73	Sample 74
BY ABSON METHOD: <i>Select the Box to Show the Method Used- T170 <input type="checkbox"/>, D1856 <input type="checkbox"/></i>		
Penetration of Residue at 25°C, 100 g, 5 s (nearest unit): <i>Method Used? - T49 <input type="checkbox"/>, D5 <input type="checkbox"/></i>(13)		
Kinematic Viscosity of Residue at 135°C (mm ² /s, 4 sig. figures): <i>Method? - T201 <input type="checkbox"/>, D2170 <input type="checkbox"/></i>(14)		
Viscosity of Residue at 60°C (Pa.s, 4 sig. figures): <i>Method? - T202 <input type="checkbox"/>, D2171 <input type="checkbox"/></i>(15)		
G* / sin δ at 64°C tested as original binder (nearest 0.01 kPa): <i>Method? - T315 <input type="checkbox"/>, D7175 <input type="checkbox"/></i>(16)		
BY ROTAVAPOR METHOD: <i>Select the Box to Confirm the Method Used- D5404 <input type="checkbox"/>, T319 <input type="checkbox"/></i>		
Penetration of Residue at 25°C, 100 g, 5 s (nearest unit): <i>Method Used? - T49 <input type="checkbox"/>, D5 <input type="checkbox"/></i>(17)		
Kinematic Viscosity of Residue at 135°C (mm ² /s, 4 sig. figures): <i>Method? - T201 <input type="checkbox"/>, D2170 <input type="checkbox"/></i>(18)		
Viscosity of Residue at 60°C (Pa.s, 4 sig. figures): <i>Method? - T202 <input type="checkbox"/>, D2171 <input type="checkbox"/></i>(19)		
G* / sin δ at 64°C tested as original binder (nearest 0.01 kPa): <i>Method? - T315 <input type="checkbox"/>, D7175 <input type="checkbox"/></i>(20)		

Please complete the information below to identify your laboratory.

Lab Name:		Lab Number:	
City, State:			
Country:			
Tested By:			
Lab Phone:			

Comments:

□

APPENDIX B - T 96 COARSE AGGREGATE GRAPHS

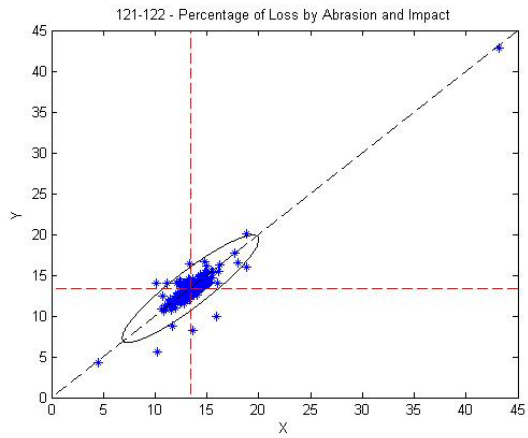


Figure B-1- AGC 121-122

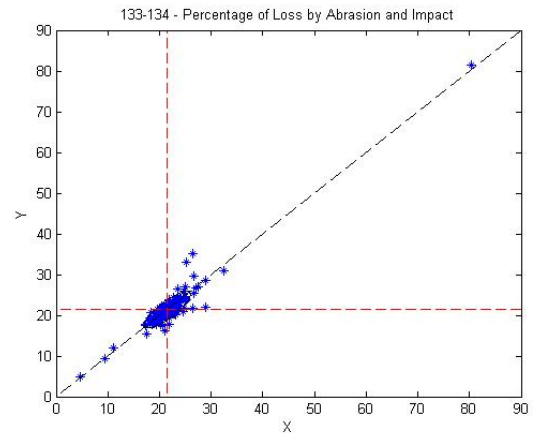


Figure B-4- AGC 133-134

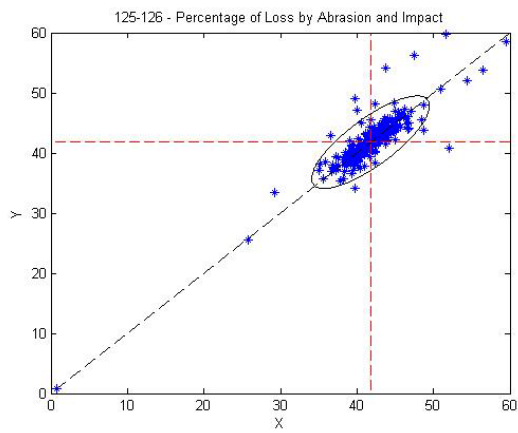


Figure B-2- AGC 125-126

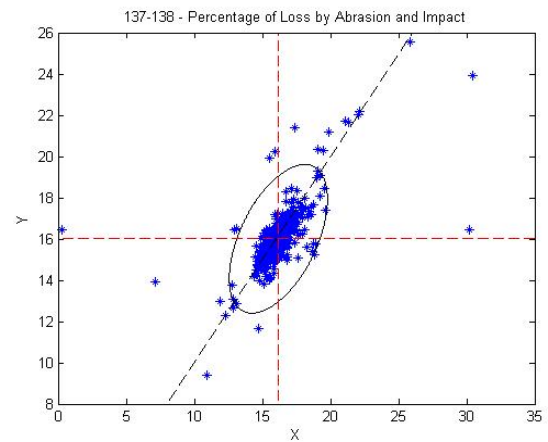


Figure B-5- AGC 137-138

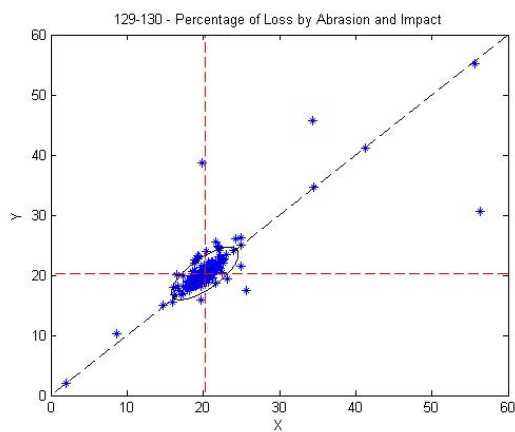


Figure B-3- AGC 129-130

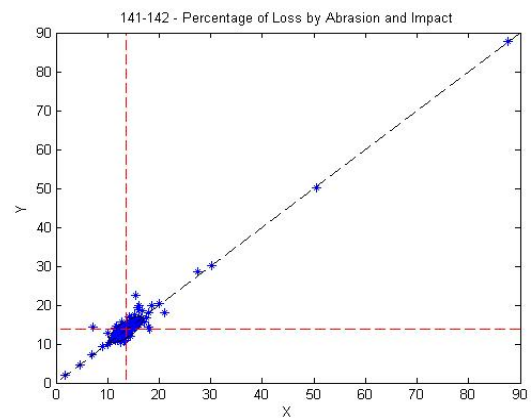


Figure B-6- AGC 141-142

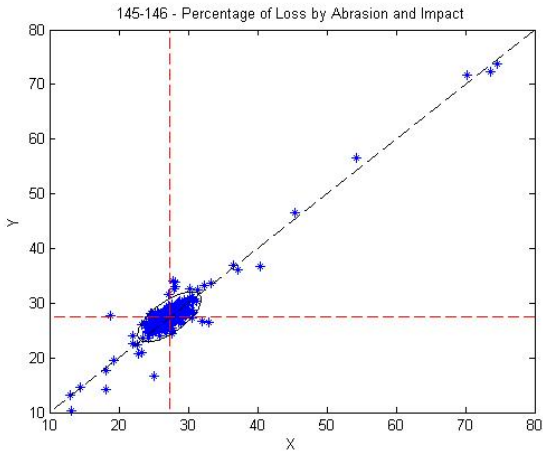


Figure B-7- AGC 145-146

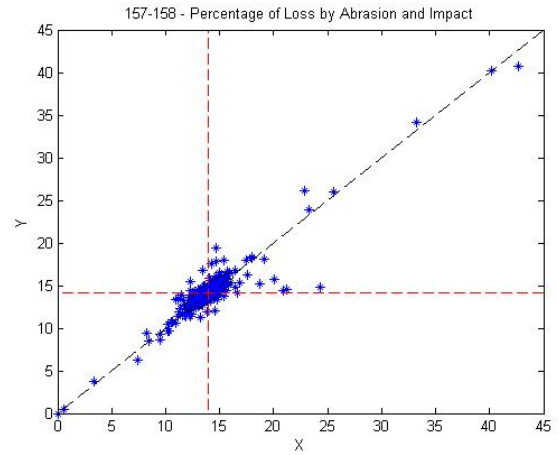


Figure B-10- AGC 157-158

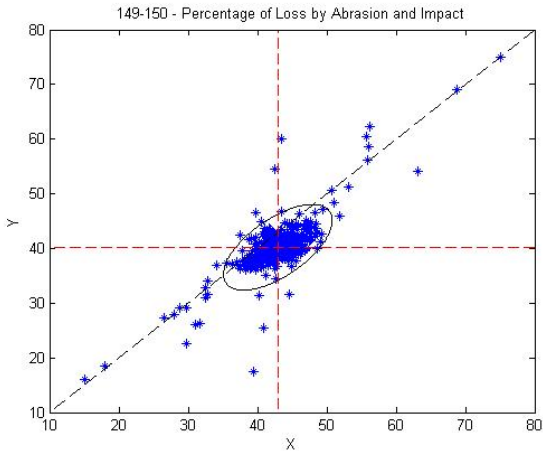


Figure B-8- AGC 149-150

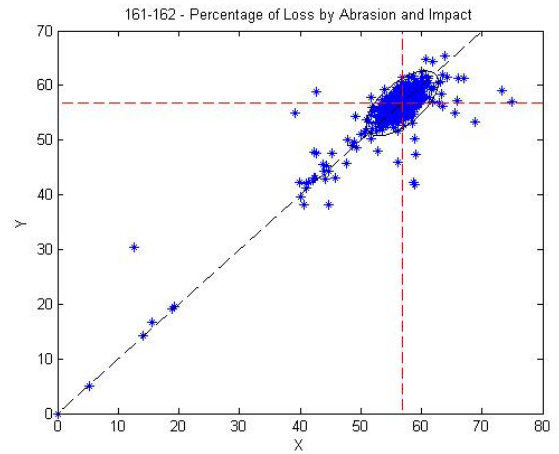


Figure B-11- AGC 161-162

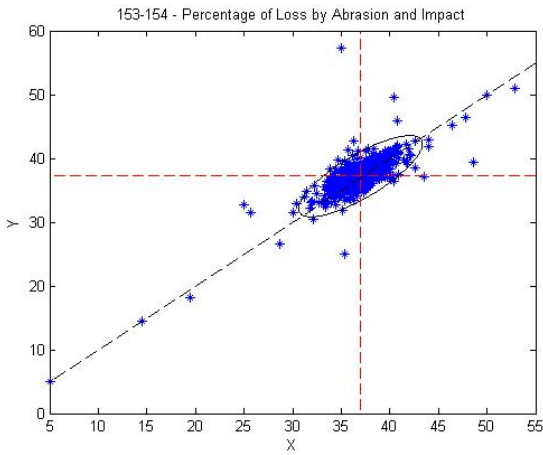


Figure B-9- AGC 153-154

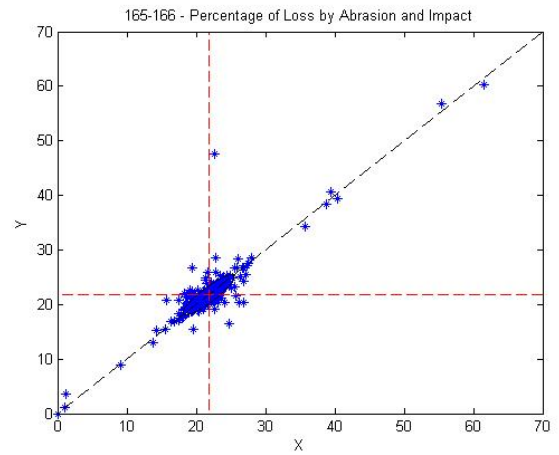


Figure B-12- AGC 165-166

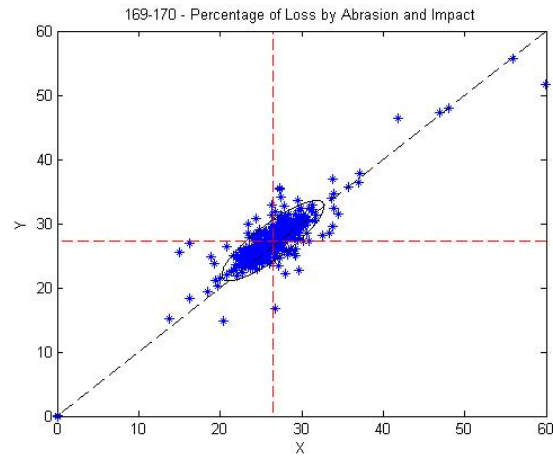


Figure B-13- AGC 169-170

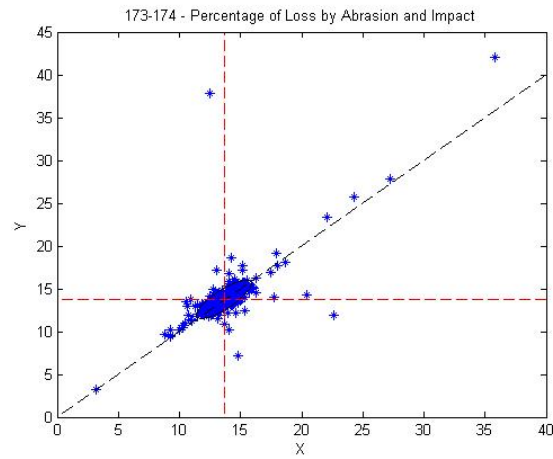


Figure B-14- AGC 173-174

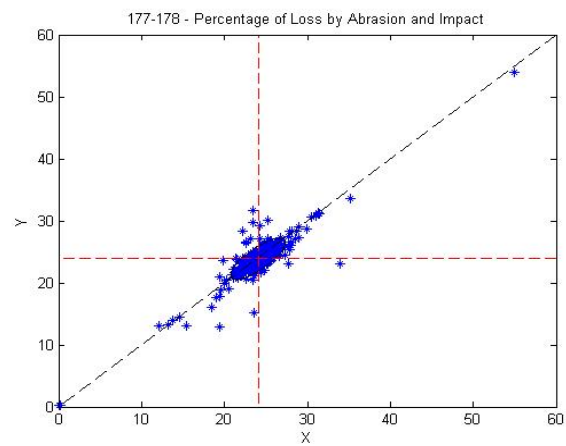


Figure B-15- AGC 177-178

APPENDIX C - T 304 FINE AGGREGATE GRAPHS

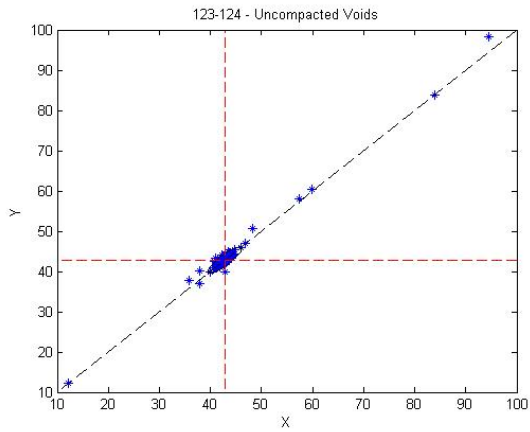


Figure C-1- AGF 123-124

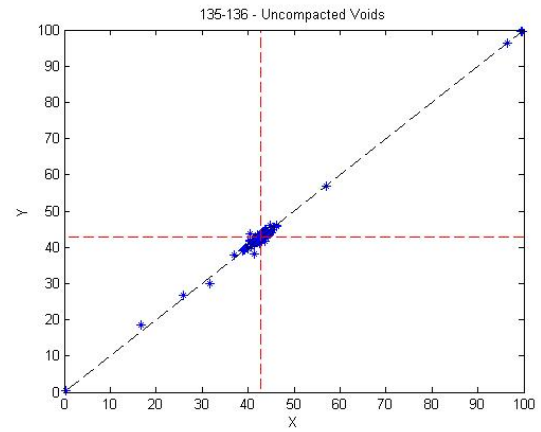


Figure C-4- AGF 135-136

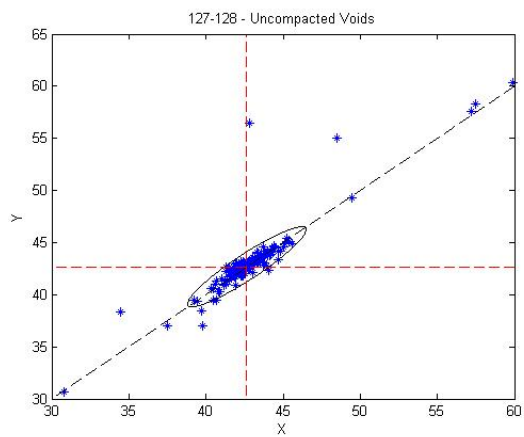


Figure C-2- AGF 127-128

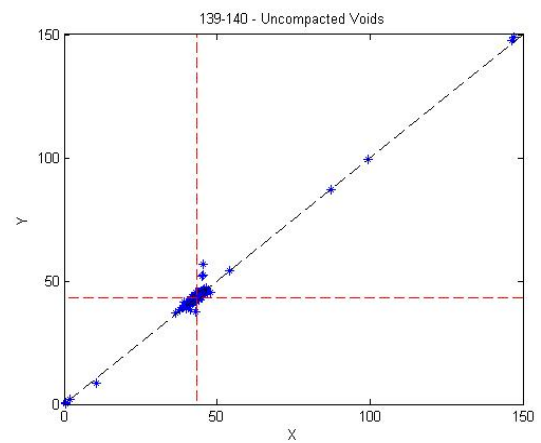


Figure C-5- AGF 139-140

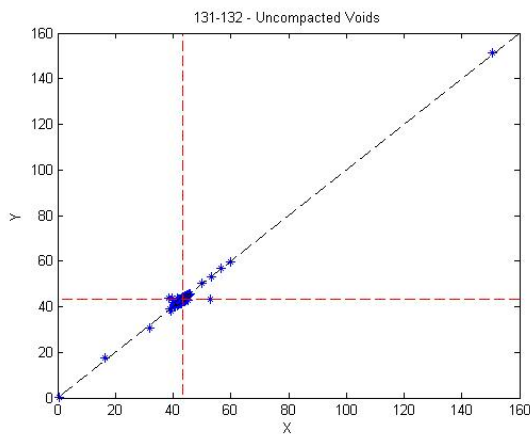


Figure C-3- AGF 131-132

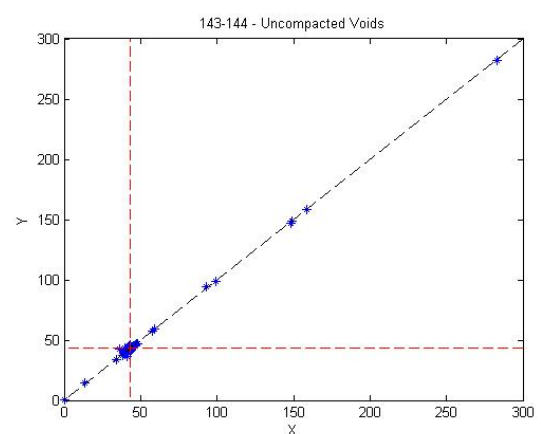


Figure C-6- AGF 143-144

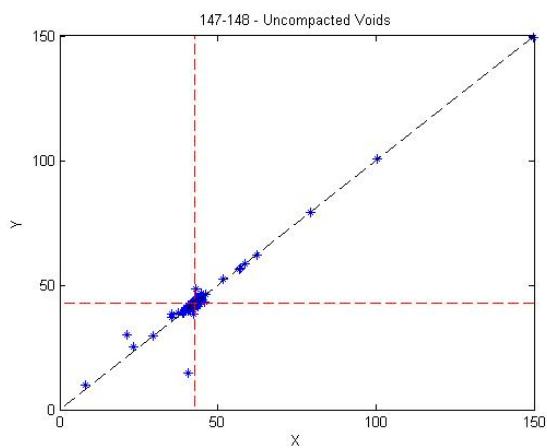


Figure C-7- AGF 147-148

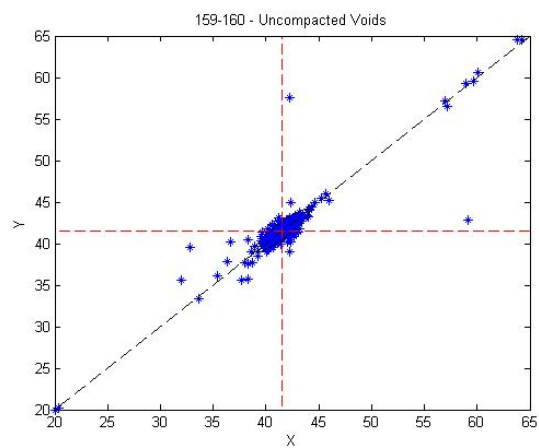


Figure C-10- AGF 159-160

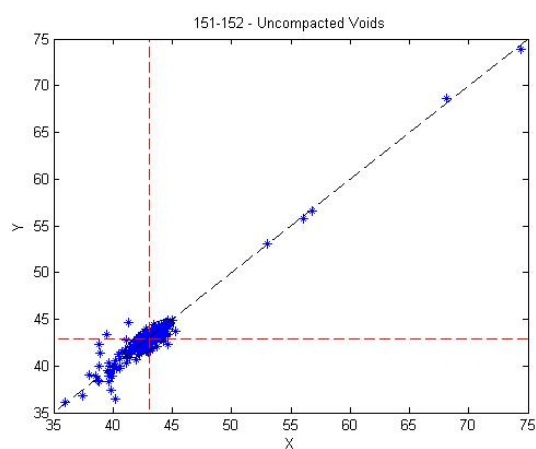


Figure C-8- AGF 151-152

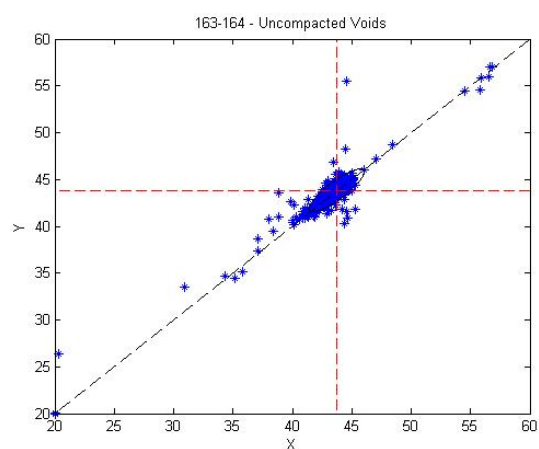


Figure C-11- AGF 163-164

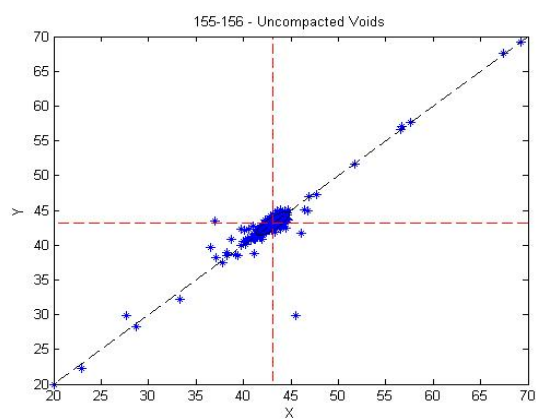


Figure C-9- AGF 155-156

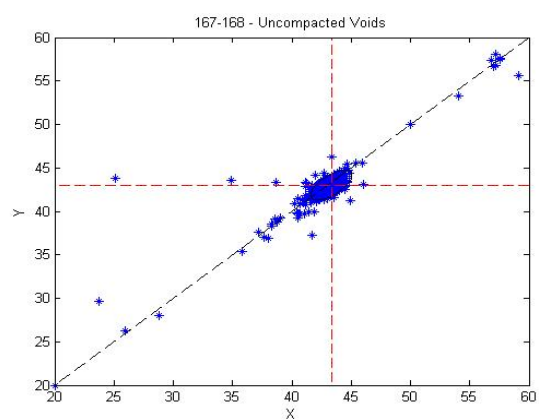


Figure C-12- AGF 167-168

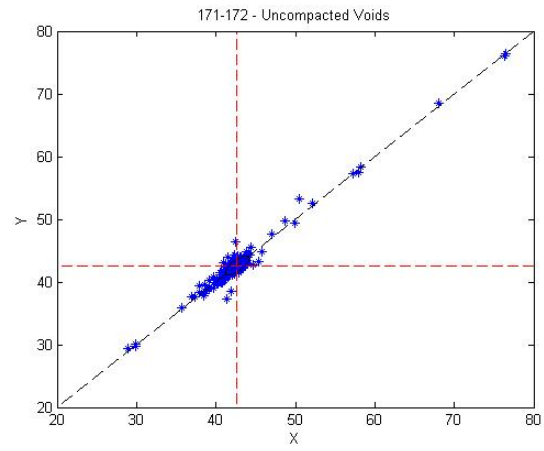


Figure C-13- AGF 171-172

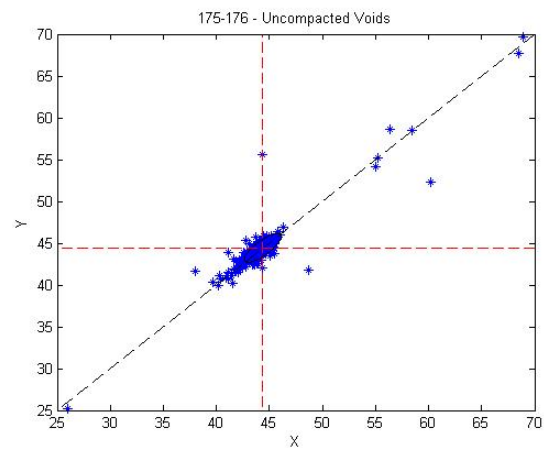


Figure C-14- AGF 175-176

APPENDIX D - T 11 COARSE AND FINE AGGREGATE GRAPHS

AGC Graphs

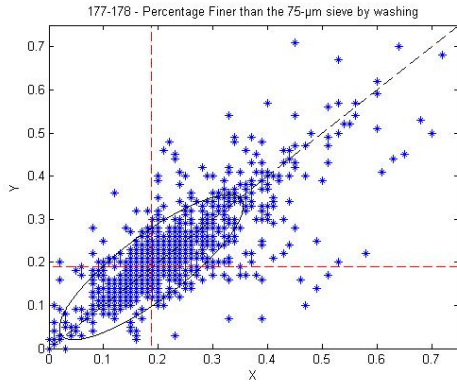


Figure D-1- AGC 177-178

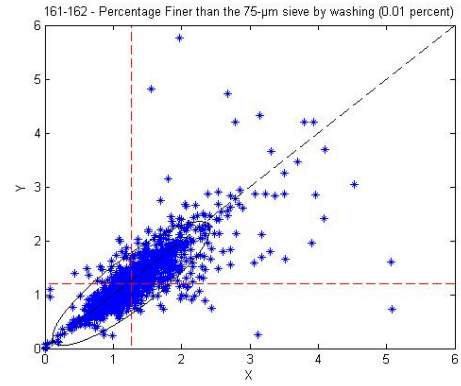


Figure D-5- AGC 161-162

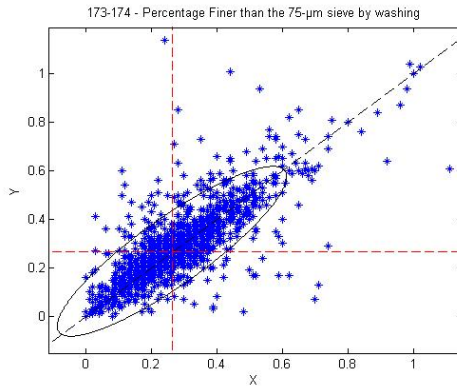


Figure D-2- AGC 173-174

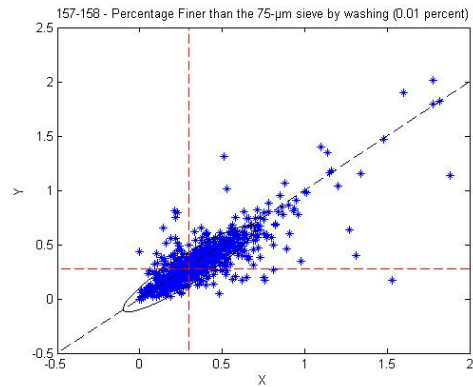


Figure D-6- AGC 157-158

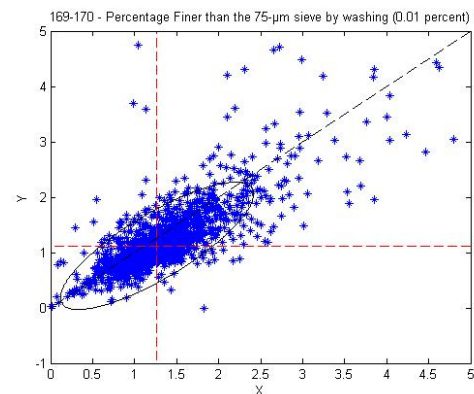


Figure D-3- AGC 169-170

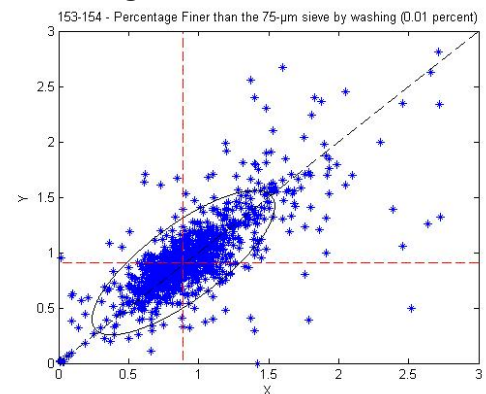


Figure D-7- AGC 153-154

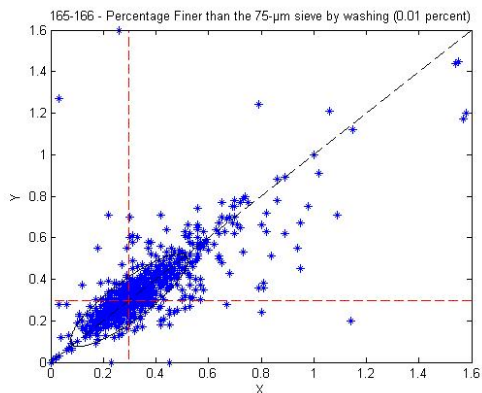


Figure D-4- AGC 165-166

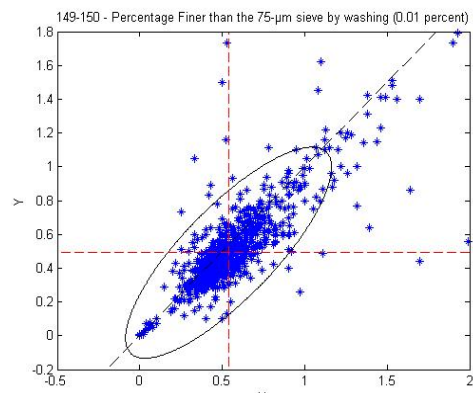


Figure D-8- AGC 149-150

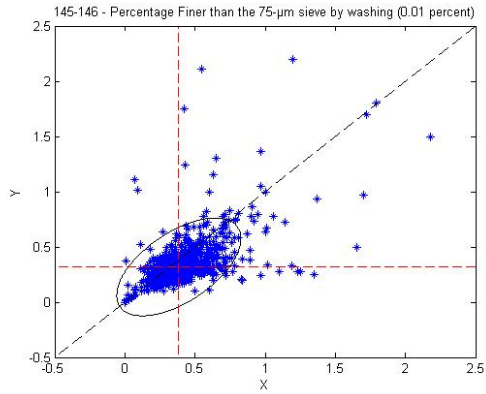


Figure D-9- AGC 145-146

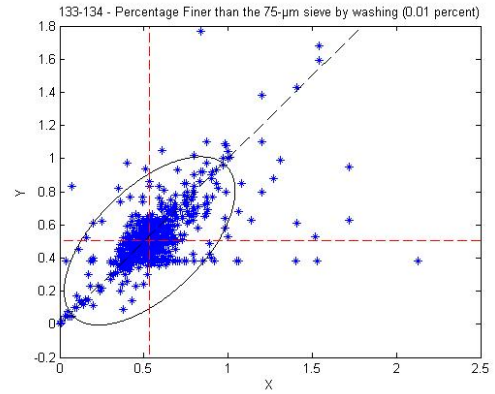


Figure D-12- AGC 133-134

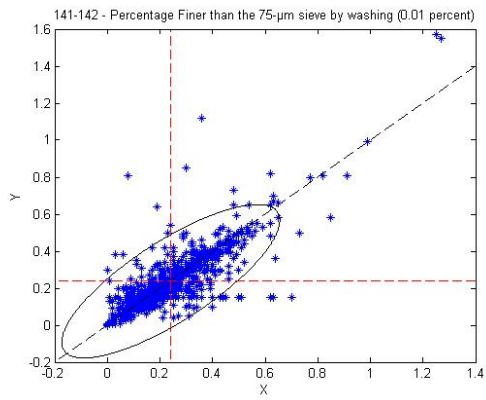


Figure D-10- AGC 141-142

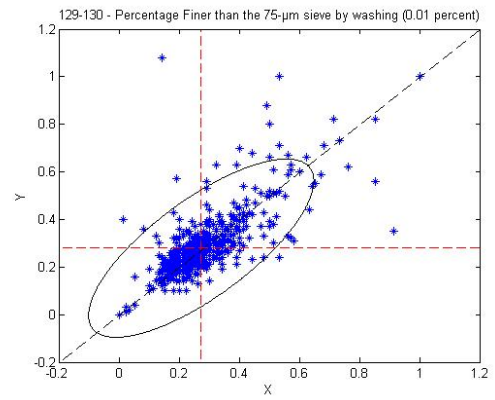


Figure D-13- AGC 129-130

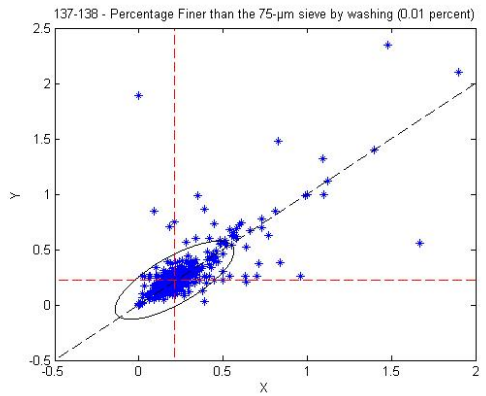


Figure D-11- AGC 137-138

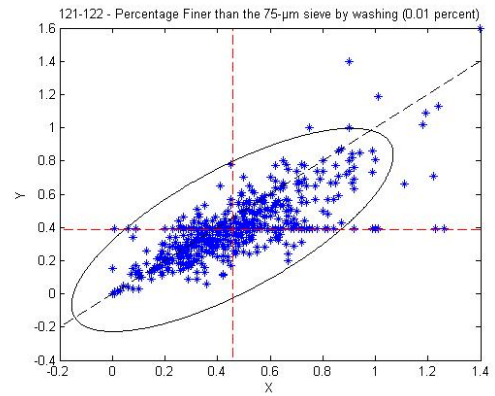


Figure D-14- AGC 121-122

AGF Graphs

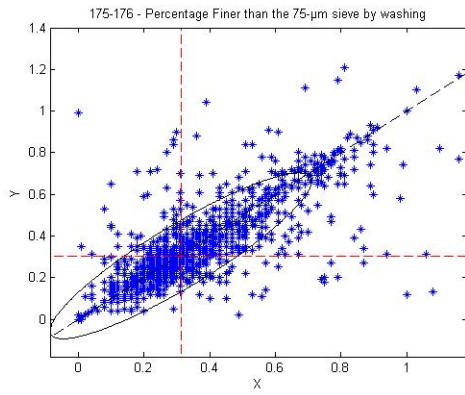


Figure D-15- AGF 175-176

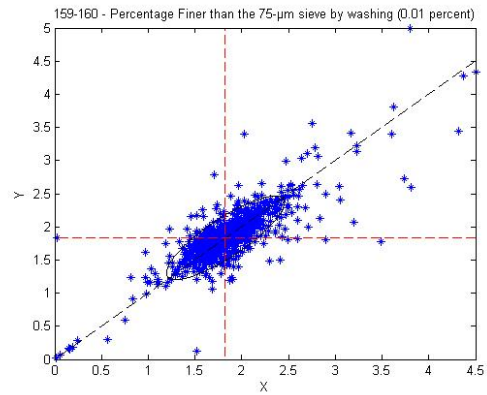


Figure D-19- AGF 159-160

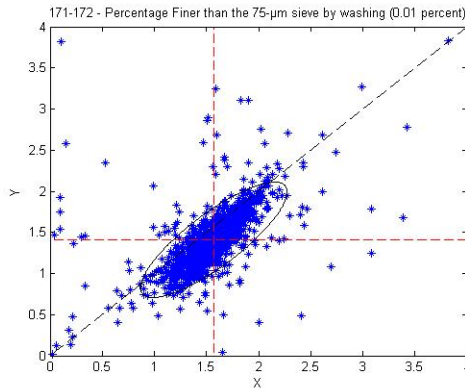


Figure D-16- AGF 171-172

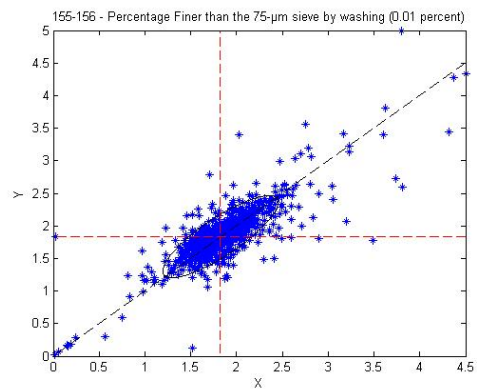


Figure D-20- AGF 155-156

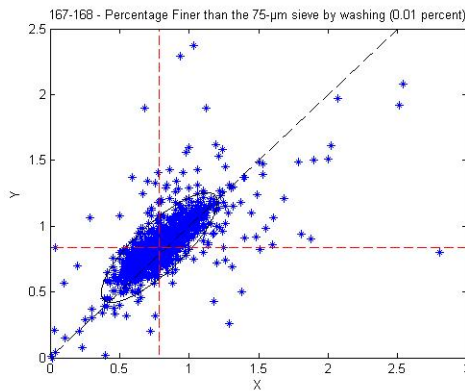


Figure D-17- AGF 167-168

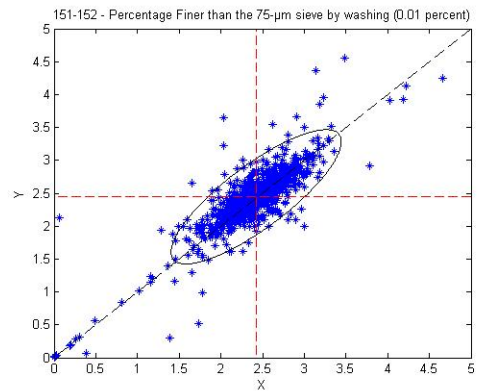


Figure D-21- AGF 151-152

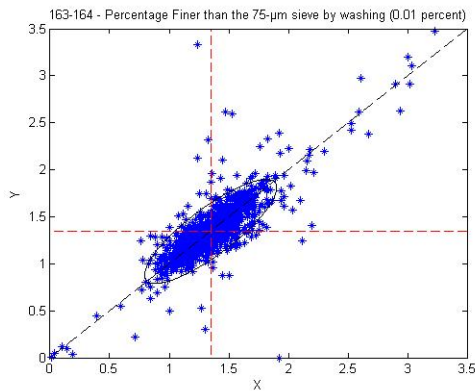


Figure D-18- AGF 163-164

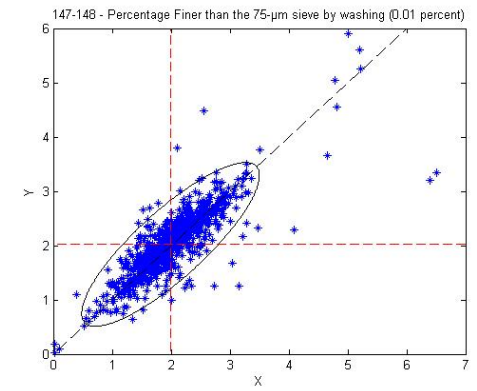


Figure D-22- AGF 147-148

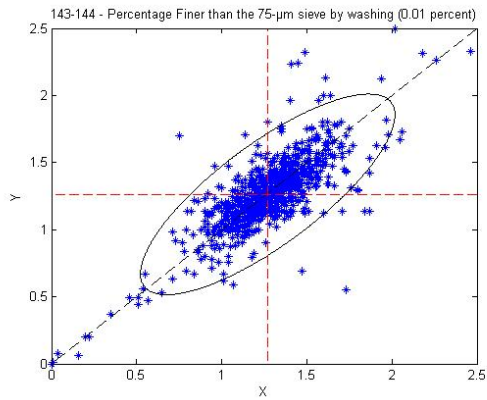


Figure D-23- AGF 143-144

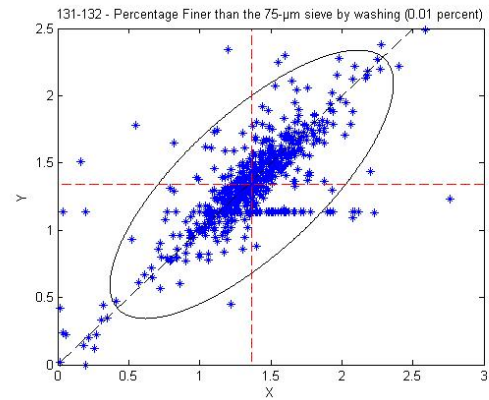


Figure D-26- AGF 131-132

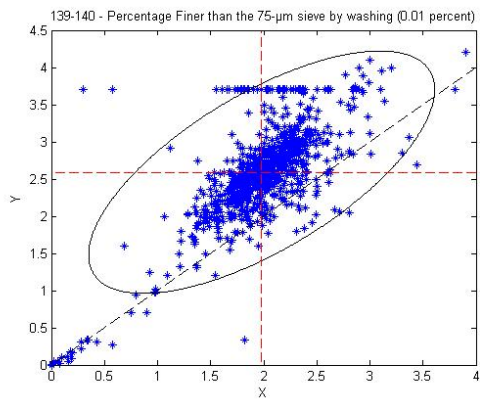


Figure D-24- AGF 139-140

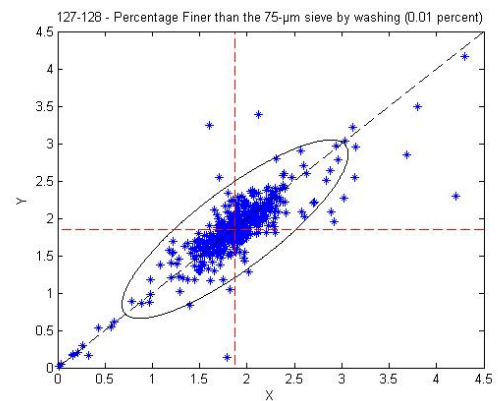


Figure D-27- AGF 127-128

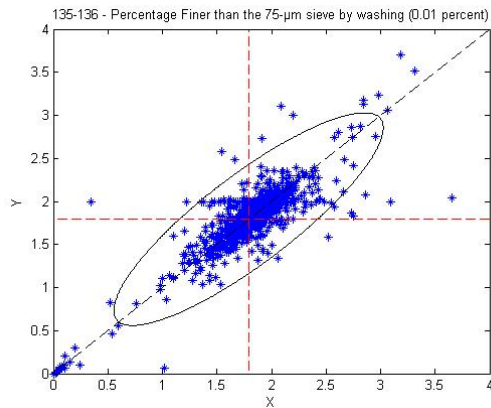


Figure D-25- AGF 135-136

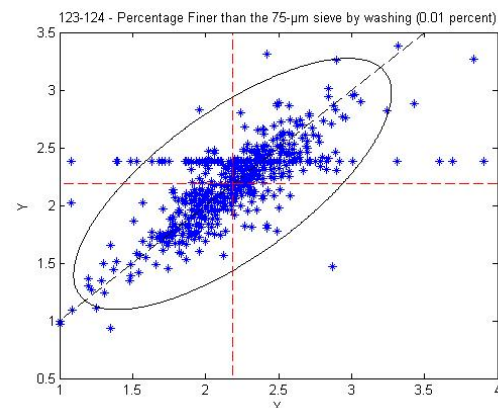


Figure D-28- AGF 123-124

APPENDIX E - PRECISION STATEMENTS FOR T 96, T 304 AND T 11

Precision Estimate for AASHTO T 96 - Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

E.1 Precision and Bias

E.1.1 Precision – Criteria for judging the acceptability of resistance to degradation results obtained by this method are given in Table E-1.

E.1.1.1 Single-Operator Precision (Repeatability) – The figures in Column 2 of Table E-1 are the coefficients of variation that have been found to be appropriate for the conditions of test described in Column 1. Two results obtained in the same laboratory, by the same operator using the same equipment, in the shortest practical period of time, should not be considered suspect unless the difference in the two results, expressed as a percent of their mean, exceeds the values given in Table E-1, Column 3.

E.1.1.2 Multilaboratory Precision (Reproducibility) – The figures in Column 2 of Table E-1 are the coefficients of variation that have been found to be appropriate for the conditions of test described in Column 1. Two results submitted by two different operators testing the same material in different laboratories shall not be considered suspect unless the difference in the two results, expressed as a percent of their mean, exceeds the values given in Table E-1, Column 3.

Table E-1- Precision Estimates

Statistics	Coefficient of Variation 1s (%) ^a	Acceptable Range of Two Test Results d2s (%) ^a
Single-operator Precision LA Abrasion loss (%)	3.0	8.5
Multilaboratory Precision LA Abrasion Loss (%)	6.2	17.6

^aThese values represent the 1s% and d2s% limits described in ASTM Practice C670

Note – The precision estimates given in Table E are based on the analysis of test results from fifteen pairs of AMRL Coarse Aggregate proficiency samples. The data analyzed consisted of results from 290 to 513 laboratories for each of the fifteen pairs of samples. The average percent LA Abrasion loss ranged from 13% to 57%. The details of this analysis are in the NCHRP final report for Task 2/Phase A-3 of Research Project 10-87.

E.1.2 Bias – The bias of the procedure in this test method cannot be determined.

Precision Estimate for AASHTO T 304 – Uncompacted Void Content of Fine Aggregate

E.2 Precision and Bias

E.2.1 Precision – Criteria for judging the acceptability of void content obtained by this method are given in Table E-2.

E.2.1.1 Single-Operator Precision (Repeatability) – The figures in Column 2 of Table E-2 are the standard deviations that have been found to be appropriate for the conditions of test described in Column 1. Two results obtained in the same laboratory, by the same operator using the same equipment, in the shortest practical period of time, should not be considered suspect unless the difference in the two results exceeds the values given in Table E-2, Column 3.

E.2.1.2 Multilaboratory Precision (Reproducibility) – The figures in Column 2 of Table E-2 are the standard deviations that have been found to be appropriate for the conditions of test described in Column 1. Two results submitted by two different operators testing the same material in different laboratories shall not be considered suspect unless the difference in the two results exceeds the values given in Table E-2, Column 3.

Table E-2- Precision Estimates

Statistics	Standard Deviations 1s ^a	Acceptable Range of Two Test Results d2s ^a
Single-operator Precision Uncompacted Voids (%)	0.33	0.95
Multilaboratory Precision Uncompacted Voids (%)	0.81	2.29

^aThese values represent the 1s (or 1s%) and d2s (or d2s%) limits described in ASTM Practice C670

Note – The precision estimates given in Table E-2 are based on the analysis of test results from fourteen pairs of AMRL Fine Aggregate proficiency samples. The data analyzed consisted of results from 183 to 535 laboratories for each of the fourteen pairs of samples. The average percent uncompacted voids ranged from 42% to 45%. The details of this analysis are in the NCHRP final report for Task 2/Phase A-3 of Research Project 10-87.

E.2.2 Bias – The bias of the procedure in this test method cannot be determined.

Precision Estimate for AASHTO T 11 – Materials Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing

E.3 Precision and Bias

E.3.1 Precision – Criteria for judging the acceptability of percent material finer than a 75- μ m (No. 200) sieve by washing obtained by this method are given in Table E-3.

E.3.1.1 Single-Operator Precision (Repeatability) – The figures in Column 2 of Table E-3 are the standard deviations that have been found to be appropriate for the conditions of test described in Column 1. Two results obtained in the same laboratory, by the same operator using the same equipment, in the shortest practical period of time, should not be considered suspect unless the difference in the two results, exceeds the values given in Table E-3, Column 3.

E.3.1.2 Multilaboratory Precision (Reproducibility) – The figures in Column 2 of Table E-3 are the standard deviations that have been found to be appropriate for the conditions of test described in Column 1. Two results submitted by two different operators testing the same material in different laboratories shall not be considered suspect unless the difference in the two results exceeds the values given in Table E-3, Column 3.

Table E-3- Precision Estimates

Condition of Test	Standard Deviation 1s ^a	Acceptable Range of Two Test Results d2s ^a
Single-operator Precision		
Percent finer than 75- μ m sieve by washing (%)		
Coarse Aggregate	0.10	0.28
Fine Aggregate	0.14	0.39
Multilaboratory Precision		
Percent finer than 75- μ m sieve by washing (%)		
Coarse Aggregate	0.21	0.59
Fine Aggregate	0.32	0.90

^aThese values represent the 1s (or 1s%) and d2s (or d2s%) limits described in ASTM Practice C670

Note – The precision estimates given in Table E are based on the analysis of test results from fourteen pairs of Coarse Aggregate and fourteen pairs of Fine Aggregate of the AMRL Proficiency Sample Program. The data analyzed consisted of results from 552 to 1380 laboratories for each of the fourteen pairs of samples of each coarse and fine aggregates. The average percent finer than 75- μ m Sieve was less than 1.5% for coarse aggregate and in a range of 1% to 3% for fine aggregate. The details of this analysis are in the NCHRP final report of Task 2/Phase A-3 of Research Project 10-87.

E.3.2 Bias – The bias of the procedure in this test method cannot be determined.

APPENDIX F - COARSE AGGREGATE- WASHING METHOD TABLES AND GRAPHS

Total Material Passing Scatter Plot Graphs

AGC 169-170

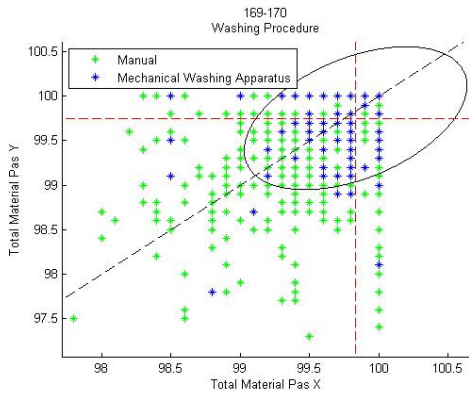


Figure F-1- Total Material Passing the 25.0-mm (1-in.) Sieve

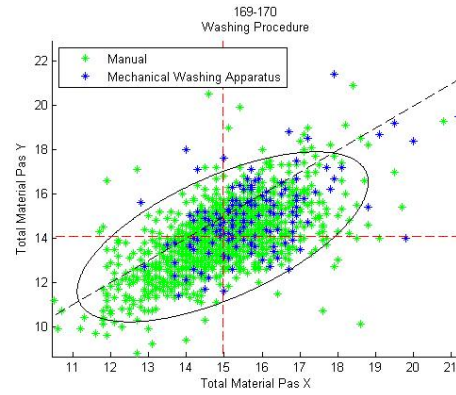


Figure F-4- Total Material Passing the 9.5-mm (38-in.) Sieve

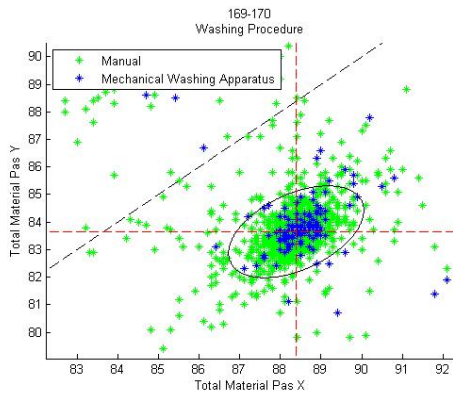


Figure F-2- Total Material Passing the 19.0-mm (34-in.) Sieve

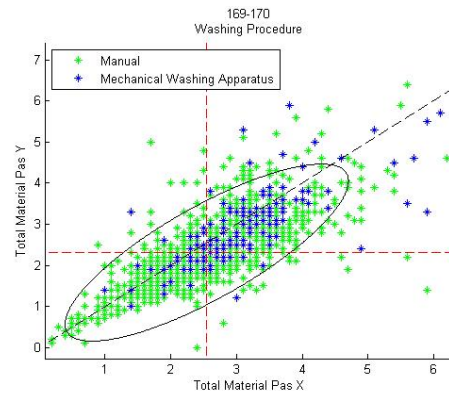


Figure F-5- Total Material Passing the 4.75-mm (No. 4) Sieve

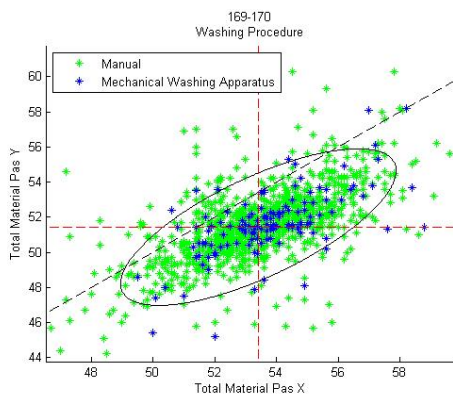


Figure F-3- Total Material Passing the 12.5-mm (12-in.) Sieve

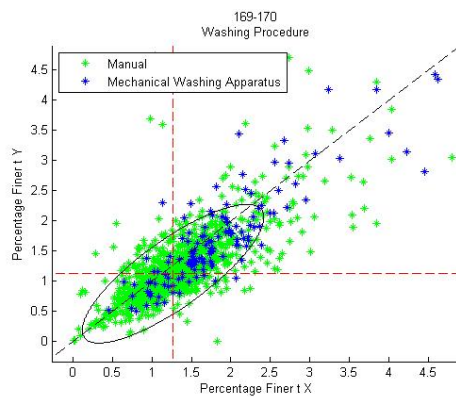


Figure F-6- Percentage Finer than the 75-μm sieve by washing

AGC 173-174

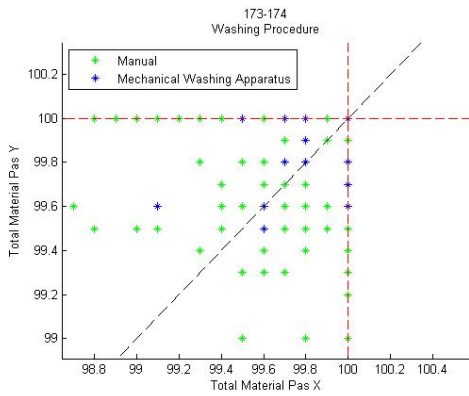


Figure F-7- Total Material Passing the 25.0-mm (1-in.) Sieve

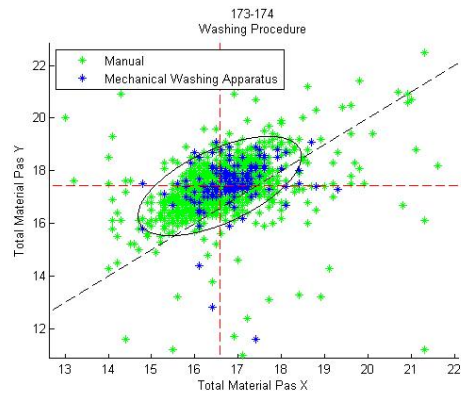


Figure F-10- Total Material Passing the 9.5-mm (38-in.) Sieve

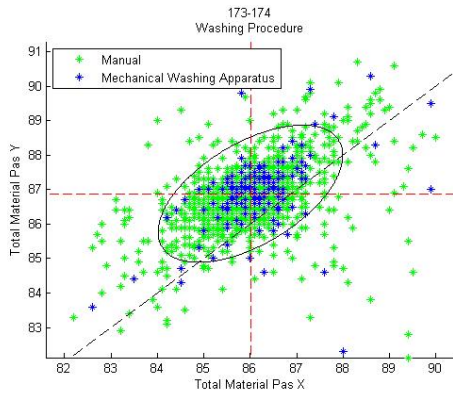


Figure F-8- Total Material Passing the 19.0-mm (34-in.) Sieve

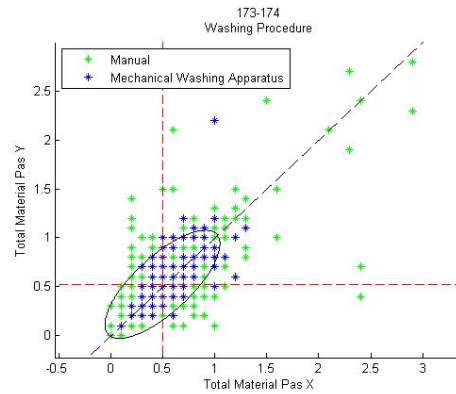


Figure F-11- Total Material Passing the 4.75-mm (No. 4) Sieve

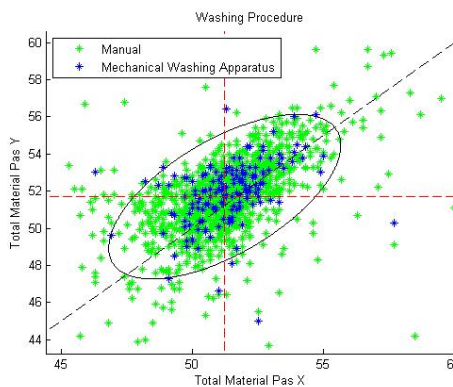


Figure F-9- Total Material Passing the 12.5-mm (12-in.) Sieve

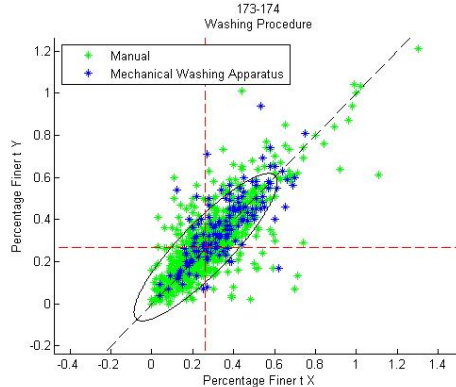


Figure F-12- Percentage Finer than the 75-μm sieve by washing

AGC 177-178

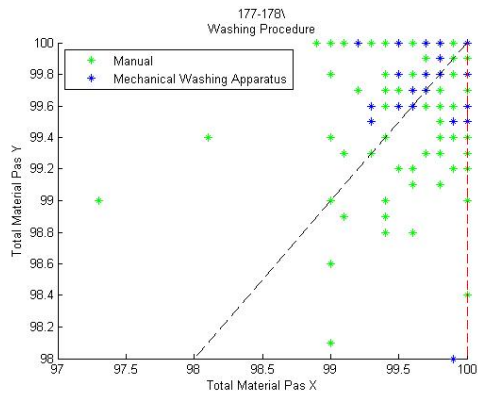


Figure F-13- Total Material Passing the 25.0-mm (1-in.) Sieve

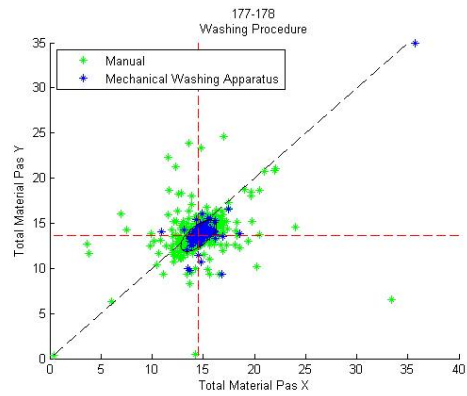


Figure F-16- Total Material Passing the 9.5-mm (38-in.) Sieve

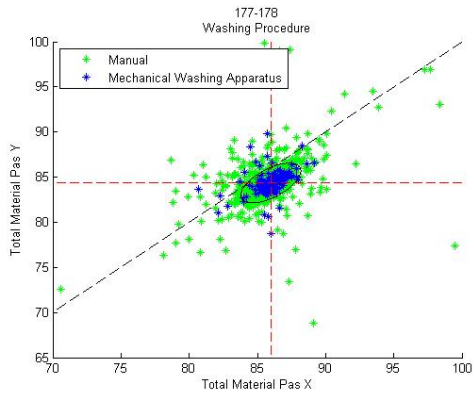


Figure F-14- Total Material Passing the 19.0-mm (34-in.) Sieve

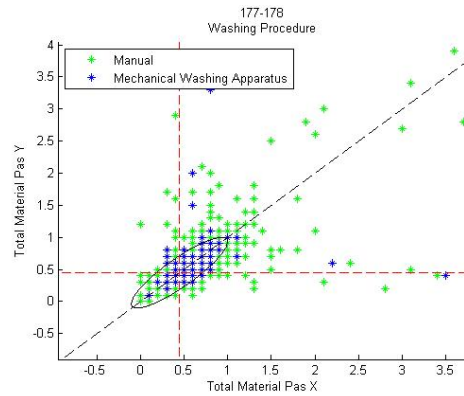


Figure F-17- Total Material Passing the 4.75-mm (No. 4) Sieve

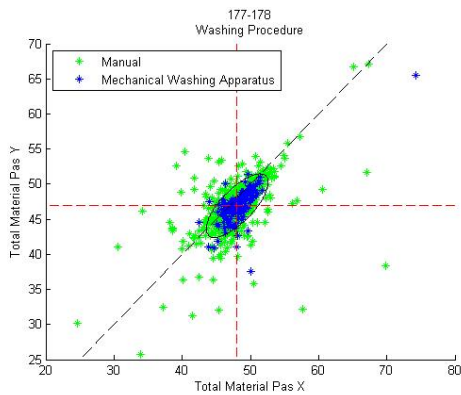


Figure F-15- Total Material Passing the 12.5-mm (12-in.) Sieve

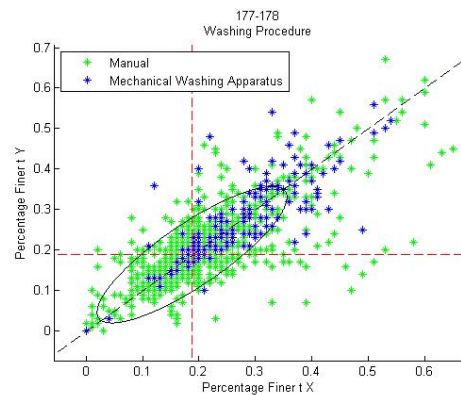


Figure F-18- Percentage Finer than the 75-μm sieve by washing

Percent Passing Bar Graphs

Average Percent Passing

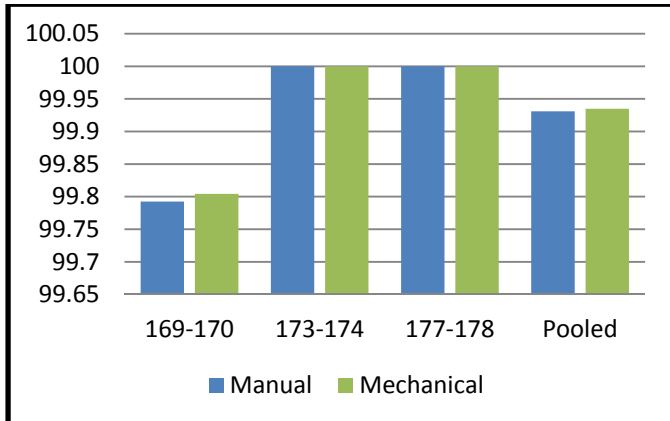


Figure F-19- Total Material Passing the 25.0-mm Sieve

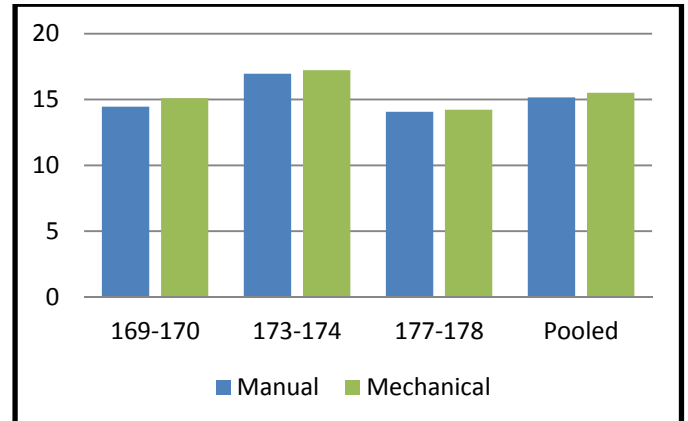


Figure F-22- Total Material Passing the 9.5-mm Sieve

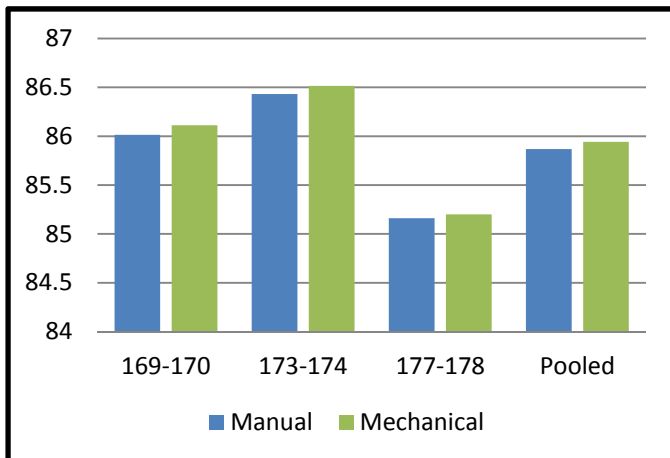


Figure F-20- Total Material Passing the 19.0-mm Sieve

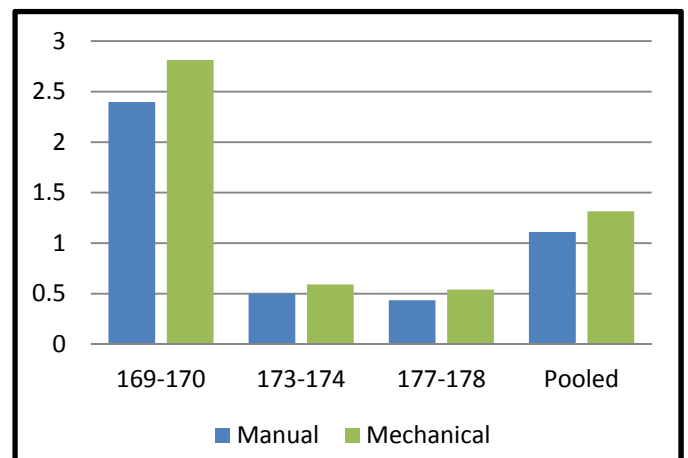


Figure F-23- Total Material Passing the 4.75-mm Sieve

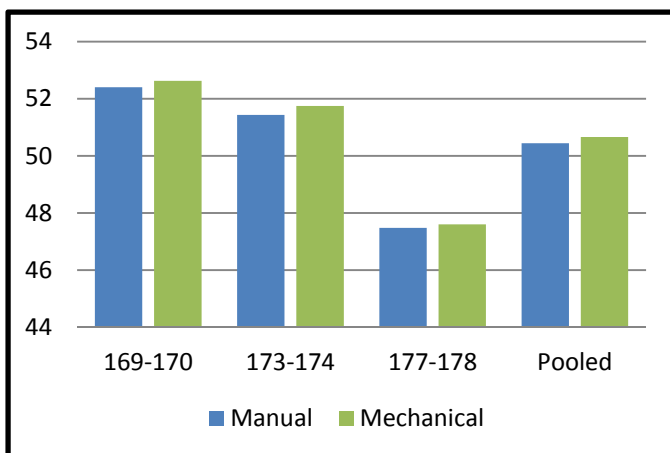


Figure F-21- Total Material Passing the 12.5-mm Sieve

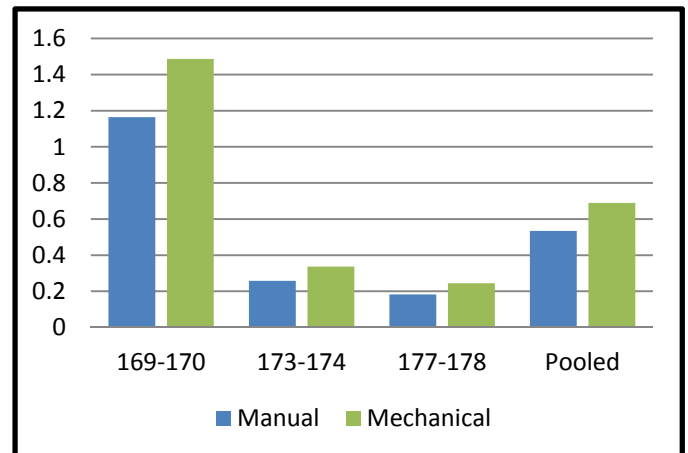


Figure F-24- Total Material Passing the 75-μm Sieve

Repeatability Standard Deviation Percent Passing

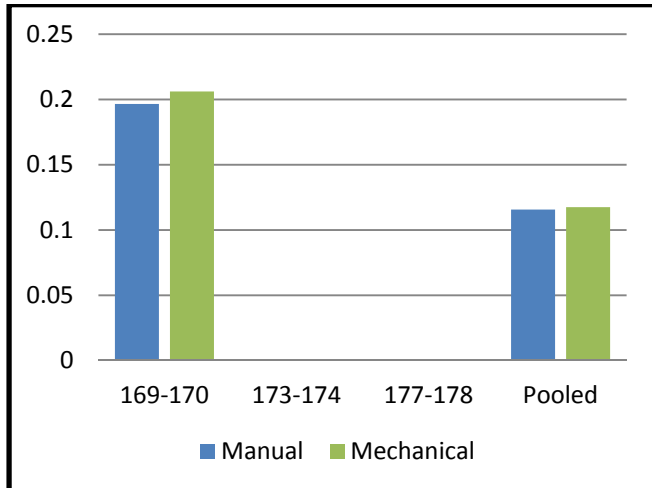


Figure F-25- Total Material Passing the 25.0-mm Sieve

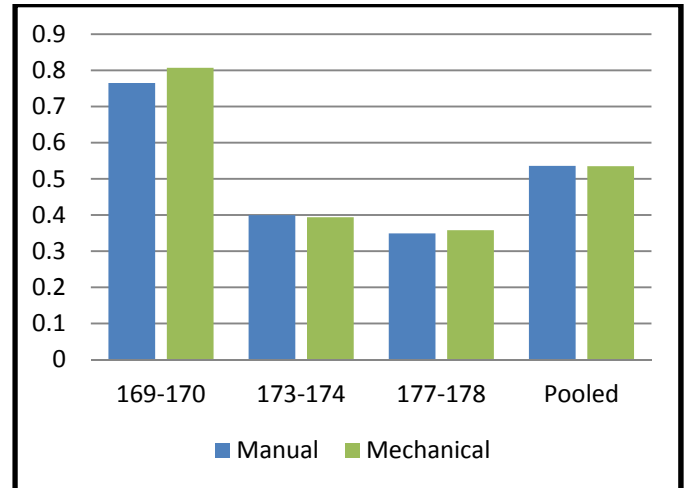


Figure F-28- Total Material Passing the 9.5-mm Sieve

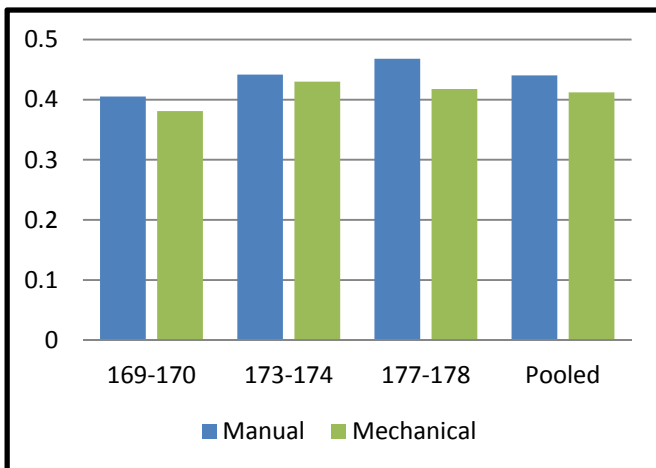


Figure F-26- Total Material Passing the 19.0-mm Sieve

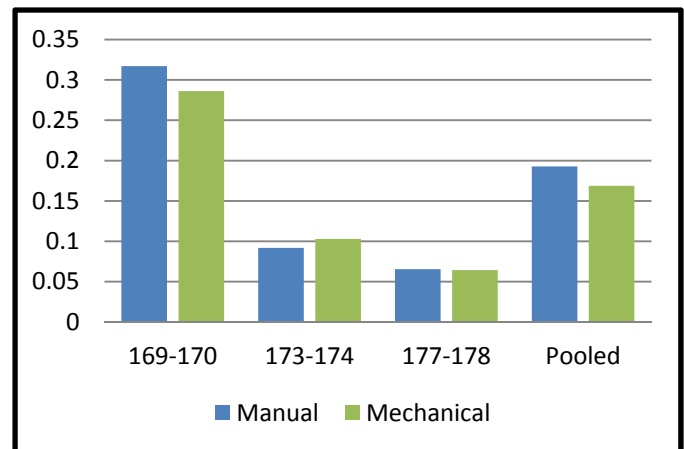


Figure F-29- Total Material Passing the 4.75-mm Sieve

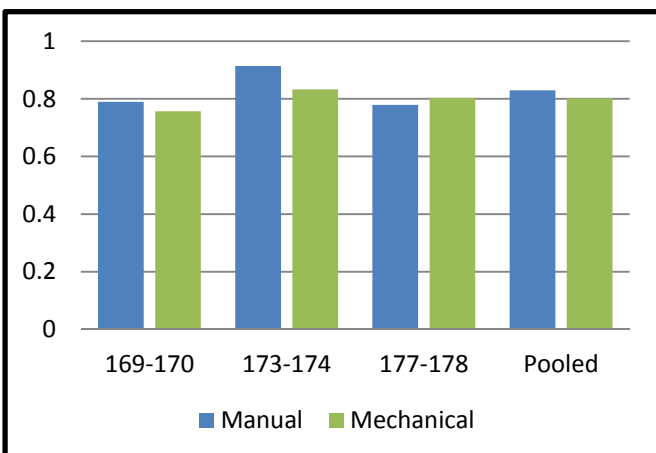


Figure F-27- Total Material Passing the 12.5-mm Sieve

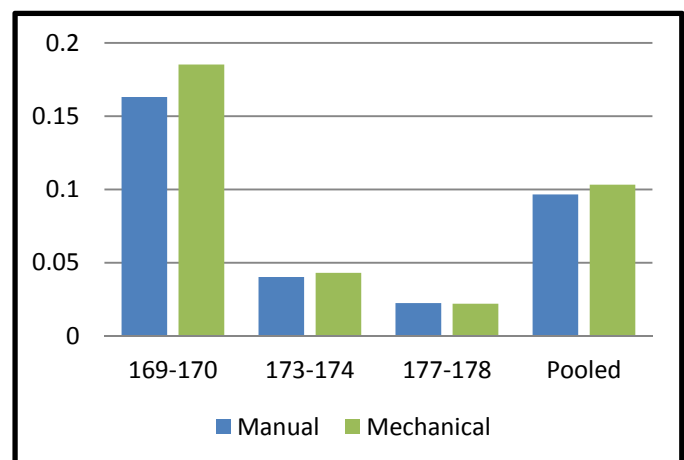


Figure F-30- Total Material Passing the 75-μm Sieve

Reproducibility Standard Deviation Percent Passing

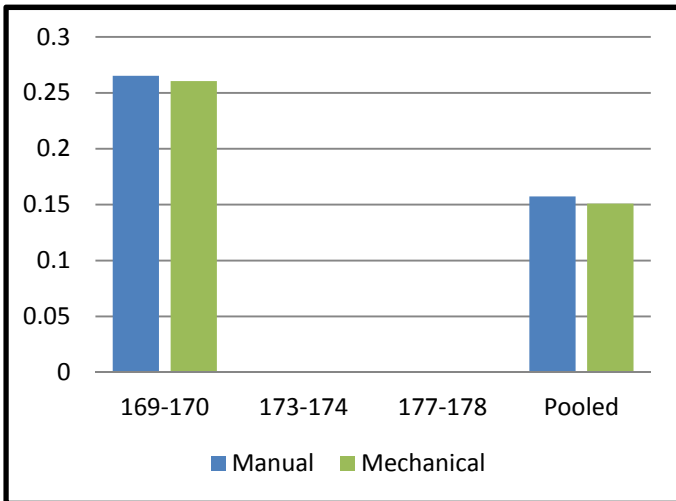


Figure F-31- Total Material Passing the 25.0-mm Sieve

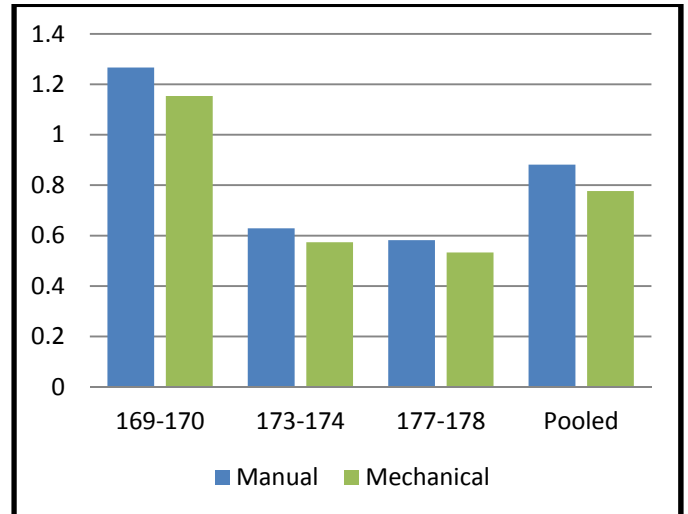


Figure F-34- Total Material Passing the 9.5-mm Sieve

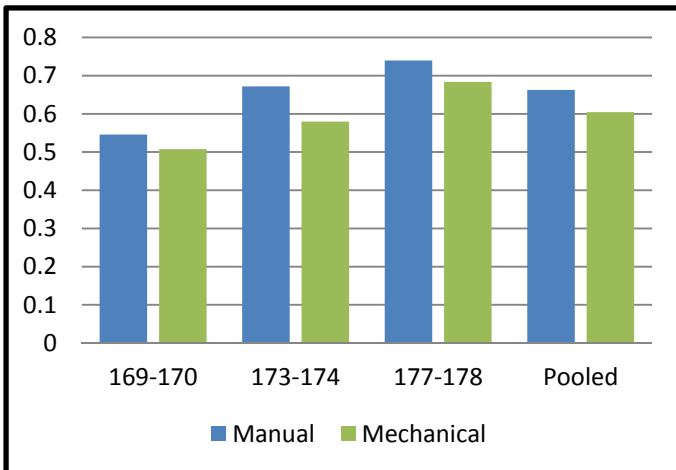


Figure F-32- Total Material Passing the 19.0-mm Sieve

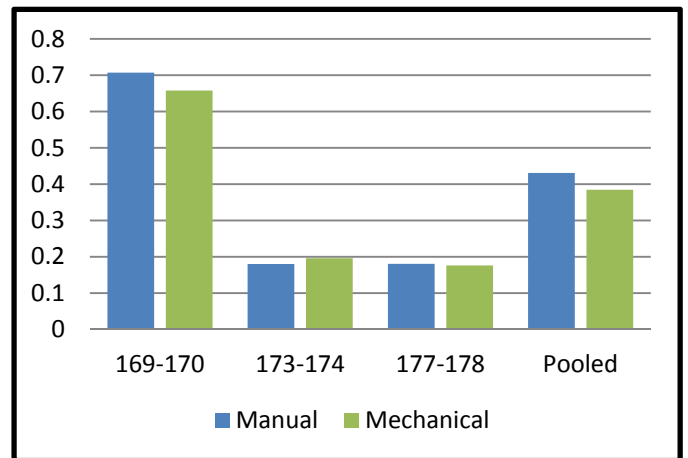


Figure F-35- Total Material Passing the 4.75-mm Sieve

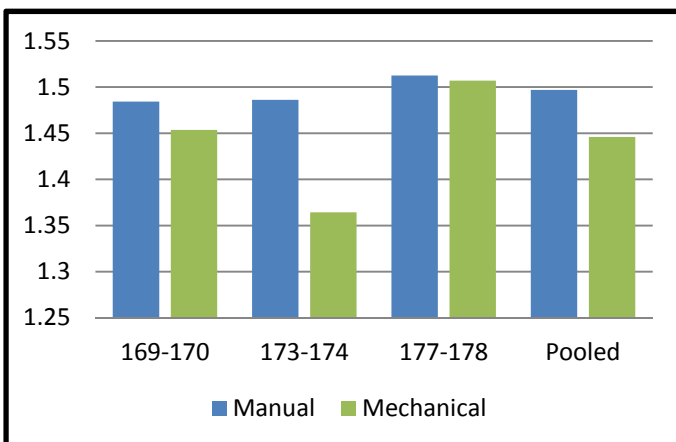


Figure F-33- Total Material Passing the 12.5-mm Sieve

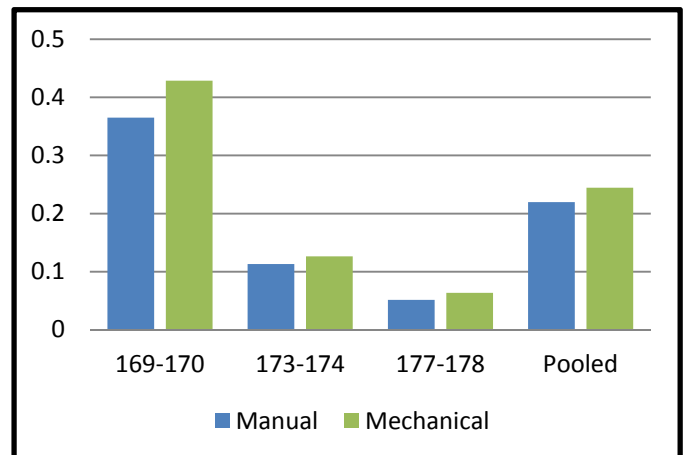


Figure F-36- Total Material Passing the 75-µm Sieve

Summaries of Statistics

AGC 169-170 Summaries of Statistics

Table F-1- Summary of statistics of percent passing various sieve sizes from washing AGC 169-170 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGC 169-170 All Methods of Washing	25.0 mm	1327	99.8	99.8	0.20	0.20	0.20	0.23	0.23	0.30	0.30
	19.0 mm	1246	88.4	83.6	0.41	0.46	0.49	0.49	0.56	0.61	0.73
	12.5 mm	1307	53.4	51.4	0.78	1.47	1.52	1.57	2.95	1.40	2.71
	9.5 mm	1389	15.0	14.1	0.77	5.12	5.45	1.20	8.05	1.36	9.65
	4.75 mm	1372	2.5	2.3	0.32	12.36	13.64	0.74	28.97	0.70	30.16
	75 µm, washing	1326	1.3	1.1	0.17	13.17	14.86	0.39	30.89	0.38	33.50

Table F-2- Summary of statistics of percent passing various sieve sizes from manual washing of AGC 169-170 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGC 169-170 Manual Washing	25.0 mm	1157	99.8	99.8	0.20	0.20	0.20	0.23	0.23	0.30	0.30
	19.0 mm	1090	88.4	83.6	0.41	0.46	0.48	0.49	0.55	0.61	0.72
	12.5 mm	1147	53.4	51.4	0.79	1.48	1.54	1.58	2.96	1.39	2.70
	9.5 mm	1219	14.9	14.0	0.77	5.14	5.46	1.20	8.04	1.34	9.54
	4.75 mm	1206	2.5	2.3	0.32	12.58	13.94	0.73	29.15	0.68	29.87
	75 µm, washing	1178	1.2	1.1	0.16	13.21	14.93	0.37	30.18	0.36	32.69

Table F-3- Summary of statistics of percent passing various sieve sizes from mechanical washing of AGC 169-170 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGC 169-170 Mechanical Washing	25.0 mm	126	99.8	99.8	0.21	0.21	0.21	0.21	0.21	0.31	0.31
	19.0 mm	116	88.5	83.8	0.38	0.43	0.45	0.44	0.50	0.57	0.68
	12.5 mm	117	53.6	51.6	0.76	1.41	1.47	1.50	2.79	1.41	2.73
	9.5 mm	121	15.5	14.7	0.81	5.20	5.50	1.01	6.50	1.30	8.85
	4.75 mm	118	2.9	2.7	0.29	9.81	10.56	0.65	22.14	0.67	24.71
	75 µm, washing	106	1.6	1.4	0.19	11.71	13.31	0.43	27.38	0.42	30.49

AGC 173-174 Summaries of Statistics

Table F-4- Summary of statistics of percent passing various sieve sizes from washing of AGC 173-174 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGC 173-174 All Methods of Washing	25.0 mm	1230	100.0	100.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	19.0 mm	1350	86.0	86.9	0.44	0.51	0.51	0.67	0.78	0.65	0.75
	12.5 mm	1387	51.2	51.7	0.91	1.77	1.75	1.40	2.73	1.55	3.00
	9.5 mm	1370	16.6	17.4	0.40	2.40	2.28	0.62	3.74	0.64	3.65
	4.75 mm	1404	0.50	0.52	0.09	18.87	17.82	0.18	35.68	0.19	36.71
	75 µm washing	1371	0.26	0.27	0.04	15.45	15.12	0.12	44.15	0.12	43.81

Table F-5- Summary of statistics of percent passing various sieve sizes from manual washing of AGC 173-174 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGC 173-174 Manual Washing	25.0 mm	1074	100.0	100.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	19.0 mm	1189	86.0	86.9	0.44	0.51	0.51	0.68	0.79	0.66	0.76
	12.5 mm	1219	51.2	51.7	0.91	1.78	1.77	1.41	2.75	1.56	3.02
	9.5 mm	1205	16.5	17.4	0.40	2.42	2.30	0.62	3.75	0.64	3.67
	4.75 mm	1240	0.5	0.5	0.09	18.92	17.88	0.17	35.92	0.19	36.35
	75 µm washing	1227	0.3	0.3	0.04	15.79	15.44	0.11	44.08	0.11	43.67

Table F-6- Summary of statistics of percent passing various sieve sizes from mechanical washing of AGC 173-174 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGC 173-174 Mechanical Washing	25.0 mm	135	100.0	100.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	19.0 mm	140	86.1	87.0	0.43	0.50	0.49	0.58	0.67	0.58	0.67
	12.5 mm	149	51.5	52.0	0.83	1.62	1.60	1.28	2.48	1.45	2.79
	9.5 mm	145	16.8	17.6	0.39	2.34	2.23	0.57	3.37	0.58	3.30
	4.75 mm	143	0.6	0.6	0.10	18.07	16.79	0.18	31.58	0.21	34.58
	75 µm washing	133	0.3	0.3	0.04	13.00	12.58	0.13	37.99	0.13	37.01

AGC 177-178 Summaries of Statistics

Table F-7- Summary of statistics of percent passing various sieve sizes from washing of AGC 177-178 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGC 177-178 All Methods of Washing	25.0 mm	1259	100	100	0	0	0	0	0	0	0
	19.0 mm	1416	86.0	84.3	0.46	0.54	0.55	0.72	0.83	0.75	0.89
	12.5 mm	1475	48.1	46.9	0.78	1.63	1.67	1.46	3.04	1.56	3.33
	9.5 mm	1449	14.6	13.6	0.35	2.41	2.57	0.60	4.10	0.57	4.16
	4.75 mm	1411	0.45	0.45	0.07	14.64	14.57	0.18	40.89	0.18	41.22
	75 μ m washing	1380	0.19	0.19	0.02	12.0	11.89	0.06	30.11	0.06	29.57

Table F-8- Summary of statistics of percent passing various sieve sizes from manual washing of AGC 177-178 samples

Sample No./ Washin g Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGC 177-178 Manual Washing	25.0 mm	1112	100	100	0	0	0	0	0	0	0
	19.0 mm	1240	85.98	84.35	0.47	0.54	0.55	0.72	0.83	0.76	0.90
	12.5 mm	1291	48.04	46.92	0.78	1.62	1.66	1.46	3.04	1.57	3.34
	9.5 mm	1270	14.54	13.61	0.35	2.40	2.56	0.60	4.11	0.57	4.17
	4.75 mm	1239	0.43	0.44	0.07	15.10	14.99	0.18	41.26	0.18	41.77
	75 μ m washing	1238	0.18	0.18	0.02	12.38	12.29	0.05	28.56	0.05	28.10

Table F-9- Summary of statistics of percent passing various sieve sizes from mechanical washing of AGC 177-178 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGC 177-178 Mechanical Washing	25.0 mm	127	100	100	0	0	0	0	0	0	0
	19.0 mm	157	86.06	84.34	0.42	0.49	0.50	0.70	0.82	0.66	0.79
	12.5 mm	165	48.15	47.06	0.80	1.67	1.71	1.45	3.01	1.57	3.33
	9.5 mm	159	14.69	13.77	0.36	2.44	2.60	0.54	3.67	0.53	3.83
	4.75 mm	153	0.54	0.54	0.06	11.79	11.94	0.18	32.63	0.17	32.48
	75 μ m washing	131	0.25	0.24	0.02	8.98	9.01	0.06	25.71	0.06	26.14

Statistical Tests of Significance

AGC 169-170 Statistical test of significance

Table F-10- Statistical t-test for comparison of average percent passing various sieve sizes from mechanical and manual washing of AGC 169-170 samples

Sieve Size	percent passing, Manual	Percent passing, Mechanical	Degrees of Freedom	computed t
25.0-mm	99.8	99.8	154	-0.47
19.0-mm	86	86.1	145	-1.97
12.5-mm	52.4	52.6	142	-1.55
9.5-mm	14.5	15.1	150	-5.82
4.75-mm	2.4	2.8	145	-6.52
75- μ m washing	1.2	1.5	119	-7.5

Note: Critical t for 1% level of significance is 2.61 and for 5% level of significance is 1.98

Table F-11- Statistical F-test for comparison of repeatability standard deviation s of percent passing various sieve sizes from mechanical and manual washing of AGC 169-170 samples

Sieve Size	Repeatability Manual	Repeatability Mechanical	Deg. of Freedom	F Computed	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
25.0-mm	0.2	0.21	125 & 1156	1.1	1.34	1.23
19.0-mm	0.41	0.38	1089 & 115	1.13	1.41	1.27
12.5-mm	0.79	0.76	1146 & 116	1.09	1.41	1.27
9.5-mm	0.77	0.81	120 & 1218	1.11	1.35	1.24
4.75-mm	0.32	0.29	1205 & 117	1.23	1.4	1.27
75- μ m washing	0.16	0.19	105 & 1177	1.29	1.37	1.25

Table F-12- Statistical F-test for comparison of reproducibility standard deviation of percent passing various sieve sizes from mechanical and manual washing of AGC 169-170 samples

Sieve Size	Reproducibility Manual	Reproducibility Mechanical	Deg. of Freedom	F Computed	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
25.0-mm	0.27	0.26	1156 & 125	1.02	1.39	1.26
19.0-mm	0.55	0.51	1089 & 115	1.15	1.41	1.27
12.5-mm	1.49	1.45	1146 & 116	1.05	1.41	1.27
9.5-mm	1.27	1.16	1218 & 120	1.19	1.4	1.27
4.75-mm	0.71	0.66	1205 & 117	1.16	1.4	1.27
75- μ m washing	0.37	0.43	105 & 1177	1.38	1.37	1.25

AGC 173-174 Statistical test of significance

Table F-13- Statistical t-test for comparison of average percent passing various sieve sizes from mechanical and manual washing of AGC 173-174 samples

Sieve Size	percent passing, Manual	Percent passing, Mechanical	Deg. of Freedom	computed t
25.0-mm	100	100	-	-
19.0-mm	86.4	86.5	186	-1.59
12.5-mm	51.4	51.7	193	-2.59
9.5-mm	17	17.2	188	-5.05
4.75-mm	0.5	0.59	171	-5.37
75- μ m washing	0.26	0.34	156	-6.95

Note: Critical t for 1% level of significance is 2.60 and for 5% level of significance is 1.97

Table F-14- Statistical F-test for comparison of repeatability standard deviation of percent passing various sieve sizes from mechanical and manual washing of AGC 173-174 samples

Sieve Size	1s Repeatability std, Manual	1s Repeatability Std, Mechanical	Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
25.0-mm	0	0	134 & 1073	-	1.33	1.23
19.0-mm	0.44	0.43	1188 & 139	1.06	1.37	1.24
12.5-mm	0.91	0.83	1218 & 148	1.2	1.35	1.24
9.5-mm	0.4	0.39	1204 & 144	1.03	1.36	1.24
4.75-mm	0.09	0.1	142 & 1239	1.26	1.32	1.22
75- μ m washing	0.04	0.04	132 & 1226	1.15	1.33	1.23

Table F-15- Statistical F test for comparison of reproducibility standard deviation of percent passing various sieve sizes from mechanical and manual washing of AGC 173-174

Sieve Size	1s Reproducibility std, Manual	1s Reproducibility Std, Mechanical	Deg. of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
25.0-mm	0	0	134 & 1073	-	1.33	1.23
19.0-mm	0.67	0.58	1188 & 139	1.34	1.37	1.24
12.5-mm	1.49	1.37	1218 & 148	1.18	1.35	1.24
9.5-mm	0.63	0.57	1204 & 144	1.2	1.36	1.24
4.75-mm	0.18	0.2	142 & 1239	1.19	1.32	1.22
75- μ m washing	0.11	0.13	132 & 1226	1.25	1.33	1.23

AGC 177-178 Statistical test of significance

Table F-16- Statistical t-test for comparison of average percent passing various sieve sizes from mechanical and manual washing of AGC 177-178 samples

Sieve Size	percent passing, Manual	Percent passing, Mechanical	Deg. of Freedom	computed t
25.0-mm	100	100	-	-
19.0-mm	85.2	85.2	205	-0.66
12.5-mm	47.5	47.6	209	-1
9.5-mm	14.1	14.2	208	-3.46
4.75-mm	0.44	0.54	194	-6.99
75- μ m washing	0.18	0.24	149	-10.9

Note: Critical t for 1% level of significance is 2.60 and for 5% level of significance is 1.97

Table F-17- Statistical F-test for comparison of repeatability standard deviation of percent passing various sieve sizes from mechanical and manual washing of AGC 177-178 samples

Sieve Size	1s Repeatability std, Manual	1s Repeatability Std, Mechanical	Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
25.0-mm	0	0	126 & 1111	-	1.34	1.23
19.0-mm	0.47	0.42	1239 & 156	1.25	1.34	1.23
12.5-mm	0.78	0.8	164 & 1290	1.06	1.3	1.2
9.5-mm	0.35	0.36	158 & 1269	1.05	1.3	1.21
4.75-mm	0.07	0.06	1238 & 152	1.04	1.35	1.23
75- μ m washing	0.02	0.02	1237 & 130	1.04	1.38	1.25

Table F-18- Statistical F test for comparison of reproducibility standard deviation of percent passing various sieve sizes from mechanical and manual washing of AGC 177-178

Sieve Size	1s Reproducibility std, Manual	1s Reproducibility Std, Mechanical	Deg. of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
25.0-mm	0	0	126 & 1111	-	1.34	1.23
19.0-mm	0.74	0.68	1239 & 156	1.17	1.34	1.23
12.5-mm	1.51	1.51	1290 & 164	1.01	1.33	1.22
9.5-mm	0.58	0.53	1269 & 158	1.19	1.34	1.23
4.75-mm	0.18	0.18	1238 & 152	1.05	1.35	1.23
75- μ m washing	0.05	0.06	130 & 1237	1.51	1.33	1.23

APPENDIX G - FINE AGGREGATE- WASHING METHOD TABLES AND GRAPHS

Total Material Passing Scatter Plot Graphs

AGF 171-172

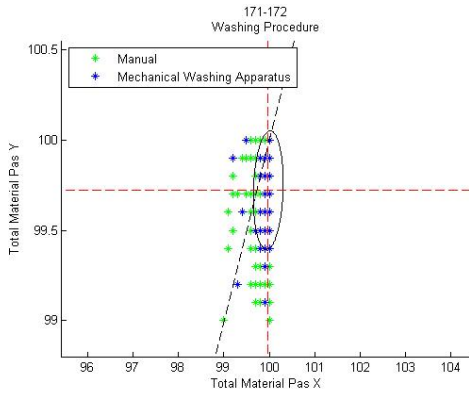


Figure G-1- Total Material Passing the 4.75-mm (No. 4) Sieve

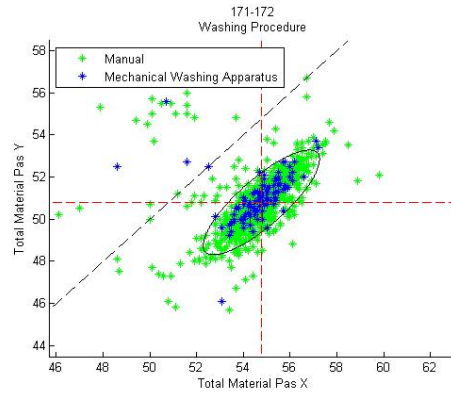


Figure G-4- Total Material Passing the 600-µm (No. 30) Sieve

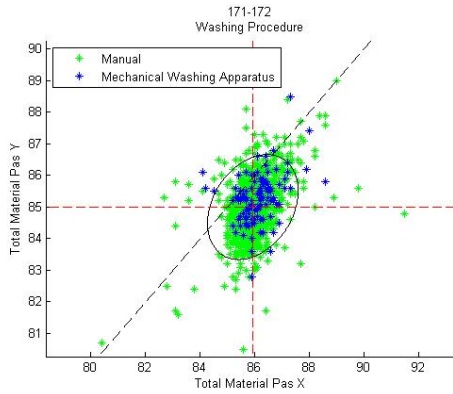


Figure G-2- Total Material Passing the 2.36-mm (No. 8) Sieve

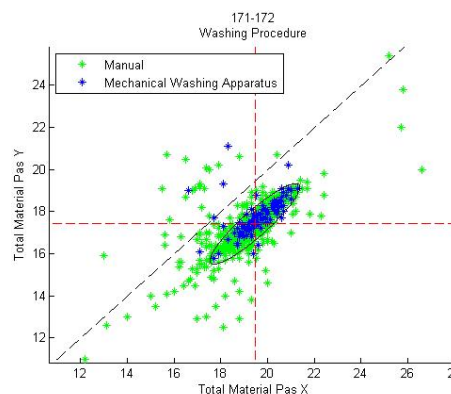


Figure G-5- Total Material Passing the 300-µm (No. 50) Sieve

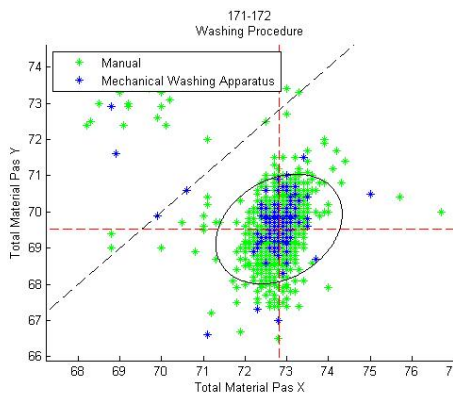


Figure G-3- Total Material Passing the 1.18-mm (No. 16) Sieve

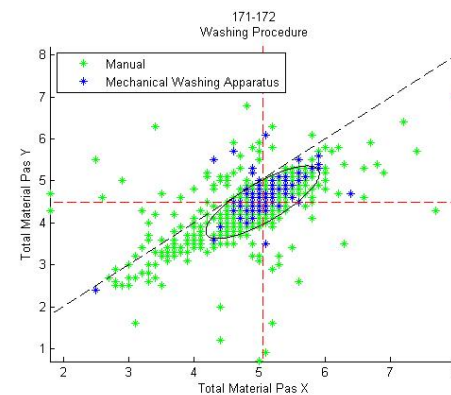


Figure G-6- Total Material Passing the 150-µm (No. 100) Sieve

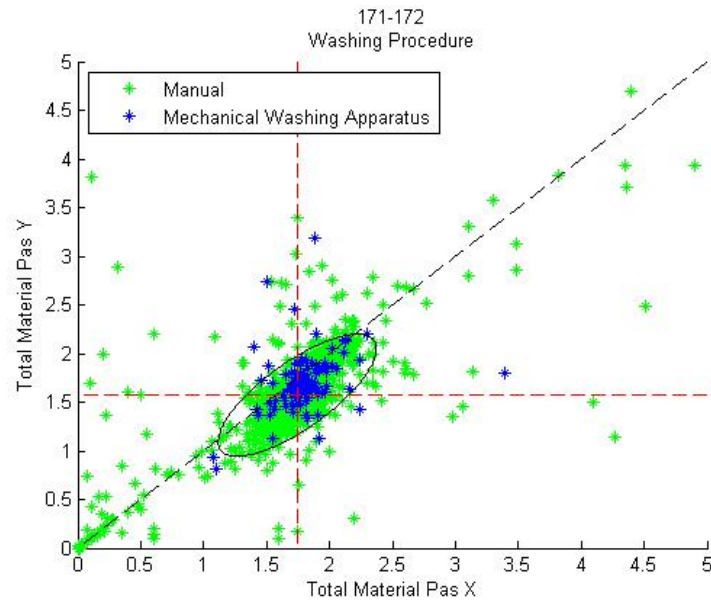


Figure G-7- Total Material Passing the 75- μ m (No. 200) Sieve

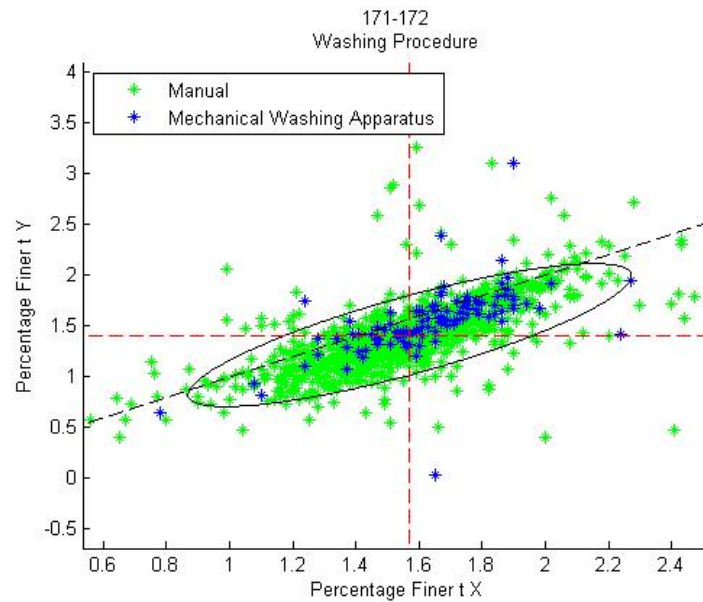


Figure G-8- Percentage Finer than the 75- μ m sieve by washing

AGF 175-176

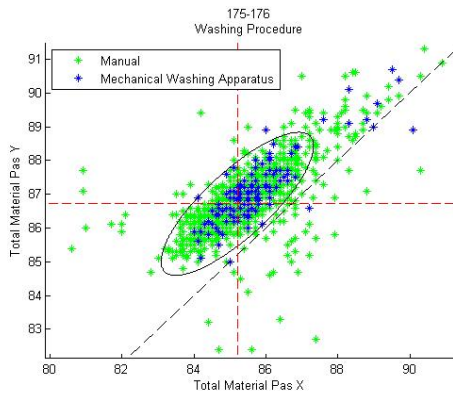


Figure G-9- Total Material Passing the 2.36-mm (No. 8) Sieve

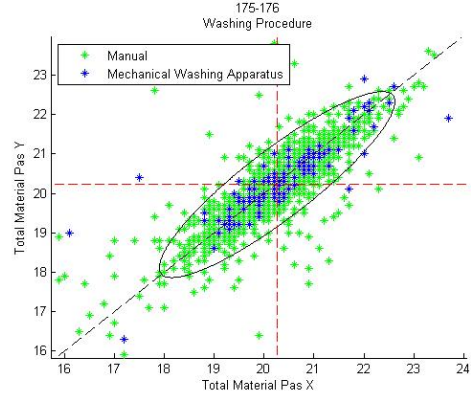


Figure G-12- Total Material Passing the 300-μm (No. 4) Sieve

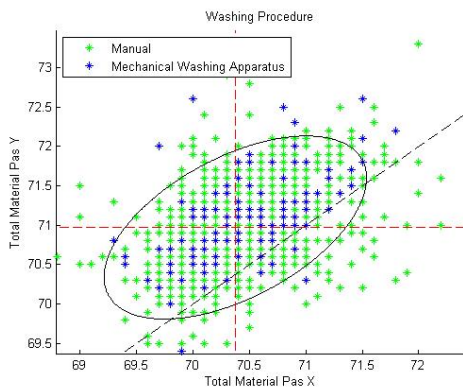


Figure G-10- Total Material Passing the 1.18-mm (No. 16) Sieve

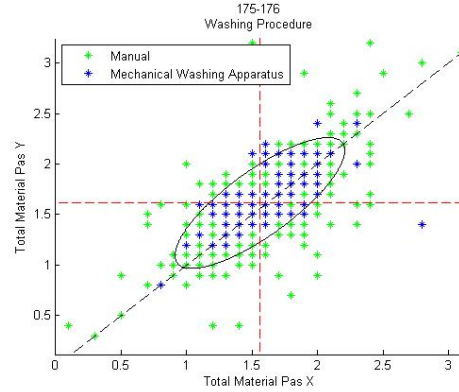


Figure G-13- Total Material Passing the 150-μm (No. 4) Sieve

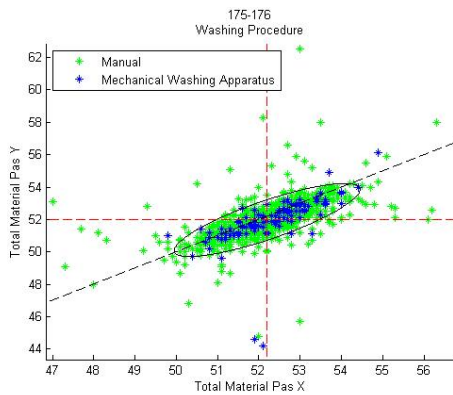


Figure G-11- Total Material Passing the 600-μm (No. 4) Sieve

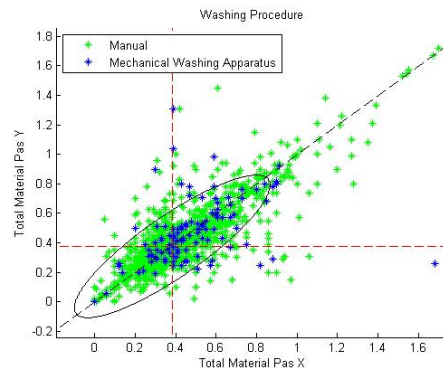


Figure G-14- Total Material Passing the 75-μm (No. 4) Sieve

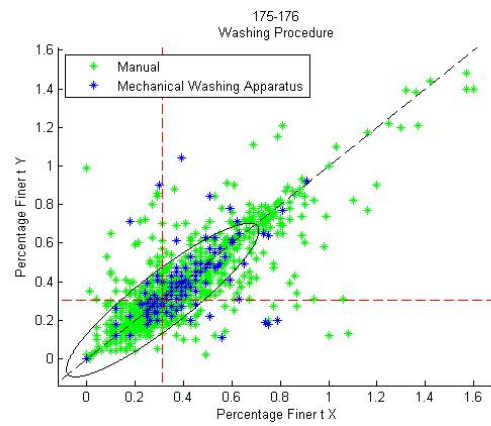


Figure G-15- Percentage Finer than the 75-um sieve by washing

AGF 179-180

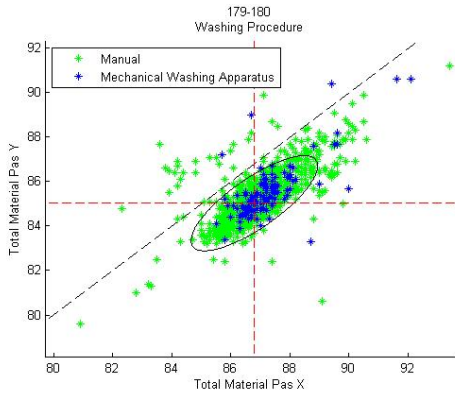
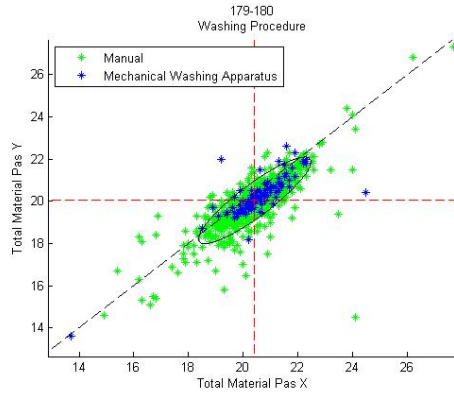


Figure G-16- Total Material Passing the 2.36-mm (No. 8) Sieve



**Figure G-19- Total Material Passing the 300-
µm (No. 4) Sieve**

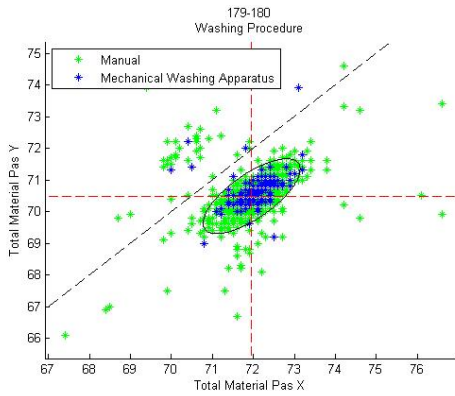
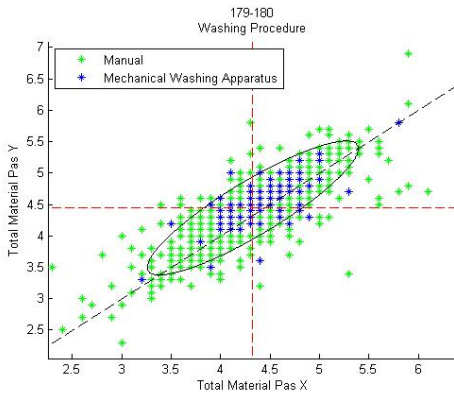
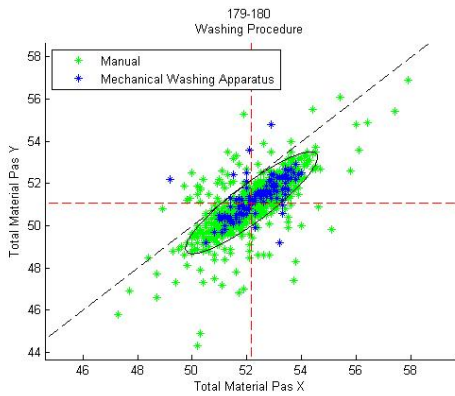


Figure G-17- Total Material Passing the 1.18-mm (No. 16) Sieve



**Figure G-20- Total Material Passing the 150-
μm (No. 4) Sieve**



**Figure G-18- Total Material Passing the 600-
μm (No. 4) Sieve**

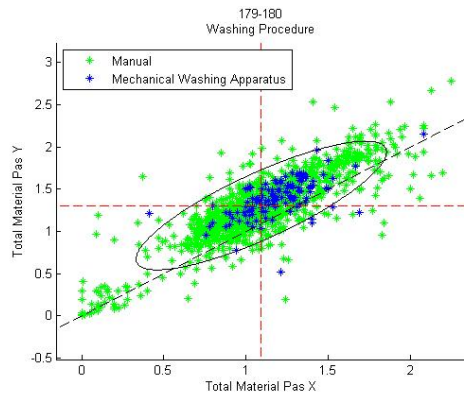


Figure G-21- Total Material Passing the 75-µm (No. 4) Sieve

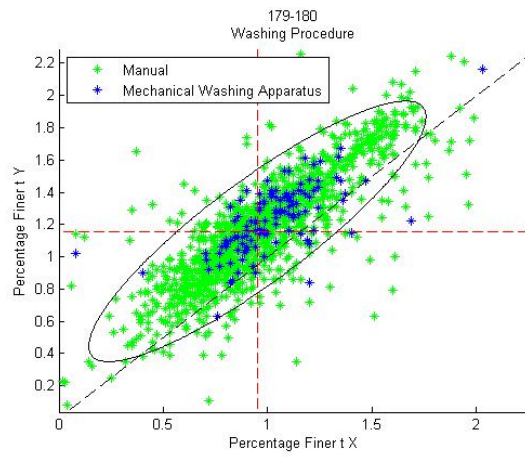


Figure G-22- Percentage Finer than the 75-um sieve by washing

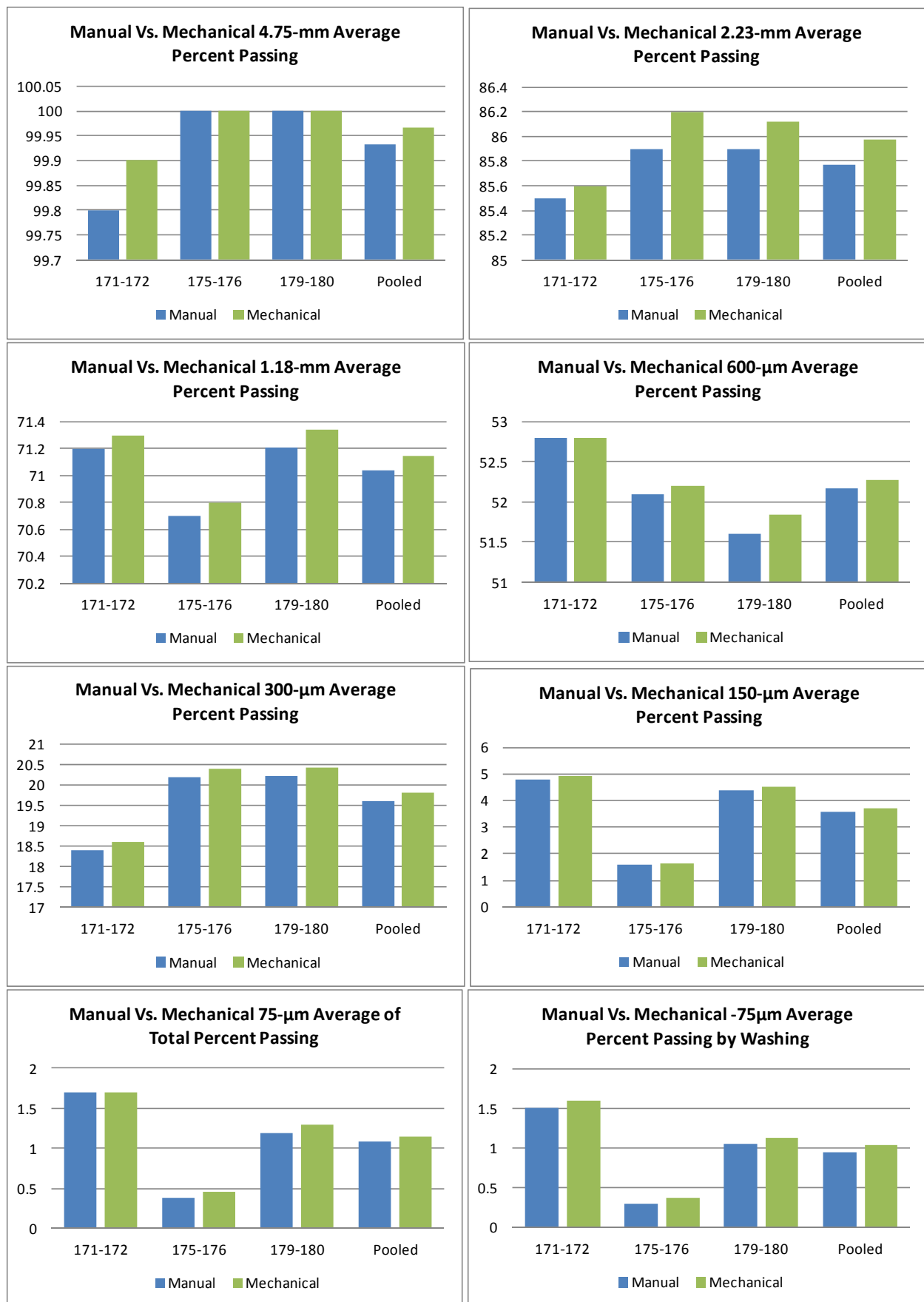
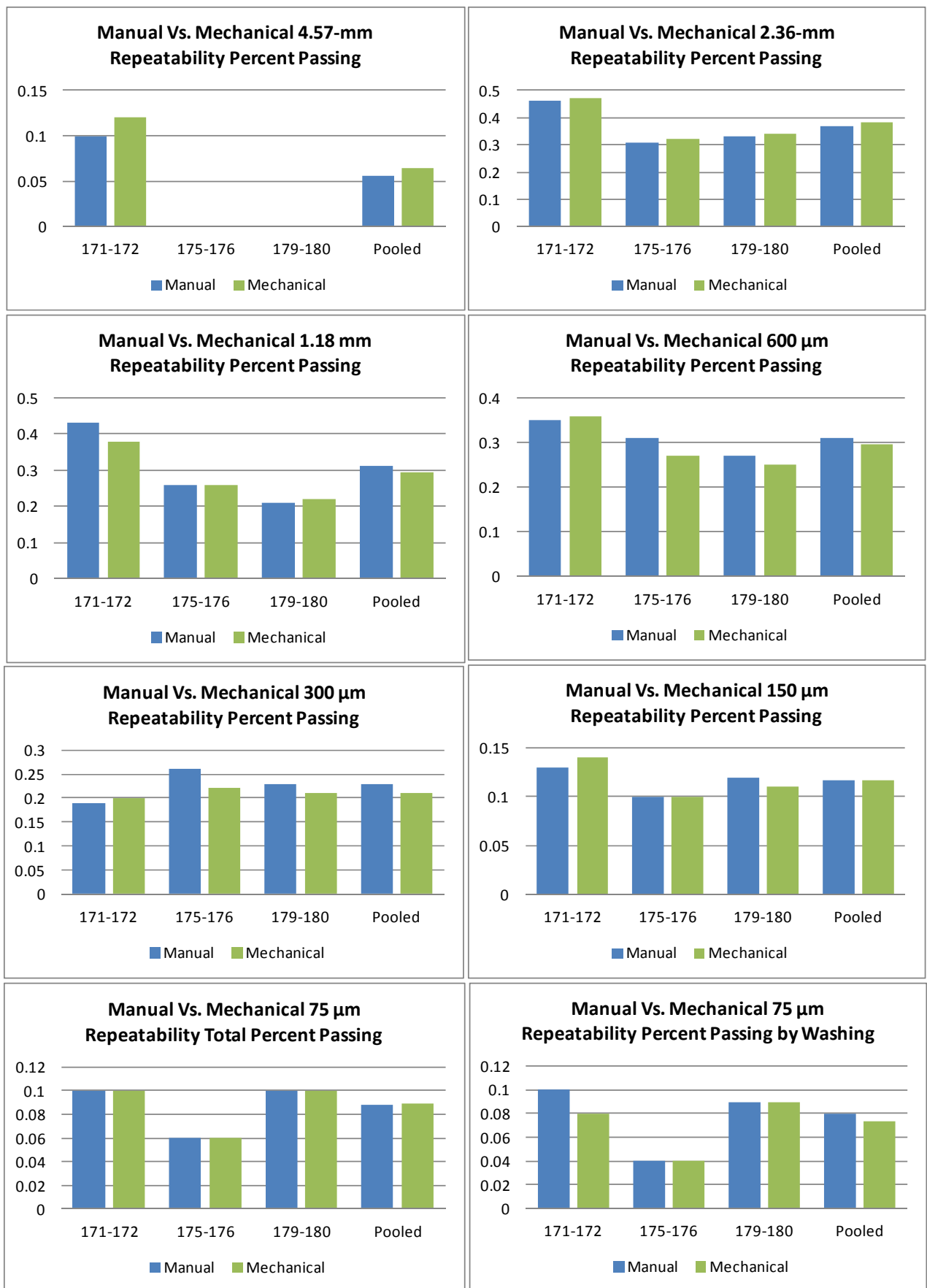
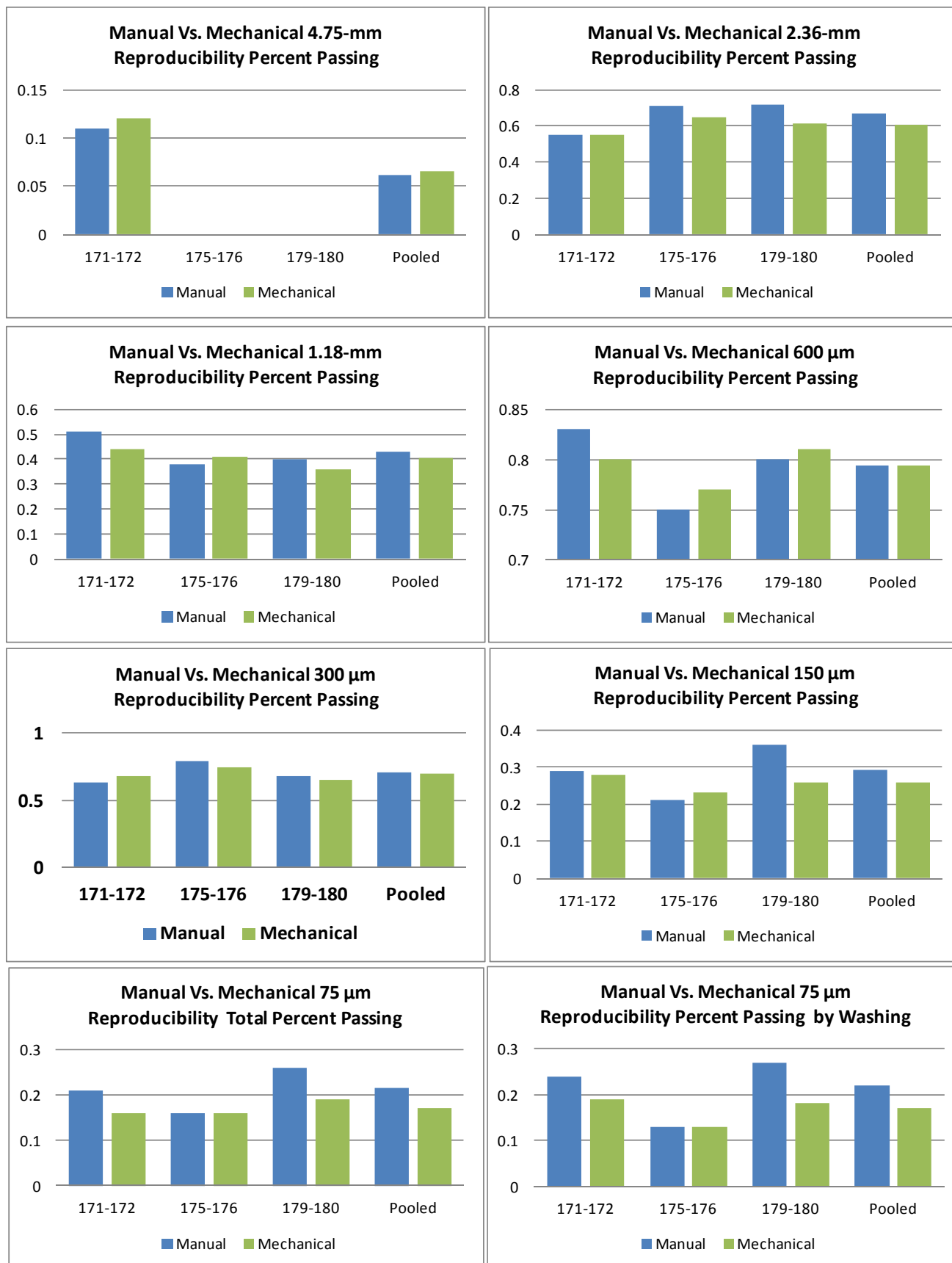


Figure G-23- Average percent passing from manual and mechanical washing of AGF



G-24- Repeatability of percent passing from manual and mechanical washing of AGF



G-25- Reproducibility of percent passing from manual and mechanical washing of AGF

Summaries of Statistics

AGF 171-172 Summaries of Statistics

Table G-1- Summary of statistics for percent passing various sieve sizes after washing of AGF 171-172, all methods combined

Sample No./Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGF171-172 All Methods of Washing	4.75 mm	1327	100	99.7	0.1	0.1	0.1	0.04	0.04	0.15	0.15
	2.36 mm	1347	85.9	85	0.46	0.54	0.54	0.43	0.5	0.66	0.77
	1.18 mm	1347	72.8	69.5	0.43	0.59	0.62	0.29	0.4	0.65	0.94
	600 µm	1319	54.8	50.8	0.35	0.64	0.7	0.78	1.42	0.87	1.72
	300 µm	1292	19.5	17.4	0.19	1	1.11	0.65	3.33	0.63	3.6
	150 µm	1271	5	4.5	0.13	2.64	2.96	0.28	5.49	0.3	6.69
	75 µm, total	1292	1.7	1.6	0.1	5.91	6.55	0.18	10.07	0.24	15.15
	75 µm, washing	1331	1.6	1.4	0.1	6.17	6.88	0.21	13.33	0.26	18.19

Table G-2- Summary of statistics of percent passing various sieve sizes from manual washing of AGF 171-172 samples

Sample No./Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGF171-172 Manual Method of Washing	4.75 mm	1217	100	99.7	0.1	0.1	0.1	0.04	0.04	0.15	0.15
	2.36 mm	1237	85.9	85	0.46	0.54	0.54	0.42	0.49	0.66	0.77
	1.18 mm	1233	72.8	69.5	0.43	0.6	0.62	0.29	0.4	0.66	0.94
	600 µm	1207	54.8	50.8	0.35	0.64	0.69	0.78	1.42	0.88	1.72
	300 µm	1183	19.4	17.4	0.19	0.99	1.1	0.64	3.31	0.62	3.56
	150 µm	1159	5	4.5	0.13	2.6	2.92	0.28	5.49	0.3	6.70
	75 µm, total	1182	1.7	1.6	0.1	5.88	6.55	0.18	10.16	0.24	15.38
	75 µm washing	1222	1.6	1.4	0.1	6.2	6.94	0.21	13.48	0.26	18.43

Table G-3- Summary of statistics of percent passing various sieve sizes from mechanical washing of AGF 171-172 samples

Sample No./Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGF171-172 Mechanical Method of Washing	4.75 mm	98	100	99.7	0.12	0.12	0.12	0.04	0.04	0.17	0.17
	2.36 mm	99	86.1	85.2	0.47	0.54	0.55	0.45	0.53	0.62	0.73
	1.18 mm	102	72.8	69.7	0.38	0.52	0.55	0.28	0.4	0.55	0.8
	600 µm	101	54.8	50.9	0.36	0.66	0.71	0.77	1.41	0.82	1.61
	300 µm	98	19.6	17.6	0.2	1.01	1.12	0.7	3.57	0.66	3.77
	150 µm	99	5.1	4.6	0.14	2.68	2.96	0.28	5.45	0.28	6.04
	75 µm	99	1.8	1.7	0.1	5.81	6.24	0.15	8.21	0.18	10.72
	75 µm washing	102	1.6	1.5	0.08	4.96	5.29	0.18	11.13	0.21	13.55

AGF 175-176 Summaries of Statistics

Table G-4- Summary of statistics for percent passing various sieve sizes after washing of AGF 175-176 samples, all methods combined

Sample No./Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGF175-176 All Methods of Washing	4.75 mm	1520	100.0	100.0	0	0.00	0.00	0.00	0.00	0.00	0.00
	2.36 mm	1404	85.2	86.7	0.31	0.37	0.36	0.75	0.88	0.66	0.76
	1.18 mm	1429	70.4	71.0	0.26	0.37	0.37	0.36	0.51	0.41	0.58
	600 µm	1451	52.2	52.0	0.31	0.59	0.59	0.74	1.42	0.76	1.46
	300 µm	1426	20.3	20.2	0.26	1.28	1.29	0.79	3.89	0.78	3.88
	150 µm	1428	1.6	1.6	0.10	6.20	5.99	0.22	13.85	0.22	13.37
	75 µm	1397	0.38	0.4	0.06	15.73	16.02	0.16	42.37	0.16	42.49
	75 µm washing	1354	0.31	0.30	0.04	13.33	13.69	0.13	42.29	0.13	43.71

Table G-5- Summary of statistics of percent passing various sieve sizes from manual washing of AGF 175-176 samples

Sample No./Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGF175-176 Manual Method of Washing	4.75 mm	1237	100	100	0	0	0	0	0	0	0
	2.36 mm	1281	85.2	86.7	0.31	0.37	0.36	0.76	0.89	0.65	0.75
	1.18 mm	1304	70.4	71	0.26	0.37	0.37	0.35	0.50	0.41	0.58
	600 µm	1300	52.2	52	0.31	0.6	0.6	0.74	1.41	0.76	1.46
	300 µm	1325	20.3	20.2	0.26	1.3	1.3	0.79	3.89	0.78	3.88
	150 µm	1308	1.55	1.61	0.1	6.2	5.99	0.21	13.74	0.21	13.3
	75 µm, total	1280	0.38	0.37	0.06	15.8	16.2	0.16	42.48	0.16	42.8
	75 µm washing	1383	0.31	0.30	0.04	13.4	13.8	0.13	42.63	0.13	44.2

Table G-6- Summary of statistics of percent passing various sieve sizes from mechanical washing of AGF 175-176 samples

Sample No./Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGF175-176 Mechanical Method of Washing	4.75 mm	122	100.0	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.36 mm	110	85.45	86.93	0.32	0.38	0.37	0.64	0.74	0.66	0.76
	1.18 mm	108	70.47	71.05	0.26	0.36	0.36	0.40	0.57	0.42	0.58
	600 µm	113	52.31	52.06	0.27	0.52	0.52	0.79	1.50	0.76	1.45
	300 µm	113	20.38	20.36	0.22	1.07	1.07	0.77	3.76	0.74	3.61
	150 µm	111	1.63	1.68	0.10	6.31	6.11	0.23	14.02	0.22	13.26
	75 µm, total	102	0.45	0.44	0.06	13.75	14.03	0.17	36.60	0.16	36.19
	75 µm washing	107	0.37	0.37	0.04	12.06	12.19	0.13	35.18	0.13	35.43

AGF 179-180 Summaries of Statistics

Table G-7- Summary of statistics of percent passing various sieve sizes from manual washing of AGF 179-180 samples

Sample No./Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGF179-180 All Methods of Washing	4.75 mm	1588	100	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.36 mm	1484	86.80	85.03	0.33	0.38	0.39	0.67	0.78	0.75	0.88
	1.18 mm	1493	71.95	70.48	0.21	0.29	0.30	0.40	0.55	0.39	0.56
	600 µm	1507	52.17	51.09	0.26	0.51	0.52	0.80	1.54	0.80	1.57
	300 µm	1498	20.43	20.05	0.23	1.12	1.14	0.68	3.35	0.68	3.41
	150 µm	1475	4.33	4.45	0.12	2.80	2.72	0.34	7.96	0.37	8.24
	75 µm, total	1494	1.09	1.31	0.10	9.54	7.98	0.24	22.40	0.26	20.10
	75 µm washing	1526	0.95	1.16	0.09	9.82	8.06	0.26	27.06	0.28	24.23

Table G-8- Summary of statistics of percent passing various sieve sizes from manual washing of AGF 179-180 samples

Sample No./Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGF179-180 Manual Method of Washing	4.75 mm	1445	100	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.36 mm	1356	86.78	85.01	0.33	0.38	0.39	0.68	0.78	0.76	0.89
	1.18 mm	1364	71.95	70.47	0.21	0.29	0.30	0.40	0.55	0.39	0.56
	600 µm	1376	52.15	51.07	0.27	0.51	0.52	0.80	1.53	0.80	1.57
	300 µm	1364	20.41	20.03	0.23	1.13	1.15	0.68	3.33	0.68	3.41
	150 µm	1343	4.32	4.44	0.12	2.83	2.75	0.35	8.05	0.37	8.34
	75 µm, total	1355	1.09	1.30	0.10	9.59	8.02	0.25	22.83	0.26	20.36
	75 µm washing	1394	0.94	1.15	0.09	9.88	8.11	0.26	27.73	0.28	24.75

Table G-9- Summary of statistics of percent passing various sieve sizes from manual washing of AGF 179-180 samples

Sample No./Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
AGF179-180 Mechanical Method of Washing	4.75 mm	116	100	100	0	0	0	0	0	0	0
	2.36 mm	105	87.01	85.23	0.34	0.39	0.40	0.56	0.64	0.66	0.77
	1.18 mm	108	72.07	70.62	0.22	0.30	0.31	0.38	0.53	0.33	0.47
	600 µm	110	52.39	51.30	0.25	0.47	0.48	0.84	1.60	0.79	1.54
	300 µm	111	20.62	20.24	0.21	1.00	1.02	0.67	3.23	0.62	3.09
	150 µm	109	4.45	4.58	0.11	2.51	2.44	0.26	5.85	0.27	5.86
	75 µm, total	117	1.18	1.40	0.10	8.75	7.37	0.18	15.10	0.20	14.02
	75 µm washing	118	1.02	1.24	0.09	9.21	7.56	0.17	16.91	0.19	15.39

Statistical Tests of Significance

AGF 171-172 Statistical test of significance

Table G-10- Statistical t-test for comparison of average percent passing of various sieve sizes from mechanical and manual washing of AGF 171-172 samples

Sieve Sizes	Average Percent Passing		Deg. of Freedom	Computed t
	Manual	Mechanical		
4.75-mm	99.8	99.9	108	-0.47
2.36-mm	85.5	85.6	113	-3.2
1.18-mm	71.2	71.3	123	-2.12
600-μm	52.8	52.8	119	-0.64
300-μm	18.4	18.6	110	-2.67
150-μm	4.8	4.9	115	-3.02
75-μm	1.7	1.7	125	-4.6
75-μm washing	1.5	1.6	127	-4.55

Note: Critical t for 1% level of significance is 2.62 and for 5% level of significance is 1.98

Table G-11- Statistical F-test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of AGF 171-172 samples

Sieve Sizes	1S Repeatability, Percent Passing		Degrees of Freedom	Computed F	Critical F(α=.01)	Critical F(α=.05)
	Manual	Mechanical				
4.75-mm	0.1	0.12	96 & 1217	1.33	1.39	1.26
2.36-mm	0.46	0.47	97 & 1236	1.02	1.38	1.26
1.18-mm	0.43	0.38	1232 & 100	1.29	1.44	1.29
600-μm	0.35	0.36	100 & 1205	1.05	1.38	1.26
300-μm	0.19	0.2	96 & 1182	1.05	1.39	1.26
150-μm	0.13	0.14	97 & 1158	1.08	1.39	1.26
75-μm	0.1	0.1	97 & 1182	1.04	1.39	1.26
75-μm washing	0.1	0.08	1221 & 101	1.45	1.44	1.29

Table G-12- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of AGF 171-172 samples

Sieve Sizes	1S Reproducibility, Percent Passing		Deg. of Freedom	Computed F	Critical F(α=.01)	Critical F(α=.05)
	Manual	Mech.				
4.75-mm	0.11	0.12	96 & 1217	1.28	1.39	1.26
2.36-mm	0.55	0.55	1236 & 97	1.02	1.45	1.3
1.18-mm	0.51	0.44	1232 & 100	1.33	1.44	1.29
600-μm	0.83	0.8	1205 & 100	1.08	1.44	1.29
300-μm	0.63	0.68	96 & 1182	1.17	1.39	1.26
150-μm	0.29	0.28	1158 & 97	1.08	1.45	1.3
75-μm	0.21	0.16	1182 & 97	1.65	1.45	1.3
75-μm washing	0.24	0.19	1221 & 101	1.47	1.44	1.29

AGF 175-176 Statistical test of significance

Table G-13- Statistical t-test for comparison of average percent passing of various sieve sizes from mechanical and manual washing of AGF 175-176 samples

Sieve Sizes	Average Percent Passing		Degrees of Freedom	Computed t
	Manual	Mechanical		
4.75-mm	100	100	-	-
2.36-mm	85.9	86.2	132	-3.87
1.18-mm	70.7	70.8	123	-2.15
600-μm	52.1	52.2	131	-1.42
300-μm	20.2	20.4	134	-1.85
150-μm	1.58	1.65	127	-3.14
75-μm, total	0.38	0.45	117	-4.29
75-μm, washing	0.3	0.37	126	-4.97

Note: Critical t for 1% level of significance is 2.61 and for 5% level of significance is 1.98

Table G-14- Statistical F-test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of AGF 175-176 samples

Sieve Sizes	1S Repeatability, Percent Passing		Degrees Of Freedom	Computed F	Critical F(α=.01)	Critical F(α=.05)
	Manual	Mechanical				
4.75-mm	0	0	121 & 1382	-	1.34	1.23
2.36-mm	0.31	0.32	109 & 1279	1.06	1.36	1.25
1.18-mm	0.26	0.26	1307 & 107	1.07	1.42	1.28
600-μm	0.31	0.27	1324 & 112	1.35	1.41	1.27
300-μm	0.26	0.22	1299 & 112	1.46	1.41	1.27
150-μm	0.1	0.1	110 & 1303	1.13	1.36	1.24
75-μm, total	0.06	0.06	101 & 1280	1.07	1.38	1.25
75-μm, washing	0.04	0.04	106 & 1236	1.17	1.37	1.25

Table G-15- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of AGF 175-176

Sieve Sizes	1S Reproducibility, Percent Passing		Degrees of Freedom	Computed F	Critical F(α=.01)	Critical F(α=.05)
	Manual	Mechanical				
4.75-mm	0	0	121 & 1382	-	1.34	1.23
2.36-mm	0.71	0.65	1279 & 109	1.20	1.42	1.28
1.18-mm	0.38	0.41	107 & 1307	1.13	1.37	1.25
600-μm	0.75	0.77	112 & 1324	1.06	1.36	1.24
300-μm	0.79	0.75	1299 & 112	1.09	1.41	1.27
150-μm	0.21	0.23	110 & 1303	1.11	1.36	1.24
75-μm, total	0.16	0.16	101 & 1280	1.03	1.38	1.25
75-μm washing	0.13	0.13	1236 & 106	1.02	1.43	1.28

AGF 179-180 Statistical test of significance

Table G-16- Statistical t-test for comparison of average percent passing of various sieve sizes from mechanical and manual washing of AGF 179-180 samples

Sieve Sizes	Average Percent Passing		Degrees of Freedom	Computed t
	Manual	Mechanical		
4.75-mm	100	100	-	-
2.36-mm	85.9	86.12	127	-3.56
1.18-mm	71.21	71.34	128	-3.66
600-μm	51.61	51.84	126	-2.89
300-μm	20.22	20.43	131	-3.23
150-μm	4.38	4.52	143	-5.09
75-μm, total	1.19	1.29	156	-4.97
75-μm, washing	1.05	1.13	166	-4.39

Note: Critical t for 1% level of significance is 2.61 and for 5% level of significance is 1.98

Table G-17- Statistical F-test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of AGF 179-180 samples

Sieve Sizes	1S Repeatability, Percent Passing		Degrees Of Freedom	Computed F	Critical F(α=.01)	Critical F(α=.05)
	Manual	Mechanical				
4.75 mm	0	0	115 & 1444	-	1.35	1.24
2.36 mm	0.33	0.34	104 & 1355	1.05	1.37	1.25
1.18 mm	0.21	0.22	107 & 1363	1.09	1.36	1.25
600 μm	0.27	0.25	1375 & 109	1.16	1.42	1.28
300 μm	0.23	0.21	1363 & 110	1.25	1.42	1.28
150 μm	0.12	0.11	1342 & 108	1.19	1.42	1.28
75 μm total	0.1	0.1	1354 & 116	1.03	1.40	1.27
75 μm washing	0.09	0.09	117 & 1393	1.01	1.35	1.24

Table G-18- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of AGF 179-180

Sieve Sizes	1S Reproducibility, Percent Passing		Degrees of Freedom	Computed F	Critical F(α=.01)	Critical F(α=.05)
	Manual	Mechanical				
4.75-mm	0	0	115 & 1444	-	1.35	1.24
2.36-mm	0.72	0.61	1355 & 104	1.38	1.43	1.29
1.18-mm	0.4	0.36	1363 & 107	1.21	1.42	1.28
600-μm	0.8	0.81	109 & 1375	1.04	1.36	1.24
300-μm	0.68	0.65	1363 & 110	1.12	1.42	1.28
150-μm	0.36	0.26	1342 & 108	1.85	1.42	1.28
75-μm, total	0.26	0.19	1354 & 116	1.88	1.40	1.27
75-μm washing	0.27	0.18	1393 & 117	2.27	1.40	1.27

APPENDIX H - HOT MIX ASPHALT IGNITION OVEN- WASHING METHOD TABLES AND GRAPHS

Total Material Passing Scatter Plot Graphs

HMAIO 19-20

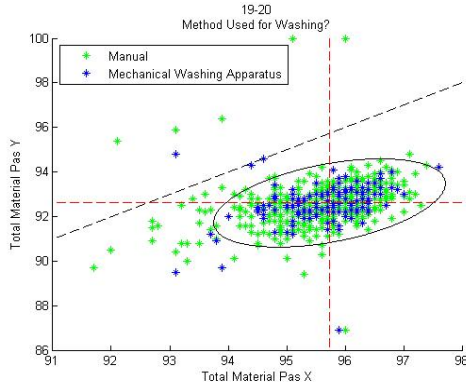


Figure H-1- Total Material Passing the 12.5-mm (12 in.) Sieve

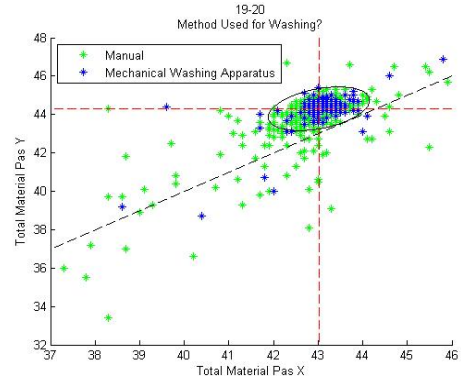


Figure H-4- Total Material Passing the 2.36-mm (No. 8) Sieve

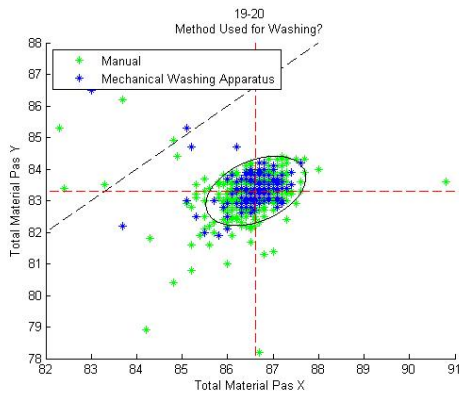


Figure H-2- Total Material Passing the 9.5-mm (38 in.) Sieve

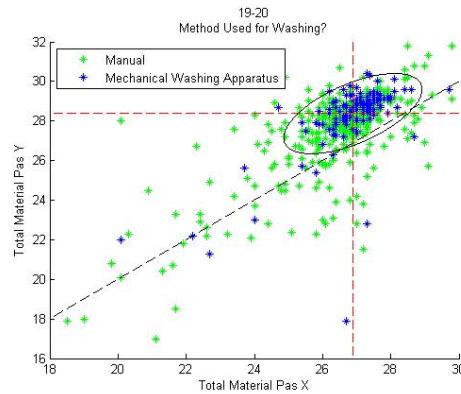


Figure H-5- Total Material Passing the 1.18-mm (No. 16) Sieve

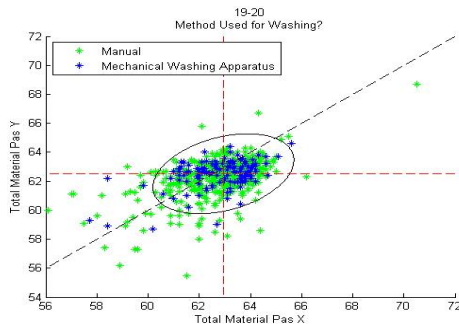


Figure H-3- Total Material Passing the 4.75-mm (No. 4) Sieve

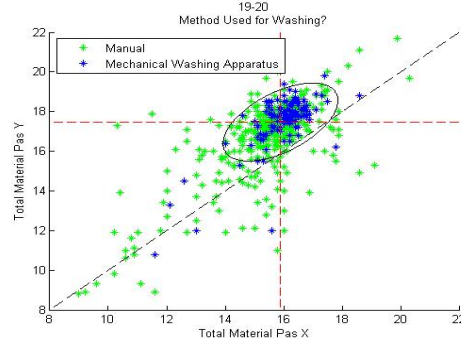
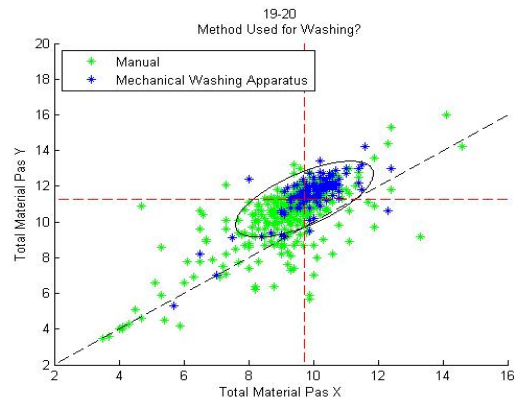
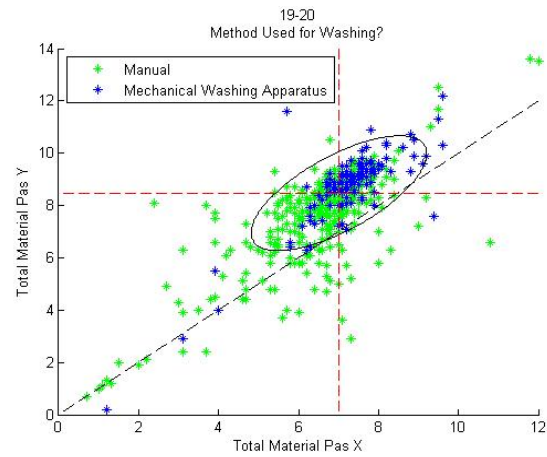


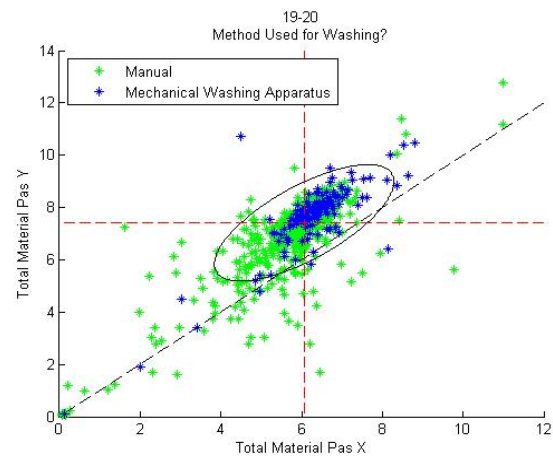
Figure H-6- Total Material Passing the 600-µm (No. 30) Sieve



**Figure H-7- Total Material Passing the 300- μ m
(No. 50) Sieve**



**Figure H-8- Total Material Passing the 150- μ m
(No. 100) Sieve**



**Figure H-9- Total Material Passing the 75- μ m
(No. 200) Sieve**

HMAIO 21-22

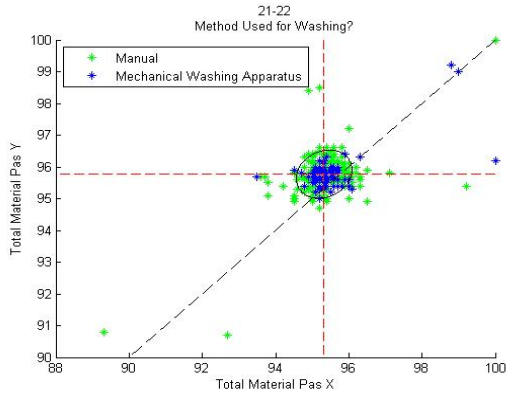


Figure H-10- Total Material Passing the 12.5-mm (12 in.) Sieve

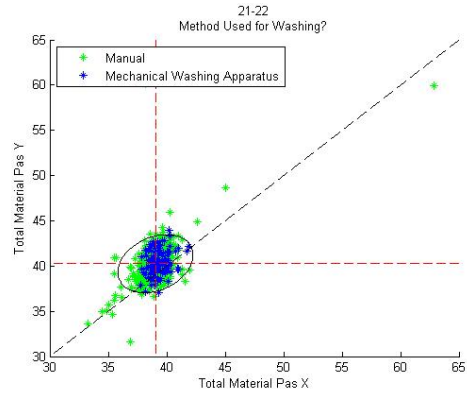


Figure H-13- Total Material Passing the 2.36-mm (No. 8) Sieve

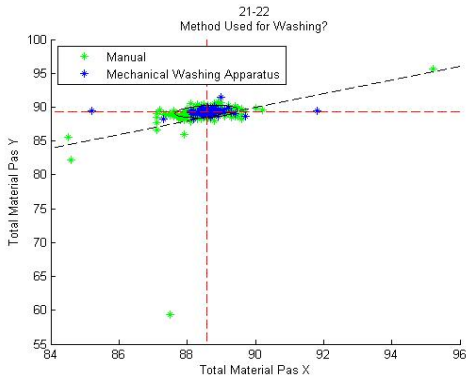


Figure H-11- Total Material Passing the 9.5-mm (38 in.) Sieve

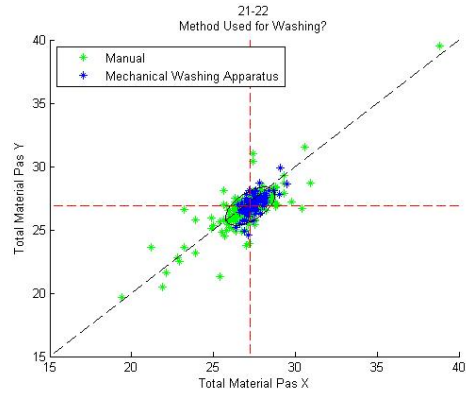


Figure H-14- Total Material Passing the 1.18-mm (No. 16) Sieve

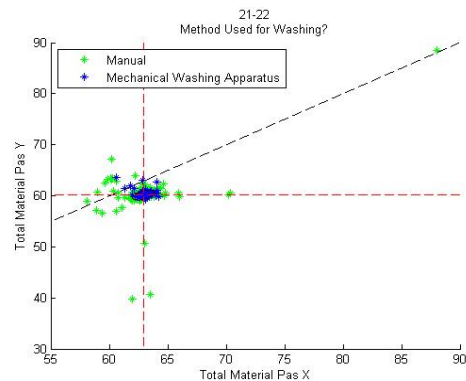


Figure H-12- Total Material Passing the 4.75-mm (No. 4) Sieve

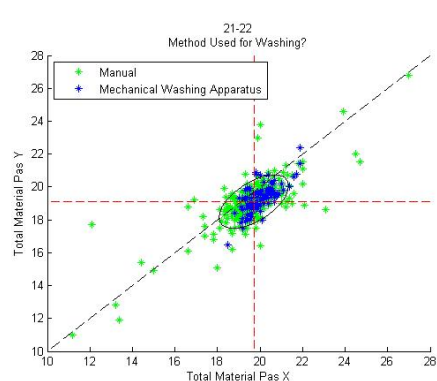


Figure H-15- Total Material Passing the 600-μm (No. 30) Sieve

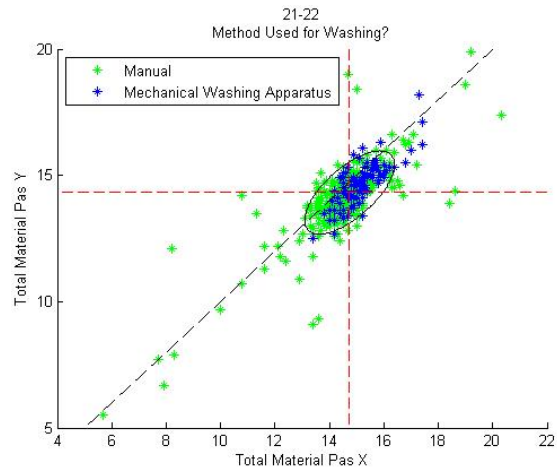


Figure H-16- Total Material Passing the 300- μ m (No. 50) Sieve

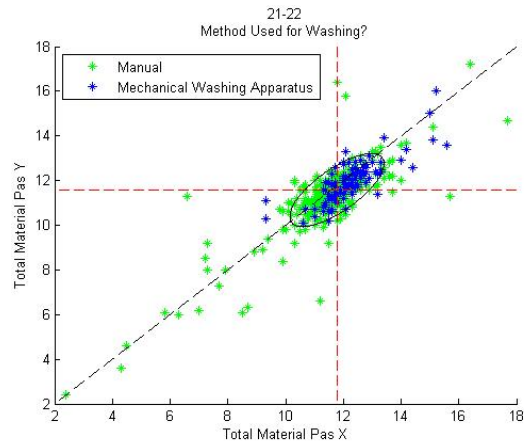


Figure H-17- Total Material Passing the 150- μ m (No. 100) Sieve

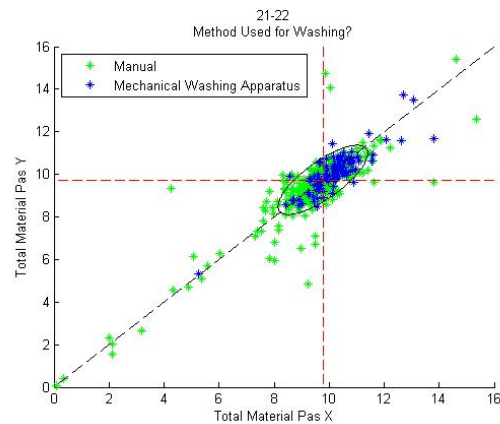


Figure H-18- Total Material Passing the 75- μ m (No. 200) Sieve

HMAIO 23-24

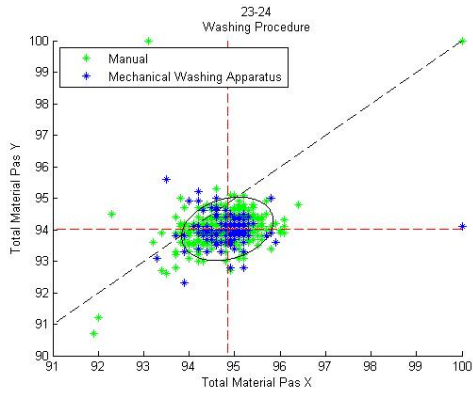


Figure H-19- Total Material Passing the 12.5-mm (1/2 in.) Sieve

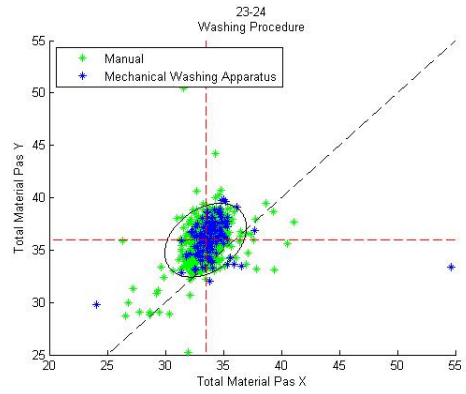


Figure H-22- Total Material Passing the 2.36-mm (No. 8) Sieve

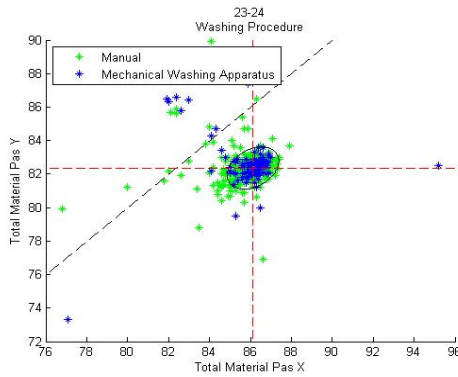


Figure H-20- Total Material Passing the 9.5-mm (3/8 in.) Sieve

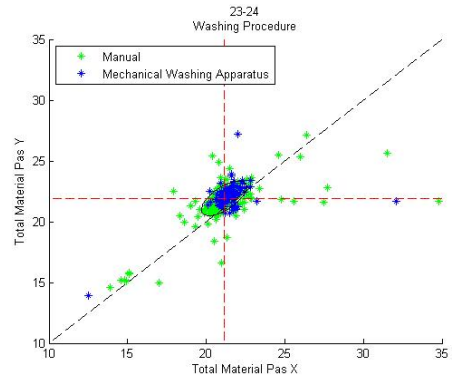


Figure H-23- Total Material Passing the 1.18-mm (No. 16) Sieve

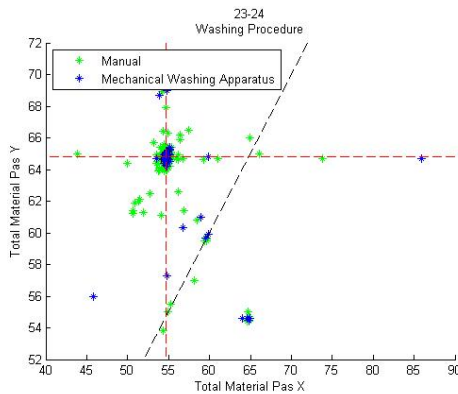


Figure H-21- Total Material Passing the 4.75-mm (No. 4) Sieve

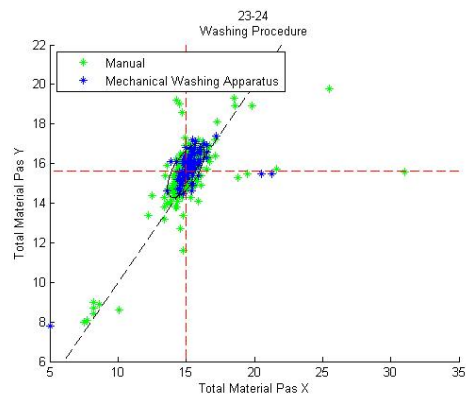


Figure H-24- Total Material Passing the 600-μm (No. 30) Sieve

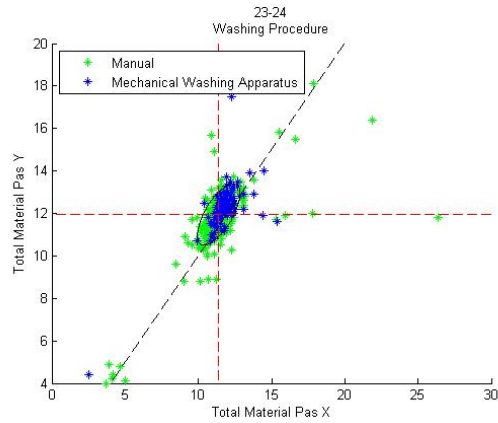


Figure H-25- Total Material Passing the 300- μ m (No. 50) Sieve

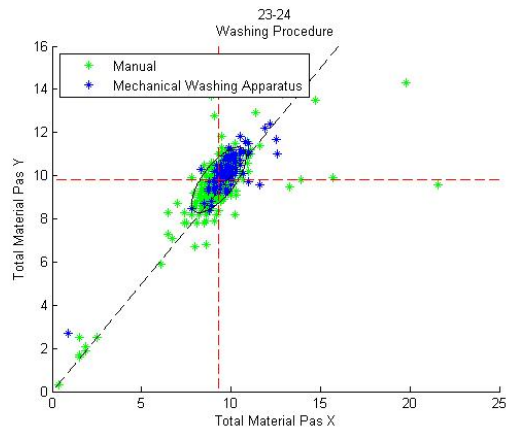


Figure H-26- Total Material Passing the 150- μ m (No. 100) Sieve

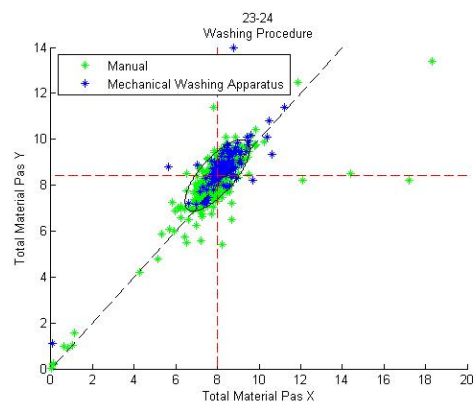


Figure H-27- Total Material Passing the 75- μ m (No. 200) Sieve

Percent Passing Bar Graphs

Average Percent Passing

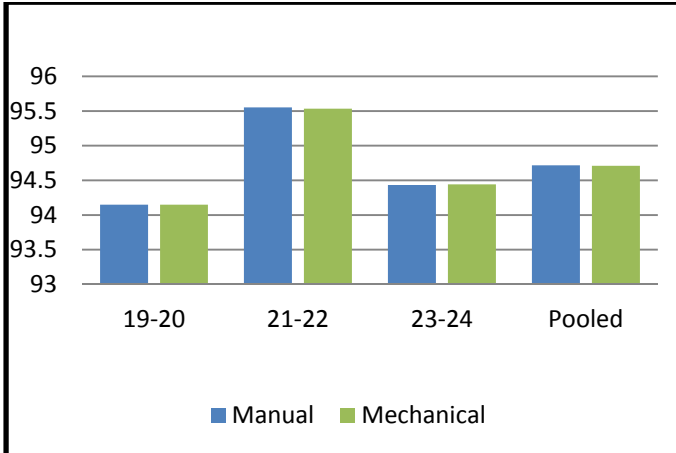


Figure H-28- Total Material Passing the 12.5-mm Sieve

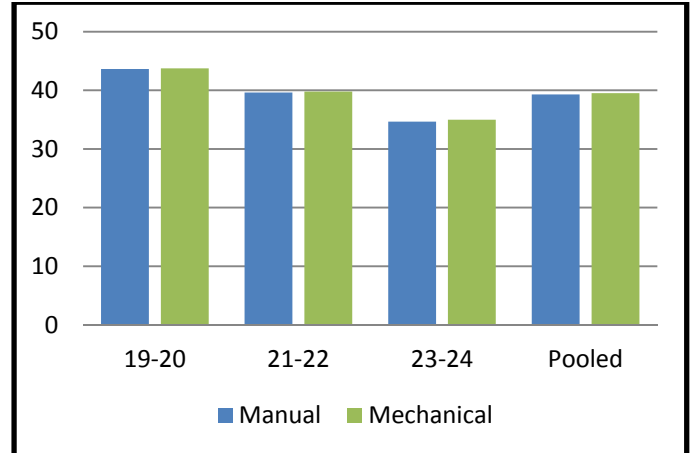


Figure H-31- Total Material Passing the 2.36- mm Sieve

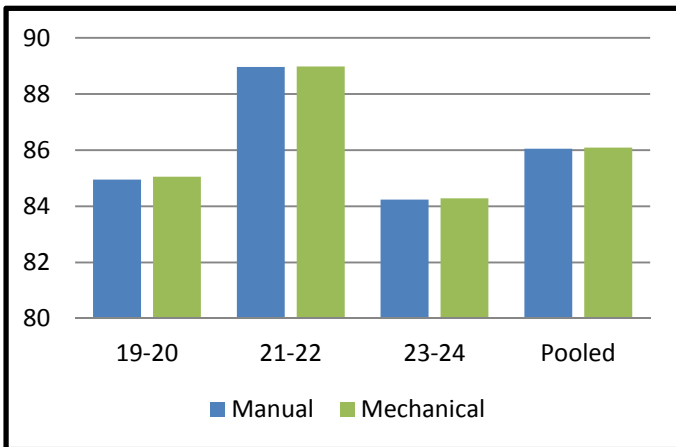


Figure H-29- Total Material Passing the 9.5-mm Sieve

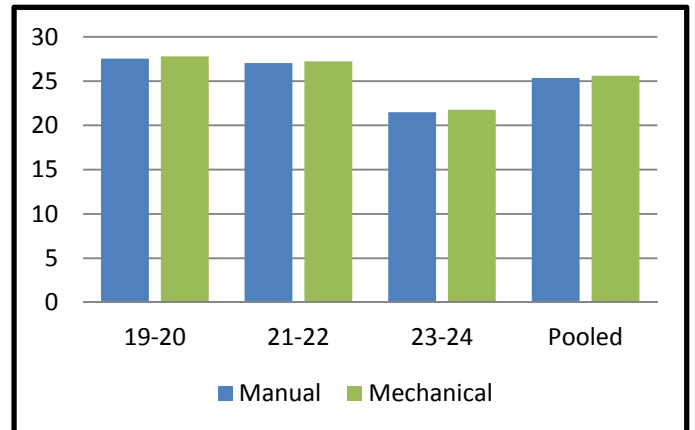


Figure H-32- Total Material Passing the 1.18- mm Sieve

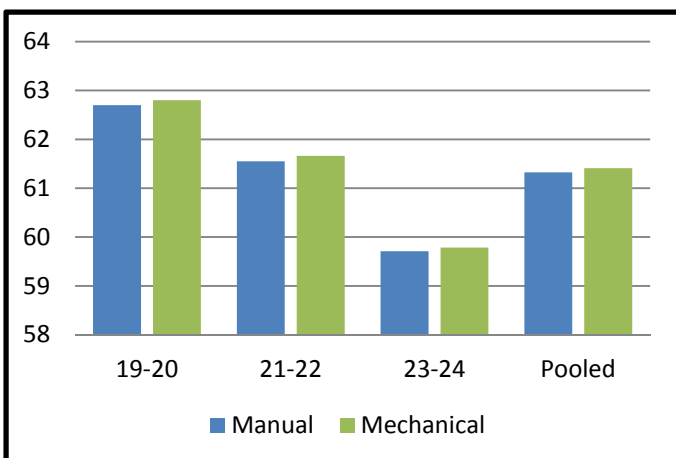


Figure H-30- Total Material Passing the 4.75-mm Sieve

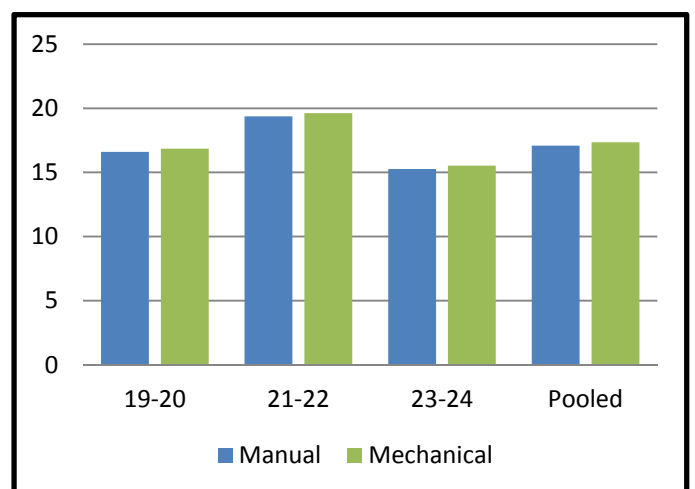


Figure H-33- Total Material Passing the 600-µm Sieve

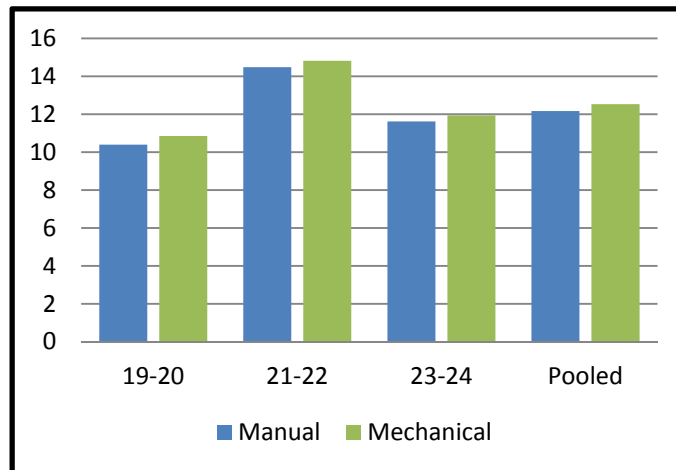


Figure H-34- Total Material Passing the 300-μm Sieve

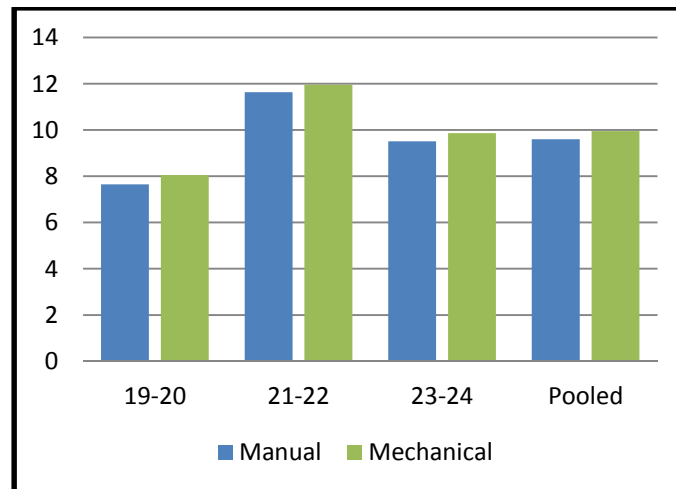


Figure H-35- Total Material Passing the 150-μm Sieve

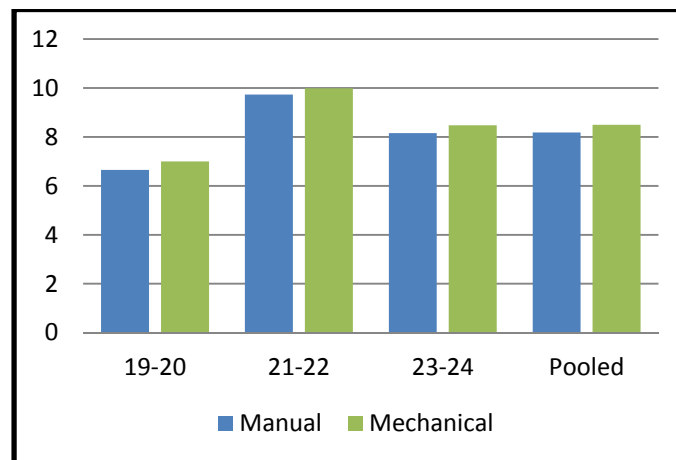


Figure H-36- Total Material Passing the 75-μm Sieve

Repeatability Standard Deviation Percent Passing

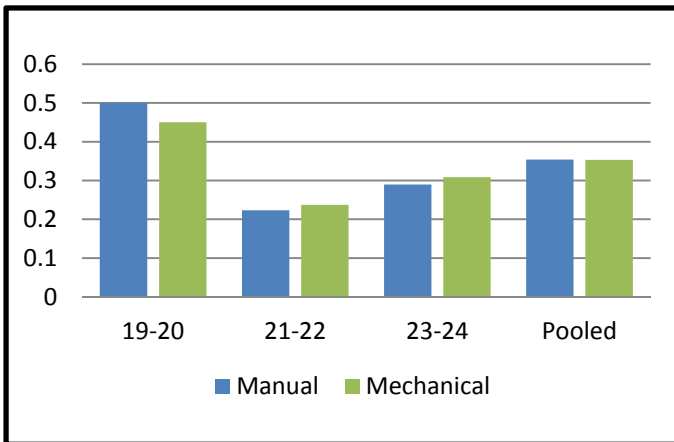


Figure H-37- Total Material Passing the 12.5-mm Sieve

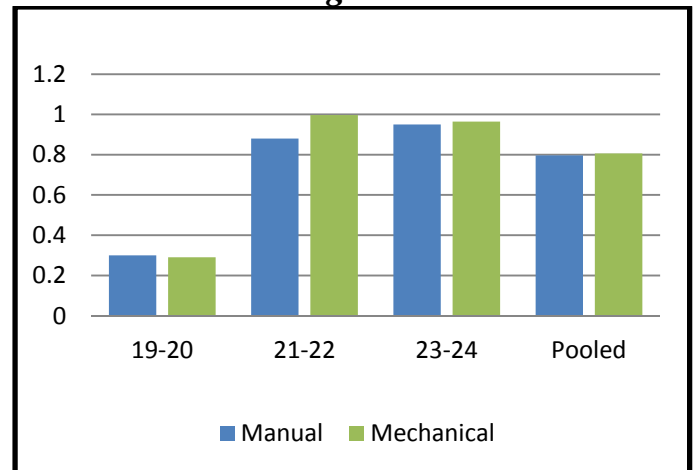


Figure H-40- Total Material Passing the 2.36- mm Sieve

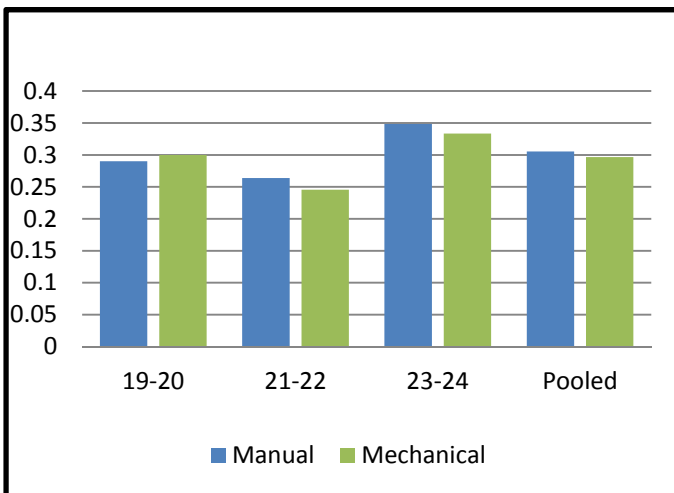


Figure H-38- Total Material Passing the 9.5-mm Sieve

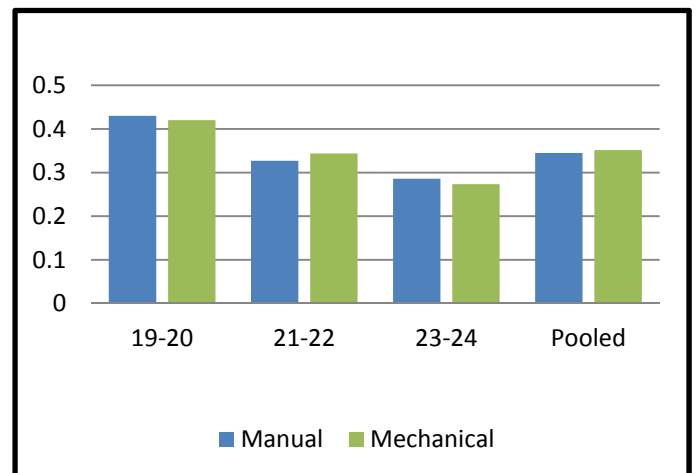


Figure H-41- Total Material Passing the 1.18- mm Sieve

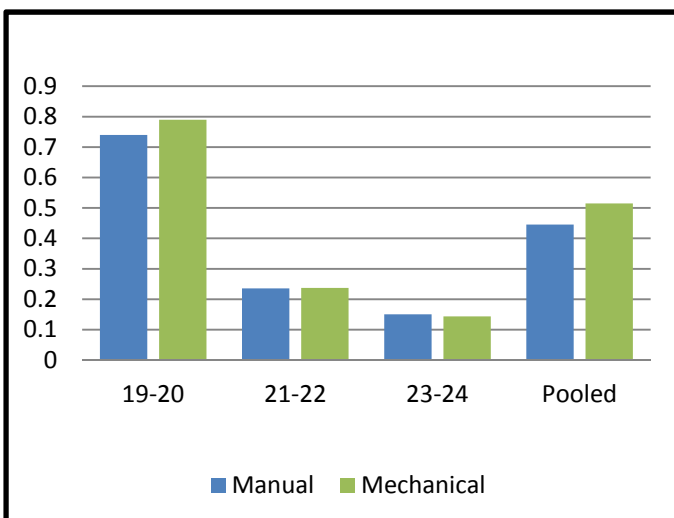


Figure H-39- Total Material Passing the 4.75-mm Sieve

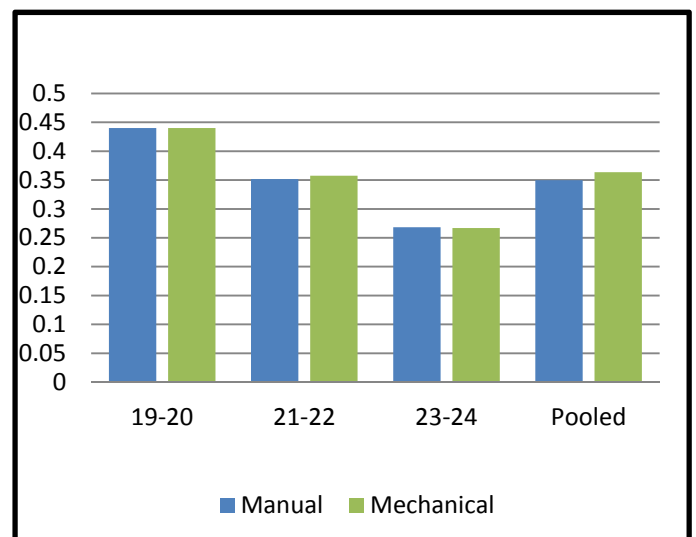


Figure H-42- Total Material Passing the 600-μm Sieve

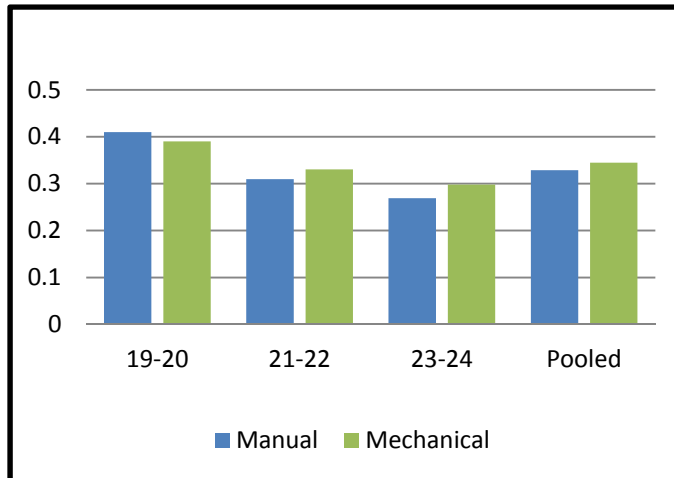


Figure H-43- Total Material Passing the 300-μm Sieve

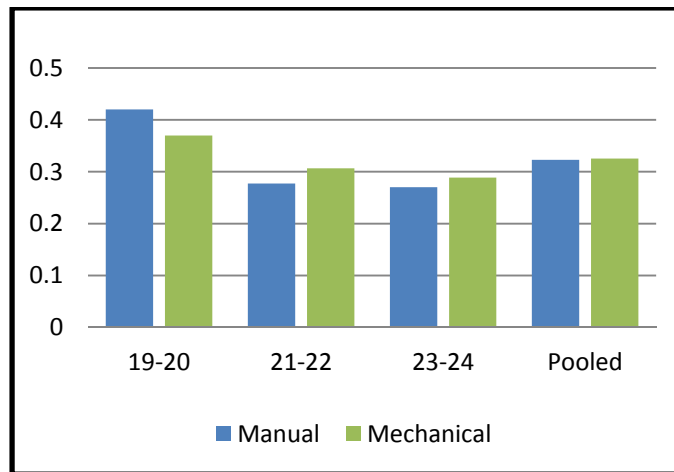


Figure H-44- Total Material Passing the 150-μm Sieve

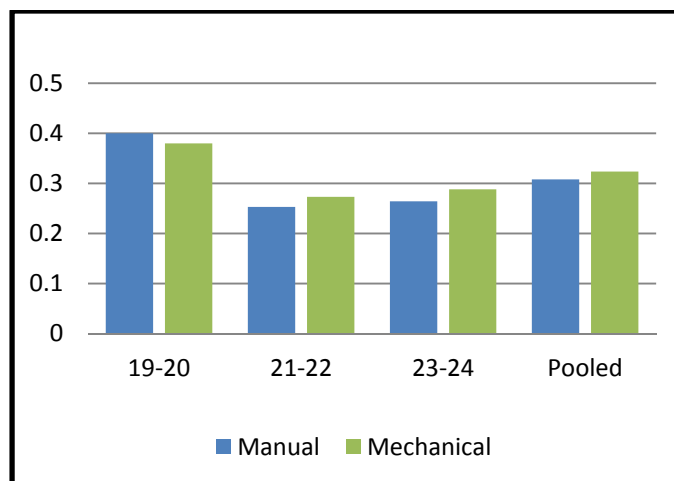


Figure H-45- Total Material Passing the 75-μm Sieve

Reproducibility Standard Deviation Percent Passing

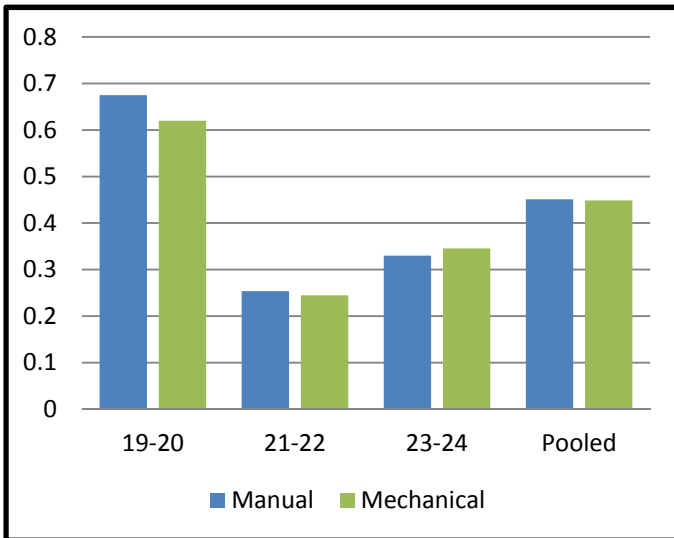


Figure H-46- Total Material Passing the 12.5-mm Sieve

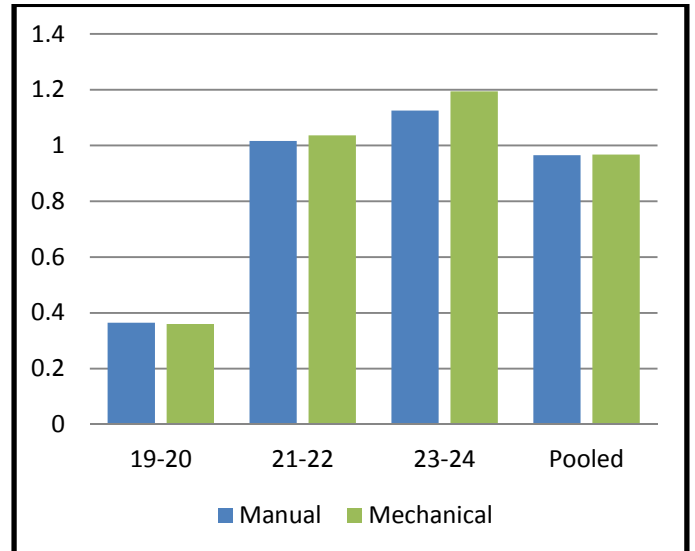


Figure H-49- Total Material Passing the 2.36- mm Sieve

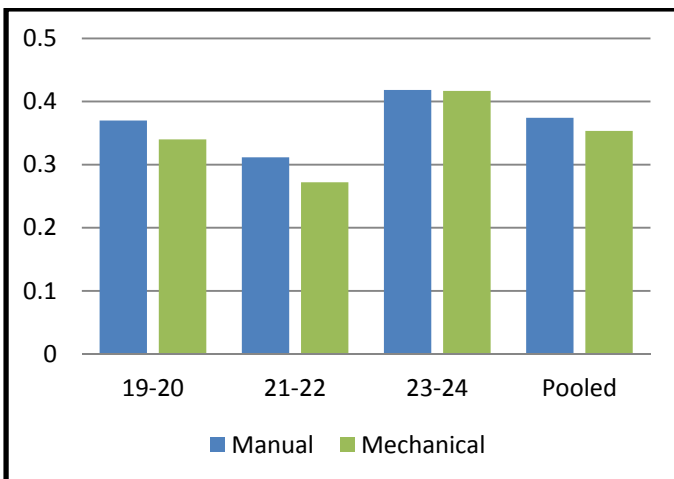


Figure H-47- Total Material Passing the 9.5-mm Sieve

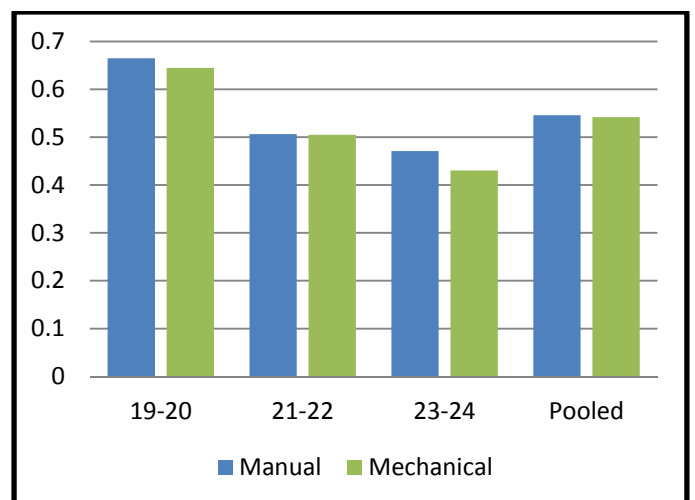


Figure H-50- Total Material Passing the 1.18- mm Sieve

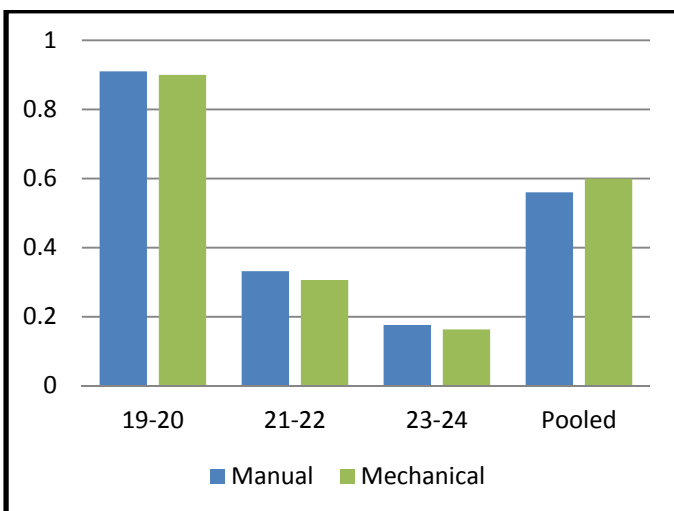


Figure H-48- Total Material Passing the 4.75-mm Sieve

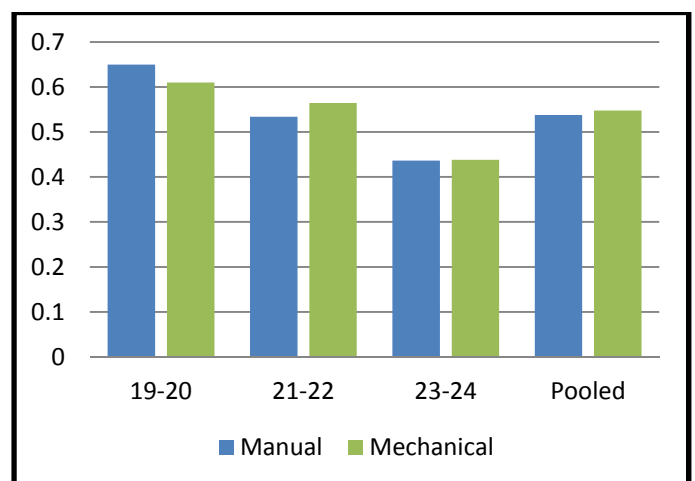


Figure H-51- Total Material Passing the 600-µm Sieve

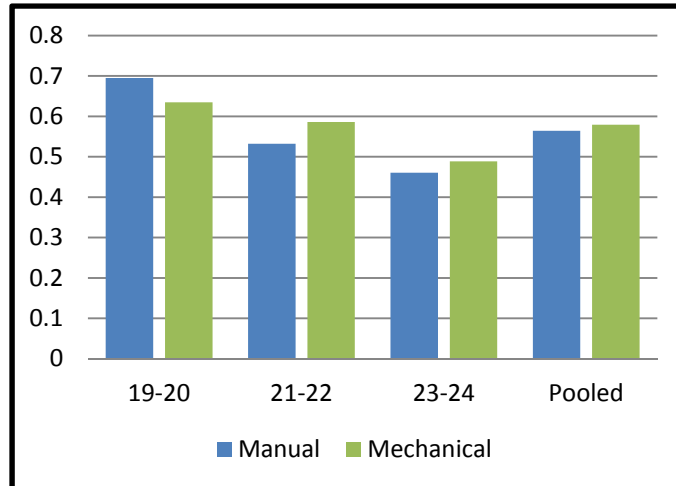


Figure H-52- Total Material Passing the 300-μm Sieve

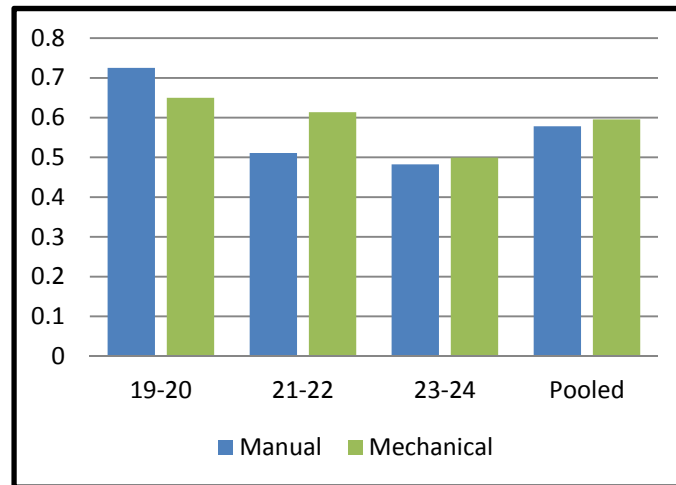


Figure H-53- Total Material Passing the 150-μm Sieve

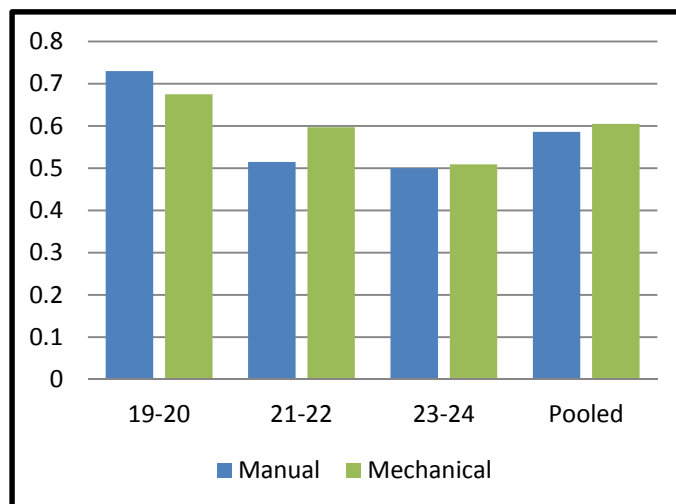


Figure H-54- Total Material Passing the 75-μm Sieve

Summaries of Statistics

HMAIO 19-20 Summaries of Statistics

Table H-1- Summary of statistics of percent passing various sieve sizes from washing of HMAIO 19-20 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	x samples		Y samples	
								1s	CV%	1s	CV%
HMAIO 19-20 All Methods of Washing	12.5 mm	684	95.7	92.6	0.49	0.52	0.53	0.65	0.68	0.67	0.72
	9.5 mm	670	86.6	83.3	0.29	0.33	0.34	0.34	0.39	0.39	0.47
	4.75 mm	676	62.9	62.5	0.75	1.19	1.2	1.04	1.65	0.78	1.25
	2.36 mm	621	43	44.3	0.3	0.69	0.67	0.33	0.78	0.42	0.95
	1.18 mm	615	26.9	28.4	0.43	1.58	0.43	0.6	2.24	0.74	2.61
	600 µm	617	15.9	17.5	0.44	2.76	2.51	0.57	3.58	0.73	4.18
	300 µm	635	9.7	11.3	0.41	4.19	3.62	0.6	6.22	0.8	7.09
	150 µm	646	7	8.5	0.41	5.85	4.84	0.61	8.77	0.83	9.83
	75 µm, Total	649	6.1	7.4	0.4	6.62	5.41	0.61	10.1	0.85	11.5

Table H-2- Summary of statistics of percent passing various sieve sizes from manual washing of HMAIO 19-20 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMAIO 19-20 Manual Washing	12.5 mm	508	95.7	92.6	0.5	0.53	0.54	0.66	0.69	0.69	0.75
	9.5 mm	499	86.6	83.3	0.29	0.33	0.34	0.35	0.4	0.39	0.47
	4.75 mm	498	62.9	62.5	0.74	1.17	1.18	1.03	1.64	0.79	1.26
	2.36 mm	452	43	44.3	0.3	0.71	0.69	0.32	0.75	0.41	0.94
	1.18 mm	444	26.8	28.3	0.43	1.6	1.52	0.6	2.24	0.73	2.59
	600 µm	444	15.8	17.4	0.44	2.75	2.5	0.58	3.64	0.72	4.14
	300 µm	465	9.6	11.2	0.41	4.25	3.67	0.6	6.27	0.79	2.22
	150 µm	477	6.9	8.4	0.42	5.99	4.96	0.63	9.03	0.82	9.84
	75 µm, Total	475	6	7.3	0.4	6.66	5.44	0.62	10.4	0.84	11.4

Table H-3- Summary of statistics of percent passing various sieve sizes from mechanical washing of HMAIO 19-20

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMAIO 19-20 Mechanical Method of Washing	12.5 mm	132	95.7	92.6	0.45	0.47	0.49	0.63	0.65	0.61	0.66
	9.5 mm	128	86.7	83.4	0.3	0.34	0.36	0.32	0.37	0.36	0.44
	4.75 mm	134	63	62.6	0.79	1.25	1.26	1.04	1.65	0.76	1.21
	2.36 mm	127	43.1	44.4	0.29	0.67	0.65	0.34	0.79	0.38	0.86
	1.18 mm	127	27	28.6	0.42	1.54	1.45	0.59	2.2	0.7	2.44
	600 µm	129	16	17.7	0.44	2.72	2.46	0.52	3.27	0.7	3.92
	300 µm	127	10	11.7	0.39	3.93	3.37	0.53	5.3	0.74	6.36
	150 µm	124	7.3	8.8	0.37	5.08	4.19	0.52	7.11	0.78	8.84
	75 µm, Total	128	6.3	7.7	0.38	6.09	4.97	0.54	8.57	0.81	10.4

HMAIO 21-22 Summaries of Statistics

Table H-4- Summary of statistics of percent passing various sieve sizes from washing of HMAIO 21-22 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X		Y	
								1s	CV%	1s	CV%
HMAIO 21-22 All Methods of Washing	12.5 mm	729	95.3	95.8	0.23	0.24	0.24	0.26	0.27	0.25	0.26
	9.5 mm	716	88.6	89.4	0.26	0.3	0.29	0.29	0.32	0.33	0.37
	4.75 mm	701	63	60.2	0.23	0.37	0.39	0.33	0.53	0.32	0.54
	2.36 mm	751	39	40.3	0.91	2.33	2.26	0.71	1.81	1.34	3.33
	1.18 mm	721	27.3	26.9	0.33	1.21	1.23	0.49	1.81	0.51	1.91
	600 µm	714	19.7	19.1	0.35	1.79	1.84	0.53	2.67	0.56	2.92
	300 µm	708	14.7	14.3	0.32	2.15	2.21	0.55	3.7	0.55	3.85
	150 µm	696	11.8	11.6	0.29	2.43	2.47	0.55	4.69	0.54	4.62
	75 µm, Total	704	9.77	9.74	0.26	2.69	2.7	0.55	5.6	0.54	5.53

Table H-5- Summary of statistics for percent passing various sieve sizes from manual washing of HMAIO 21-22 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMAIO 21-22 Manual Washing	12.5 mm	507	95.3	95.8	0.22	0.23	0.23	0.26	0.28	0.24	0.25
	9.5 mm	494	88.6	89.4	0.26	0.3	0.3	0.3	0.33	0.33	0.37
	4.75 mm	487	62.9	60.2	0.24	0.37	0.39	0.34	0.54	0.32	0.54
	2.36 mm	521	39	40.2	0.88	2.26	2.19	0.7	1.79	1.33	3.31
	1.18 mm	503	27.2	26.8	0.33	1.2	1.22	0.5	1.84	0.51	1.9
	600 µm	498	19.7	19.1	0.35	1.79	1.84	0.52	2.63	0.55	2.89
	300 µm	494	14.7	14.3	0.31	2.11	2.17	0.53	3.58	0.54	3.78
	150 µm	484	11.7	11.5	0.28	2.36	2.4	0.52	4.42	0.5	4.36
	75 µm, Total	486	9.75	9.72	0.25	2.59	2.6	0.51	5.28	0.52	5.31

Table H-6- Summary of statistics for percent passing various sieve sizes from mechanical washing of HMAIO 21-22 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMAIO 21-22 Mechanical Method of Washing	12.5 mm	98	95.3	95.7	0.24	0.25	0.25	0.26	0.27	0.23	0.24
	9.5 mm	100	88.6	89.4	0.25	0.28	0.27	0.24	0.27	0.3	0.34
	4.75 mm	94	63.1	60.2	0.24	0.38	0.39	0.31	0.49	0.3	0.5
	2.36 mm	105	39.3	40.3	1	2.54	2.47	0.69	1.75	1.39	3.44
	1.18 mm	100	27.5	27	0.34	1.25	1.27	0.46	1.66	0.55	2.05
	600 µm	98	20	19.3	0.36	1.79	1.85	0.51	2.57	0.62	3.19
	300 µm	96	15.1	14.6	0.33	2.19	2.27	0.54	3.61	0.63	4.31
	150 µm	92	12.1	11.8	0.31	2.53	2.59	0.58	4.76	0.65	5.52
	75 µm, Total	94	10	9.94	0.27	2.72	2.75	0.57	5.65	0.63	6.31

HMAIO 23-24 Summaries of Statistics

Table H-7- Summary of statistics of percent passing various sieve sizes from washing of HMAIO 23-24 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X		Y	
								1s	CV%	1s	CV%
HMAIO 23-24 All Methods of Washing	12.5 mm	756	94.8	94	0.29	0.31	0.31	0.38	0.4	0.29	0.3
	9.5 mm	731	86.1	82.4	0.35	0.4	0.42	0.46	0.54	0.38	0.46
	4.75 mm	701	54.7	64.8	0.15	0.28	0.23	0.19	0.35	0.16	0.25
	2.36 mm	764	33.5	35.9	0.95	2.84	2.65	0.89	2.65	1.4	3.9
	1.18 mm	734	21.1	21.9	0.28	1.34	1.29	0.44	2.08	0.51	2.33
	600 µm	723	15	15.6	0.27	1.79	1.71	0.4	2.65	0.5	3.18
	300 µm	728	11.4	12	0.27	2.41	2.29	0.43	3.78	0.53	4.42
	150 µm	729	9.33	9.81	0.27	2.93	2.79	0.45	4.86	0.55	5.61
	75 µm, Total	735	7.99	8.43	0.27	3.36	3.18	0.47	5.92	0.56	6.6

Table H-8- Summary of statistics of percent passing various sieve sizes from manual washing of HMAIO 23-24 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMAIO 23-24 Manual Washing	12.5 mm	637	94.8	94	0.29	0.31	0.31	0.38	0.4	0.28	0.3
	9.5 mm	617	86.1	82.4	0.35	0.4	0.42	0.46	0.54	0.37	0.45
	4.75 mm	588	54.6	64.8	0.15	0.28	0.23	0.19	0.35	0.16	0.25
	2.36 mm	638	33.4	35.9	0.95	2.84	2.65	0.88	2.62	1.37	3.83
	1.18 mm	620	21.1	21.9	0.29	1.36	1.31	0.43	2.04	0.51	2.34
	600 µm	608	14.9	15.6	0.27	1.8	1.72	0.38	2.56	0.49	3.14
	300 µm	610	11.3	11.9	0.27	2.37	2.26	0.41	3.6	0.51	4.31
	150 µm	612	9.27	9.76	0.27	2.92	2.77	0.43	4.64	0.54	5.48
	75 µm, Total	615	7.94	8.38	0.26	3.33	3.15	0.46	5.73	0.55	6.51

Table H-9- Summary of statistics of percent passing various sieve sizes from mechanical washing of HMAIO 23-24 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMAIO 23-24 Mechanical Method of Washing	12.5 mm	121	94.9	94	0.31	0.33	0.33	0.37	0.39	0.32	0.34
	9.5 mm	116	86.2	82.4	0.33	0.39	0.4	0.45	0.53	0.38	0.46
	4.75 mm	115	54.7	64.8	0.14	0.26	0.22	0.17	0.32	0.15	0.24
	2.36 mm	128	33.8	36.2	0.96	2.86	2.66	0.88	2.61	1.51	4.16
	1.18 mm	116	21.4	22.1	0.27	1.28	1.23	0.42	1.95	0.44	2.01
	600 µm	117	15.2	15.9	0.27	1.75	1.68	0.39	2.55	0.49	3.08
	300 µm	120	11.7	12.2	0.3	2.55	2.44	0.43	3.67	0.55	4.49
	150 µm	119	9.65	10.1	0.29	2.99	2.87	0.44	4.56	0.56	5.54
	75 µm, Total	122	8.27	8.68	0.29	3.48	3.32	0.46	5.61	0.55	6.39

HMAIO 25-26 Summaries of Statistics

Table H-10- Summary of statistics of percent passing various sieve sizes from washing of HMAIO 25-26 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X		Y	
								1s	CV%	1s	CV%
HMAIO 25-26 All Methods of Washing	12.5 mm	827	94.8	94.3	0.46	0.48	0.49	0.52	0.55	0.57	0.6
	9.5 mm	821	87.2	86.2	0.38	0.43	0.44	0.52	0.59	0.48	0.56
	4.75 mm	792	58.8	61	0.2	0.35	0.33	0.37	0.63	0.37	0.61
	2.36 mm	814	39	39.5	0.57	1.45	1.44	0.7	1.8	0.81	2.06
	1.18 mm	796	26.4	26.2	0.26	0.99	0.99	0.47	1.79	0.47	1.78
	600 µm	799	18.1	17.9	0.24	1.33	1.35	0.5	2.78	0.5	2.77
	300 µm	798	13.2	13.1	0.24	1.83	1.84	0.52	3.91	0.5	3.81
	150 µm	792	10.4	10.5	0.25	2.42	2.41	0.53	5.12	0.52	4.92
	75 µm, Total	781	8.76	8.84	0.23	2.67	2.64	0.52	5.92	0.51	5.73

Table H-11- Summary of statistics of percent passing various sieve sizes from manual washing of HMAIO 25-26 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMAIO 25-26 Manual Washing	12.5 mm	670	94.8	94.3	0.46	0.48	0.49	0.53	0.56	0.57	0.6
	9.5 mm	664	87.2	86.2	0.38	0.43	0.44	0.52	0.6	0.49	0.57
	4.75 mm	640	58.8	61	0.2	0.34	0.33	0.37	0.63	0.37	0.61
	2.36 mm	665	38.9	39.4	0.55	1.42	1.41	0.7	1.8	0.8	2.03
	1.18 mm	642	26.4	26.2	0.26	0.98	0.99	0.47	1.78	0.46	1.76
	600 µm	650	18	17.9	0.24	1.34	1.36	0.49	2.72	0.49	2.77
	300 µm	650	13.1	13.1	0.24	1.83	1.84	0.49	3.74	0.48	3.71
	150 µm	647	10.4	10.4	0.25	2.4	2.39	0.51	4.92	0.5	4.79
	75 µm, Total	636	8.69	8.78	0.23	2.65	2.63	0.5	5.76	0.49	5.58

Table H-12- Summary of statistics of percent passing various sieve sizes from mechanical washing of HMAIO 25-26 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMAIO 25-26 Mechanical Method of Washing	12.5 mm	156	94.8	94.4	0.47	0.5	0.5	0.46	0.48	0.55	0.58
	9.5 mm	157	87.2	86.3	0.39	0.44	0.45	0.49	0.56	0.44	0.51
	4.75 mm	151	58.9	61.1	0.21	0.36	0.35	0.32	0.55	0.34	0.55
	2.36 mm	148	39.3	39.7	0.62	1.57	1.55	0.62	1.58	0.82	2.07
	1.18 mm	153	26.6	26.4	0.27	1	1.01	0.43	1.6	0.44	1.65
	600 µm	148	18.4	18.2	0.24	1.28	1.3	0.46	2.48	0.43	2.37
	300 µm	147	13.5	13.4	0.24	1.8	1.81	0.47	3.48	0.45	3.35
	150 µm	144	10.8	10.8	0.26	2.46	2.45	0.5	4.63	0.48	4.44
	75 µm, Total	144	9.05	9.13	0.24	2.69	2.67	0.49	5.47	0.48	5.27

Statistical Tests of Significance

HMAIO 19-20 Statistical test of significance

Table H-13- Statistical t-test for comparison of average percent passing of various sieve sizes from mechanical and manual washing of HMAIO 19-20

Sieve Sizes	Average Percent Passing		Degrees of Freedom	Computed t
	Manual	Mechanical		
12.5-mm	94.2	94.2	220	0.25
9.5-mm	85	85	208	-2.14
4.75-mm	62.7	62.8	212	-0.81
2.36-mm	43.6	43.8	207	-4.03
1.18-mm	27.6	27.8	209	-4.23
600- μ m	16.6	16.9	218	-4.38
300- μ m	10.4	10.8	214	-6.54
150- μ m	7.65	8.03	209	-5.53
75 μ m, Total	6.65	7.02	212	-5.35

Note: Critical t for 1% level of significance is 2.60 and for 5% level of significance is 1.97

Table H-14- Statistical F-test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMAIO 19-20

Sieve Sizes	1S Repeatability, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mech.				
12.5-mm	0.5	0.45	507 & 131	1.25	1.40	1.27
9.5-mm	0.29	0.3	127 & 498	1.08	1.37	1.25
4.75-mm	0.74	0.79	133 & 497	1.14	1.36	1.24
2.36-mm	0.3	0.29	451 & 126	1.12	1.42	1.28
1.18-mm	0.43	0.42	443 & 126	1.07	1.42	1.28
600- μ m	0.44	0.44	128 & 443	1.01	1.37	1.25
300- μ m	0.41	0.39	464 & 126	1.09	1.41	1.28
150- μ m	0.42	0.37	476 & 123	1.27	1.42	1.28
75 μ m, Total	0.4	0.38	474 & 127	1.07	1.41	1.27

Table H-15- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMAIO 19-20

Sieve Sizes	1S Reproducibility, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mech.				
12.5-mm	0.68	0.62	507 & 131	1.20	1.40	1.27
9.5-mm	0.37	0.34	498 & 127	1.15	1.41	1.27
4.75-mm	0.92	0.91	497 & 133	1.02	1.40	1.27
2.36-mm	0.37	0.36	451 & 126	1.06	1.42	1.28
1.18-mm	0.67	0.65	443 & 126	1.07	1.42	1.28
600- μ m	0.65	0.62	443 & 128	1.12	1.41	1.27
300- μ m	0.7	0.65	464 & 126	1.18	1.41	1.28
150- μ m	0.73	0.66	476 & 123	1.23	1.42	1.28
75 μ m, Total	0.74	0.69	474 & 127	1.15	1.41	1.27

HMAIO 21-22 Statistical test of significance

Table H-16- Statistical t-test for comparison of average percent passing various sieve sizes from mechanical and manual washing of HMAIO 21-22 samples

Sieve Sizes	Average Percent Passing		Degrees of Freedom	Computed t
	Manual	Mechanical		
12.5-mm	95.6	95.5	140	0.67
9.5-mm	89	89	156	-0.51
4.75-mm	61.6	61.7	138	-3.15
2.36-mm	39.6	39.8	146	-1.32
1.18-mm	27	27.2	141	-3.55
600-μm	19.4	19.6	133	-4.00
300-μm	14.5	14.8	127	-5.23
150-μm	11.6	12	116	-4.78
75 μm, Total	9.7	10	121	-3.86

Note: Critical t for 1% level of significance is 2.61 and for 5% level of significance is 1.98

Table H-17- Statistical F-test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMAIO 21-22 samples

Sieve Sizes	1S Repeatability, Percent Passing		Degrees of Freedom	Computed F	Critical F(α=.01)	Critical F(α=.05)
	Manual	Mech.				
12.5-mm	0.22	0.24	97 & 506	1.13	1.41	1.28
9.5-mm	0.26	0.25	493 & 99	1.15	1.47	1.31
4.75-mm	0.24	0.24	93 & 486	1.01	1.42	1.28
2.36-mm	0.88	1	104 & 520	1.28	1.40	1.27
1.18-mm	0.33	0.34	99 & 502	1.10	1.41	1.28
600-μm	0.35	0.36	97 & 497	1.03	1.41	1.28
300-μm	0.31	0.33	95 & 493	1.14	1.42	1.28
150-μm	0.28	0.31	91 & 483	1.22	1.43	1.29
75 μm, Total	0.25	0.27	93 & 485	1.17	1.42	1.28

Table H-18- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMAIO 21-22 samples

Sieve Sizes	1S Reproducibility, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mech.				
12.5-mm	0.25	0.25	506 & 97	1.07	1.47	1.31
9.5-mm	0.31	0.27	493 & 99	1.30	1.47	1.31
4.75-mm	0.33	0.31	486 & 93	1.17	1.49	1.32
2.36-mm	1.06	1.09	104 & 520	1.06	1.40	1.27
1.18-mm	0.51	0.51	99 & 502	1.00	1.41	1.28
600- μ m	0.53	0.57	97 & 497	1.12	1.41	1.28
300- μ m	0.53	0.59	95 & 493	1.22	1.42	1.28
150- μ m	0.51	0.61	91 & 483	1.45	1.43	1.29
75 μ m, Total	0.51	0.6	93 & 485	1.35	1.42	1.28

HMAIO 23-24 Statistical test of significance

Table H-19- Statistical t-test for comparison of average percent passing various sieve sizes from mechanical and manual washing of HMAIO 23-24 samples

Sieve Sizes	Average Percent Passing		Degrees of Freedom	Computed t
	Manual	Mechanical		
12.5-mm	94.4	94.4	165	-0.30
9.5-mm	84.2	84.3	162	-1.06
4.75-mm	59.7	59.8	171	-4.50
2.36-mm	34.7	35	174	-2.87
1.18-mm	21.5	21.8	171	-6.01
600-μm	15.3	15.5	163	-6.00
300-μm	11.6	11.9	163	-6.60
150-μm	9.5	9.9	164	-7.03
75 μm, Total	8.2	8.5	171	-6.28

Note: Critical t for 1% level of significance is 2.61 and for 5% level of significance is 1.97

Table H-20- Statistical F- test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMAIO 23-24 samples

Sieve Sizes	1S Repeatability, Percent Passing		Degrees of Freedom	Computed F	Critical F(α=.01)	Critical F(α=.05)
	Manual	Mech.				
12.5-mm	0.29	0.31	120 & 636	1.13	1.37	1.25
9.5-mm	0.35	0.33	616 & 115	1.09	1.42	1.28
4.75-mm	0.15	0.14	587 & 114	1.10	1.43	1.28
2.36-mm	0.95	0.96	127 & 637	1.03	1.36	1.24
1.18-mm	0.29	0.27	619 & 115	1.10	1.42	1.28
600-μm	0.27	0.27	607 & 116	1.01	1.42	1.28
300-μm	0.27	0.3	119 & 609	1.23	1.37	1.25
150-μm	0.27	0.29	118 & 611	1.14	1.37	1.25
75 μm, Total	0.26	0.29	121 & 614	1.19	1.37	1.25

Table H-21- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMAIO 23-24 samples

Sieve Sizes	1S Reproducibility, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mech.				
12.5-mm	0.35	0.33	120 & 636	1.07	1.37	1.25
9.5-mm	0.42	0.42	616 & 115	1.01	1.42	1.28
4.75-mm	0.18	0.16	587 & 114	1.17	1.43	1.28
2.36-mm	1.23	1.15	127 & 637	1.15	1.36	1.24
1.18-mm	0.47	0.43	619 & 115	1.21	1.42	1.28
600- μ m	0.44	0.44	116 & 607	1.01	1.37	1.25
300- μ m	0.49	0.46	119 & 609	1.13	1.37	1.25
150- μ m	0.5	0.49	118 & 611	1.07	1.37	1.25
75 μ m, Total	0.51	0.5	121 & 614	1.04	1.37	1.25

HMAIO 25-26

Statistical test of significance

Table H-22- Statistical t-test for comparison of average percent passing various sieve sizes from mechanical and manual washing of HMAIO 25-26 samples

Sieve Sizes	Average Percent Passing		Degrees of Freedom	Computed t
	Manual	Mechanical		
12.5-mm	94.5	94.6	247	-1.64
9.5-mm	86.7	86.8	251	-1.19
4.75-mm	59.9	60	249	-4.42
2.36-mm	39.2	39.5	222	-5.15
1.18-mm	26.3	26.5	244	-6.70
600- μ m	17.9	18.3	237	-8.12
300- μ m	13.1	13.5	226	-9.58
150- μ m	10.4	10.8	216	-8.80
75 μ m, Total	8.7	9.1	215	-7.85

Note: Critical t for 1% level of significance is 2.60 and for 5% level of significance is 1.97

Table H-23- Statistical F- test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMAIO 25-26 samples

Sieve Sizes	1S Repeatability, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mech.				
12.5-mm	0.46	0.47	155 & 669	1.05	1.33	1.22
9.5-mm	0.38	0.39	156 & 663	1.05	1.33	1.22
4.75-mm	0.2	0.21	150 & 639	1.09	1.33	1.23
2.36-mm	0.55	0.62	147 & 664	1.24	1.33	1.23
1.18-mm	0.26	0.27	152 & 641	1.06	1.33	1.22
600- μ m	0.24	0.24	649 & 147	1.05	1.37	1.25
300- μ m	0.24	0.24	146 & 649	1.03	1.34	1.23
150- μ m	0.25	0.26	143 & 646	1.13	1.34	1.23
75 μ m, Total	0.23	0.24	143 & 635	1.12	1.34	1.23

Table H-24- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMAIO 25-26 samples

Sieve Sizes	1S Reproducibility, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mech.				
12.5-mm	0.55	0.51	669 & 155	1.17	1.36	1.24
9.5-mm	0.51	0.47	663 & 156	1.19	1.36	1.24
4.75-mm	0.37	0.33	639 & 150	1.28	1.37	1.25
2.36-mm	0.75	0.73	664 & 147	1.07	1.37	1.25
1.18-mm	0.47	0.43	641 & 152	1.17	1.36	1.24
600- μ m	0.49	0.44	649 & 147	1.23	1.37	1.25
300- μ m	0.49	0.46	649 & 146	1.12	1.37	1.25
150- μ m	0.5	0.49	646 & 143	1.06	1.38	1.25
75 μ m, Total	0.5	0.49	635 & 143	1.03	1.38	1.25

**APPENDIX I - HOT MIX ASPHALT SOLVENT EXTRACTION- WASHING
METHOD TABLES AND GRAPHS**

Total Material Passing Scatter Plot Graphs

HMASE 73-74

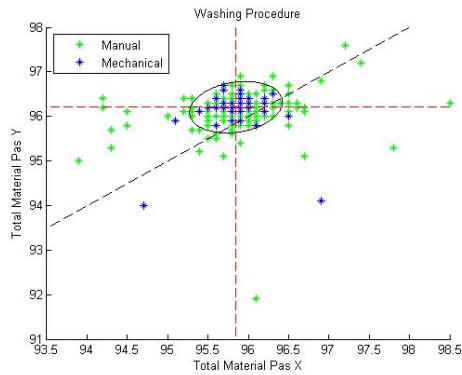


Figure I-1- Total Material Passing the 12.5-mm (12 in.) Sieve

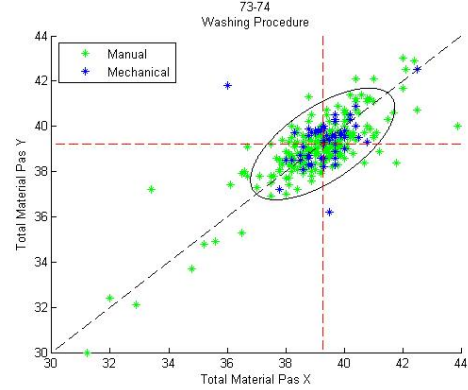


Figure I-4- Total Material Passing the 2.36-mm (No. 8) Sieve

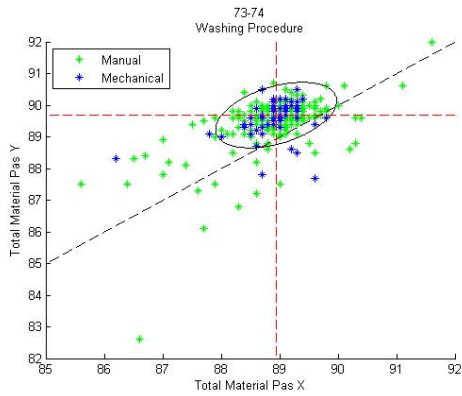


Figure I-2- Total Material Passing the 9.5-mm (38 in.) Sieve

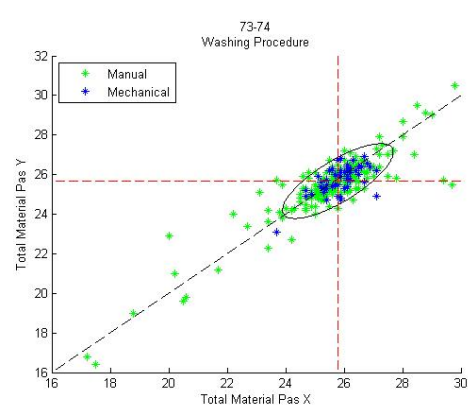


Figure I-5- Total Material Passing the 1.18-mm (No. 16) Sieve

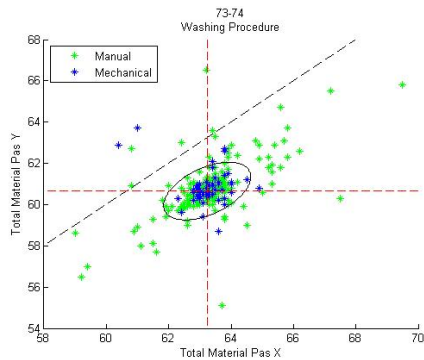


Figure I-3- Total Material Passing the 4.75-mm (No. 4) Sieve

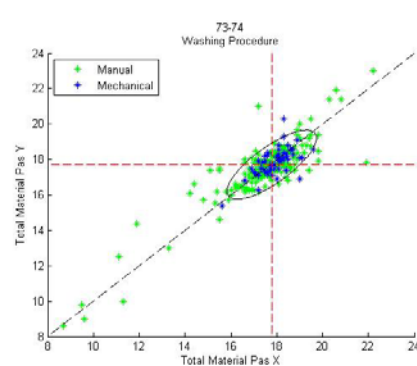


Figure I-6- Total Material Passing the 600-µm (No. 30) Sieve

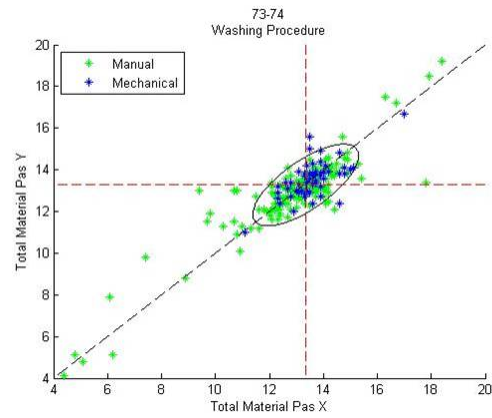


Figure I-7- Total Material Passing the 300- μ m (No. 50) Sieve

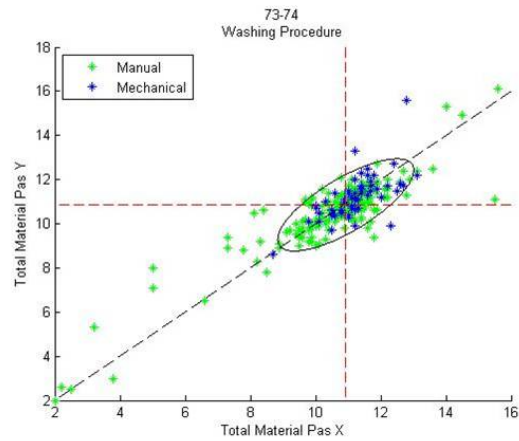


Figure I-8- Total Material Passing the 150- μ m (No. 100) Sieve

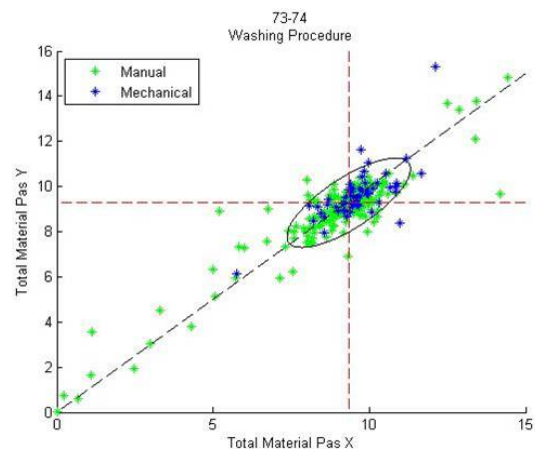


Figure I-9- Total Material Passing the 75- μ m (No. 200) Sieve

HMASE 75-76

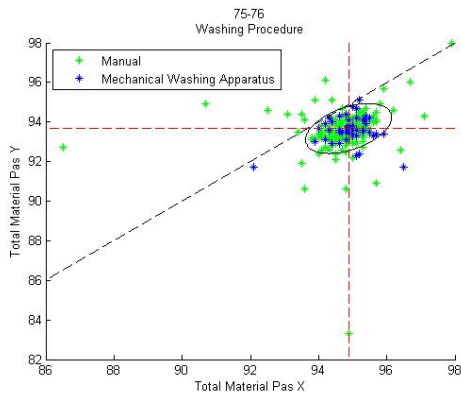


Figure I-10- Total Material Passing the 12.5-mm (12 in.) Sieve

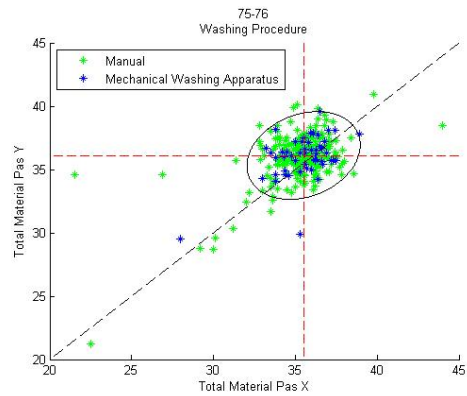


Figure I-13- Total Material Passing the 2.36-mm (No. 8) Sieve

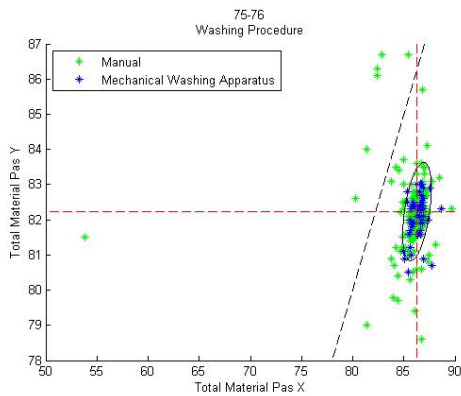


Figure I-11- Total Material Passing the 9.5-mm (38 in.) Sieve

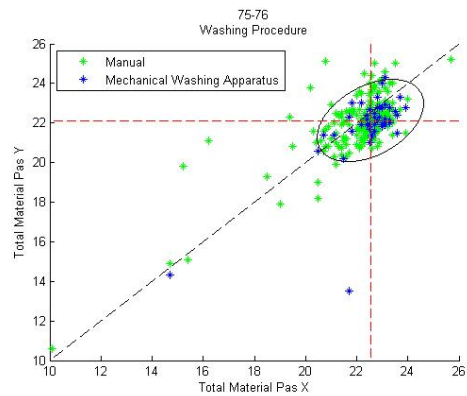


Figure I-14- Total Material Passing the 1.18-mm (No. 16) Sieve

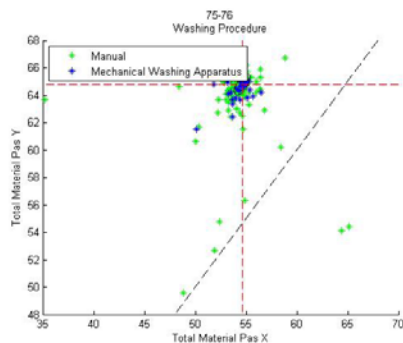


Figure I-12- Total Material Passing the 4.75-mm (No. 4) Sieve

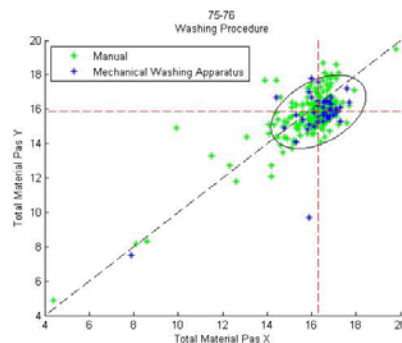


Figure I-15- Total Material Passing the 600-μm (No. 30) Sieve

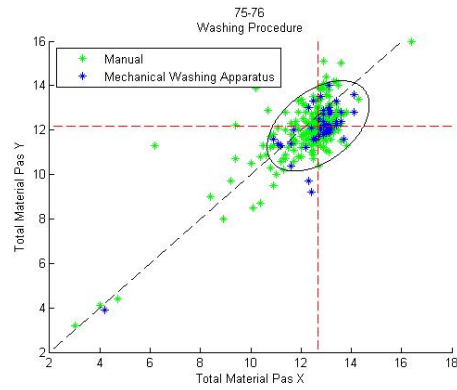


Figure I-16- Total Material Passing the 300- μ m (No. 50) Sieve

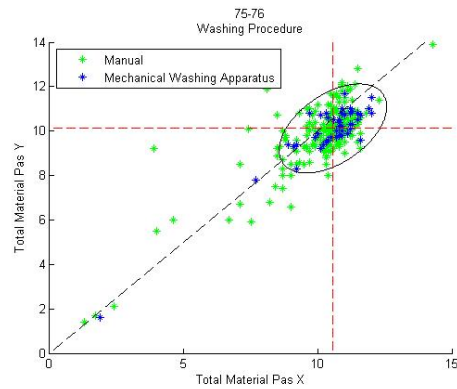


Figure I-17- Total Material Passing the 150- μ m (No. 100) Sieve

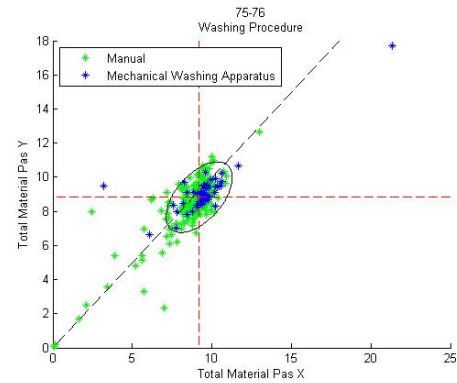


Figure I-18- Total Material Passing the 75- μ m (No. 200) Sieve

Percent Passing Bar Graphs

Average Percent Passing

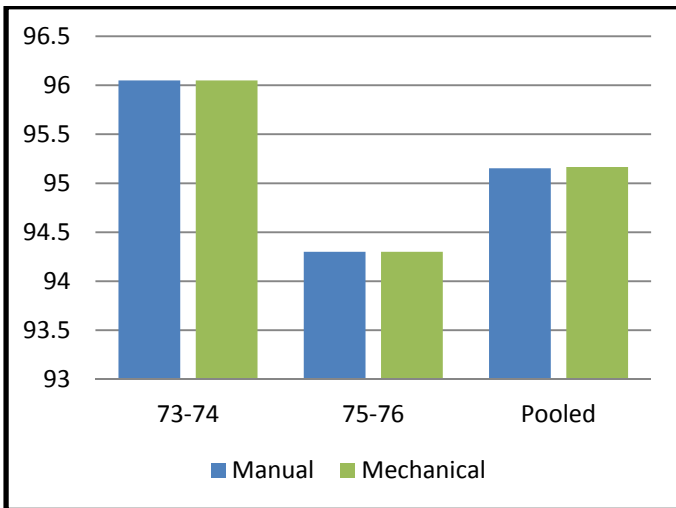


Figure I-19- Total Material Passing the 25.0-mm Sieve

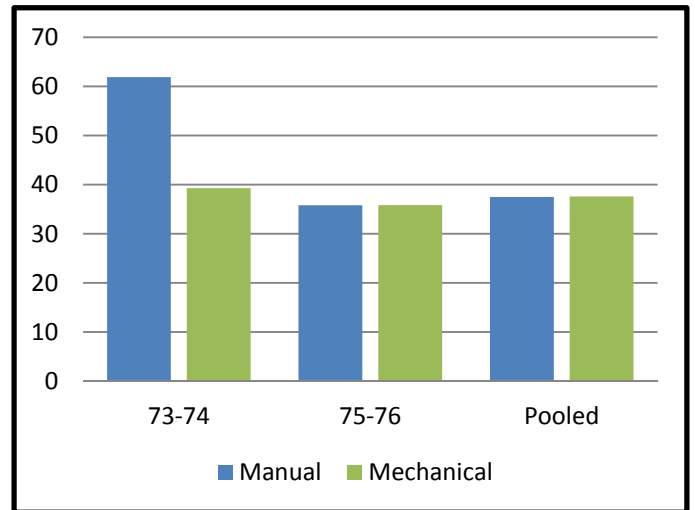


Figure I-22- Total Material Passing the 2.36- mm Sieve

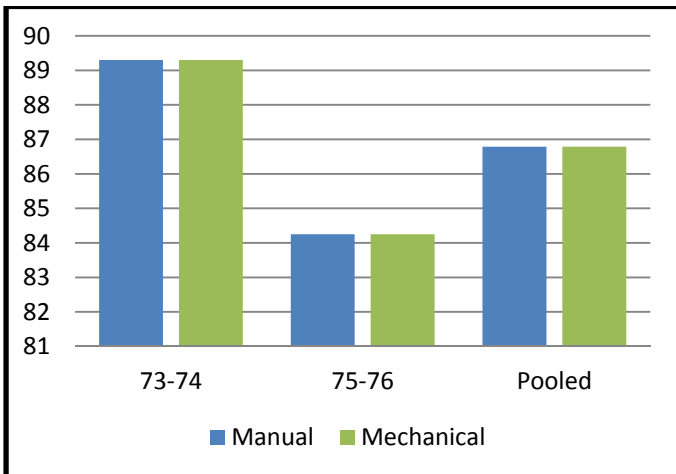


Figure I-20- Total Material Passing the 9.5-mm Sieve

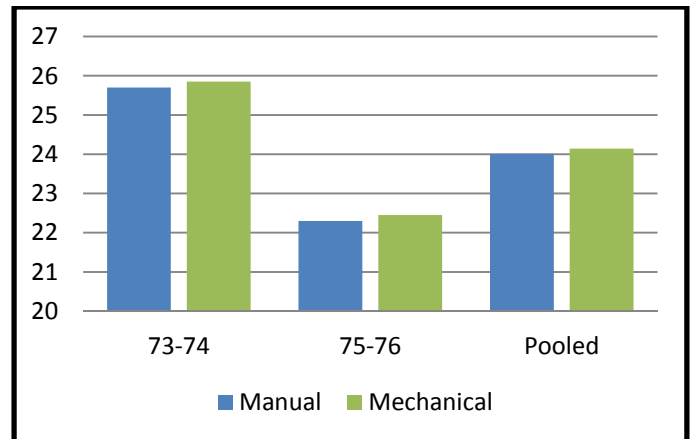


Figure I-23- Total Material Passing the 1.18- mm Sieve

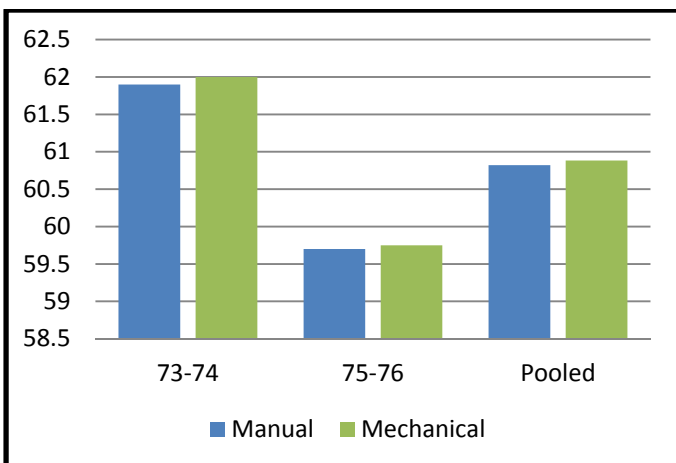


Figure I-21- Total Material Passing the 4.75-mm Sieve

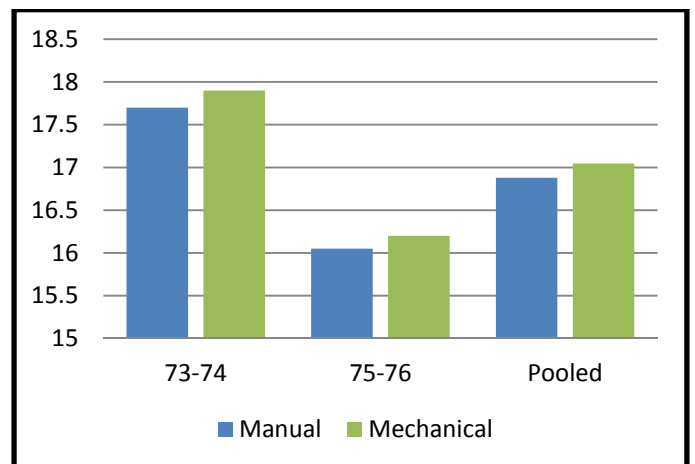


Figure I-24- Total Material Passing the 600-µm Sieve

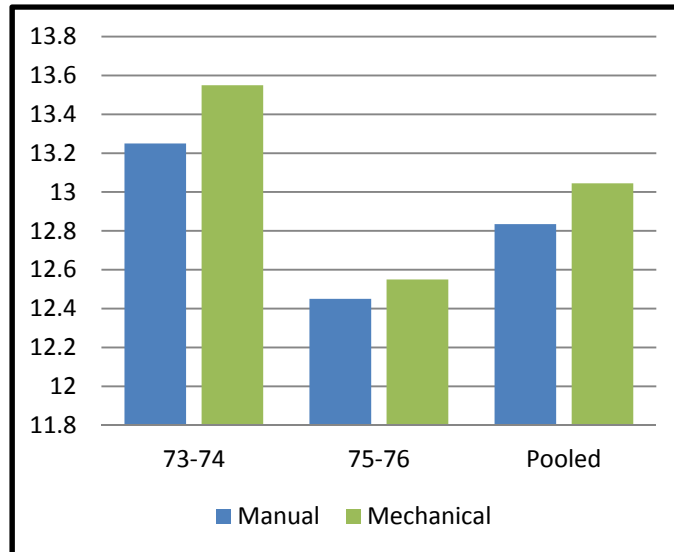


Figure I-25- Total Material Passing the 300-μm Sieve

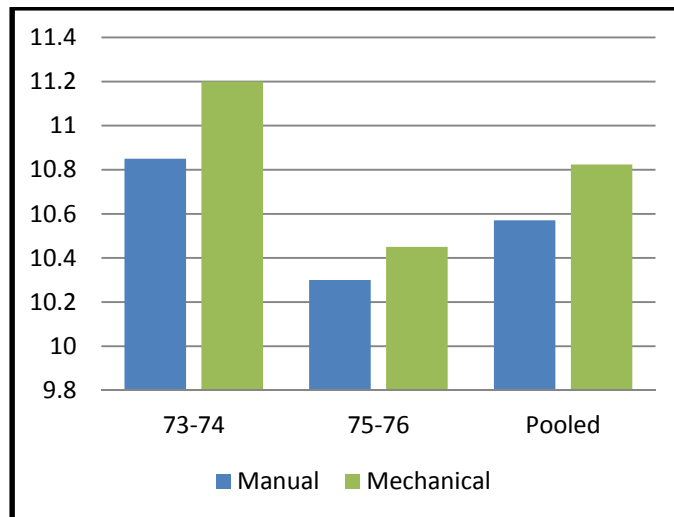


Figure I-26- Total Material Passing the 150-μm Sieve

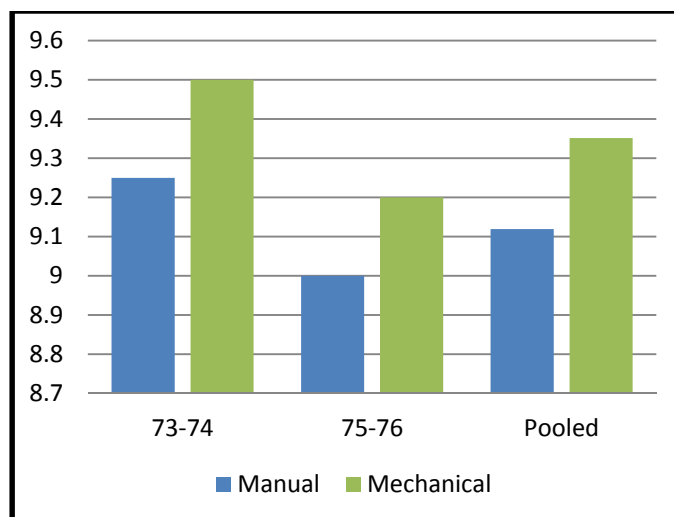


Figure I-27- Total Material Passing the 75-μm Sieve

Repeatability Standard Deviation Percent Passing

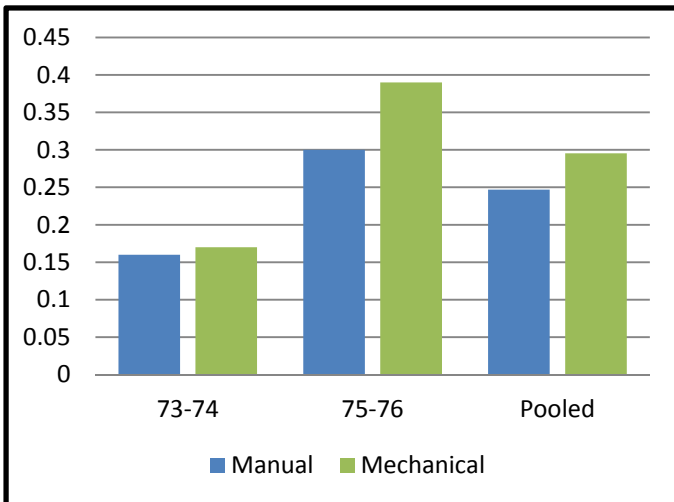


Figure I-28- Total Material Passing the 25.0-mm Sieve

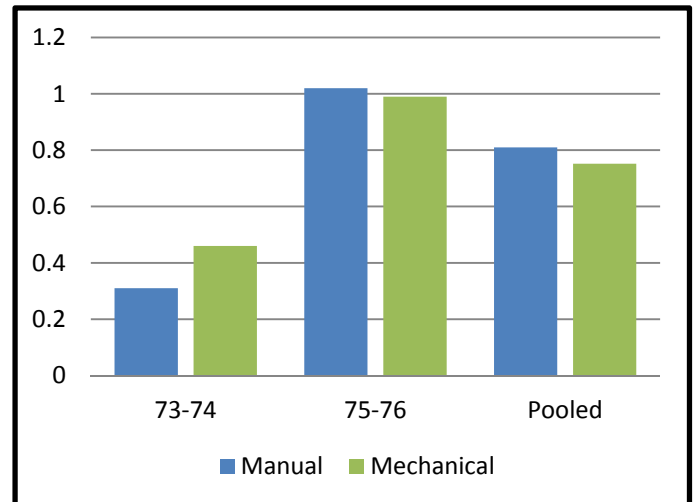


Figure I-31- Total Material Passing the 2.36- mm Sieve

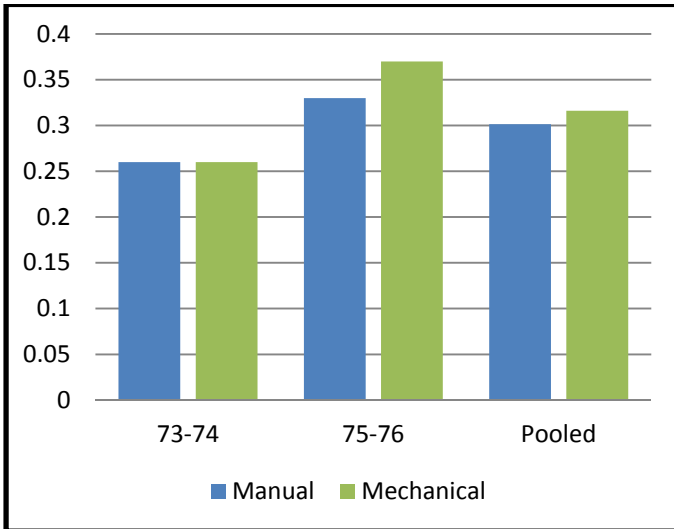


Figure I-29- Total Material Passing the 9.5-mm Sieve

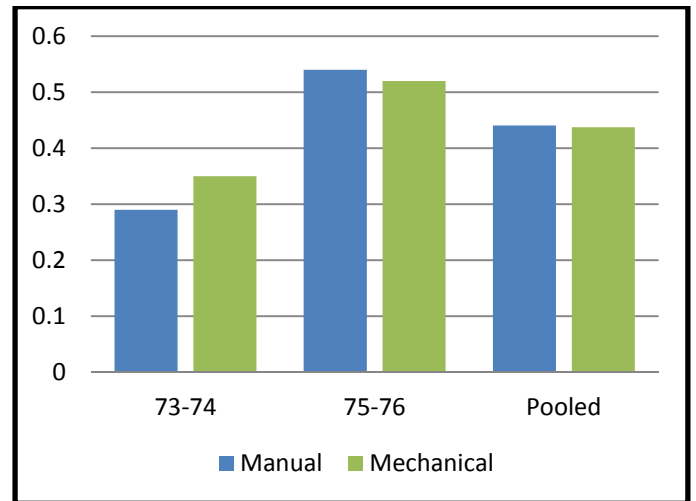


Figure I-32- Total Material Passing the 1.18- mm Sieve

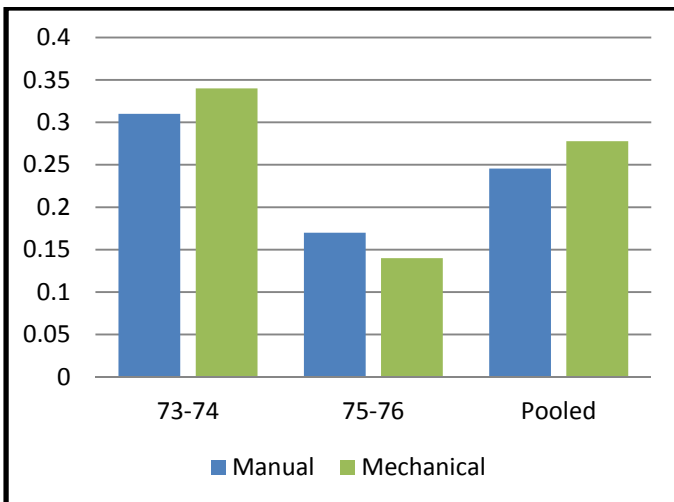


Figure I-30- Total Material Passing the 4.75-mm Sieve

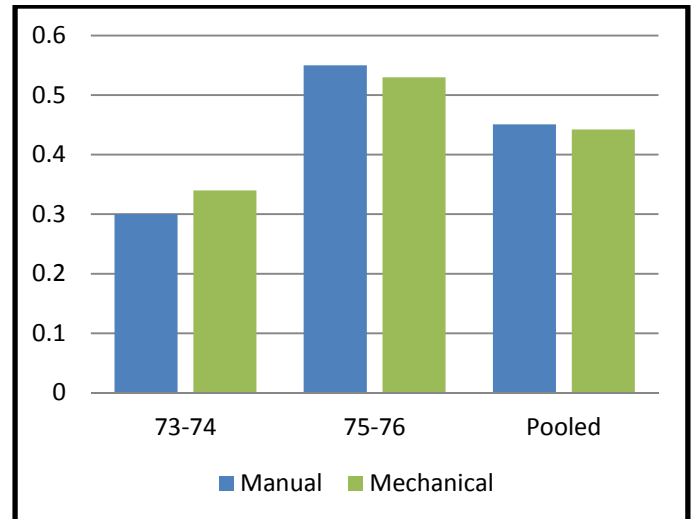


Figure I-33- Total Material Passing the 600-μm Sieve

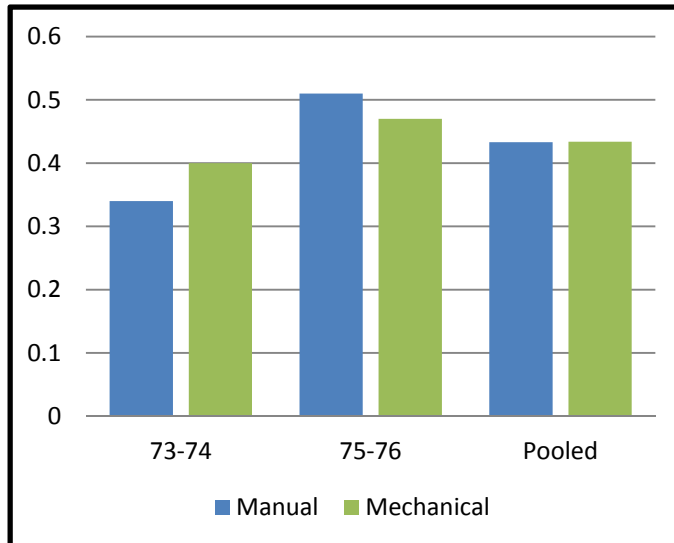


Figure I-34- Total Material Passing the 300-μm Sieve

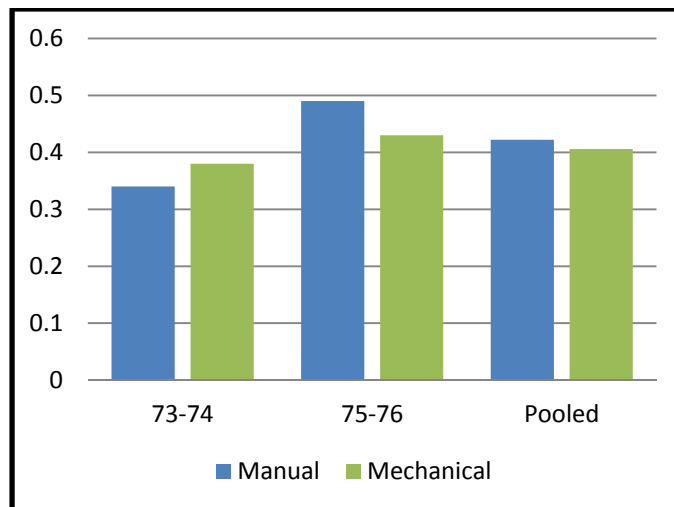


Figure I-35- Total Material Passing the 150-μm Sieve

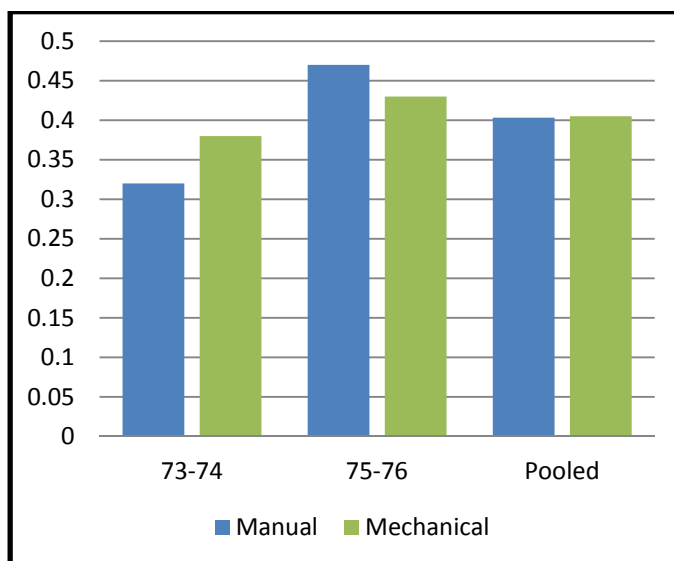


Figure I-36- Total Material Passing the 75-μm Sieve

Reproducibility Standard Deviation Percent Passing

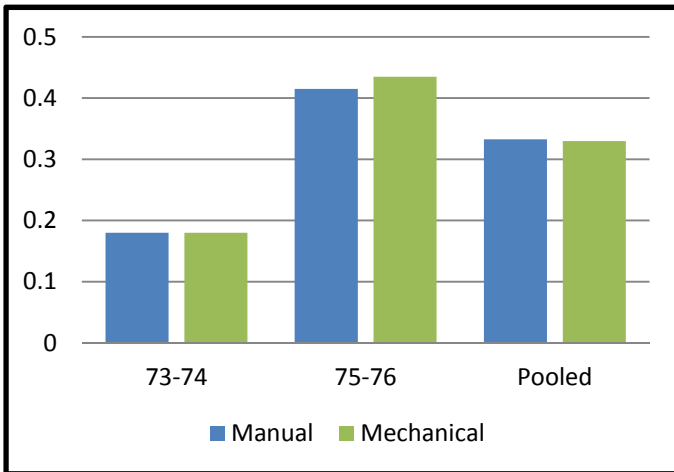


Figure I-37- Total Material Passing the 25.0-mm Sieve

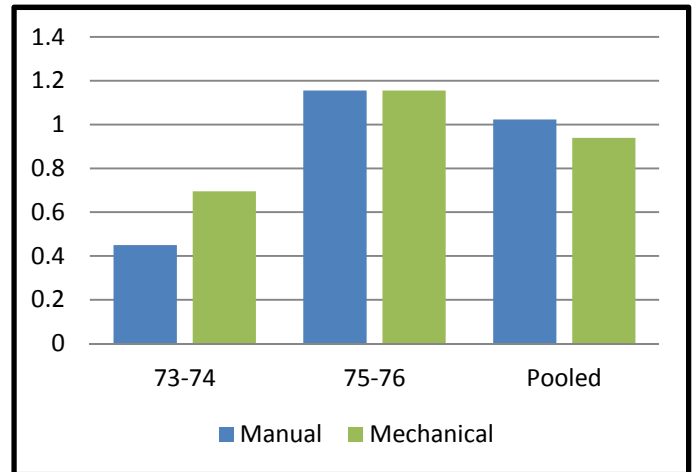


Figure I-40- Total Material Passing the 2.36- mm Sieve

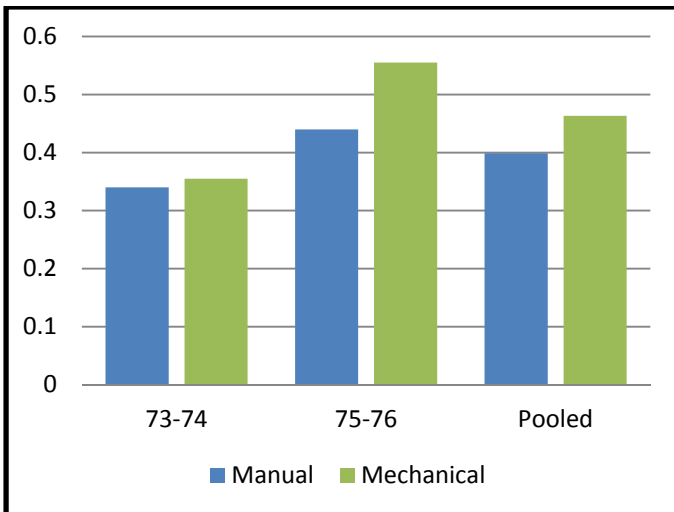


Figure I-38- Total Material Passing the 9.5-mm Sieve

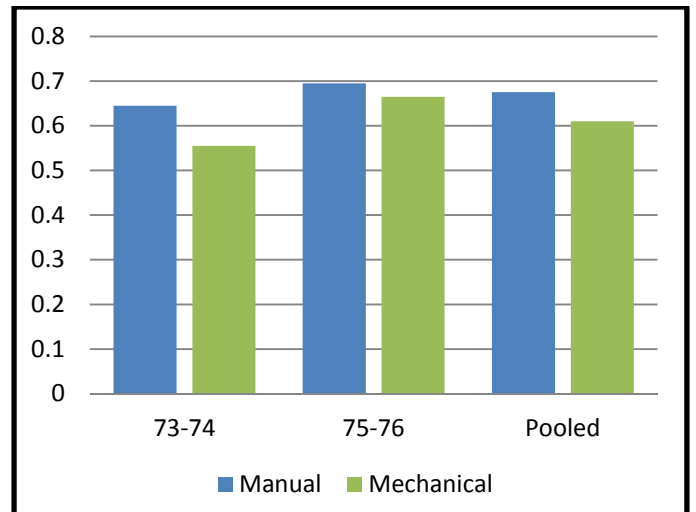


Figure I-41- Total Material Passing the 1.18- mm Sieve

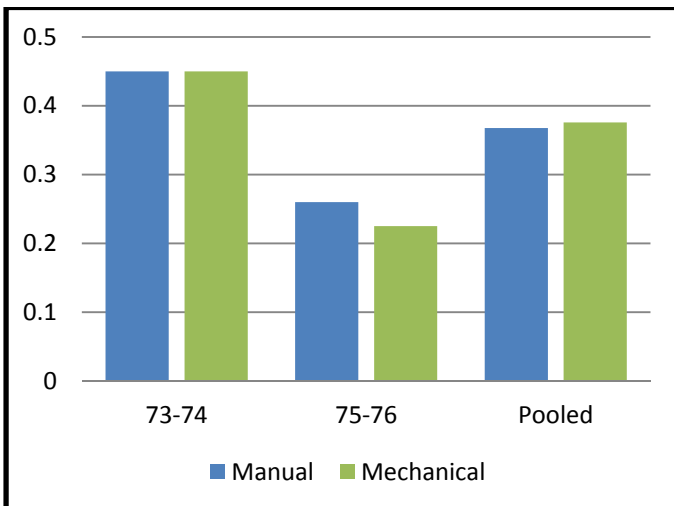


Figure I-39- Total Material Passing the 4.75-mm Sieve

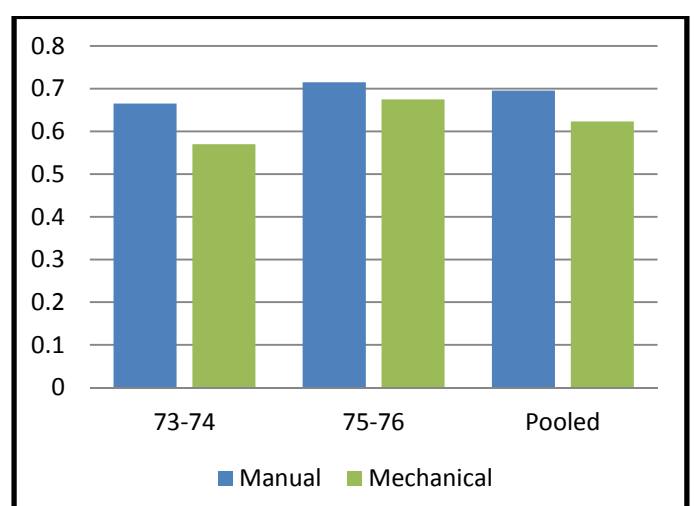


Figure I-42- Total Material Passing the 600-μm Sieve

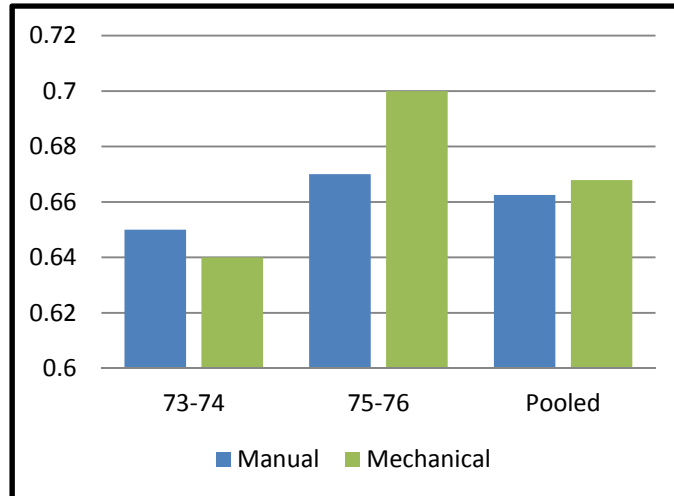


Figure I-43- Total Material Passing the 300-μm Sieve

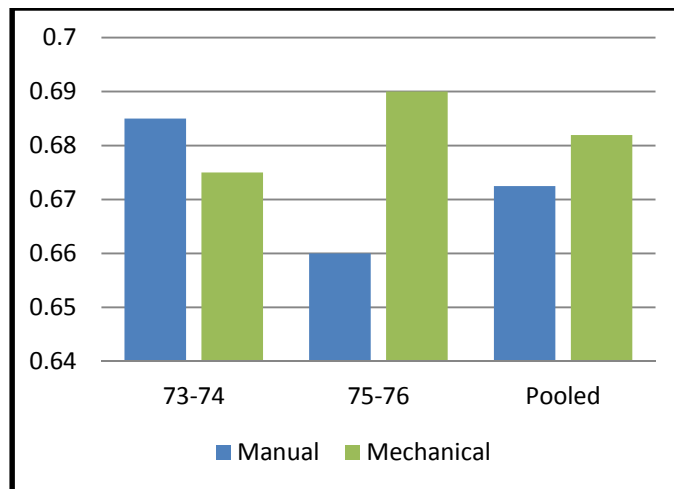


Figure I-44- Total Material Passing the 150-μm Sieve

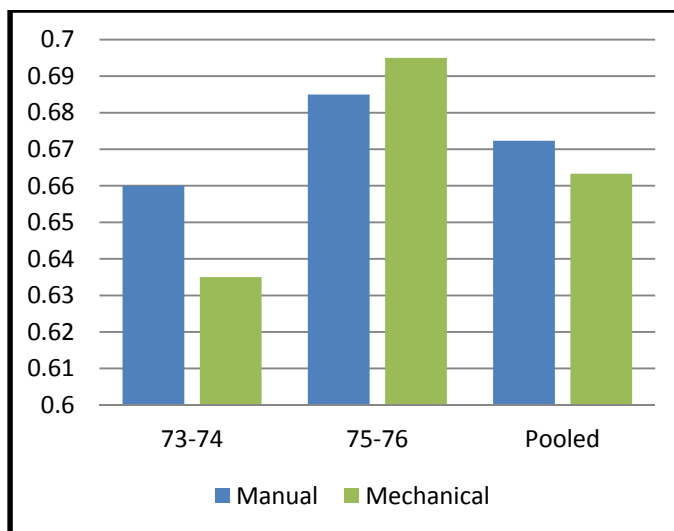


Figure I-45- Total Material Passing the 75-μm Sieve

Summaries of Statistics

HMASE 73-74 Summaries of Statistics

Table I-1- Summary of statistics of percent passing various sieve sizes from washing of HMASE 73-74 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	x samples		Y samples	
								1s	CV%	1s	CV%
HMASE 73-74 All Methods of Washing	12.5 mm	47	95.9	96.2	0.17	0.17	0.17	0.18	0.19	0.18	0.19
	9.5 mm	50	88.9	89.7	0.26	0.29	0.29	0.33	0.37	0.38	0.43
	4.75 mm	50	63.3	60.7	0.34	0.54	0.56	0.42	0.66	0.48	0.80
	2.36 mm	53	39.3	39.3	0.46	1.17	1.17	0.66	1.68	0.73	1.86
	1.18 mm	52	25.9	25.8	0.35	1.37	1.37	0.54	2.08	0.57	2.22
	600 µm	52	17.9	17.9	0.34	1.92	1.92	0.55	3.08	0.59	3.32
	300 µm	52	13.6	13.5	0.40	2.93	2.94	0.67	4.90	0.61	4.51
	150 µm	52	11.2	11.2	0.38	3.41	3.41	0.68	6.06	0.67	6.03
	75 µm, Total	51	9.5	9.5	0.38	4.04	4.05	0.66	6.89	0.61	6.37

Table I-2- Summary of statistics of percent passing various sieve sizes from manual washing of HMASE 73-74 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMASE 73-74 Manual Washing	12.5 mm	194	95.9	96.2	0.16	0.17	0.17	0.19	0.20	0.17	0.17
	9.5 mm	209	88.9	89.7	0.26	0.29	0.29	0.37	0.42	0.31	0.35
	4.75 mm	194	63.2	60.6	0.31	0.49	0.51	0.44	0.70	0.46	0.77
	2.36 mm	219	39.2	39.2	0.49	1.26	1.26	0.85	2.16	0.86	2.19
	1.18 mm	204	25.8	25.6	0.29	1.14	1.14	0.66	2.57	0.63	2.47
	600 µm	207	17.7	17.7	0.30	1.72	1.73	0.68	3.83	0.65	3.70
	300 µm	215	13.3	13.2	0.34	2.53	2.54	0.68	5.15	0.62	4.66
	150 µm	218	10.9	10.8	0.34	3.14	3.16	0.70	6.41	0.67	6.23
	75 µm, Total	211	9.3	9.2	0.32	3.40	3.43	0.67	7.17	0.65	7.04

Table I-3- Summary of statistics of percent passing various sieve sizes from mechanical washing of HMASE 73-74 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMASE 73-74 Mechanical Method of Washing	12.5 mm	47	95.9	96.2	0.17	0.17	0.17	0.18	0.19	0.18	0.19
	9.5 mm	50	88.9	89.7	0.26	0.29	0.29	0.33	0.37	0.38	0.43
	4.75 mm	50	63.3	60.7	0.34	0.54	0.56	0.42	0.66	0.48	0.80
	2.36 mm	53	39.3	39.3	0.46	1.17	1.17	0.66	1.68	0.73	1.86
	1.18 mm	52	25.9	25.8	0.35	1.37	1.37	0.54	2.08	0.57	2.22
	600 µm	52	17.9	17.9	0.34	1.92	1.92	0.55	3.08	0.59	3.32
	300 µm	52	13.6	13.5	0.40	2.93	2.94	0.67	4.90	0.61	4.51
	150 µm	52	11.2	11.2	0.38	3.41	3.41	0.68	6.06	0.67	6.03
	75 µm, Total	51	9.5	9.5	0.38	4.04	4.05	0.66	6.89	0.61	6.37

HMASE 75-76 Summaries of Statistics

Table I-4- Summary of statistics of percent passing various sieve sizes from washing of HMASE 75-76 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X		Y	
								1s	CV%	1s	CV%
HMASE 75-76, All Methods of Washing	12.5 mm	280	94.9	93.7	0.31	0.33	0.33	0.39	0.41	0.45	0.48
	9.5 mm	266	86.3	82.2	0.34	0.40	0.42	0.49	0.57	0.43	0.53
	4.75 mm	237	54.6	64.8	0.16	0.30	0.25	0.27	0.50	0.24	0.36
	2.36 mm	287	35.5	36.1	1.01	2.84	2.79	1.14	3.21	1.17	3.23
	1.18 mm	284	22.5	22.1	0.53	2.36	2.41	0.64	2.84	0.74	3.35
	600 µm	286	16.3	15.8	0.54	3.33	3.43	0.66	4.04	0.76	4.80
	300 µm	281	12.7	12.2	0.50	3.94	4.10	0.63	4.97	0.72	5.92
	150 µm	281	10.6	10.1	0.48	4.54	4.74	0.64	6.07	0.69	6.86
	75 µm, Total	280	9.2	8.8	0.47	5.07	5.29	0.67	7.26	0.71	8.09

Table I-5- Summary of statistics for percent passing various sieve sizes from manual washing of HMASE 75-76 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMASE 75-76, Manual Washing	12.5 mm	236	94.9	93.7	0.30	0.31	0.32	0.38	0.40	0.45	0.48
	9.5 mm	221	86.3	82.2	0.33	0.39	0.41	0.47	0.55	0.41	0.50
	4.75 mm	202	54.6	64.8	0.17	0.31	0.26	0.28	0.51	0.24	0.37
	2.36 mm	241	35.5	36.1	1.02	2.86	2.81	1.13	3.18	1.18	3.27
	1.18 mm	237	22.5	22.1	0.54	2.38	2.42	0.64	2.83	0.75	3.41
	600 µm	238	16.3	15.8	0.55	3.36	3.46	0.66	4.08	0.77	4.87
	300 µm	233	12.7	12.2	0.51	4.00	4.16	0.61	4.84	0.73	5.98
	150 µm	232	10.5	10.1	0.49	4.62	4.81	0.62	5.87	0.70	6.95
	75 µm, Total	233	9.2	8.8	0.47	5.12	5.32	0.64	7.02	0.73	8.24

Table I-6- Summary of statistics for percent passing various sieve sizes from mechanical washing of HMASE 75-76 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMASE 75-76, Mechanical Method of Washing	12.5 mm	44	94.9	93.7	0.39	0.41	0.42	0.42	0.45	0.45	0.48
	9.5 mm	45	86.3	82.2	0.37	0.43	0.45	0.59	0.68	0.52	0.64
	4.75 mm	35	54.7	64.8	0.14	0.26	0.22	0.24	0.43	0.21	0.32
	2.36 mm	46	35.5	36.2	0.99	2.78	2.73	1.20	3.38	1.11	3.07
	1.18 mm	46	22.7	22.2	0.52	2.27	2.33	0.65	2.85	0.68	3.09
	600 µm	47	16.5	15.9	0.53	3.23	3.34	0.63	3.83	0.72	4.49
	300 µm	47	12.8	12.3	0.47	3.67	3.84	0.70	5.48	0.70	5.67
	150 µm	48	10.7	10.2	0.43	4.01	4.22	0.72	6.72	0.66	6.41
	75 µm, Total	46	9.4	9.0	0.43	4.53	4.76	0.74	7.89	0.65	7.24

HMASE 77-78 Summaries of Statistics

Table I-7- Summary of statistics of percent passing various sieve sizes from washing of HMASE 77-78 samples, all washing methods

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X		Y	
								1s	CV%	1s	CV%
HMASE 77-78, All Methods of Washing	12.5 mm	283	94.7	94.2	0.37	0.39	0.39	0.43	0.46	0.52	0.55
	9.5 mm	272	87.1	85.9	0.28	0.33	0.33	0.36	0.41	0.36	0.42
	4.75 mm	257	58.2	60.4	0.16	0.28	0.27	0.28	0.47	0.28	0.47
	2.36 mm	291	39.7	39.5	0.74	1.86	1.87	0.85	2.15	0.98	2.49
	1.18 mm	271	25.9	26	0.28	1.08	1.07	0.5	1.92	0.49	1.88
	600 µm	272	17.6	17.7	0.27	1.53	1.52	0.56	3.15	0.53	3
	300 µm	272	12.9	13	0.28	2.15	2.13	0.52	4.02	0.5	3.81
	150 µm	274	10.4	10.5	0.26	2.52	2.5	0.57	5.51	0.55	5.23
	75 µm, Total	267	8.88	8.96	0.25	2.76	2.74	0.53	6.02	0.52	5.78

Table I-8- Summary of statistics for percent passing various sieve sizes from manual washing of HMASE 77-78 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMASE 77-78, Manual Washing	12.5 mm	225	94.7	94.2	0.38	0.4	0.4	0.43	0.46	0.52	0.55
	9.5 mm	216	87.1	85.9	0.28	0.33	0.33	0.35	0.41	0.37	0.43
	4.75 mm	205	58.2	60.4	0.16	0.28	0.27	0.27	0.46	0.29	0.47
	2.36 mm	234	39.7	39.5	0.7	1.77	1.78	0.85	2.14	1	2.54
	1.18 mm	218	25.9	26	0.28	1.07	1.06	0.5	1.92	0.49	1.89
	600 µm	220	17.6	17.7	0.26	1.49	1.49	0.56	3.16	0.54	3.07
	300 µm	217	12.9	13	0.27	2.07	2.06	0.52	4.05	0.5	3.83
	150 µm	223	10.3	10.4	0.26	2.52	2.5	0.57	5.53	0.55	5.32
	75 µm, Total	216	8.86	8.93	0.24	2.7	2.68	0.52	5.92	0.52	5.87

Table I-9- Summary of statistics for percent passing various sieve sizes from mechanical washing of HMASE 77-78 samples

Sample No./ Washing Method	Size	No. of Labs	Average Results		Repeatability			Reproducibility			
			X	Y	1s	X samples CV%	Y samples CV%	X samples		Y samples	
								1s	CV%	1s	CV%
HMASE 77-78, Mechanical Method of Washing	12.5 mm	54	94.6	94.3	0.34	0.36	0.36	0.43	0.46	0.51	0.54
	9.5 mm	52	87.2	86	0.28	0.32	0.33	0.36	0.41	0.31	0.36
	4.75 mm	48	58.2	60.4	0.17	0.3	0.29	0.31	0.53	0.27	0.44
	2.36 mm	53	39.6	39.5	0.89	2.24	2.24	0.89	2.24	0.9	2.28
	1.18 mm	49	25.9	26.2	0.29	1.12	1.11	0.51	1.97	0.47	1.82
	600 µm	48	17.7	17.8	0.3	1.72	1.71	0.57	3.24	0.48	2.72
	300 µm	51	13	13.2	0.31	2.41	2.36	0.52	4.04	0.46	3.5
	150 µm	47	10.5	10.7	0.27	2.54	2.49	0.59	5.64	0.49	4.62
	75 µm, Total	47	8.95	9.13	0.27	3.06	3	0.6	6.68	0.48	5.26

Statistical Tests of Significance

HMASE 73-74 Statistical test of significance

Table I-10- Statistical t-test for comparison of average percent passing of various sieve sizes from mechanical and manual washing of HMASE 73-74

Sieve Sizes	Average Percent Passing		Degrees of Freedom	Computed t
	Manual	Mechanical		
12.5-mm	94.3	94.3	59	-0.31
9.5-mm	84.3	84.3	56	0.15
4.75-mm	59.7	59.8	52	-1.57
2.36-mm	35.8	35.8	63	-0.21
1.18-mm	22.3	22.4	66	-1.10
600- μ m	16.1	16.1	68	-1.17
300- μ m	12.4	12.6	64	-1.39
150- μ m	10.3	10.5	66	-1.54
75 μ m, Total	9	9.2	63	-1.80

Note: Critical t for 1% level of significance is 2.66 and for 5% level of significance is 2.00

Table I-11- Statistical F-test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMASE 73-74

Sieve Sizes	1S Repeatability, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mechanical				
12.5-mm	0.3	0.39	43 & 235	1.70	1.66	1.43
9.5-mm	0.33	0.37	44 & 220	1.23	1.66	1.43
4.75-mm	0.17	0.14	201 & 34	1.39	1.98	1.61
2.36-mm	1.02	0.99	240 & 45	1.06	1.80	1.51
1.18-mm	0.54	0.52	236 & 45	1.08	1.80	1.51
600- μ m	0.55	0.53	237 & 46	1.06	1.79	1.50
300- μ m	0.51	0.47	232 & 46	1.16	1.79	1.50
150- μ m	0.49	0.43	231 & 47	1.27	1.78	1.50
75 μ m, Total	0.47	0.43	232 & 45	1.21	1.80	1.51

Table I-12- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMASE 73-74

Sieve Sizes	1S Reproducibility, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mechanical				
12.5-mm	0.42	0.44	43 & 235	1.09	1.66	1.43
9.5-mm	0.45	0.56	44 & 220	1.56	1.66	1.43
4.75-mm	0.26	0.22	201 & 34	1.37	1.98	1.61
2.36-mm	1.16	1.16	45 & 240	1.00	1.64	1.42
1.18-mm	0.7	0.67	236 & 45	1.10	1.80	1.51
600- μ m	0.72	0.67	237 & 46	1.14	1.79	1.50
300- μ m	0.67	0.7	46 & 232	1.08	1.64	1.42
150- μ m	0.66	0.69	47 & 231	1.09	1.63	1.42
75 μ m, Total	0.69	0.7	45 & 232	1.03	1.64	1.42

HMASE 75-76 Statistical test of significance

Table I-13- Statistical t-test for comparison of average percent passing various sieve sizes from mechanical and manual washing of HMASE 75-76 samples

Sieve Sizes	Average Percent Passing		Degrees of Freedom	Computed t
	Manual	Mechanical		
12.5-mm	94.27	94.30	119	-0.44
9.5-mm	84.26	84.25	113	0.21
4.75-mm	59.70	59.77	105	-2.22
2.36-mm	35.80	35.84	128	-0.29
1.18-mm	22.31	22.43	133	-1.56
600- μ m	16.06	16.18	138	-1.66
300- μ m	12.41	12.56	130	-1.96
150- μ m	10.31	10.48	134	-2.61
75 μ m, Total	8.98	9.18	128	-2.55

Note: Critical t for 1% level of significance is 2.61 and for 5% level of significance is 1.98

Table I-14- Statistical F-test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMASE 75-76 samples

Sieve Sizes	1S Repeatability, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mech.				
12.5-mm	0.30	0.39	43 & 235	1.70	1.66	1.43
9.5-mm	0.33	0.37	44 & 220	1.23	1.66	1.43
4.75-mm	0.17	0.14	201 & 34	1.39	1.98	1.61
2.36-mm	1.02	0.99	45 & 240	1.06	1.80	1.51
1.18-mm	0.54	0.52	236 & 45	1.08	1.80	1.51
600- μ m	0.55	0.53	237 & 46	1.06	1.79	1.50
300- μ m	0.51	0.47	46 & 232	1.16	1.79	1.50
150- μ m	0.49	0.43	47 & 231	1.27	1.78	1.50
75 μ m, Total	0.47	0.43	45 & 232	1.21	1.80	1.51

Table I-15- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMASE 75-76 samples

Sieve Sizes	1S Reproducibility, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mech.				
12.5-mm	0.42	0.44	43 & 235	1.09	1.66	1.43
9.5-mm	0.45	0.56	44 & 220	1.56	1.66	1.43
4.75-mm	0.26	0.22	201 & 34	1.37	1.98	1.61
2.36-mm	1.16	1.16	45 & 240	1.00	1.64	1.42
1.18-mm	0.70	0.67	236 & 45	1.10	1.80	1.51
600- μ m	0.72	0.67	237 & 46	1.14	1.79	1.50
300- μ m	0.67	0.70	46 & 232	1.8	1.64	1.42
150- μ m	0.66	0.69	47 & 231	1.09	1.63	1.42
75 μ m, Total	0.69	0.70	45 & 232	1.03	1.64	1.42

HMASE 77-78 Statistical test of significance

Table I-16- Statistical t-test for comparison of average percent passing of various sieve sizes from mechanical and manual washing of HMASE 77-78

Sieve Sizes	Average Percent Passing		Degrees of Freedom	Computed t
	Manual	Mechanical		
12.5-mm	94.4	94.4	81	0.10
9.5-mm	86.5	86.6	83	-1.06
4.75-mm	59.3	59.3	69	-0.73
2.36-mm	39.6	39.5	79	0.36
1.18-mm	26	26	71	-1.11
600- μ m	17.7	17.7	71	-0.97
300- μ m	12.9	13.1	77	-2.08
150- μ m	10.4	10.6	68	-2.03
75 μ m, Total	8.9	9	66	-1.67

Note: Critical t for 1% level of significance is 2.64 and for 5% level of significance is 1.99

Table I-17- Statistical F-test for comparison of repeatability standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMASE 77-78

Sieve Sizes	1S Repeatability, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mechanical				
12.5-mm	0.38	0.34	224 & 53	1.25	1.72	1.46
9.5-mm	0.28	0.28	215 & 51	1.01	1.74	1.48
4.75-mm	0.16	0.17	47 & 204	1.16	1.64	1.42
2.36-mm	0.7	0.89	52 & 233	1.60	1.60	1.40
1.18-mm	0.28	0.29	48 & 217	1.09	1.63	1.42
600- μ m	0.26	0.3	47 & 219	1.34	1.64	1.42
300- μ m	0.27	0.31	50 & 216	1.37	1.62	1.41
150- μ m	0.26	0.27	46 & 222	1.04	1.64	1.42
75 μ m, Total	0.24	0.27	46 & 215	1.31	1.65	1.42

Table I-18- Statistical F-test for comparison of reproducibility standard deviations of percent passing various sieve sizes from mechanical and manual washing of HMASE 77-78

Sieve Sizes	1S Reproducibility, Percent Passing		Degrees of Freedom	Computed F	Critical F($\alpha=.01$)	Critical F($\alpha=.05$)
	Manual	Mechanical				
12.5-mm	0.48	0.48	224 & 53	1.01	1.72	1.46
9.5-mm	0.36	0.33	215 & 51	1.18	1.74	1.48
4.75-mm	0.29	0.28	47 & 204	1.08	1.64	1.42
2.36-mm	0.93	0.89	233 & 52	1.08	1.73	1.47
1.18-mm	0.49	0.49	217 & 48	1.01	1.77	1.49
600- μ m	0.55	0.53	219 & 47	1.08	1.78	1.50
300- μ m	0.51	0.49	216 & 50	1.06	1.75	1.48
150- μ m	0.56	0.54	222 & 46	1.07	1.79	1.50
75 μ m, Total	0.54	0.52	46 & 215	1.07	1.65	1.42