Blank Filter Results in the U.S. Environmental Protection Agency's $PM_{2.5}$ Chemical Speciation Network (CSN) for Calendar Year 2013

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Abstract

The $PM_{2.5}$ Chemical Speciation Network (CSN) consists of approximately 190 sampling sites (52 Trends sites for routine speciation monitoring and approximately another 138 supplemental sites for state/local driven monitoring needs) with 175 sites supported by RTI. RTI has held the laboratory support contract for the CSN since field sampling commenced in early 2000.

- CSN data is used in emission mitigation approaches to reduce ambient aerosol levels and in health research and modeling studies.
- All field sampling locations use the MET ONE SASS sampler and the URG 3000N carbon sampler to collect 24-hour ambient filter samples.
- For the MET ONE SASS samplers a Field Blank filter was collected at a frequency of 3% of the sampling dates in 2013.
- For the URG 3000N samplers a 24 Hour Blank filter was collected at a frequency of 10% of the sampling dates and a Backup Filter was collected at a frequency of 5% of the sampling dates in 2013.

The $PM_{2.5}$ Chemical Speciation Network (CSN)

- RTI has been the national laboratory for the CSN since sampling commenced in early 2000.
- Filter-based collection of particles with aerodynamic diameter of 2.5 microns and smaller.
- Nationwide network of mostly urban sampling sites.
- 52 trends sites for speciation monitoring and approximately another 138 sites for state and local monitoring needs.
- All sites collect a 24-hour sample using a MET ONE SASS sampler and a URG 3000N carbon sampler. During 2013, 80 sites sampled every third day and another 100 sites sampled every sixth day.
- The MET ONE SASS sampler uses a Teflon and nylon filter. Particulate matter collected on the Teflon filter is analyzed for gravimetric mass and 33 elements using EDXRF. Particulate matter collected on the nylon filter is analyzed for key anions and cations using IC.
- URG 3000N sampler uses a quartz filter. Particulate matter collected on the quartz filter is analyzed for organic, elemental carbon and its fractions.
- In addition to the routine sampled filters, a number of different blank filters are periodically deployed in the CSN and analyzed in the same manner as the sampled filters.
- CSN data is posted to the EPA Air Quality System (AQS). The AQS is the repository of ambient air quality data.
- Data from the CSN is used to develop emission mitigation approaches to reduce ambient aerosol levels. Also used in health research and modeling studies.

CSN Network Samplers: MET ONE SASS and URG 3000N

Why Use Blanks in the CSN?

- Allows for assessment of any filter lot anomalies for new filters from the manufacturer.
- Allows for identification of possible contamination during:
  - Filter handling and assembly into sampling modules and cartridges at the laboratory.
  - Shipping and transit to the field sampling location and back to the laboratory.
  - Installation of filter modules and cartridges into the sampler at the field sampling location.
  - Post sampling handling of the filter at the laboratory.
- Allows for determination of adsorption from air during handling, shipping and sampling of the quartz filter. This is known as the "carbon artifact".
- Blank data in the CSN is not currently used to blank correct the routine sample data. It is reported separately for the data user to take into consideration when using CSN data.

CSN Blank Types

Name	Type	Filter	Analytes	Description
Field Blank (3% of sample dates)	Field (MET ONE SASS Only)	Teflon and nylon	Gravimetric mass and 33 elements using EDXRF	Shipped from the laboratory to the field sites and loaded into the sampler for a few minutes. No air drawn through the filters
24-hour Blank (10% of sample dates)	Field (URG 3000N Only)	Quartz	Organic and elemental carbon fractions	Shipped from the laboratory to the field sites in the same filter cartridge as the filter which will sample. No air drawn through the filter. Remains in the sampler with the filter that samples
Backup Filter (5% of sample dates)	Field (URG 3000N Only)	Quartz	Organic and elemental carbon fractions	Placed directly behind the filter that will sample. Shipped from the laboratory to the field sites. Air passes through the sampled filter and then through the backup filter during sampling
LAB Blank (1% of filters sent to analytical laboratories)	Laboratory	Teflon, nylon, and quartz	All CSN analytes	A blank filter sent to each analytical laboratory along with a group of CSN filters. These are analyzed at the same time as the sampled filters.

Mean Concentration Values for Mass, Selected Elements and Ions: Blanks and Routine Sampled Filters in the CSN, 2013

Parameter	Analysis Laboratory	Field Blank Mean Value ($\mu g/m^3$) *		Lab Blank Mean Value ($\mu g/m^3$) *		CSN Network Mean Value ($\mu g/m^3$)	
		Value	Number of Field Blank Filters	Value	Number of Lab Blank Filters	Value	Number of Valid Sampled Filters
$PM_{2.5}$ Mass	Gravimetric Analysis Lab	0.695	500	-0.050	112	9.586	14,122
Fe	XRF Lab	0.003	504	0.001	117	0.080	14,160
Al	XRF Lab	0.004	504	0.000	117	0.035	14,160
Si	XRF Lab	0.002	504	0.001	117	0.094	14,160
Mg	XRF Lab	0.002	504	0.001	117	0.008	14,160
Ca	XRF Lab	0.001	504	0.000	117	0.042	14,160
SO_4^{2-}	Ion Chromatography Lab	0.029	505	0.011	126	1.576	14,192
NO_3^-	Ion Chromatography Lab	0.006	505	0.003	126	1.185	14,192
Na^+	Ion Chromatography Lab	0.023	505	0.010	126	0.101	14,192
NH_4^+	Ion Chromatography Lab	0.003	505	0.001	126	0.640	14,192
K^+	Ion Chromatography Lab	0.005	505	0.002	126	0.042	14,192

* Nominal volume of 9.65 m^3 used for calculating Met One SASS blank volumes

Mean Concentration Values for Blanks and Routine Sampled Filters in the CSN, 2013

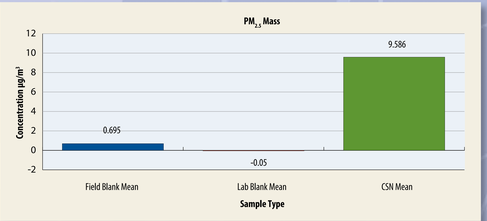
Parameter	CSN Network Mean Value ($\mu g/m^3$)	Lab Blank Mean Value ($\mu g/m^3$) *	24-hour Blank Mean Value ($\mu g/m^3$) *	Backup Filter Mean Value ($\mu g/m^3$) *
OC	2.050	0.025	0.136	0.260
EC	0.568	0.000	0.003	0.006
TC	2.618	0.025	0.139	0.266
Number (n)	13,707	164	1,399	233

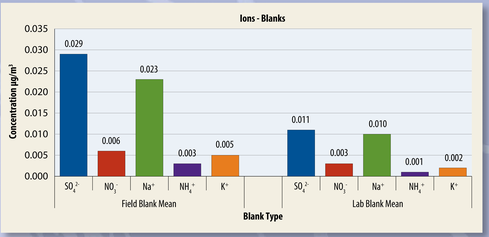
* Nominal volume of 31.68 m^3 used for calculating URG 3000N blanks

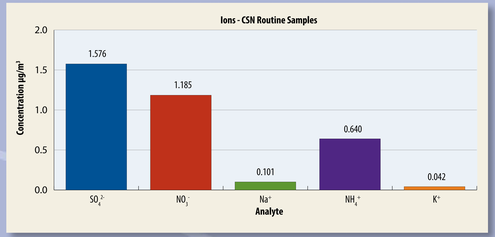
Blank Filter Values as Percentage of Mean CSN Values

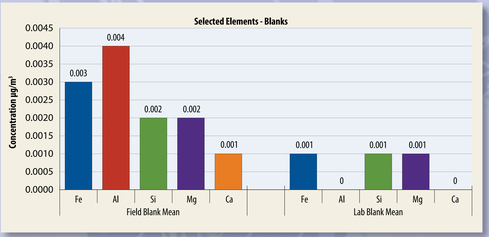
Analyte	CSN Mean Value	Lab Blank Value	Percent Lab Blank/CSN	Field Blank Value	Percent Field Blank/CSN
Mass	9.586	-0.050	-0.52	0.695	7.25
Fe	0.080	0.001	1.25	0.003	3.75
Al	0.035	0.000	0.00	0.004	11.43
Si	0.094	0.001	1.06	0.002	2.13
Mg	0.008	0.001	12.50	0.002	25.00
Ca	0.042	0.000	0.00	0.001	2.38
SO_4^{2}	1.576	0.011	0.70	0.029	1.84
NO_3^-	1.185	0.003	0.25	0.006	0.51
Na^+	0.101	0.010	9.90	0.023	22.77
NH_4^+	0.64	0.001	0.16	0.003	0.47
K^+	0.042	0.002	4.76	0.005	11.90

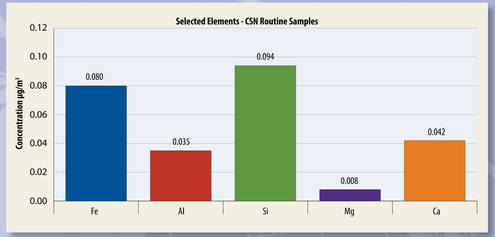
Analyte	CSN Mean Value	24 Hour Blank Value	Percent 24-Hour Blank/CSN	Backup Filter Value	Percent Backup Filter/CSN	Lab Blank Value	Percent Lab Blank/CSN
OC	2.050	0.136	6.63	0.26	12.68	0.025	1.22
EC	0.568	0.003	0.53	0.006	1.06	0.000	0.00
TC	2.618	0.139	5.19	0.266	10.16	0.025	0.95

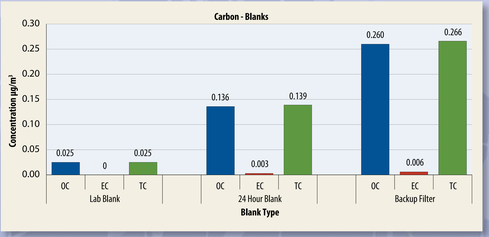


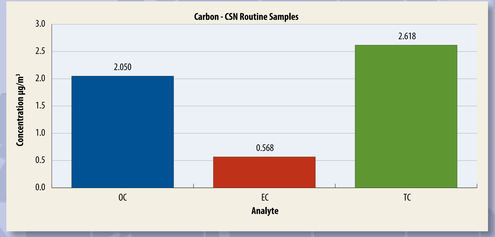












Summary and Conclusions

A number of blank filter types are used in the CSN. The blank filters are used to assess possible contamination in new filter lots and from filter handling in the laboratory and at the field sampling locations. During 2013, the levels measured on blank filters for mass, organic, and elemental carbon fractions, selected elements, and ionic species were considerably below the levels found on sampled CSN filters. The levels found on the different types of blank filters can assist data users when analyzing CSN data. Blank levels can give the data user insight into the "carbon artifact" and a reasonable level of background for a number of species. CSN data is not blank-corrected but may be in the future.

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More Information

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