

MLR - 84-5

SIEVE ANALYSIS OF COMBINED AGGREGATE SAMPLES
BY DIFFERENT TEST METHODS

BY

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Testing Performed by Technicians
from
The District Materials Offices
and
Central Materials Laboratory
Iowa Department of Transportation

This past winter the sieve analysis of combined aggregate was investigated. This study was given No. 26 by the Central Laboratory. The purpose of this work was to try and develop a sieve analysis procedure for combined aggregate which is less time consuming and has the same accuracy as the method described in I.M. 304.

In an attempt to use a variety of aggregates for this investigation, a request was made to each District Materials Office to obtain at least 3 different combined aggregate samples in their respective districts. At the same time it was also requested that the field technician test these samples, prior to submitting them to the Central Laboratory. The field technician was instructed to test each sample as described in method I.M. 304 and also by a modified AASHTO T27 method which will be identified in the report as Method A.

The modified AASHTO Method A was identical to T27 with the exception that a smaller sample is used for testing.

The field technicians submitted the samples, test results and also comments regarding the modified AASHTO procedure. The general comments of the modified AASHTO procedure were: The method was much simpler to follow; however, it took about the same amount of time so there was no real advantage.

After reviewing AASHTO T27, T164, I.M. 304 and Report No. FHWA-RD-77-53 another test method was purposed. Report No. FHWA-RD-77-53 is a report prepared by FHWA from data they gathered concerning control practices and shortcut or alternative test methods for aggregate gradation.

A second test method was developed which also was very similar to AASHTO T27. The test procedure for this method is attached and is identified as Method B.

The following is a summary of test results submitted by the Field Technicians and obtained by the aggregate section of the Central Laboratory.

Laboratory Number - AAT1-701
Sample Submitted by - Dist. 1

Sieve Size	Test Results - % Passing				
	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05	100	00			
3/4	99	99	100	100	100
0.525	93	92	93	92	93
3/8	86	84	85	85	84
#4	70	70	69	68	68
#8	54	53	53	53	52
#16	41	40	40	40	42
#30	24	24	25	25	25
#50	7.8	11	12	12	12
#100	4.2	5.7	5.7	5.7	6.1
#200	2.8	4.1	4.0	4.0	4.5

Laboratory Number - AAT1-702
Sample Submitted by - Dist. 1

Sieve Size	Test Results - % Passing				
	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05					
3/4					
0.525	100-	99	100-	100-	100-
3.8	89	92	91	91	92
#4	66	70	66	67	68
#8	52	56	53	54	54
#16	41	44	42	42	44
#30	27	30	28	28	30
#50	13	15	14	14	15
#100	6.7	8.4	7.2	7.4	7.6
#200	5.5	6.4	5.6	5.7	6.1

Laboratory Number - AAT1-703
Sample Submitted by - Dist. 1

Sieve Size	Field Tech		Test Results - % Passing			
	I.M. 304	Method A	AASHTO T27	Central Laboratory		Method B
1.05	100	100	100	100		100
3/4	99	98	98	98	100-	98
0.525	86	85	86	87	88	87
3/8	76	76	74	77	79	77
#4	62	63	60	63	66	64
#8	49	51	48	50	54	52
#16	38	40	36	39	42	40
#30	26	27	24	27	29	28
#50	14	14	11	15	15	15
#100	7.8	7.3	5.2	8.0	8.3	8.0
#200	6.3	6.1	3.9	6.4	6.6	6.4

Laboratory Number - AAT2-5
Sample Submitted by - Dist. 2

Sieve Size	Field Tech		Test Result - % Passing		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05					
3/4	100				
0.525	99	100	100-	100	100
3/8	84	84	86	88	87
#4	46	47	47	48	48
#8	25	25	25	25	25
#16	15	16	15	15	16
#30	11	11	11	11	11
#50	9.0	9.0	8.8	8.8	8.9
#100	7.5	7.5	7.4	7.5	7.3
#200	6.4	6.2	6.0	6.1	5.7

Laboratory Number - AAT2-6
Sample Submitted by - Dist. 2

Sieve Size	Test Results - % Passing				
	Field Tech		Central Laboratory		
	<u>I.M. 304</u>	<u>Method A</u>	<u>AASHTO T27</u>	<u>I.M. 304</u>	<u>Method B</u>
1.05					
3/4	100	100	100	100	100
0.525	85	87	87	87	84
3/8	62	65	65	67	63
#4	34	32	32	36	33
#8	21	20	20	23	21
#16	15	15	14	17	15
#30	12	12	12	14	12
#50	11	10	9.9	12	10
#100	9.5	8.9	8.5	10	8.9
#200	8.0	7.3	6.8	8.2	7.3

Laboratory Number - AAT2-7
Sample Submitted by - Dist. 2

Sieve Size	Test Results - % Passing				
	Field Tech		Central Laboratory		
	<u>I.M. 304</u>	<u>Method A</u>	<u>AASHTO T27</u>	<u>I.M. 304</u>	<u>Method B</u>
3/4	100	99	100	100	100
0.525	92	91	92	91	92
3/8	84	84	82	83	83
#4	71	70	70	70	70
#8	60	58	60	59	59
#16	49	47	50	48	48
#30	36	35	37	36	35
#50	17	17	18	18	17
#100	7.2	7.1	7.6	7.5	6.7
#200	5.1	4.9	5.1	5.3	4.7

Laboratory Number - AAT1-704
 Sample Submitted by - Dist. 3

Sieve Size	Field Tech						Central Laboratory			Dist.
	I.M. 304			Method A			AASHTO T27	I.M. 304	Method B	
	A	B	C	A	B	C				
1.05	100	100	100	100	100	100	100	100	100	100
3/4	98	96	97	99	98	98	97	98	97	98
0.525	95	92	92	94	92	94	93	93	95	94
3/8	91	89	87	90	88	90	88	89	90	91
#4	78	76	76	79	76	78	76	77	77	80
#8	63	60	60	63	61	62	60	64	61	60
#16	46	43	43	46	44	44	44	45	44	49
#30	25	23	23	26	24	22	23	23	23	20
#50	7.4	6.6	6.6	7.4	6.9	7.0	7.2	7.6	7.1	7.0
#100	2.2	2.0	2.2	2.3	2.2	2.1	2.2	2.3	2.0	2.1
#200	1.7	1.5	1.7	1.8	1.6	1.6	1.7	1.9	1.7	1.5

Laboratory Number - AAT1-705
 Sample Submitted by - Dist. 3

Sieve Size	Field Tech						Central Laboratory		
	I.M. 304			Method A			AASHTO T27	I.M. 304	Method B
	A	B	C	A	B	C			
1.05	100	100	100	100	100	100	100	100	100
3/4	96	95	97	98	98	96	97	96	96
0.525	84	83	84	85	88	85	83	81	85
3/8	76	76	75	76	79	76	75	73	76
#4	62	62	63	63	66	63	62	60	61
#8	52	51	50	51	53	50	50	50	50
#16	41	40	40	40	42	39	39	39	41
#30	29	29	28	29	30	27	28	27	28
#50	18	18	18	18	19	17	18	17	17
#100	14	14	13	14	14	13	13	12	12
#200	12	12	12	12	12	11	11	10	10

Laboratory Number - AAT1-706
 Sample Submitted by - Dist. 3

Sieve Size	Field Tech						Central Laboratory		
	I.M. 304			Method A			AASHTO T27	I.M. 304	Method B
	A	B	C	A	B	C			
7.05 100	100	100	100	99	100	100	100	100	99
0.525 70	90	91	90	93	93	92	90	91	91
3/8 80	79	81	81	83	83	82	82	81	81
#4 66	66	67	67	69	69	68	67	67	67
#8 53	54	54	55	56	55	56	54	55	55
#16 39	41	41	41	42	42	43	40	42	42
#30 23	27	26	26	28	26	27	24	26	26
#50 10	13	12	13	14	13	13	12	13	13
#100 4.5	7.5	7.3	7.0	8.1	7.3	7.0	6.7	7.2	7.2
#200 8.9	5.6	5.6	5.3	6.2	5.6	5.2	5.1	5.3	5.1

Laboratory Number - AAT1-707
 Sample Submitted by - Dist. 4

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1 1/2		100		100	
1.05	100	99	100	98	100
3/4	81	79	78	79	76
0.525	63	63	58	57	54
3/8	50	48	46	45	41
#4	32	30	30	29	27
#8	22	20	22	21	20
#16	17	15	18	16	16
#30	14	12	16	14	14
#50	12	9.7	15	13	13
#100	11	8.5	13	12	12
#200	9.9	7.6	12	11	11

Laboratory Number AAT1-708
Sample Submitted by - Dist. 4

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
3/4	100	100	100	100	100
0.525	99	99	99	99	99
3/8	89	90	86	90	89
#4	67	70	63	69	66
#8	52	54	50	54	52
#16	40	43	40	43	42
#30	25	29	27	29	28
#50	12	14	14	14	14
#100	6.8	8.7	8.4	8.2	8.3
#200	5.6	7.2	6.6	6.5	6.8

Laboratory Number AAT1-709
Sample Submitted by - Dist. 4

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05	100	96	98	99	100
3/4	92	89	92	98	94
0.525	87	86	86	92	88
3/8	84	83	83	88	85
#4	80	80	79	84	81
#8	77	76	76	80	77
#16	71	71	70	74	71
#30	58	59	56	60	58
#50	29	30	28	30	30
#100	7.6	7.3	8.2	8.9	9.0
#200	4.9	4.6	5.0	5.4	5.8

Dist

Laboratory Number AAT1-714
 Sample Submitted by - Dist. 5

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05		100		100	
3/4	100	99	100-	99	100-
0.525	87	85	86	84	83
3/8	65	67	69	66	66
#4	36	37	37	37	36
#8	18	20	19	18	18
#16	11	12	12	11	11
#30	8.7	9.4	8.9	9.0	8.0
#50	7.4	8.0	7.6	7.6	6.6
#100	6.5	7.1	6.7	6.7	5.7
#200	5.5	6.1	5.6	5.7	4.8

Laboratory Number - AAT1-715
 Sample Submitted by - Dist. 5

Dist 2

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05	100	100	100	100	100
3/4	100-	99	100	99	99
1/2	85	84	85	88	86
3/8	66	64	67	70	69
#4	36	35	37	39	40
#8	18	18	18	20	20
#16	10	10	9.8	11	11
#30	7.8	7.5	7.3	8.5	8.1
#50	6.4	6.2	6.1	7.1	6.5
#100	5.6	5.4	5.3	6.2	5.5
#200	4.8	4.6	4.5	5.1	4.6

Laboratory Number - AAT1-716
Sample Submitted by - Dist. 5

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05		100	100	100	100
3/4	100	99	99	99	99
0.525	84	88	85	85	84
3/8	69	66	68	68	64
#4	36	35	36	37	34
#8	18	17	17	18	16
#16	10	9.4	9.4	10	8.8
#30	7.8	7.2	7.1	7.4	6.4
#50	6.6	6.1	5.9	6.0	5.2
#100	5.8	5.4	5.1	5.1	4.5
#200	5.1	4.7	4.3	4.4	3.8

Laboratory Number - AAT1-717
Sample Submitted by - Dist. 5

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05	100	100		100	100
3/4	100	100	100	99	100
0.525	86	84	86	83	86
3/8	64	66	68	66	69
#4	37	37	39	38	39
#8	20	19	10	21	20
#16	12	12	13	14	13
#30	9.5	9.6	10	11	10
#50	7.9	8.3	8.7	9.5	8.6
#100	7.0	7.4	7.7	8.4	7.7
#200	6.2	6.5	6.7	7.4	6.8

Laboratory Number - AAT1-718
Sample Submitted by - Dist. 5

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05	100				100
3/4	100-		100-	100-	99
0.525	87		86	84	86
3/8	67		69	65	68
#4	37		38	37	40
#8	18		20	18	20
#16	11		12	12	12
#30	8.5		9.4	9.2	8.8
#50	7.2		8.0	7.9	7.4
#100	6.4		7.0	7.0	6.6
#200	5.6		5.9	5.9	5.8

v. 3
100
99
86
64
36
17
12
9.0
7.5
6.7
5.9

Laboratory Number - AAT1-710
Sample Submitted by - Dist. 6

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1 1/2					
1.05	100	100	100	100	100
3/4	91	98	94	96	95
1/2	79	85	83	86	82
3/8	67	74	72	75	73
#4	42	48	45	47	47
#8	27	32	30	31	31
#16	22	26	24	25	26
#30	20	24	22	22	23
#50	18	21	20	20	21
#100	16	19	18	18	18
#200	12	14	13	13	13

Laboratory Number - AAT1-711
Sample Submitted by - Dist. 6

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05	100	100	100	100	100
3/4	93	93	96	95	95
0.525	77	74	77	76	74
3/8	58	57	59	59	57
#4	36	35	36	36	36
#8	24	22	24	25	24
#16	16	15	16	16	16
#30	12	11	12	12	12
#50	9.5	8.7	9.2	9.6	9.3
#100	8.2	7.5	7.8	8.2	7.9
#200	7.6	6.8	6.9	7.3	7.0

Laboratory Number - AAT1-712
Sample Submitted by - Dist. 6

Sieve Size	Field Tech		Central Laboratory		
	I.M. 304	Method A	AASHTO T27	I.M. 304	Method B
1.05	100	100	100	100	100
3/4	89	89	90	89	87
0.525	73	74	74	71	69
3/8	59	63	65	62	58
#4	42	44	44	43	40
#8	29	33	32	30	29
#16	22	24	23	21	21
#30	17	18	18	16	16
#50	13	15	14	13	13
#100	11	12	12	10	11
#200	10	11	10	8.6	9.4

It took a considerable amount of time to complete the sieve analysis as done by AASHTO T27. This was due to using a larger sample and oven drying the material. The actual time spent on I.M. 304 and Method B was not determined on every sample. It was estimated by the technician that Method B took about half as much time to perform the test as it did for Method I.M. 304.

The test data was analyzed for accuracy by using the AASHTO T27 method as the standard and comparing all results against it.

The results of the comparisons are as follows in the tables.

Laboratory Number - AAT1-701
Sample Submitted by - Dist. 1

Sieve Size	Deviation From AASHTO T27 Method			
	Field Tech		Central Laboratory	
	<u>I.M. 304</u>	<u>Method A</u>	<u>I.M. 304</u>	<u>Method B</u>
3/4	1	0	0	0
0.525	1	0	1	0
3/8	1	1	0	1
#4	1	2	1	1
#8	0	3	0	1
#16	0	2	0	0
#30	1	1	0	0
#50	1	1	0	0
#100	0	0	0	0.4
#200	0.1	0.2	0	0.5
Avg.	0.61	1.02	0.2	0.39

Laboratory Number AAT1-702
Sample Submitted by - Dist. 1

Deviation from AASHTO T27 Method

Sieve Size	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
0.525	0	0	0	0
3/8	2	1	0	1
#4	0	4	1	1
#8	1	3	1	0
#16	1	2	0	2
#30	1	2	0	2
#50	1	1	0	1
#100	0.5	1.2	0.2	0.4
#200	0.9	0.8	0.1	0.4
Avg.	0.82	1.67	0.26	0.87

Laboratory Number AAT1-703
Sample Submitted by - Dist. 1

Deviation from AASHTO T27 Method

Sieve Size	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
1.05	0	0	0	0
3/4	1	0	2	0
0.525	1	2	1	0
3/8	1	1	2	0
#4	1	0	3	1
#8	1	1	4	2
#16	0	1	3	1
#30	1	0	2	1
#50	1	1	0	0
#100	0.2	0.7	0.3	0
#200	0.1	0.3	0.2	0
Avg.	0.67	0.64	1.59	0.45

Laboratory Number AAT2-5
Sample Submitted by - Dist. 2

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
3/4				
0.525	1	0	0	0
3/8	2	2	2	1
#4	1	0	1	1
#8	0	0	0	0
#16	0	1	0	1
#30	0	0	0	0
#50	0.2	0.2	0	0.1
#100	0.1	0.1	0	0.1
#200	0.4	0.2	0.1	0.3
Avg.	0.52	0.39	0.34	0.39

Laboratory Number AAT2-6
Sample Submitted by - Dist. 2

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
3/4	0	0	0	0
0.525	2	0	0	3
3/8	3	0	2	2
#4	2	0	4	1
#8	1	0	3	1
#16	1	1	2	1
#30	0	0	2	0
#50	1.1	0.1	2.1	0.1
#100	1.0	0.4	1.5	0.4
#200	1.2	0.5	1.4	0.5
Avg.	1.23	0.20	1.8	0.9

Laboratory Number AAT2-7
Sample Submitted by - Dist. 2

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	<u>I.M. 304</u>	<u>Method A</u>	<u>I.M. 304</u>	<u>Method B</u>
3/4	0	1	0	0
0.525	0	1	1	0
3/8	2	2	1	1
#4	1	0	0	0
#8	0	2	1	1
#16	1	3	2	2
#30	1	2	1	2
#50	1	1	0	1
#100	0.4	0.5	0.1	0.9
#200	0	0.2	0.2	0.4
Avg.	0.64	1.27	0.63	0.83

Laboratory Number AAT1-704
Sample Submitted by - Dist. 3

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	<u>I.M. 304</u>	<u>Method A</u>	<u>I.M. 304</u>	<u>Method B</u>
1.05	0	0	0	0
3/4	1	2	1	0
0.525	2	1	0	2
3/8	3	2	1	2
#4	2	3	1	1
#8	3	3	4	1
#16	2	2	1	0
#30	2	3	0	0
#50	0.2	0.2	0.4	0.1
#100	0	0.1	0.1	0.2
#200	0	1.7	0.2	0
Avg.	1.38	1.64	0.79	0.57

Laboratory No. AAT1-705
Sample Submitted by Dist. 3

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
1.05	0	0	0	0
3/4	2	2	1	1
0.525	0	1	2	2
3/8	1	0	2	1
#4	0	1	2	1
#8	2	1	0	0
#16	2	0	0	2
#30	1	1	1	0
#50	0	0	1	1
#100	1	1	1	1
#200	1	1	1	1
Avg.	0.91	0.73	1.0	0.91

Laboratory Number AAT1-706
Sample Submitted by Dist. 3

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
3/4	0	1	0	1
0.525	0	3	1	1
3/8	3	1	1	1
#4	1	2	0	0
#8	0	2	1	1
#16	1	2	2	2
#30	3	4	2	2
#50	1	2	1	1
#100	0.8	1.4	0.5	0.5
#200	0.5	1.1	0.2	0
Avg.	1.03	1.85	0.87	0.95

Note: District 3 had 3 operators that performed tests. Only the results of operator A was used for this evaluation.

Laboratory Number - AAT1-707
Sample Submitted by - Dist. 4

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
1 1/2				
1.05	0	1	2	0
3/4	3	1	1	2
0.525	5	5	1	4
3/8	4	2	1	5
#4	2	0	1	3
#8	0	2	1	2
#16	1	3	2	2
#30	2	4	2	2
#50	3	5.3	2	2
#100	2	4.5	1	1
#200	2	4.4	1	1
Avg.	2.18	2.93	1.5	2.18

Laboratory Number - AAT1-708
Sample Submitted by - Dist. 4

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	I.M.304	Method A	I.M. 304	Method B
3/4	0	0	0	0
0.525	1	0	0	0
3/8	5	4	4	3
#4	7	7	6	3
#8	6	4	4	2
#16	5	3	3	2
#30	3	2	2	1
#50	0	0	0	1
#100	0.5	0.3	0.2	0.1
#200	0.2	0.6	0.1	0.2
Avg.	2.77	2.09	1.93	1.23

Laboratory Number - AAT1-709
Sample Submitted by - Dist. 4

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	<u>I.M. 304</u>	<u>Method A</u>	<u>I.M. 304</u>	<u>Method B</u>
1/05	2	2	1	2
3/4	0	3	6	2
0.525	1	0	6	2
3/8	1	0	5	2
#4	1	1	5	3
#8	1	0	4	1
#16	1	1	4	1
#30	2	3	4	2
#50	1	2	2	2
#100	0.6	0.9	0.7	0.8
#200	0.1	0.4	0.4	0.8
Avg.	0.97	1.21	3.46	1.69

Laboratory Number - AAT1-714
Sample Submitted by - Dist. 5

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	<u>I.M. 304</u>	<u>Method A</u>	<u>I.M. 304</u>	<u>Method B</u>
1.05				
3/4	0	1	1	0
0.525	1	1	2	3
3/8	4	2	3	3
#4	1	0	0	1
#8	1	1	1	1
#16	1	0	1	1
#30	0.2	0.5	0.1	0.9
#50	0.2	0.4	0.1	1.0
#100	0.2	0.4	0	1.0
#200	0.1	0.5	0.1	0.8
Avg.	0.87	0.68	0.83	1.27

Laboratory Number AAT1-715
Sample Submitted by Dist. 5

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	<u>I.M. 304</u>	<u>Method A</u>	<u>I.M. 304</u>	<u>Method B</u>
1.05	0	0	0	0
3/4	1	0	0	0
1/2	0	1	3	1
3/8	1	3	3	2
#4	1	2	2	3
#8	0	0	2	2
#16	0.2	0.2	1.2	1.2
#30	0.5	0.2	1.2	0.8
#50	0.3	0.1	1.0	0.4
#100	0.3	0.1	0.9	0.2
#200	0.3	0.1	0.6	0.1
Avg.	0.42	0.67	1.49	1.07

Laboratory Number AAT1-716
Sample Submitted by Dist. 5

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	<u>I.M. 304</u>	<u>Method A</u>	<u>I.M. 304</u>	<u>Method B</u>
1.05	0	0	0	0
3/4	1	0	0	0
0.525	1	3	0	1
3/8	1	2	0	3
#4	0	1	1	2
#8	1	0	1	1
#16	0.6	0	0.6	0.6
#30	0.7	0.1	0.3	0.7
#50	0.7	0.2	0.1	0.7
#100	0.7	0.3	0	0.6
#200	0.8	0.4	0.1	0.5
Avg.	0.68	0.64	0.28	0.92

Laboratory Number AAT1-710
Sample Submitted by - Dist. 6

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
1.05	0	0	0	0
3/4	3	4	2	1
0.525	4	2	3	1
3/8	5	2	3	1
#4	3	3	2	2
#8	3	2	1	1
#16	2	2	1	2
#30	2	2	0	1
#50	2	1	0	1
#100	2	1	0	0
#200	1	1	0	0
Avg.	2.36	1.91	1.09	0.91

Laboratory Number AAT1-711
Sample Submitted by - Dist. 6

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
1.05	0	0	0	0
3/4	3	3	1	1
0.525	0	3	1	3
3/8	1	2	0	2
#4	0	1	0	0
#8	0	2	1	0
#16	0	1	0	0
#30	0	1	0	0
#50	0.3	0.5	0.4	0.1
#100	0.4	0.3	0.4	0.1
#200	0.7	0.1	0.4	0.1
Avg.	0.49	1.22	0.38	0.57

Laboratory Number AAT1-712
 Sample Submitted by - Dist. 6

Sieve Size	Deviation from AASHTO T27 Method			
	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
1.05	0	0	0	0
3/4	1	1	1	3
0.525	1	0	3	5
3/8	6	2	3	7
#4	2	0	1	4
#8	3	1	2	3
#16	1	1	2	2
#30	1	0	2	2
#50	1	1	1	1
#100	1	0	2	1
#200	0	1	1.4	0.6
Avg.	1.55	0.64	1.67	2.6

The Overall Average Deviation From
 AASHTO T27 Method for Each Sieve Size for Each Method

Sieve Size	Field Tech		Central Laboratory	
	I.M. 304	Method A	I.M. 304	Method B
1.05	0.22	0.33	0.33	0.22
3/4	1.06	1.19	1.00	0.69
0.525	1.17	1.28	1.33	1.56
3/8	2.56	1.61	1.83	2.11
#4	1.56	1.61	1.89	1.67
#8	1.33	1.67	1.78	1.28
#16	1.10	1.40	1.38	1.27
#30	1.13	1.43	0.98	0.97
#50	0.72	0.83	0.51	0.74
#100	0.65	0.73	0.49	0.48
#200	0.56	0.81	0.42	0.40
Avg.	1.10	1.17	1.09	1.04

My conclusions for this investigation are:

1. Sieve analysis test results having very good reproducibility percision can be obtained with different test methods.
2. Possibly we place too much emphases on the details of I.M. 304 when other methods or modification of this method produces test results of the same percision.
3. This investigation indicated that Method B had the same percision as the others when compared to the results of AASHTO T27 method. This test procedure (Method B) was estimated to take about half as much time to complete as did I.M. 304

The original outline of this study included having some contractors and aggregate producers participating in the testing. They were contacted and they agreed to participate, but some how this phase did not materialize.

Even though Method B offers encouraging results, I would like to study its reproducibility percision with the District Materials Technicians as I.M. 304 was done in this study.

The portion used to determine the sieve analysis below the No. 8 sieve in Method B is about 150 grams. This amount is adequate for accurate results; however, I am concerned that possibly some of the fractions may be so small that difficulty will be experienced in weighing them on the type of balances used in the field.

Method of Sieve Analysis of
Combined Aggregate for Method B

1. Obtain a test sample of 3000 plus grams by splitting.
2. Dry the test sample on a hot plate that is adjusted to a high temperature.
3. After the sample has attained a dry condition, remove it from the stove and immediately weigh.
4. Sieve the sample over the No. 8 sieve.
5. Weigh the plus No. 8 sieve size portion of the sample.
6. Wash this plus No. 8 portion over a No. 200 sieve.
7. Place the washed material on the hot plate and dry.
8. Weigh the material immediately after it has attained the dry condition.
9. Calculate the percent loss by washing based on weight of the total sample which was obtained from Step 3.
10. Sieve the coarse part ^(+ No. 8) of the sample (after washing and drying) on the coarse size sieves.
11. Calculate the gradation based on the total weight of the sample (obtained in Step 3).
12. Split the minus No. 8 sieve size portion of the sample down to a test sample size of about 200 grams.
13. Weigh this fine sample and wash it over the No. 200 sieve.
14. Place this washed material on a hot plate and dry.
15. After the washed sample has attained a dry condition, immediately remove it from the hot plate and weigh.
16. Calculate the % loss by washing based on the sample weight obtained in Step 13.
17. Place this part of the sample in a nest of fine sieves and shake in a mechanical sieve shaker for about 10 minutes.
18. Weigh each sieve size fraction and calculate the % retained on each sieve based on the weight of the fine sample obtained in Step 13.

19. To convert the fine gradation (% retained) back to the bases of the original sample weight obtained in Step 3, the following calculations must be done: Multiply each % retained by difference of subtracting the % minus No. 200 wash of the coarse portion of the sample from the % passing the No. 8 sieve. After this conversion has been done, the % passing is figured in the normal manner.

Note: A great amount of time can be saved in completing this test if the following steps are followed:

1. Divide the sample into two portions for drying to obtain the original weight obtained in Step 3.
2. Immediately after sieving the sample on the No. 8 sieve (Step 4) obtain the fine portion (Step 12).
3. Both portions of the sample can be drying at the same time if Step 6 and Step 13 are done at the same time.
4. If the fine portion dries (Step 13) before the coarse portion (Step 6), place it in the fine sieves and start the sieving.
5. Generally, sieving the coarse portion by hand (Step 10) can be done at the same time the fine portion is being sieved (Step 17).
6. Every time the material is dried, the weighings should be done immediately after removing it from the hot plate.

Note: Super heating the aggregate and weighing it hot was recommended in Report No. FHWA-RD-77-53. If one would have doubts as to what effect super heating a certain aggregate source would have, he should compare sieve analysis performed by oven drying at $230 \pm 9^{\circ}\text{F}$. to sieve analysis performed by super heating on a hot plate.