WSDOT Errata to WAQTC FOP for AASHTO T 27_T 11

Sieve Analysis of Fine and Coarse Aggregates

WAQTC FOP for AASHTO T 27_T 11 has been adopted by WSDOT with the following changes:

Procedure Method C – *Method not recognized by WSDOT.*

Sample Preparation

Table 1 Test Sample Sizes for Aggregate Gradation Test – *Shall conform to the following table.*

Nominal Maximum Size*in (mm)		Minimum Dry Mass lb (kg)	
US No. 4	(4.75)	1	(0.5)
¼	(6.3)	2	(1)
⅜	(9.5)	2	(1)
½	(12.5)	5	(2)
⅝	(16.0)	5	(2)
¾	(19.0)	7	(3)
1	(25.0)	13	(6)
1¼	(31.5)	17	(7.5)
1½	(37.5)	20	(9)
2	(50)	22	(10)
2½	(63)	27	(12)
3	(75)	33	(15)
3½	(90)	44	(20)

FOP for AASHTO T 27
Sieve Analysis of Fine and Coarse Aggregates

FOP for AASHTO T 11
Materials Finer Than 75 μm (No. 200) Sieve In Mineral Aggregate By Washing

Scope

A sieve analysis, or 'gradation,' measures distribution of aggregate particle sizes within a given sample.

Accurate determination of the amount of material smaller than 75 μm (No. 200) cannot be made using just AASHTO T 27. If quantifying this material is required, use AASHTO T 11 in conjunction with AASHTO T 27.

This FOP covers sieve analysis in accordance with AASHTO T 27-14 and materials finer than 75 μm (No. 200) in accordance with AASHTO T 11-05 performed in conjunction with AASHTO T 27. The procedure includes three methods: A, B, and C.

Apparatus

- Balance or scale: Capacity sufficient for the masses shown in Table 1, accurate to 0.1 percent of the sample mass or readable to 0.1 g, and meeting the requirements of AASHTO M 231
- Sieves: Meeting the requirements of ASTM E11
- Mechanical sieve shaker: Meeting the requirements of AASHTO T 27
- Suitable drying equipment (refer to FOP for AASHTO T 255)
- Containers and utensils: A pan or vessel of sufficient size to contain the test sample covered with water and permit vigorous agitation without loss of test material or water
- Optional: mechanical washing device

Sample Sieving

- In all procedures, the test sample is shaken in nested sieves. Sieves are selected to furnish information required by specification. Intermediate sieves are added for additional information or to avoid overloading sieves, or both.
- The sieves are nested in order of increasing size from the bottom to the top, and the test sample, or a portion of the test sample, is placed on the top sieve.
- The loaded sieves are shaken in a mechanical shaker for approximately 10 minutes, refer to Annex A; *Time Evaluation*.
- Care must be taken so that sieves are not overloaded, refer to Annex B; *Overload Determination*. The test sample may be sieved in increments and the mass retained for each sieve added together from each test sample increment to avoid overloading sieves.

Sample Preparation

Obtain samples according to the FOP for AASHTO T 2 and reduce to test sample size, shown in Table 1, according to the FOP for AASHTO R 76.

Table 1   Test Sample Sizes for Aggregate Gradation Test

Nominal Maximum Size* mm (in)		Minimum Dry Mass g (lb)	
125	(5)	300,000	(660)
100	(4)	150,000	(330)
90	(3½)	100,000	(220)
75	(3)	60,000	(130)
63	(2½)	35,000	(77)
50	(2)	20,000	(44)
37.5	(1½)	15,000	(33)
25.0	(1)	10,000	(22)
19.0	(¾)	5000	(11)
12.5	(½)	2000	(4)
9.5	(⅜)	1000	(2)
6.3	(¼)	1000	(2)
4.75	(No. 4)	500	(1)

*Nominal maximum size: One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps between specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum size.

Test sample sizes in Table 1 are standard for aggregate sieve analysis, due to equipment restraints samples may need to be divided into several "subsamples." For example, a gradation that requires 100 kg (220 lbs) of material would not fit into a large tray shaker all at once.

Some agencies permit reduced test sample sizes if it is proven that doing so is not detrimental to the test results. Some agencies require larger test sample sizes. Check agency guidelines for required or permitted test sample sizes.

Selection of Procedure

Agencies may specify which method to perform. If a method is not specified, perform Method A.

Overview

Method A

- Determine dry mass of original test sample
- Wash over a 75mm (No. 200) sieve
- Determine dry mass of washed test sample
- Sieve washed test sample
- Calculate and report percent retained and passing each sieve

Method B

- Determine dry mass of original test sample
- Wash over a 75mm (No. 200) sieve
- Determine dry mass of washed test sample
- Sieve test sample through coarse sieves, 4.75 mm (No. 4) sieves and larger
- Determine dry mass of fine material, minus 4.75 mm (No. 4)
- Reduce fine material
- Determine mass of reduced portion
- Sieve reduced portion
- Calculate and report percent retained and passing each sieve

Method C

- Determine dry mass of original test sample
- Sieve test sample through coarse sieves, 4.75 mm (No. 4) sieves and larger
- Determine mass of fine material, minus 4.75 mm (No. 4)
- Reduce fine material
- Determine mass of reduced portion
- Wash reduced portion over a 75mm (No. 200) sieve
- Determine dry mass of washed reduced portion
- Sieve washed reduced portion
- Calculate and report percent retained and passing each sieve

Procedure Method A

1. Dry the test sample to constant mass according to the FOP for AASHTO T 255. Cool to room temperature. Determine and record the total dry mass of the sample to the nearest 0.1 percent or 0.1 g. Designate this mass as M.

   When the specification does not require the amount of material finer than 75 μm (No. 200) be determined by washing, skip to Step 11.

2. Nest a sieve, such as a 2.0 mm (No. 10), above the 75 μm (No. 200) sieve.

3. Place the test sample in a container and cover with water.

   Note 1: A detergent, dispersing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the 75 μm (No. 200) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.

4. Agitate vigorously to ensure complete separation of the material finer than 75 μm (No. 200) from coarser particles and bring the fine material into suspension above the coarser material. Avoid degradation of the sample when using a mechanical washing device.

5. Immediately pour the wash water containing the suspended material over the nested sieves; be careful not to pour out the coarser particles or over fill the 75 μm (No. 200) sieve.

6. Add water to cover material remaining in the container, agitate, and repeat Step 5. Continue until the wash water is reasonably clear.

7. Remove the upper sieve and return material retained to the washed test sample.

8. Rinse the material retained on the 75 µm (No. 200) sieve until water passing through the sieve is reasonably clear and detergent or dispersing agent is removed, if used.

9. Return all material retained on the 75 µm (No. 200) sieve to the container by rinsing into the washed sample.

   Note 2: Excess water may be carefully removed with a bulb syringe; the removed water must be discharged back over the 75 µm (No. 200) sieve to prevent loss of fines.

10. Dry the washed test sample to constant mass according to the FOP for AASHTO T 255. Cool to room temperature. Determine and record the dry mass.

11. Select sieves required by the specification and those necessary to avoid overloading. With a pan on bottom, nest the sieves increasing in size starting with the 75 µm (No. 200).

12. Place the test sample, or a portion of the test sample, on the top sieve. Sieves may already be in the mechanical shaker, if not place sieves in mechanical shaker and shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).

   Note 3: Excessive shaking (more than 10 minutes) may result in degradation of the sample.

13. Determine and record the individual or cumulative mass retained for each sieve and in the pan. Ensure that all material trapped in full openings of the sieve are removed and included in the mass retained.

   Note 4: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening by sieving over a full opening. Use coarse wire brushes to clean the 600 µm (No. 30) and larger sieves, and soft bristle brushes for smaller sieves.

   Note 5: In the case of coarse/fine aggregate mixtures, distribute the minus 4.75 mm (No. 4) among two or more sets of sieves to prevent overloading of individual sieves.

14. Perform the *Check Sum* calculation – Verify the *total mass after sieving* agrees with the *dry mass before sieving* to within 0.3 percent. The *dry mass before sieving* is the dry mass after wash or the original dry mass (*M*) if performing the sieve analysis without washing. Do not use test results for acceptance if the *Check Sum* result is greater than 0.3 percent.

15. Calculate the total percentages passing, and the individual or cumulative percentages retained to the nearest 0.1 percent by dividing the individual sieve masses or cumulative sieve masses by the total mass of the initial dry sample (*M*).

16. Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

Method A Calculations

Check Sum

$$Check\ Sum = \frac{dry\ mass\ before\ seiving - total\ mass\ after\ sieving}{dry\ mass\ before\ sieving} \times 100$$

Percent Retained

$$IPR = \frac{IMR}{M} \times 100 \qquad or \qquad CPR = \frac{CMR}{M} \times 100$$

Where:

       IPR = Individual Percent Retained
       CPR = Cumulative Percent Retained
       M = Total Dry Sample mass before washing
       IMR = Individual Mass Retained
       CMR = Cumulative Mass Retained

Percent Passing (PP)

$$PP = PPP - IPR \qquad or \qquad PP = 100 - CPR$$

Where:

       PP = Percent Passing
       PPP = Previous Percent Passing

Method A Example Individual Mass Retained

Dry mass of total sample before washing (*M*):	5168.7 g
Dry mass of sample after washing:	4911.3 g
Total mass after sieving is equals	
Sum of Individual Masses Retained (IPR), including pan:	4905.9 g
Amount of 75µm (No. 200) minus washed out (5168.7 g – 4911.3 g):	257.4 g

Check Sum

$$Check\ Sum = \frac{4911.3\ g - 4905.9\ g}{4911.3\ g} \times 100 = 0.1\%$$

The result is less than 0.3 percent therefore the results can be used for acceptance purposes.

Individual Percent Retained (IPR) for 9.5 mm (⅜ in) sieve:

$$CPR = \frac{1343.9\ g}{5168.7\ g} \times 100 = 26.0\%$$

Percent Passing (PP) 9.5 mm (⅜ in) sieve:

$$PP = 86.0\% - 12.0\% = 74.0\%$$

Reported Percent Passing = 74 percent

As shown in the following table:

Gradation on All Sieves Individual Mass

Sieve Size mm (in)		Individual Mass Retained g (IMR)	Individual Percent Retained (IPR)	Percent Passing (PP)	Reported Percent Passing*
19.0	(¾)	0	0	100.0	100
12.5	(½)	724.7	14.0	86.0	86
9.5	(⅜)	619.2	12.0	74.0	74
4.75	(No. 4)	1189.8	23.0	51.0	51
2.36	(No. 8)	877.6	17.0	34.0	34
1.18	(No. 16)	574.8	11.1	22.9	23
0.600	(No. 30)	329.8	6.4	16.5	17
0.300	(No. 50)	228.5	4.4	12.1	12
0.150	(No. 100)	205.7	4.0	8.1	8
0.075	(No. 200)	135.4	2.6	5.5	5.5
Pan		20.4			

*Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

Method A Example Cumulative Mass Retained

Dry mass of total sample before washing (M):   5168.7 g

Dry mass of sample after washing: 4911.3 g

Total mass after sieving is equals

   Final Cumulative Mass Retained (CMR) in pan: 4905.9 g

Amount of 75µm (No. 200) minus washed out (5168.7 g – 4911.3 g):   257.4 g

Check Sum

$$Check\ Sum = \frac{4911.3\ g - 4905.9\ g}{4911.3\ g} \times 100 = 0.1\%$$

The result is less than 0.3 percent therefore the results can be used for acceptance purposes.

Cumulative Percent Retained (CPR) for 9.5 mm (⅜ in) sieve:

$$CPR = \frac{1343.9\ g}{5168.7\ g} \times 100 = 26.0\%$$

Percent Passing (PP) 9.5 mm (⅜ in) sieve:

$$PP = 86.0\% - 12.0\% = 74.0\%$$

Reported Percent Passing = 74 percent

As shown in the following table:

Gradation on All Sieves				
Sieve Size mm (in)	Cumulative Mass Retained g (CMR)	Cumulative Percent Retained (CPR)	Percent Passing (PP)	Reported Percent Passing*
19.0 (¾)	0	0.0	100.0	100
12.5 (½)	724.7	14.0	86.0	86
9.5 (⅜)	1343.9	26.0	74.0	74
4.75 (No. 4)	2533.7	49.0	51.0	51
2.36 (No. 8)	3411.3	66.0	34.0	34
1.18 (No. 16)	3986.1	77.1	22.9	23
0.600 (No. 30)	4315.9	83.5	16.5	17
0.300 (No. 50)	4544.4	87.9	12.1	12
0.150 (No. 100)	4750.1	91.9	8.1	8
0.075 (No. 200)	4885.5	94.5	5.5	5.5
Pan	4905.9			
* Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.				

Procedure Method B

1. Dry the test sample to constant mass according to the FOP for AASHTO T 255. Cool to room temperature. Determine and record the total dry mass of the sample to the nearest 0.1 percent or 0.1 g. Designate this mass as *M*.

   When the specification does not require the amount of material finer than 75 µm (No. 200) be determined by washing, skip to Step 11.

2. Nest a protective sieve, such as a 2.0 mm (No. 10), above the 75 µm (No. 200) sieve.

3. Place the test sample in a container and cover with water.

   Note 1: A detergent, dispersing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the 75 µm (No. 200) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.

4. Agitate vigorously to ensure complete separation of the material finer than 75 µm (No. 200) from coarser particles and bring the fine material into suspension above the coarser material. Avoid degradation of the sample when using a mechanical washing device.

5. Immediately pour the wash water containing the suspended material over the nested sieves; be careful not to pour out the coarser particles or over fill the 75 µm (No. 200) sieve.

6. Add water to cover material remaining in the container, agitate, and repeat Step 5. Continue until the wash water is reasonably clear.

7. Remove the upper sieve and return material retained to the washed test sample.

8. Rinse the material retained on the 75 μm (No. 200) sieve until water passing through the sieve is reasonably clear and detergent or dispersing agent is removed, if used.

9. Return all material retained on the 75 μm (No. 200) sieve to the container by rinsing into the washed sample.

   Note 2: Excess water may be carefully removed with a bulb syringe; the removed water must be discharged back over the 75 μm (No. 200) sieve to prevent loss of fines.

10. Dry the washed test sample to constant mass according to the FOP for AASHTO T 255. Cool to room temperature. Determine and record the dry mass.

11. Select sieves required by the specification and those necessary to avoid overloading. With a pan on bottom, nest the sieves increasing in size starting with the 4.75 mm (No. 4).

12. Place the test sample, or a portion of the test sample, on the top sieve. Sieves may already be in the mechanical shaker, if not place the sieves in the mechanical shaker and shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).

    Note 3: Excessive shaking (more than 10 minutes) may result in degradation of the sample.

13. Determine and record the individual or cumulative mass retained for each sieve. Ensure that all particles trapped in full openings of the sieve are removed and included in the mass retained.

    Note 4: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening by sieving over a full opening. Use coarse wire brushes to clean the 600 μm (No. 30) and larger sieves, and soft hair bristle for smaller sieves.

14. Determine and record the mass of the minus 4.75 mm (No. 4) material in the pan. Designate this mass as M_1.

15. Perform the *Coarse Check Sum* calculation – Verify the *total mass after coarse sieving* agrees with the *dry mass before sieving* to within 0.3 percent. The *dry mass before sieving* is the dry mass after wash or the original dry mass (*M*) if performing the sieve analysis without washing. Do not use test results for acceptance if the *Check Sum* result is greater than 0.3 percent.

16. Reduce the minus 4.75 mm (No. 4) according to the FOP for AASHTO R 76 to produce a sample with a minimum mass of 500 g. Determine and record the mass of the minus 4.75 mm (No. 4) split, designate this mass as M_2.

17. Select sieves required by the specification and those necessary to avoid overloading. With a pan on bottom, nest the sieves increasing in size starting with the 75 μm (No. 200) up to, but not including, the 4.75 mm (No. 4) sieve.

18. Place the test sample portion on the top sieve and place the sieves in the mechanical shaker. Shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).

19. Determine and record the individual or cumulative mass retained for each sieve and in the pan. Ensure that all particles trapped in full openings of the sieve are removed and included in the mass retained.

    Note 4: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening by sieving over a full opening. Use coarse wire brushes to clean the 600 µm (No. 30) and larger sieves, and soft hair bristle for smaller sieves.

20. Perform the *Fine Check Sum* calculation – Verify the *total mass after sieving* agrees with the *dry mass before sieving* (M_2) to within 0.3 percent. Do not use test results for acceptance if the *Check Sum* result is greater than 0.3 percent.

21. Calculate to the nearest 0.1 percent, the Individual Mass Retained (IMR) or Cumulative Mass Retained (CMR) of the size increment of the reduced sample and the original sample.

22. Calculate the total percent passing.

23. Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

Method B Calculations

Check Sum

$$Coarse\ Check\ Sum = \frac{dry\ mass\ before\ sieveing - total\ mass\ after\ coarse\ sieving}{dry\ mass\ before\ sieving} \times 100$$

$$Fine\ Check\ Sum = \frac{M_2 - total\ mass\ after\ fine\ sieving}{M_2} \times 100$$

Percent Retained for 4.75 mm (No. 4) and larger

$$IPR = \frac{IMR}{M} \times 100 \qquad or \qquad CPR = \frac{CMR}{M} \times 100$$

Where:

 IPR = Individual Percent Retained
 CPR = Cumulative Percent Retained
 M = Total dry test sample mass before washing
 IMR = Individual Mass Retained
 CMR = Cumulative Mass Retained

Percent Passing (PP) for 4.75 mm (No. 4) and larger

$$PP = PPP - IPR \qquad or \qquad PP = 100 - CPR$$

Where:

 PP = Percent Passing
 PPP = Previous Percent Passing

Minus 4.75mm (No. 4) adjustment factor (R)

The mass of material retained for each sieve is multiplied by the adjustment factor, the total mass of the minus 4.75 mm (No. 4) from the pan, M_1, divided by the mass of the reduced split of minus 4.75 mm (No. 4), M_2. For consistency, this adjustment factor is carried to three decimal places.

$$R = \frac{M_1}{M_2}$$

Where:
   R = minus 4.75 mm (No. 4) adjustment factor
   M_1 = total mass of minus 4.75 mm (No. 4) before reducing
   M_2 = mass of the reduced split of minus 4.75 mm (No. 4)

Adjusted Individual Mass Retained (AIMR):

$$AIMR = R \times B$$

Where:
   AIMR = Adjusted Individual Mass Retained
   R = minus 4.75 mm (No. 4) adjustment factor
   B = individual mass of the size increment in the reduced portion sieved

Adjusted Cumulative Mass Retained (ACMR)

$$ACMR = (R \times B) + D$$

Where:
   ACMR = Adjusted Cumulative Mass Retained
   R = minus 4.75 mm (No. 4) adjustment factor
   B = cumulative mass of the size increment in the reduced portion sieved
   D = cumulative mass of plus 4.75mm (No. 4) portion of sample

Method B Example Individual Mass Retained

Dry mass of total sample, before washing:	3214.0 g
Dry mass of sample after washing:	3085.1 g
Total mass after sieving	
Sum of Individual Masses Retained (IPR) and pan	3085.0 g
Amount of 75 μm (No. 200) minus washed out (3214.0 g – 3085.1 g):	128.9 g

Coarse Check Sum

$$Coarse\ Check\ Sum = \frac{3085.1\ g - 3085.0\ g}{3085.1\ g} \times 100 = 0.0\%$$

The result is less than 0.3 percent therefore the results can be used for acceptance purposes.

Individual Percent Retained (IPR) for 9.5 mm (⅜ in) sieve

$$IPR = \frac{481.4\ g}{3214.0\ g} \times 100 = 15.0\%$$

Percent Passing (PP) for 9.5 mm (⅜ in) sieve:

$$PP = 95.0\% - 15.0\% = 80.0\%$$

As shown in the following table:

Gradation on Coarse Sieves Individual Mass

Sieve Size mm (in)		Individual Mass Retained g (IMR)	Individual Percent Retained (IPR)	Percent Passing (PP)
16.0	(⅝)	0	0	100
12.5	(½)	161.1	5.0	95.0
9.50	(⅜)	481.4	15.0	80.0
4.75	(No. 4)	475.8	14.8	65.2
Pan		1966.7 (**M₁**)		
Total mass after sieving = sum of sieves + pan = 3085.0				
Dry mass of total sample, before washing (M): 3214.0 g				

Fine Test Sample

The pan, M_1 (1966.7 g), was reduced according to the FOP for AASHTO R 76, to at least 500 g. In this case, the reduced mass was determined to be **512.8 g**. This is M_2.

The reduced mass was sieved.

Total mass after sieving equals

    Sum of Individual Masses Retained (IPR) and pan   511.8 g

Fine Check Sum

$$Fine\ Check\ Sum = \frac{512.8\ g - 511.8\ g}{512.8\ g} \times 100 = 0.2\%$$

The result is less than 0.3 percent therefore the results can be used for acceptance purposes.

Adjustment Factor (R) for Adjusted Individual Mass Retained (AIMR) on minus 4.75 (No. 4) sieves

The mass of material retained for each sieve is multiplied by the adjustment factor (R) carried to three decimal places.

$$R = \frac{M_1}{M_2} = \frac{1,966.7\ g}{512.8\ g} = 3.835$$

  Where:
        R = minus 4.75 mm (No. 4) adjustment factor
        M_1 = total mass of minus 4.75 mm (No. 4) from the pan
        M_2 = mass of the reduced split of minus 4.75 mm (No. 4)

Each "individual mass retained" on the fine sieves must be multiplied by R to obtain the Adjusted Individual Mass Retained.

Adjusted Individual Mass Retained (AIMR) for 2.00 mm (No. 10) sieve

$$AIMR = 3.835 \times 207.1 \; g = 794.2 \; g$$

Individual Percent Retained (IPR) for 2.00 mm (No. 10) sieve:

$$IPR = \frac{794.2 \; g}{3214.0 \; g} \times 100 = 24.7\%$$

Percent Passing (PP) 2 mm (No. 10) sieve:

$$PP = 65.2\% - 24.7\% = 40.5\%$$

As shown in the following table:

Final Gradation on All Sieves Individual Mass

Sieve Size mm (in)		Individual Mass Retained, g (IMR)	Adjusted Individual Mass Retained (AIMR)	Individual Percent Retained (IPR)	Percent Passing (PP)	Reported Percent Passing*
16.0	(⅝)	0		0.0	100.0	100
12.5	(½)	161.1		5.0	95.0	95
9.5	(⅜)	481.4		15.0	80.0	80
4.75	(No. 4)	475.8		14.8	65.2	65
2.00	(No. 10)	207.1 × 3.835	794.2	24.7	40.5	41
0.425	(No. 40)	187.9 × 3.835	720.6	22.4	18.1	18
0.210	(No. 80)	59.9 × 3.835	229.7	7.1	11.0	11
0.075	(No. 200)	49.1 × 3.835	188.3	5.9	5.1	5.1
Pan		7.8 × 3.835	29.9			
Total Sum of masses on fine sieves + pan = 511.8						
Dry mass of total sample, before washing: 3214.0 g						

* Report total percent passing to 1 percent except report the 75 μm (No. 200) sieve to 0.1 percent.

Method B Example Cumulative Mass Retained

Dry mass of total sample, before washing:	3214.0 g
Dry mass of sample, after washing out the 75 μm (No. 200) minus:	3085.1 g

Total mass after sieving equals

Cumulative Mass Retained (CMR) on the 4.75 (No. 4) plus the pan: 3085.0 g

Amount of 75 μm (No. 200) minus washed out (3214.0 g – 3085.1 g):   128.9 g

Coarse Check Sum

$$\boldsymbol{Coarse\ Check\ Sum} = \frac{3085.1 \; g - 3085.0 \; g}{3085.1 \; g} \times 100 = 0.0\%$$

The result is less than 0.3 percent therefore the results can be used for acceptance purposes.

Cumulative Percent Retained (CPR) for 9.5 mm (⅜ in) sieve

$$CPR = \frac{642.5\ g}{3214.0\ g} \times 100 = 20.0\%$$

Percent Passing (PP) for 9.5 mm (⅜ in) sieve

$$PP = 100.0\% - 20.0\% = 80.0\%$$

Reported Percent Passing = 80 percent

As shown in the following table:

Gradation on Coarse Sieves Cumulative Mass

Sieve Size mm (in)		Cumulative Mass Retained g (CMR)	Cumulative Percent Retained (CPR)	Percent Passing (PP)
16.0	(⅝)	0	0	100
12.5	(½)	161.1	5.0	95.0
9.50	(⅜)	642.5	20.0	80.0
4.75	(No. 4)	1118.3 (*D*)	34.8	65.2
Mass in Pan		1966.7 (*M₁*)		
Cumulative sieved mass: 1118.3 + 1966.7 = 3085.0				
Dry mass of total sample, before washing (M): 3214.0 g				

The mass of minus 4.75 mm (No. 4) material in the pan, M_1 (1966.7 g), was reduced according to the FOP for AASHTO R 76, to at least 500 g. In this case, the reduced mass was determined to be **512.8 g**. This is M_2.

The reduced mass was sieved.

Total mass after sieving equals

Final Cumulative Mass Retained (CMR) in pan: 511.8 g

Fine Check Sum

$$Fine\ Check\ Sum = \frac{512.8\ g - 511.8\ g}{512.8\ g} \times 100 = 0.2\%$$

The result is less than 0.3 percent therefore the results can be used for acceptance purposes.

The cumulative mass of material retained for each sieve is multiplied by the adjustment factor (R) carried to three decimal places and added to the cumulative mass retained on the 4.75 mm (No. 4) sieve, D, to obtain the Adjusted Cumulative Mass Retained (ACMR).

Adjustment factor (R) for Cumulative Mass Retained (CMR) in minus 4.75 (No. 4) sieves

$$R = \frac{M_1}{M_2} = \frac{1,966.7\ g}{512.8\ g} = 3.835$$

Where:

R = minus 4.75 mm (No. 4) adjustment factor

M_1 = total mass of minus 4.75 mm (No. 4) from the pan

M_2 = mass of the reduced split of minus 4.75 mm (No. 4)

Adjusted Cumulative Mass Retained (ACMR) for the 2.00 mm (No. 10) sieve

$$ACMR = 3.835 \times 207.1\ g = 794.2\ g$$

Total Cumulative Mass Retained (TCMR) for the 2.00 mm (No. 10) sieve

$$TCMR = 794.2\ g + 1118.3\ g = 1912.5\ g$$

Cumulative Percent Retained (CPR) for 2.00 mm (No. 10) sieve:

$$CPR = \frac{1912.5\ g}{3214.0\ g} \times 100 = 59.5\%$$

Percent Passing (PP) 2.00 mm (No. 10) sieve:

$$PP = 100.0\% - 59.5\% = 40.5\%$$

Reported Percent Passing = 41 percent

As shown in the following table:

Final Gradation on All Sieves Cumulative Mass

Sieve Size mm (in)		Cumulative Mass Retained g (CMR)	Adjusted Cumulative Mass Retained, g (ACMR)	Total Cumulative Mass Retained g (TCMR)	Cumulative Percent Retained (CPR)	Percent Passing (PP)	Reported Percent Passing*
16.0	(⅝)	0		0	0.0	100.0	100
12.5	(½)	161.1		161.1	5.0	95.0	95
9.5	(⅜)	642.5		642.5	20.0	80.0	80
4.75	(No. 4)	1118.3		1118.3	34.8	65.2	65
2.00	(No. 10)	207.1 × 3.835	794.2 + 1118.3	1912.5	59.5	40.5	41
0.425	(No. 40)	395.0 × 3.835	1514.8 + 1118.3	2633.1	81.9	18.1	18
0.210	(No. 80)	454.9 × 3.835	1744.5 + 1118.3	2862.8	89.1	10.9	11
0.075	(No. 200)	504.0 × 3.835	1932.8 + 1118.3	3051.1	94.9	5.1	5.1
Pan		511.8 × 3.835	1962.8 + 1118.3	3081.1			
Total sum of masses on fine sieves + pan = 511.8							
Dry mass of total sample, before washing: 3214.0 g							

* Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

Procedure Method C

1   Dry the test sample to constant mass according to the FOP for AASHTO T 255. Cool to room temperature. Determine and record the total dry mass of the sample to the nearest 0.1 percent or 0.1 g. Designate this mass as *M*.

2.   Break up any aggregations or lumps of clay, silt or adhering fines to pass the 4.75 mm (No. 4) sieve.

3.   Select sieves required by the specification and those necessary to avoid overloading. With a pan on bottom, nest the sieves increasing in size starting with the 4.75 mm (No. 4) sieve.

4.   Place the sample, or a portion of the sample, on the top sieve. Sieves may already be in the mechanical shaker, if not place the sieves in the mechanical shaker and shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).

   Note 3: Excessive shaking (more than 10 minutes) may result in degradation of the sample.

5.   Determine and record the cumulative mass retained for each sieve. Ensure that all material trapped in full openings of the sieve are removed and included in the mass retained.

   Note 4: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening sieving over a full opening. Use coarse wire brushes to clean the 600 µm (No. 30) and larger sieves, and soft bristle brush for smaller sieves.

6.   Determine and record the mass of the minus 4.75 mm (No. 4) material in the pan. Designate this mass as M_1.

7.   Perform the *Coarse Check Sum* calculation –Verify the *total mass after coarse sieving* agrees with the *dry mass before sieving (M)* within 0.3 percent.

8.   Reduce the minus 4.75 mm (No. 4) according to the FOP for AASHTO R 76, to produce a sample with a minimum mass of 500 g.

9.   Determine and record the mass of the minus 4.75 mm (No. 4) split, designate this mass as M_3.

10. Nest a protective sieve, such as a 2.0 mm (No. 10), above the 75 µm (No. 200) sieve.

11. Place the test sample in a container and cover with water.

   Note 1: A detergent, dispersing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the 75 µm (No. 200) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.

12. Agitate vigorously to ensure complete separation of the material finer than 75 µm (No. 200) from coarser particles and bring the fine material into suspension above the coarser material. Avoid degradation of the sample when using a mechanical washing device.

13. Immediately pour the wash water containing the suspended material over the nested sieves; be careful not to pour out the coarser particles or over fill the 75 μm (No. 200) sieve.

14. Add water to cover material remaining in the container, agitate, and repeat Step 12. Repeat until the wash water is reasonably clear.

15. Remove the upper sieve and return material retained to the washed test sample.

16. Rinse the material retained on the 75 μm (No. 200) sieve until water passing through the sieve is reasonably clear and detergent or dispersing agent is removed, if used.

17. Return all material retained on the 75 μm (No. 200) sieve to the container by flushing into the washed sample.

    Note 2: Excess water may be carefully removed with a bulb syringe; the removed water must be discharged back over the 75 μm (No. 200) sieve to prevent loss of fines.

18. Dry the washed test sample to constant mass according to the FOP for AASHTO T 255. Cool to room temperature. Determine and record the dry mass, designate this mass as *dry mass before sieving*.

19. Select sieves required by the specification and those necessary to avoid overloading. With a pan on bottom, nest the sieves increasing in size starting with the 75 μm (No. 200) sieve up to, but not including, the 4.75 mm (No. 4) sieve.

20. Place the sample on the top sieve. Place the sieves in the mechanical shaker and shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).

    Note 3: Excessive shaking (more than 10 minutes) may result in degradation of the sample.

21. Determine and record the cumulative mass retained for each sieve. Ensure that all material trapped in full openings of the sieve are removed and included in the mass retained.

    Note 4: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening by sieving over a full opening. Use coarse wire brushes to clean the 600 μm (No. 30) and larger sieves, and soft bristle brushes for smaller sieves.

22. Perform the *Fine Check Sum* calculation – Verify the *total mass after fine sieving* agrees with the *dry mass before sieving* within 0.3 percent. Do not use test results for acceptance if the Check Sum is greater than 0.3 percent.

23. Calculate the Cumulative Percent Retained (CPR) and Percent Passing (PP) for the 4.75 mm (No. 4) and larger.

24. Calculate the Cumulative Percent Retained ($CPR_{-\#4}$) and the Percent Passing ($PP_{-\#4}$) for minus 4.75 mm (No. 4) split and Percent Passing (PP) for the minus 4.75 mm (No. 4).

25. Report total percent passing to 1 percent except report the 75 μm (No. 200) sieve to 0.1 percent.

Method C Calculations

Check Sum

$$Coarse\ check\ sum = \frac{M - total\ mass\ after\ coarse\ sieving}{M} \times 100$$

$$Fine\ check\ sum = \frac{dry\ mass\ before\ sieving - total\ mass\ after\ fine\ sieving}{dry\ mass\ before\ sieving} \times 100$$

where:

M = Total dry sample mass before washing

Cumulative Percent Retained (CPR) for 4.75 mm (No. 4) sieve and larger

$$CPR = \frac{CMR}{M} \times 100$$

where:

CPR = Cumulative Percent Retained of the size increment for the total sample
CMR = Cumulative Mass Retained of the size increment for the total sample
M = Total dry sample mass before washing

Percent Passing (PP) 4.75 mm (No. 4) sieve and larger

$$PP = 100 - CPR$$

where:

PP = Percent Passing of the size increment for the total sample
CPR = Cumulative Percent Retained of the size increment for the total sample

Or, calculate PP for sieves larger than 4.75 mm (No. 4) sieve without calculating CPR

$$\frac{M - CMR}{M} \times 100$$

Cumulative Percent Retained (CPR$_{-\#4}$) for minus 4.75 mm (No. 4) split

$$CPR_{-\#4} = \frac{CMR_{-\#4}}{M_3} \times 100$$

Where:

$CPR_{-\#4}$ = Cumulative Percent Retained for the sieve sizes of M_3
$CMR_{-\#4}$ = Cumulative Mass Retained for the sieve sizes of M_3
M_3 = Total mass of the minus 4.75 mm (No. 4) split before washing

Percent Passing (PP$_{-\#4}$) for minus 4.75 mm (No. 4) split

$$PP_{-\#4} = 100 - CPR_{-\#4}$$

where:

$PP_{-\#4}$ = Percent Passing for the sieve sizes of M_3
$CPR_{-\#4}$ = Cumulative Percent Retained for the sieve sizes of M_3

Percent Passing (PP) for sieves smaller than 4.75 mm (No. 4) sieve

$$PP = \frac{(PP_{-\#4} \times \#4\ PP)}{100}$$

where:

      PP = Total Percent Passing

      $PP_{-\#4}$ = Percent Passing for the sieve sizes of M_3

      #4 PP = Total Percent Passing the 4.75 mm (No. 4) sieve

Or, calculate PP for sieves smaller than 4.75 mm (No. 4) sieve without calculating CPR$_{-\#4}$ and PP$_{-\#4}$

$$PP = \frac{\#4\ PP}{M_3} \times (M_3 - CMR_{-\#4})$$

Where:

      PP = Total Percent Passing

      #4 PP = Total Percent Passing the 4.75 mm (No. 4) sieve

      M_3 = Total mass of the minus 4.75 mm (No. 4) split before washing

      $CMR_{-\#4}$ = Cumulative Mass Retained for the sieve sizes of M_3

Method C Example

Dry Mass of total sample (M):   3304.5 g

Total mass after sieving equals

    Cumulative Mass Retained (CMR) on the 4.75 (No. 4) plus the pan: 3085.0 g

Coarse Check Sum

$$Coarse\ Check\ Sum = \frac{3304.5\ g - 3304.5\ g}{3304.5\ g} \times 100 = 0.0\%$$

The result is less than 0.3 percent therefore the results can be used for acceptance purposes.

Cumulative Percent Retained (CPR) for the 9.5 mm (⅜ in) sieve:

$$CPR = \frac{604.1\ g}{3304.5\ g} \times 100 = 18.3\%$$

Percent Passing (PP) for the 9.5 mm (⅜ in) sieve:

$$PP = 100.0\% - 18.3\% = 81.7\%$$

   Reported Percent Passing = 82 percent

Example for Alternate Percent Passing (PP) formula for the 9.5 mm (⅜ in) sieve:

$$PP = \frac{3304.5 - 604.1}{3304.5} \times 100 = 81.7\%$$

Reported Percent Passing = 82 percent

Gradation on Coarse Sieves Cumulative Mass

Sieve Size mm (in)	Cumulative Mass Retained, g (CMR)	Cumulative Percent Retained (CPR)	Percent Passing (PP)	Reported Percent Passing*
16.0 (⅝)	0	0.0	100.0	100
12.5 (½)	125.9	3.8	96.2	96
9.5 (⅜)	604.1	18.3	81.7	82
4.75 (No. 4)	1295.6	39.2	**60.8** **(#4 PP)**	61
Mass in Pan	2008.9			
Cumulative sieved mass: 1295.6 + 2008.9 = 3304.5				
Total Dry Sample (**M**) = 3304.5				

Fine Test Sample

The pan (2008.9 g) was reduced according to the FOP for AASHTO R 76, to at least 500 g. In this case, the reduced mass was determined to be **527.6 g**. This is M_3.

Dry Mass of minus 4.75mm (No. 4) reduced portion before wash (M_3):   527.6 g

Dry Mass of minus 4.75mm (No. 4) reduced portion after wash: 495.3 g

Total mass after sieving equals

Final Cumulative Mass Retained (CMR) in pan: 495.1 g

Fine Check Sum

$$Fine\ Check\ Sum = \frac{495.3\ g - 495.1\ g}{495.3\ g} \times 100 = 0.04\%$$

The result is less than 0.3 percent therefore the results can be used for acceptance purposes.

Cumulative Percent Retained (CPR$_{-\#4}$) for minus 4.75 mm (No. 4) for the 2.0 mm (No. 10) sieve:

$$CPR_{-\#4} = \frac{194.3\ g}{527.6\ g} \times 100 = 36.8\%$$

Percent Passing (PP$_{-\#4}$) for minus 4.75 mm (No. 4) for the 2.0 mm (No. 10) sieve:

$$PP_{-\#4} = 100.0\% - 36.8\% = 63.2\%$$

Gradation on Minus No. 4 Sieves Cumulative Mass

Sieve Size mm (in)		Cumulative Mass Retained g (CMR$_{-\#4}$)	Cumulative Percent Retained$_{-\#4}$ (CPR$_{-\#4}$)	Percent Passing$_{-\#4}$ (PP$_{-\#4}$)
2.0	(No. 10)	194.3	36.8	63.2
0.425	(No. 40)	365.6	69.3	30.7
0.210	(No. 80)	430.8	81.7	18.3
0.075	(No. 200)	484.4	91.8	8.2
Pan		495.1		
Dry mass before washing (M$_3$): 527.6 g				
Dry mass after washing: 495.3 g				

Percent Passing (PP) for the 2.0 mm (No. 10) sieve for the entire test sample:

#4 PP (Total Percent Passing the 4.75 mm (No. 4) sieve) = 60.8 percent

$$PP = \frac{63.2\% \times 60.8\%}{100} = 38.4\%$$

Reported Percent Passing = 38 percent

As shown in the following table:

Final Gradation on All Sieves Cumulative Mass

Sieve Size mm (in)		Cumulative Mass Retained, g (CMR)	Cumulative Percent Retained (CPR)	Percent Passing (PP$_{-\#4}$)	Percent Passing (PP)	Reported Percent Passing*
16.0	(⅝)	0	0.0		100.0	100
12.5	(½)	125.9	3.8		96.2	96
9.5	(⅜)	604.1	18.3		81.7	82
4.75	(No. 4)	1295.6	39.2		60.8 (#4 PP)	61
2.0	(No. 10)	194.3	36.8	63.2	38.4	38
0.425	(No. 40)	365.6	69.3	30.7	18.7	19
0.210	(No. 80)	430.8	81.7	18.3	11.1	11
0.075	(No. 200)	484.4	91.8	8.2	5.0	5.0
Pan		495.1				

* Report total percent passing to 1 percent except report the 75 μm (No. 200) sieve to 0.1 percent.

Example for Alternate Percent Passing (PP) for the 2.0 mm (No. 10) sieve for the entire test sample:

#4 PP (Total Percent Passing the 4.75 mm (No. 4) sieve) = 60.8 percent

$$PP = \frac{60.8\%}{527.6} \times (527.6 - 194.3) = 38.4\%$$

Reported Percent Passing = 38 percent

As shown in the following table:

Final Gradation on All Sieves Cumulative Mass

Sieve Size mm (in)		Cumulative Mass Retained, g (CMR)	Cumulative Percent Retained (CPR)	Determined Percent Passing (PP)	Reported Percent Passing*
16.0	(⅝)	0	0.0	100.0	100
12.5	(½)	125.9	3.8	96.2	96
9.5	(⅜)	604.1	18.3	81.7	82
4.75	(No. 4)	1295.6	39.2	**60.8** **(#4 PP)**	61
2.0	(No. 10)	194.3		38.4	38
0.425	(No. 40)	365.6		18.7	19
0.210	(No. 80)	430.8		11.2	11
0.075	(No. 200)	484.4		5.0	5.0
Pan		495.1			
Dry mass before washing (M₃):	527.6 g				

Dry mass before washing (M_3):   527.6 g

* Report total percent passing to 1 percent except report the 75 μm (No. 200) sieve to 0.1 percent.

Fineness Modulus

Fineness Modulus (FM) is used in determining the degree of uniformity of the aggregate gradation in PCC mix designs. It is an empirical number relating to the fineness of the aggregate. The higher the FM the coarser the aggregate. Values of 2.40 to 3.00 are common for fine aggregate in PCC.

The sum of the cumulative percentages retained on specified sieves in the following table divided by 100 gives the FM.

Sample Calculation

Sieve Size mm (in)		Example A			Example B		
			Percent			Percent	
				Retained			Retained
		Passing		On Spec'd Sieves*	Passing		On Spec'd Sieves*
75*	(3)	100	0	0	100	0	0
37.5*	(1½)	100	0	0	100	0	0
19*	(¾)	15	85	85	100	0	0
9.5*	(⅜)	0	100	100	100	0	0
4.75*	(No.4)	0	100	100	100	0	0
2.36*	(No.8)	0	100	100	87	13	13
1.18*	(No.16)	0	100	100	69	31	31
0.60*	(No. 30	0	100	100	44	56	56
0.30*	(No. 50)	0	100	100	18	82	82
0.15*	(100)	0	100	100	4	96	96
				$\sum$ = 785			$\sum$ = 278
				FM = 7.85			FM = 2.78

In decreasing size order, each * sieve is one-half the size of the preceding * sieve.

Report

- Results on forms approved by the agency
- Sample ID
- Percent passing for each sieve
- Individual mass retained for each sieve
- Individual percent retained for each sieve

    or

- Cumulative mass retained for each sieve
- Cumulative percent retained for each sieve
- FM to the nearest 0.01

Report percentages to the nearest 1 percent except for the percent passing the 75 μm (No. 200) sieve, which shall be reported to the nearest 0.1 percent.

ANNEX A Time Evaluation

The sieving time for each mechanical sieve shaker shall be checked at least annually to determine the time required for complete separation of the test sample by the following method:

1. Shake the sample over nested sieves for approximately 10 minutes.

2. Provide a snug-fitting pan and cover for each sieve, and hold in a slightly inclined position in one hand.

3. Hand-shake each sieve by striking the side of the sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per minute, turning the sieve about one sixth of a revolution at intervals of about 25 strokes.

If more than 0.5 percent by mass of the total sample before sieving passes any sieve after one minute of continuous hand shaking adjust shaker time and re-check.

In determining sieving time for sieve sizes larger than 4.75 mm (No. 4), limit the material on the sieve to a single layer of particles.

ANNEX B Overload Determination

Additional sieves may be necessary to keep from overloading sieves or to provide other information, such as fineness modulus. The sample may also be sieved in increments to prevent overloading.

- For sieves with openings smaller than 4.75 mm (No. 4), the mass retained on any sieve shall not exceed 7 kg/m^2 (4 g/in^2) of sieving surface.

- For sieves with openings 4.75 mm (No. 4) and larger, the mass, in grams shall not exceed the product of 2.5 × (sieve opening in mm) × (effective sieving area). See Table B1.

Table B1   Maximum Allowable Mass of Material Retained on a Sieve, g
Nominal Sieve Size, mm (in)
Exact size is smaller (see AASHTO T 27)

Sieve Size mm (in)		203 dia (8)	305 dia (12)	305 by 305 (12 × 12)	350 by 350 (14 × 14)	372 by 580 (16 × 24)
		Sieving Area m^2				
		0.0285	0.0670	0.0929	0.1225	0.2158
90	(3½)	*	15,100	20,900	27,600	48,500
75	(3)	*	12,600	17,400	23,000	40,500
63	(2½)	*	10,600	14,600	19,300	34,000
50	(2)	3600	8400	11,600	15,300	27,000
37.5	(1½)	2700	6300	8700	11,500	20.200
25.0	(1)	1800	4200	5800	7700	13,500
19.0	(¾)	1400	3200	4400	5800	10,200
16.0	(⅝)	1100	2700	3700	4900	8600
12.5	(½)	890	2100	2900	3800	6700
9.5	(⅜)	670	1600	2200	2900	5100
6.3	(¼)	440	1100	1500	1900	3400
4.75	(No. 4)	330	800	1100	1500	2600
-4.75	(-No. 4)	200	470	650	860	1510

PERFORMANCE EXAM CHECKLIST

METHOD A

FOP for AASHTO T 27
Sieve Analysis of Fine and Coarse Aggregates

FOP for AASHTO T 11
Materials Finer Than 75 μm (No. 200) Sieve in Mineral Aggregate by Washing

Participant Name _____   Exam Date _____

Record the symbols "P" for passing or "F" for failing on each step of the checklist.

Procedure Element	**Trial 1**	**Trial 2**
1. Minimum sample mass meets requirement of Table 1?	_____	_____
2. Test sample dried to a constant mass by FOP for AASHTO T 255?	_____	_____
3. Test sample cooled and mass determined to nearest 0.1 percent or 0.1 g?	_____	_____
4. Test sample placed in container and covered with water?	_____	_____
5. Contents of the container vigorously agitated?	_____	_____
6. Complete separation of coarse and fine particles achieved?	_____	_____
7. Wash water poured through nested sieves such as 2 mm (No. 10) and 75 μm (No. 200)?	_____	_____
8. Operation continued until wash water is clear?	_____	_____
9. Material retained on sieves returned to washed sample?	_____	_____
10. Washed test sample dried to a constant mass by FOP for AASHTO T 255?	_____	_____
11. Washed test sample cooled and mass determined to nearest 0.1 percent or 0.1 g?	_____	_____
12. Test sample placed in nest of sieves specified? (Additional sieves may be used to prevent overloading as allowed in FOP.)	_____	_____
13. Material sieved in verified mechanical shaker for proper time?	_____	_____
14. Mass of material on each sieve and pan determined to 0.1 g?	_____	_____
15. Total mass of material after sieving agrees with mass before sieving to within 0.3 percent?	_____	_____
16. Percentages calculated to the nearest 0.1 percent and reported to the nearest whole number, except 75 μm (No. 200) which is reported to the nearest 0.1 percent?	_____	_____
17. Percentage calculations based on original dry sample mass?	_____	_____
18. Calculations performed properly?	_____	_____

First Attempt: Pass   Fail   Second Attempt: Pass   Fail

Signature of Examiner _____   WAQTC #:_____

Comments:

Performance Exam Checklist

METHOD B

FOP for AASHTO T 27
Sieve Analysis of Fine and Coarse Aggregates

FOP for AASHTO T 11
Materials Finer Than 75 µm (No. 200) Sieve in Mineral Aggregate by Washing

Participant Name _____ Exam Date _____

Record the symbols "P" for passing or "F" for failing on each step of the checklist.

Procedure Element	Trial 1	Trial 2
1. Minimum sample mass meets requirement of Table 1?	_____	_____
2. Test sample dried to a constant mass by FOP for AASHTO T 255?	_____	_____
3. Test sample cooled and mass determined to nearest 0.1 percent or 0.1 g?	_____	_____
4. Test sample placed in container and covered with water?	_____	_____
5. Contents of the container vigorously agitated?	_____	_____
6. Complete separation of coarse and fine particles achieved?	_____	_____
7. Wash water poured through nested sieves such as 2 mm (No. 10) and 75 µm (No. 200)?	_____	_____
8. Operation continued until wash water is clear?	_____	_____
9. Material retained on sieves returned to washed sample?	_____	_____
10. Washed test sample dried to a constant mass by FOP for AASHTO T 255?	_____	_____
11. Washed test sample cooled and mass determined to nearest 0.1 percent or 0.1 g?	_____	_____
12. Test sample placed in nest of sieves specified? (Additional sieves may be used to prevent overloading as allowed in FOP.)	_____	_____
13. Material sieved in verified mechanical shaker for proper time?	_____	_____
14. Mass of material on each sieve and pan determined to the nearest 0.1 percent or 0.1 g?	_____	_____
15. Total mass of material after sieving agrees with mass before sieving to within 0.3 percent?	_____	_____
16. Material in pan reduced in accordance with FOP for AASHTO R 76 to at least 500 g and weighed to the nearest 0.1 g?	_____	_____
17. Test sample placed in nest of sieves specified? (Additional sieves may be used to prevent overloading as allowed in FOP.)	_____	_____
18. Material sieved in verified mechanical shaker for proper time?	_____	_____
19. Mass of material on each sieve and pan determined to the nearest percent or 0.1 g?		

Procedure Element   **Trial 1   Trial 2**

20. Total mass of material after sieving agrees with mass before sieving to within 0.3 percent?

21. Percentages calculated to the nearest 0.1 percent and reported to the nearest whole number, except 75 µm (No. 200) which is reported to the nearest 0.1 percent?

22. Percentage calculations based on original dry sample mass?

23. Calculations performed properly?

First Attempt: Pass   Fail   Second Attempt: Pass   Fail

Signature of Examiner _____   WAQTC #:_____

Comments: