Additional information on EPA ORD dichot coarse channel shipping mass loss tests
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1. In a collected PM_{10} FRM sample, all the collected $PM_{2.5}$ particles are well mixed with the collected $PM_{10-2.5}$ particles. It is the presence of these fine particles which helps bind the $PM_{10-2.5}$ particles to the filter's surface. Any particle on a filter will only become detached when the applied inertial force (e.g., during shipping or handling) exceeds the local adhesive force which binds the particle to the filter. During ORD's field tests conducted during the last several years, no appreciable particle loss was measured from either $PM_{2.5}$ or PM_{10} FRM filters, regardless of site, season, or particle size distribution. It was the uncertainty in potential $PM_{10-2.5}$ particle loss from dichot filters that was partially responsible for EPA's selection of the difference method for the 2006 $PM_{10-2.5}$ FRM rather than using a dichotomous sampling approach.

2. ORD's shipping loss tests of the Thermo dichot were conducted in January 2004 in Phoenix. For these types of tests, Phoenix could be considered a worse-case scenario because of the relatively high $PM_{10-2.5}$ concentrations coupled with the low $PM_{2.5}/PM_{10}$ ratios. Also, the $PM_{10-2.5}$ particles at the site which originate from wind-blown sand, might be considered to be harder, bouncier, and inherently less "sticky" that might exist at some other sites (e.g., Birmingham).

   The January 2004 Phoenix tests were conducted using a $PM_{2.5}$ FRM, a PM_{10} FRM, and a two Thermo sequential dichots. The dichots were operated in manual mode and the sequential samplers' exchange mechanism was not used to transfer the post-sampling cassette into the takeup magazine.

   During the ORD study, daily 22-hour tests were conducted for 15 days. 47-mm diameter Teflon filters were preweighed at RTP, shipped to Phoenix, and preweighed there. The level of agreement between the Phoenix and RTP preweigh values was high. At the completion of sampling, filters were post-weighed in Phoenix then shipped back to RTP for post-weighing. Differences in RTP/Phoenix post-weigh values were thus attributed to post-sampling handling and shipping activities.

3. As measured by the FRMs and the dichots, the mean daily $PM_{2.5}/PM_{10}$ ratio was 0.30 and 0.31, respectively. Based on site weighings, the mean of daily dichot/FRM ratios for $PM_{2.5}$, $PM_{10-2.5}$, and PM_{10} were measured to be 1.04, 0.99, and 1.00, respectively. These values indicate that the collocated dichots and the FRMs tended to agree fairly well for all three PM metrics. Incidentally, the observed 4% positive bias in the dichot's $PM_{10-2.5}$ concentration measurement is consistent with ORD's test results of the dichot's virtual impactor versus that of the FRM's WINS fractionator.

4. ORD's control method of sampler shipment was identical to that used during previous $PM_{10-2.5}$ field studies. Filters were stored in sampling cassettes and the top and bottom of each cassette was capped with SS end caps manufactured by BGI. The capped cassettes were then placed in SS canisters manufactured by Andersen. Each of the 8 cassettes per canister was firmly held in place. The canisters were then placed vertically in a large

cooler and cushioned by styrofoam. Blue ice packs kept the sample temperature below the $PM_{2.5}$ FRM requirements. For the FRM filters, no particle loss during shipping was measured as determined by mean RTP/Phoenix $PM_{2.5}$, $PM_{10-2.5}$, and PM_{10} concentration ratios of 1.00, 1.00, and 1.01.

5. Using the control method of shipping filters, the dichot filters did not show evidence of particle loss. For the dichots, mean RTP/Phoenix $PM_{2.5}$, $PM_{10-2.5}$, and PM_{10} concentration ratios were 0.99, 1.01, and 1.02.

6. Prior to the tests, it was assumed that the large, heavy shipping coolers were not being inverted during their shipment by FedEx. As indicated by the tilt indicators that were affixed to the containers, however, every cooler was inverted at least once during shipment.

7. In addition to this control shipment protocol, ORD also shipped a limited number of samples (3 tests each) in the following manner:

   - Large cooler, Andersen canister, cassettes deliberately inverted during installation into the canisters
   - Large cooler, filters in petri slides
   - Small cooler, Andersen canister, cassettes installed normally
   - Large cooler, cassettes stored in Thermo takeup magazines. Magazines were oriented vertically in cooler
   - Large cooler, cassettes stored in Thermo takeup magazines. Magazines were oriented horizontally in cooler

   Result: None of these shipping variations had any measurable effect on shipping loss. The notable exception was with the Thermo magazines oriented vertically where loss of $PM_{10-2.5}$ and PM_{10} aerosols was 32% and 23%, respectively. This loss did not occur when the Thermo magazines had been installed horizontally in the cooler.

   It should be noted that the stacked cassettes within the Thermo magazine are designed to be uncapped and are pushed to the top of the magazine by a rather heavy aluminum piston. Upon receiving these canisters in RTP, however, ORD noted that the piston had moved downwards during shipment - sometimes up to 1". As a result, the uncapped cassettes were no longer held in place and could thus move around within the magazine. This was apparently the cause of the up to 32% loss of $PM_{10-2.5}$ particles. ORD has subsequently recommended to Thermo that dichot users fill in any gaps with blank cassettes prior to shipping the magazines, to prevent movement of the cylinders during the shipping process.

8. During 30 days of Phoenix testing in 2005, the RTP/Site ratios for the FRM (standard shipping method) $PM_{2.5}$, $PM_{10-2.5}$, and PM_{10} concentration ratios were 0.97, 0.99, and 0.97, respectively. Values for the manual dichots were 0.99, 0.97, and 0.97, respectively.

9. During 30 days of Birmingham testing in 2006, the RTP/Site ratios for the FRM (standard shipping method) $PM_{2.5}$, $PM_{10-2.5}$, and PM_{10} concentration ratios were 0.99, 0.99, and 0.99, respectively. Values for the manual dichots were 0.99, 1.00, and 0.99, respectively.

10. From the information provided above, it can be concluded that uncertainties associated with $PM_{10-2.5}$ particle loss from dichot filters is probably minimal compared to other measurement uncertainties. While it is possible that some $PM_{10-2.5}$ particle loss can occur with the right combination of parameters (e.g., aerosol type, size distribution, shipping conditions), the probability of the event and its magnitude is probably not an appreciable source of measurement bias.