TECHNICAL MEMORANDUM

TO: Dennis Crumpler / OAQPS

FROM: Eric Boswell / NAREL

AUTHOR: Steve Taylor /NAREL

DATE: May 22, 2013

SUBJECT: Gravimetric Inter-Laboratory Comparison Study

Introduction

The EPA's National Analytical Radiation Environmental Laboratory (NAREL) conducts semi-annual gravimetric inter-laboratory comparison studies as part of its quality assurance support of EPA's Office of Air Quality Planning and Standards (OAQPS). The purpose of the gravimetric studies is to evaluate selected EPA and State laboratories that weigh Teflon® filters used for the determination of $PM_{2.5}$ collected with Federal Reference Method (FRM) ambient air samplers. Results for the spring study of 2013 have been submitted by the participating test laboratories. Four EPA laboratories routinely participate in this study. EPA's Region 4 laboratory located in Athens, GA provides Pre- and Post-weighing of filters for the $PM_{2.5}$ Performance Evaluation Program (PEP). The Region 2 laboratory located in Edison, NJ provides quality assurance oversight of laboratories in Region 2 that weigh filters for the $PM_{2.5}$ program. The National Center for Radiation Field Operations (NCRFO) located in Las Vegas, NV provides Pre- and Post-weighing of Teflon® filters in support of the Tribal Air Monitoring Support (TAMS) $PM_{2.5}$ air monitoring program. The Office of Air Quality Planning and Standards (OAQPS) laboratory, located in Research Triangle Park (RTP), NC, performs special studies and serves as a backup weighing facility for the $PM_{2.5}$ PEP. The Arizona Department of Environmental Quality (ADEQ) Air Filter Laboratory (AFL) and the Maryland Department of Health and Mental Hygiene (DHMH) are state laboratories that participated in this study. The state labs provide gravimetric analysis of particulate matter concentrations on filter media for their agency's air monitoring program. NAREL supplied the performance test (PT) samples and served as the reference laboratory for the study.

Mass determination of $PM_{2.5}$ is performed using a microbalance to weigh the Teflon® collection filter before and after the sampling event. The amount of particulate matter ($PM_{2.5}$) captured onto the surface of the filter can be calculated by a simple subtraction of the filter tare mass or Pre-mass from the sampled filter mass or Post-mass. In order to accurately measure particulate mass at microgram levels, the microbalance must be located in a clean, dust free environmental chamber with precise temperature and humidity control. Elimination of static from samples is also very important for accurate mass measurements.

Filters used in the study were 47-mm Teflon® filters manufactured by Measurement Technology Laboratory (MTL). MTL Inc. was awarded a contract in April 2010 to supply the nation's $PM_{2.5}$, PM_{10}, and low-volume lead (Pb) FRM networks with 47-mm Polytetrafluoroethylene (PTFE) filters. Historically, Whatman has supplied 47-mm Teflon® filters to the networks. The MTL filters use the same filter membrane material as Whatman; however, the support ring is made from polyfluoroalkoxy (PFA) which is over twice as dense as the polymethylpentene (PMP) support ring used by Whatman. As a result, the nominal filter mass of the MTL filter is 377-410 mg compared to the Whatman nominal mass of 146-150 mg. NAREL has replaced its 200-mg high side quality control check weight with a 500-mg weight in order to accommodate the larger mass range. Another noticeable difference between MTL and

Whatman filters is the serial number location. MTL filters have the serial number printed on both sides of the membrane instead of on the filter support ring.

Samples for this study were created at NAREL using Met One Super SASS air samplers to collect various amounts of $PM_{2.5}$ onto Teflon® filters. In addition to the loaded filter samples, blank filters and metallic weights were included as controls and to provide information concerning balance stability and calibration. This study compares captured mass determined by NAREL to captured mass determined by each of the participating laboratories.

Acceptance criteria for this type of comparison have not been established. There are PEP criteria established for laboratory and field blanks, and metallic standards. According to the PEP criteria, laboratory and field blanks should not vary by more than 0.015 mg and 0.030 mg respectively between Pre- and Post-measurements. Metallic standards should not vary by more than 0.003 mg. As an alternative to the PEP criteria, this study uses criteria based on actual mass data compiled from gravimetric PT studies administered by NAREL.

Experimental

Six sample sets consisting of ten new MTL Teflon® filters and two metallic weights were assembled for the test laboratories. Each filter was carefully inspected using a light table to check for pinholes and fibers. The metallic weights were commercially available 100 and 500 milligram stainless steel weights that were slightly altered by clipping a small corner section from each weight. The samples were placed into individual labeled Petri-slides and equilibrated in NAREL's weighing chamber. Pre-mass measurements were performed before the samples were shipped by overnight mail to each test laboratory with instructions to Pre-weigh each sample following their standard operating procedures for the determination of $PM_{2.5}$ mass. Each test lab completed its Pre-mass measurements and returned the samples to NAREL. The returned samples were then equilibrated and weighed a second time to determine NAREL's Pre-mass of record. Results of this weighing session were compared to NAREL's first weighing session to determine if any significant changes in mass occurred while the samples were out of NAREL's custody. As an additional QA check, a third weighing session was also performed on a different day to verify NAREL's Pre-mass results.

Four sampling events using three co-located Met One Super SASS air samplers were used to load seven filters from each sample set with $PM_{2.5}$ mass. The remaining three filters from each set served as blanks. The loading schedule for the filters is shown in table 1. Table 1 shows that each lab received replicate samples of each loaded event except for the single filter loaded on April 1.

Table 1. Sampling Schedule for Gravimetric Filters

Filter _ID	Serial Number	Sample Start	Event Duration	Receiving Lab
T13-14623	T1628374	3/28/2013	48hr	Region 2
T13-14624	T1628375	3/28/2013	48hr	Region 2
T13-14625	T1628376	3/30/2013	24hr	Region 2
T13-14626	T1628377	3/30/2013	24hr	Region 2
T13-14628	T1628379	3/31/2013	20hr	Region 2
T13-14629	T1628380	3/31/2013	20hr	Region 2
T13-14631	T1628382	4/1/2013	24hr	Region 2
T13-14634	T1628385	3/28/2013	48hr	Region 4
T13-14635	T1628386	3/28/2013	48hr	Region 4
T13-14636	T1628387	3/30/2013	24hr	Region 4
T13-14637	T1628388	3/30/2013	24hr	Region 4
T13-14638	T1628389	3/31/2013	20hr	Region 4
T13-14639	T1628390	3/31/2013	20hr	Region 4
T13-14640	T1628391	4/1/2013	24hr	Region 4
T13-14643	T1628394	3/28/2013	48hr	NCRFO

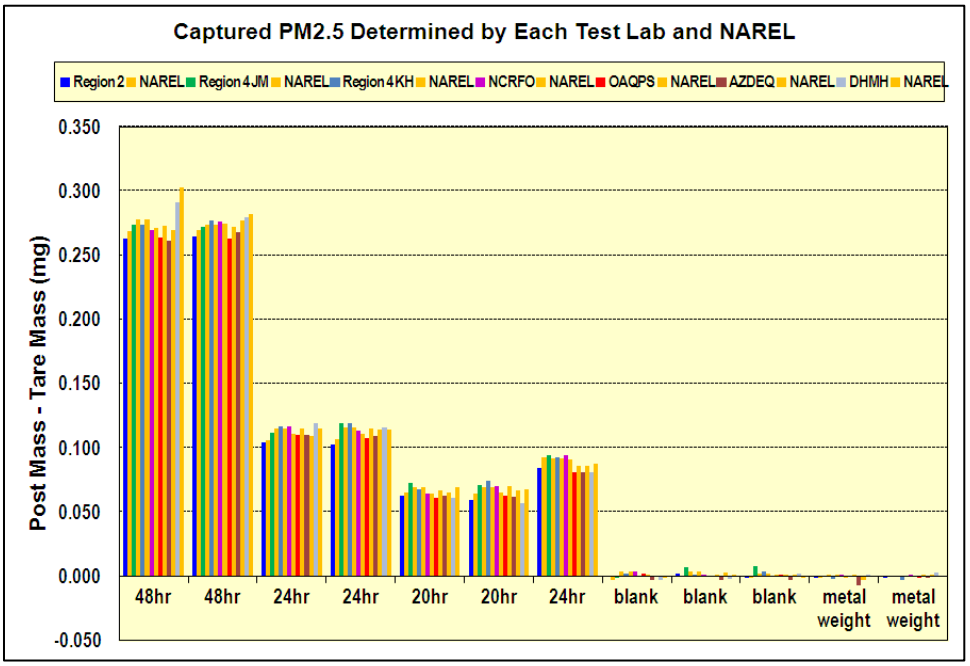
Filter _ID	Serial Number	Sample Start	Event Duration	Receiving Lab
T13-14644	T1628395	3/28/2013	48hr	NCRFO
T13-14645	T1628396	3/30/2013	24hr	NCRFO
T13-14646	T1628397	3/30/2013	24hr	NCRFO
T13-14647	T1628398	3/31/2013	20hr	NCRFO
T13-14648	T1628399	3/31/2013	20hr	NCRFO
T13-14649	T1628400	4/1/2013	24hr	NCRFO
T13-14653	T1628457	3/28/2013	48hr	OAQPS
T13-14654	T1628458	3/28/2013	48hr	OAQPS
T13-14655	T1628459	3/30/2013	24hr	OAQPS
T13-14656	T1628460	3/30/2013	24hr	OAQPS
T13-14657	T1628461	3/31/2013	20hr	OAQPS
T13-14658	T1628462	3/31/2013	20hr	OAQPS
T13-14659	T1628463	4/1/2013	24hr	OAQPS
T13-14663	T1628470	3/28/2013	48hr	AZDEQ
T13-14664	T1628471	3/28/2013	48hr	AZDEQ
T13-14665	T1628472	3/30/2013	24hr	AZDEQ
T13-14666	T1628473	3/30/2013	24hr	AZDEQ
T13-14667	T1628474	3/31/2013	20hr	AZDEQ
T13-14668	T1628475	3/31/2013	20hr	AZDEQ
T13-14669	T1628476	4/1/2013	24hr	AZDEQ
T13-14673	T1628480	3/28/2013	48hr	DHMH
T13-14674	T1628481	3/28/2013	48hr	DHMH
T13-14675	T1628482	3/30/2013	24hr	DHMH
T13-14676	T1628483	3/30/2013	24hr	DHMH
T13-14677	T1628484	3/31/2013	20hr	DHMH
T13-14678	T1628485	3/31/2013	20hr	DHMH
T13-14679	T1628486	4/1/2013	24hr	DHMH

Following each collection event, samples were returned to NAREL's weighing chamber for equilibration. After allowing several days for filter stabilization and equilibration, the first Post-mass measurements were determined for the loaded filters as well as the blank filters and metallic weights. A second Post-mass measurement of all samples was performed after several more days to verify stability of the samples. The last weighing session before shipping the samples to the test labs became NAREL's Post-mass of record. The filters and metallic weights were packed into small coolers with ice substitute and shipped back to the test labs for Post-weighing.

Gravimetric Results

The mass capture results reported by the test labs and NAREL are shown in figure 1. Each bar shown in figure 1 represents the mass capture determined by a test lab followed by NAREL's determination for the same loaded filter, blank filter, or metallic weight. As stated earlier, the capture is calculated by subtracting the Pre-mass from the Post-mass.

Figure 1



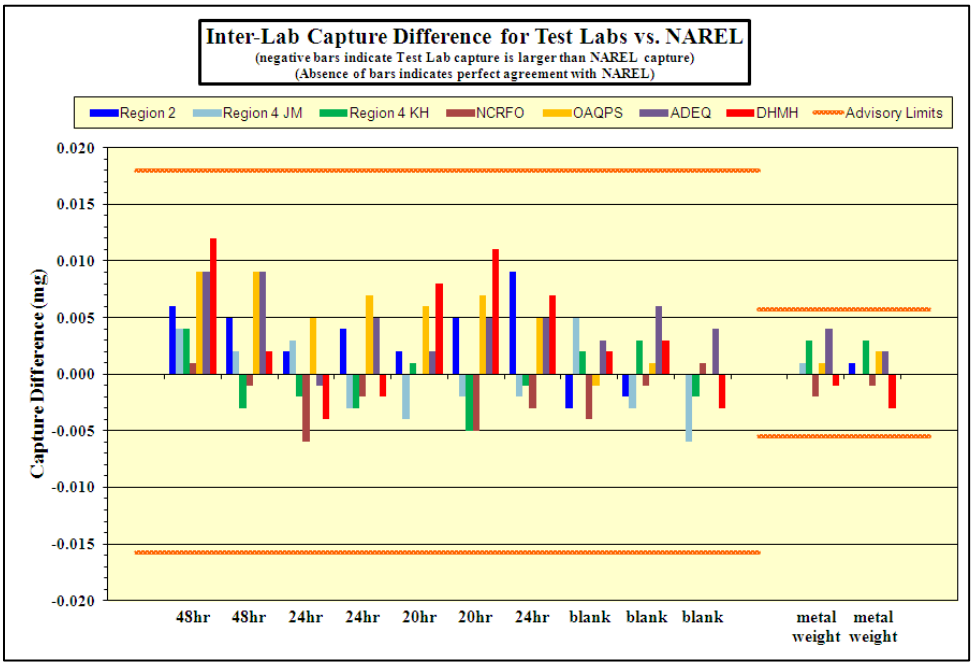


Figure 2

Figure 2 presents the inter-laboratory capture differences for all samples. Inter-laboratory differences were calculated by subtracting the capture value reported by the test laboratory from the capture value determined at NAREL. The advisory limits shown in figure 2 are 3-sigma limits derived from previous gravimetric PT studies administered by NAREL. The absence of a bar indicates perfect agreement between NAREL and the test lab. Notice that the majority of bars in figure 2 are positive, indicating NAREL's capture is larger than the test lab. Figure 2 shows that all sample results fell within the 3-sigma advisory limits.

Metallic weights were included in this study because they are less susceptible to weighing errors due to factors such as electrical static and volatility of filter constituents. This is indicated by the much tighter advisory limits for the weights. The metallic weights were weighed at each laboratory during the initial

tare sessions as well as during the final loaded sessions. The difference in initial and final mass is the calculated "mass capture" for the metallic weights. Ideally, the "mass capture" for the metallic weight samples would be zero. A large difference between an initial and final mass could indicate a balance stability or calibration problem.

The raw data used to calculate the mass capture and the inter-lab capture differences shown in figures 1 and 2 are presented in table 3 at the end of this report. The table includes the results of all filters and the metallic standards weighed at each laboratory. The tables contain the filter Pre-mass, the final Post-mass, and the calculated $PM_{2.5}$ capture for each sample. Table 2 allows laboratories a convenient way to compare each of its measurements with NAREL's corresponding measurement.

More Results

Additional weighing sessions were performed at NAREL to determine the mass of the filters and metallic weights after the test labs had performed their final measurements. As stated earlier, NAREL's post-mass of record is performed before the samples are shipped to the test labs. The filters are typically not weighed again at NAREL unless the inter-laboratory capture difference between NAREL and a test lab exceeds the advisory limit. Previous gravimetric studies conducted at NAREL have shown that it is normal for loaded filters, especially heavily loaded filters, to lose mass over time due to loss of semi-volatile components. Test labs are encouraged to perform their mass measurements as soon as possible following their SOP in order to minimize any mass loss that may occur with time. The purpose of NAREL's extra measurements for this study was to demonstrate the change in mass of the test filters over time and how the change affects the inter-laboratory capture differences.

Figure 3 presents the inter-laboratory capture differences using NAREL's post-mass measurements determined after the test lab measurements were made. The gradual loss of captured mass over time is indicated in figure 3 by the abundance of negative bars. Notice that the majority of inter-lab capture differences shown previously in figure 2 are positive. Results shown in figure 2 were calculated using NAREL's mass measurements determined before the samples were shipped to the test labs for their post-mass measurements. Approximately 21 days elapsed between the NAREL weigh sessions used to calculate results shown in figure 2 and figure 3. Although mass loss did occur, all results were well within the 3 sigma advisory limits.

Figure 3

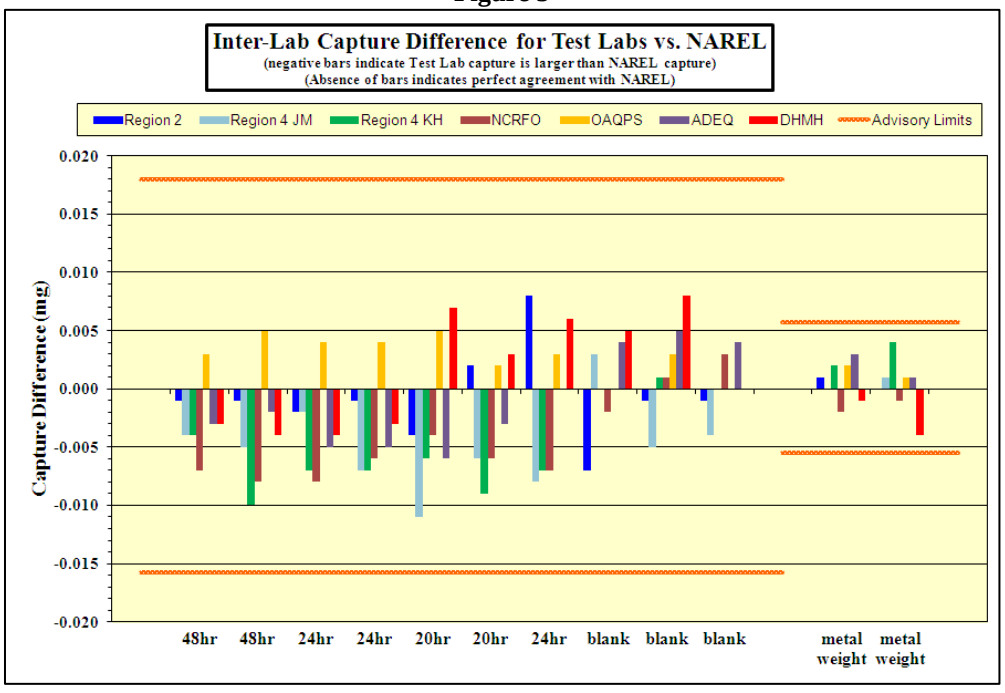


Table 2 summarizes the results of three post-mass weighing sessions conducted at NAREL. The first and second sessions were performed before shipping the samples to the test labs. The third session was done after the test labs had finished their post-mass determinations. As expected the more heavily loaded events showed the largest mass loss over time. For the blank filters and metallic weights, the mass change was essentially zero.

Table 2. NAREL Mass Capture Calculated from Three Post-Mass Sessions

Sample Description	1st Post_Mass (5 days after Sample event) (mg/filter)	2nd Post_Mass* (9 days after Sample event) (mg/filter)	Mass Difference 2nd - 1st (mg)	3rd Post_Mass (26 days after Sample event) (mg/filter)	Mass Difference 3rd - 1st (mg)
48-hr event	0.272	0.269	-0.003	0.262	-0.010
48-hr event	0.273	0.270	-0.003	0.264	-0.009
48-hr event	0.278	0.278	-0.000	0.270	-0.008
48-hr event	0.276	0.274	-0.002	0.267	-0.009
48-hr event	0.274	0.271	-0.003	0.263	-0.011
48-hr event	0.281	0.275	-0.006	0.268	-0.013
48-hr event	0.277	0.273	-0.004	0.267	-0.010
48-hr event	0.275	0.272	-0.003	0.268	-0.007
48-hr event	0.273	0.270	-0.003	0.258	-0.015
48-hr event	0.279	0.277	-0.002	0.266	-0.013
48-hr event	0.308	0.303	-0.005	0.288	-0.020
48-hr event	0.286	0.282	-0.004	0.276	-0.010
Average Change in Mass Capture of 48 hr Event			**-0.003**		**-0.011**
24-hr event 1	0.108	0.106	-0.002	0.102	-0.006
24-hr event 1	0.108	0.107	-0.001	0.102	-0.006
24-hr event 1	0.115	0.115	-0.000	0.110	-0.005
24-hr event 1	0.117	0.116	-0.001	0.112	-0.005
24-hr event 1	0.113	0.111	-0.002	0.109	-0.004
24-hr event 1	0.114	0.111	-0.003	0.107	-0.007
24-hr event 1	0.117	0.115	-0.002	0.114	-0.003
24-hr event 1	0.116	0.115	-0.001	0.112	-0.004
24-hr event 1	0.11	0.109	-0.001	0.105	-0.005
24-hr event 1	0.116	0.114	-0.002	0.104	-0.012
24-hr event 1	0.118	0.115	-0.003	0.115	-0.003
24-hr event 1	0.117	0.114	-0.003	0.113	-0.004
24-hr event 2	0.097	0.093	-0.004	0.092	-0.005
24-hr event 2	0.091	0.092	-0.001	0.086	-0.005
24-hr event 2	0.094	0.091	-0.003	0.087	-0.007
24-hr event 2	0.089	0.086	-0.003	0.084	-0.005
24-hr event 2	0.087	0.086	-0.001	0.081	-0.006
24-hr event 2	0.09	0.088	-0.002	0.087	-0.003
Average Change in Mass Capture of 24 hr Events			**-0.002**		**-0.005**
20-hr event	0.066	0.065	-0.001	0.059	-0.007
20-hr event	0.064	0.064	0.000	0.061	-0.003
20-hr event	0.069	0.069	0.000	0.062	-0.007
20-hr event	0.07	0.069	-0.001	0.065	-0.005
20-hr event	0.065	0.064	0.001	0.060	-0.005

Sample Description	1st Post_Mass (5 days after Sample event) (mg/filter)	2nd Post_Mass* (9 days after Sample event) (mg/filter)	Mass Difference 2nd - 1st (mg)	3rd Post_Mass (26 days after Sample event) (mg/filter)	Mass Difference 3rd - 1st (mg)
20-hr event	0.069	0.065	-0.004	0.064	-0.005
20-hr event	0.067	0.067	0.000	0.066	-0.001
20-hr event	0.072	0.070	-0.002	0.065	-0.007
20-hr event	0.066	0.065	-0.001	0.057	-0.009
20-hr event	0.067	0.067	0.000	0.059	-0.008
20-hr event	0.071	0.069	-0.002	0.068	-0.003
20-hr event	0.071	0.068	-0.003	0.060	-0.011
Average Change in Mass Capture of 20 hr Event			**-0.001**		**-0.006**
Blank	-0.003	-0.003	0.000	-0.007	-0.004
Blank	0.002	0.000	-0.002	0.001	-0.001
Blank	0.001	-0.001	-0.002	-0.002	-0.003
Blank	0.003	0.004	0.001	0.002	-0.001
Blank	0.003	0.004	0.001	0.002	-0.001
Blank	0.002	0.002	0.000	0.004	0.002
Blank	0.002	0.000	-0.002	0.002	0.000
Blank	0.002	0.000	-0.002	0.002	0.000
Blank	0.001	0.001	0.000	0.003	0.002
Blank	0.002	0.001	-0.001	0.002	0.000
Blank	0.002	0.001	-0.001	0.003	0.001
Blank	0.001	0.001	0.000	0.001	0.000
Blank	0.001	0.000	-0.001	0.001	0.000
Blank	0.002	0.003	0.001	0.002	0.000
Blank	0.001	0.001	0.000	0.001	0.000
Blank	0.001	-0.001	-0.002	0.002	0.001
Blank	0.001	0.001	0.000	0.006	0.005
Blank	-0.001	-0.001	0.000	0.002	0.003
Average Change in Mass Capture of Blanks			**-0.001**		**0.000**
Metal weight	0.000	-0.001	-0.001	0.000	0.000
Metal weight	0.000	0.000	0.000	-0.001	-0.001
Metal weight	0.000	0.001	0.001	0.000	0.000
Metal weight	0.000	0.000	0.000	0.001	0.001
Metal weight	0.000	-0.001	-0.001	-0.001	-0.001
Metal weight	-0.001	0.000	0.001	0.000	0.001
Metal weight	0.001	0.001	0.000	0.002	0.001
Metal weight	0.000	0.001	0.001	0.000	0.000
Metal weight	-0.002	-0.003	-0.001	-0.004	-0.002
Metal weight	0.000	0.001	0.001	0.000	0.000
Metal weight	0.000	0.000	0.000	0.000	0.000
Metal weight	0.000	0.000	0.000	-0.001	-0.001
Average Change in Mass Capture of Metallics			**0.000**		**0.000**

*** Captured mass of record**

Conclusions

This inter-laboratory gravimetric study evaluated laboratories that perform gravimetric measurements of $PM_{2.5}$ collected on 47-mm Teflon® filters. The Teflon® filters used for this study were manufactured by Measurement Technology Laboratory (MTL). Samples for this study were created by loading Teflon® filters with $PM_{2.5}$ collected from the ambient air using co-located Met One samplers. Blank filters and metallic weights were also included as samples. Each laboratory was allowed to Pre-weigh and Post-weigh a unique set of samples consisting of ten Teflon® filters and two metallic weights in order to determine the mass capture. NAREL served as the reference lab by weighing all samples. NAREL's Pre-mass of record for each sample was determined shortly after each test lab had performed its Pre-mass measurements. NAREL's Post-mass of record was determined shortly before the sample sets were shipped back to the test labs for their final Post-mass measurements. Performance was evaluated by comparing mass capture results determined by NAREL to mass capture results determined by each test laboratory. The results of this study as illustrated in figure 2 show very good inter-laboratory agreement between the test laboratories and NAREL.

Once all samples were returned to NAREL, more weighing sessions were conducted to obtain an additional set of mass measurements. The purpose of the extra measurements was to demonstrate the loss of mass that can occur over time to filters with various mass loadings. As expected, filters with the largest mass capture showed the largest mass loss over time. Blank filters and metallic weights showed little or no mass change with time. Mass capture was recalculated using the additional measurements and inter-lab differences are shown in figure 3. Figure 3 indicates that loaded filters lost mass; however, the loss was not sufficient to cause any test lab to exceed the 3-sigma advisory limits. Table 2 shows a definite trend for the loaded filters to lose mass with time, therefore, the best inter-laboratory comparison results should be obtained when the test labs and the reference lab perform their measurements as close as possible to each other while still following their SOPs for filter equilibration.

Table 3. Gravimetric Mass PT Results

Sample ID	Sample Description	Tare Mass		Loaded Mass		Captured $PM_{2.5}$		Inter-Lab Difference* of Captured $PM_{2.5}$ (mg)	Name of the Test Lab
		Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)		
T13-14623	48-hr event	396.396	396.409	396.659	396.678	0.263	0.269	0.006	Region 2
T13-14624	48-hr event	385.542	385.556	385.807	385.826	0.265	0.270	0.005	Region 2
T13-14625	24-hr event	385.825	385.840	385.929	385.946	0.104	0.106	0.002	Region 2
T13-14626	24-hr event	386.799	386.813	386.902	386.920	0.103	0.107	0.004	Region 2
T13-14627	Blank	385.455	385.478	385.455	385.475	0.000	-0.003	-0.003	Region 2
T13-14628	20-hr event	386.376	386.389	386.439	386.454	0.063	0.065	0.002	Region 2
T13-14629	20-hr event	386.110	386.126	386.169	386.190	0.059	0.064	0.005	Region 2
T13-14630	Blank	386.646	386.660	386.648	386.660	0.002	0.000	-0.002	Region 2
T13-14631	24-hr event	389.384	389.395	389.468	389.488	0.084	0.093	0.009	Region 2
T13-14632	Blank	385.129	385.146	385.128	385.145	-0.001	-0.001	0.000	Region 2
MW13-14683	Metal weight	469.843	469.849	469.842	469.848	-0.001	-0.001	0.000	Region 2
MW13-14684	Metal weight	99.710	99.714	99.709	99.714	-0.001	0.000	0.001	Region 2
T13-14633	Blank	387.172	387.164	387.171	387.168	-0.001	0.004	0.005	Region 4 JM
T13-14634	48-hr event	383.512	383.508	383.786	383.786	0.274	0.278	0.004	Region 4 JM
T13-14635	48-hr event	386.202	386.198	386.474	386.472	0.272	0.274	0.002	Region 4 JM
T13-14636	24-hr event	383.964	383.957	384.076	384.072	0.112	0.115	0.003	Region 4 JM
T13-14637	24-hr event	384.163	384.160	384.282	384.276	0.119	0.116	-0.003	Region 4 JM
T13-14638	20-hr event	385.796	385.798	385.869	385.867	0.073	0.069	-0.004	Region 4 JM
T13-14639	20-hr event	389.217	389.215	389.288	389.284	0.071	0.069	-0.002	Region 4 JM

Table 3. Gravimetric Mass PT Results

Sample ID	Sample Description	Tare Mass		Loaded Mass		Captured $PM_{2.5}$		Inter-Lab Difference* of Captured $PM_{2.5}$ (mg)	Name of the Test Lab
		Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)		
T13-14640	24-hr event	386.247	386.248	386.341	386.340	0.094	0.092	-0.002	Region 4 JM
T13-14641	Blank	381.898	381.899	381.905	381.903	0.007	0.004	-0.003	Region 4 JM
T13-14642	Blank	388.991	388.990	388.999	388.992	0.008	0.002	-0.006	Region 4 JM
MW13-14685	Metal weight	474.038	474.036	474.038	474.037	0.000	0.001	0.001	Region 4 JM
MW13-14686	Metal weight	94.832	94.831	94.832	94.831	0.000	0.000	0.000	Region 4 JM
T13-14633	Blank	387.170	387.164	387.172	387.168	0.002	0.004	0.002	Region 4 JK
T13-14634	48-hr event	383.515	383.508	383.789	383.786	0.274	0.278	0.004	Region 4 JK
T13-14635	48-hr event	386.199	386.198	386.476	386.472	0.277	0.274	-0.003	Region 4 JK
T13-14636	24-hr event	383.960	383.957	384.077	384.072	0.117	0.115	-0.002	Region 4 JK
T13-14637	24-hr event	384.165	384.160	384.284	384.276	0.119	0.116	-0.003	Region 4 JK
T13-14638	20-hr event	385.803	385.798	385.871	385.867	0.068	0.069	0.001	Region 4 JK
T13-14639	20-hr event	389.219	389.215	389.293	389.284	0.074	0.069	-0.005	Region 4 JK
T13-14640	24-hr event	386.252	386.248	386.345	386.340	0.093	0.092	-0.001	Region 4 JK
T13-14641	Blank	381.907	381.899	381.908	381.903	0.001	0.004	0.003	Region 4 JK
T13-14642	Blank	388.995	388.990	388.999	388.992	0.004	0.002	-0.002	Region 4 JK
MW13-14685	Metal weight	474.039	474.036	474.037	474.037	-0.002	0.001	0.003	Region 4 JK
MW13-14686	Metal weight	94.833	94.831	94.830	94.831	-0.003	0.000	0.003	Region 4 JK
T13-14643	48-hr event	384.052	384.048	384.322	384.319	0.270	0.271	0.001	NCRFO
T13-14644	48-hr event	385.048	385.044	385.324	385.319	0.276	0.275	-0.001	NCRFO

Table 3. Gravimetric Mass PT Results

Sample ID	Sample Description	Tare Mass		Loaded Mass		Captured $PM_{2.5}$		Inter-Lab Difference* of Captured $PM_{2.5}$ (mg)	Name of the Test Lab
		Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)		
T13-14645	24-hr event	381.590	381.585	381.707	381.696	0.117	0.111	-0.006	NCRFO
T13-14646	24-hr event	386.458	386.455	386.571	386.566	0.113	0.111	-0.002	NCRFO
T13-14647	20-hr event	386.371	386.369	386.435	386.433	0.064	0.064	0.000	NCRFO
T13-14648	20-hr event	388.263	388.262	388.333	388.327	0.070	0.065	-0.005	NCRFO
T13-14649	24-hr event	396.748	396.744	396.842	396.835	0.094	0.091	-0.003	NCRFO
T13-14650	Blank	394.491	394.489	394.495	394.489	0.004	0.000	-0.004	NCRFO
T13-14651	Blank	391.669	391.666	391.670	391.666	0.001	0.000	-0.001	NCRFO
T13-14652	Blank	387.701	387.697	387.701	387.698	0.000	0.001	0.001	NCRFO
MW13-14687	Metal weight	479.563	479.568	479.564	479.567	0.001	-0.001	-0.002	NCRFO
MW13-14688	Metal weight	96.350	96.352	96.351	96.352	0.001	0.000	-0.001	NCRFO
T13-14653	48-hr event	389.431	389.420	389.695	389.693	0.264	0.273	0.009	OAQPS
T13-14654	48-hr event	389.742	389.731	390.005	390.003	0.263	0.272	0.009	OAQPS
T13-14655	24-hr event	385.264	385.253	385.374	385.368	0.110	0.115	0.005	OAQPS
T13-14656	24-hr event	393.570	393.557	393.678	393.672	0.108	0.115	0.007	OAQPS
T13-14657	20-hr event	390.664	390.652	390.725	390.719	0.061	0.067	0.006	OAQPS
T13-14658	20-hr event	391.339	391.327	391.402	391.397	0.063	0.070	0.007	OAQPS
T13-14659	24-hr event	389.792	389.782	389.873	389.868	0.081	0.086	0.005	OAQPS
T13-14660	Blank	388.236	388.228	388.238	388.229	0.002	0.001	-0.001	OAQPS
T13-14661	Blank	391.292	391.282	391.292	391.283	0.000	0.001	0.001	OAQPS

Table 3. Gravimetric Mass PT Results

Sample ID	Sample Description	Tare Mass		Loaded Mass		Captured $PM_{2.5}$		Inter-Lab Difference* of Captured $PM_{2.5}$ (mg)	Name of the Test Lab
		Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)		
T13-14662	Blank	388.263	388.255	388.264	388.256	0.001	0.001	0.000	OAQPS
MW13-14689	Metal weight	495.550	495.542	495.550	495.543	0.000	0.001	0.001	OAQPS
MW13-14690	Metal weight	84.757	84.755	84.756	84.756	-0.001	0.001	0.002	OAQPS
T13-14663	48-hr event	388.959	388.960	389.220	389.230	0.261	0.270	0.009	AZDEQ
T13-14664	48-hr event	391.076	391.078	391.344	391.355	0.268	0.277	0.009	AZDEQ
T13-14665	24-hr event	391.589	391.596	391.699	391.705	0.110	0.109	-0.001	AZDEQ
T13-14666	24-hr event	394.018	394.024	394.127	394.138	0.109	0.114	0.005	AZDEQ
T13-14667	20-hr event	384.445	384.452	384.508	384.517	0.063	0.065	0.002	AZDEQ
T13-14668	20-hr event	395.735	395.739	395.797	395.806	0.062	0.067	0.005	AZDEQ
T13-14669	24-hr event	392.146	392.150	392.227	392.236	0.081	0.086	0.005	AZDEQ
T13-14670	Blank	394.261	394.265	394.258	394.265	-0.003	0.000	0.003	AZDEQ
T13-14671	Blank	392.686	392.690	392.683	392.693	-0.003	0.003	0.006	AZDEQ
T13-14672	Blank	384.739	384.745	384.736	384.746	-0.003	0.001	0.004	AZDEQ
MW13-14691	Metal weight	496.652	496.650	496.645	496.647	-0.007	-0.003	0.004	AZDEQ
MW13-14692	Metal weight	83.531	83.532	83.530	83.533	-0.001	0.001	0.002	AZDEQ
T13-14673	48-hr event	393.173	393.174	393.464	393.477	0.291	0.303	0.012	DHMH
T13-14674	48-hr event	392.699	392.705	392.979	392.987	0.280	0.282	0.002	DHMH
T13-14675	24-hr event	387.977	387.982	388.096	388.097	0.119	0.115	-0.004	DHMH
T13-14676	24-hr event	391.363	391.365	391.479	391.479	0.116	0.114	-0.002	DHMH

Table 3. Gravimetric Mass PT Results

Sample ID	Sample Description	Tare Mass		Loaded Mass		Captured $PM_{2.5}$		Inter-Lab Difference* of Captured $PM_{2.5}$ (mg)	Name of the Test Lab
		Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)	Test Lab (mg)	NAREL (mg)		
T13-14677	20-hr event	391.453	391.451	391.514	391.520	0.061	0.069	0.008	DHMH
T13-14678	20-hr event	386.365	386.362	386.422	386.430	0.057	0.068	0.011	DHMH
T13-14679	24-hr event	386.101	386.099	386.182	386.187	0.081	0.088	0.007	DHMH
T13-14680	Blank	391.121	391.119	391.118	391.118	-0.003	-0.001	0.002	DHMH
T13-14681	Blank	384.170	384.167	384.168	384.168	-0.002	0.001	0.003	DHMH
T13-14682	Blank	392.760	392.762	392.762	392.761	0.002	-0.001	-0.003	DHMH
MW13-14693	Metal weight	484.897	484.901	484.898	484.901	0.001	0.000	-0.001	DHMH
MW13-14694	Metal weight	87.545	87.548	87.548	87.548	0.003	0.000	-0.003	DHMH

**** Negative values indicate a smaller capture determined by NAREL.***