



Tool Kit Submittal Form (Form 2.1)

Title: Met One E-BAM portable PM_{2.5} monitor and AIRSIS data telemetry system.

Description: Airborne smoke particulate, especially particulates smaller than 2.5µm in diameter (PM_{2.5}), pose potential safety and health consequences that negatively affect the nearby community. Rapid deployment of air monitors during wild fires or other air emergency incidents is crucial to identify the episode's impact, to assess the public's level of risk, and to determine adverse health effects to the community's population. Displaying particulate concentration levels in affected areas, broadcasting health advisories, and promoting recommendations to decrease exposure have shown to be very effective when informing the community about the unhealthy influences in their environment.

General Information

The CARPA Data Subcommittee, in its review of existing deployable PM monitoring instruments, and through direct experience of CARPA member agencies, have found that the Met One portable E-BAM PM monitor to be one of the most effective, accurate, and easy to operate portable particulate monitors currently in use in California. As described below, the E-BAM system offers the user real-time data reporting capability and links to EPA's AIRNOW website to provide the public with near real-time air quality information.

The Met One Instruments Inc. model E-BAM automatically measures and records airborne PM₁₀ or PM_{2.5} particulate concentration levels using the principle of beta ray attenuation. This method provides a simple determination of concentration in units of milligrams of particulate per cubic meter of air. The E-BAM works by emitting a constant source of high-energy electrons known as beta particles. These beta particles are detected and counted by a sensitive scintillation detector. A vacuum pump pulls a measured amount of dust-laden air through the filter tape, which is positioned between the source and the detector thereby causing an attenuation of the beta particle signal. The degree of attenuation of the beta particle signal is used to determine the mass concentration of particulate matter on the filter tape, and the volumetric concentration of particulate matter in ambient air.

The E-BAM system package offers additional monitor upgrades such as the 034 wind set (which combines a 3-cup anemometer and vane into a single integrated package), ambient relative humidity sensors, and a solar panel option with battery banks mounted on a trailer, which eliminates the need for direct current shore power. When ordering an E-BAM and selecting its configuration, it is highly recommended that the instrument setup include the wind set and humidity sensor options. On site meteorological data has been found to be very useful during responses. Additionally, flow calibration equipment is required to properly insure E-BAM validity.

Calibration and Maintenance

Complete factory calibration is available from Met One and includes maintenance, system diagnostic and parameter checks, and standard calibration traceable to NIST certification. Field calibrations are performed using a volumetric flow calibration device, such as BGI Incorporated's deltaCal calibrator, which verify or calibrate the instrument flow rate. Since the E-BAM incorporates ambient temperature and pressure data to regulate flow rate, calibrations to the instrument's temperature and pressure sensors are required prior to performing the flow calibration. Leak tests are conducted to certify a leak free sampling system. Verification that the 034 wind set (if equipped) is operating properly is

conducted using a standard anemometer calibration kit. Wind speed and direction values displayed from the E-BAM reported values are compared against values from the calibration kit to ensure the sensors are operating within manufacturer specified limits.

E-BAM maintenance consists of visually inspection of the filter tape, tape drive, nozzle and inlet sensor, and ensuring the nozzle is correctly seating against the filter. Inspection and cleaning of the PM₁₀ inlet and PM_{2.5} sharp cut cyclone are also suggested. When the instrument is deployed it is recommended that flow verifications and maintenance occur bi-weekly.

It's recommended the AIRSIS satellite radio be checked for proper operation when disconnection and reconnection of the data cable occurs. Proper E-BAM telemetry operation may be verified remotely by accessing the website to where the data is being submitted, or by using the instrument's "System Manager". Additionally, generated data may be downloaded using HyperTerminal from the E-BAM communications port, for field QC confirmation.

Deployment

E-BAMs deployed during emergency responses are generally used to supplement the existing BAM_{2.5} network of monitors, and are positioned in locations where there are no existing PM_{2.5} monitors. E-BAM's may also be deployed to areas in the community where there are known sensitive receptors. The deployment procedure for the E-BAM can often be completed in 30 minutes or less and requires no special tools. The unit is capable of operating on either AC or DC power depending on how the instrument is configured. When selecting potential monitoring locations, staff should follow their agency's established procedures for siting criteria, or follow CFR Title 40, Part 58, Subpart G. Identification of a dependable power source within a secure location should be considered and evaluated when selecting each monitoring location. Exact monitor deployment location should be verified against a handheld GPS device. Care should be taken during instrument transport, and hard bodied shipment cases with foam inserts are recommended to decrease the potential for damage to the instrument.

Operational Limitations

The E-BAM does have some operational limitations that affect its function and accuracy which should be noted and considered prior to deployment. Current indications are that increased levels of RH elevate the actual particulate concentration values reported by the E-BAM. The instrument does not appear to become overly affected by high ambient temperature, but extreme temperatures can damage electronic components. Filter tape advancement can be internally configured to advance from 1 hour to 24 hours, however if particulate concentrations are high enough to cause a pressure drop across the filter exceeding a set threshold, the tape will auto-advance. The E-BAM will stop monitoring and report a hardware failure if the temperature and pressure sensors report values outside of their recommended control limits. Pump failures are the most prevalent issue with the instrument, but replacing a failed pump can be easily accomplished in a short time. The instrument will attach alarm codes to the data stream which indicate a potential problem or issue. Other limitations to be considered are related to siting criteria, and include the availability of reliable shore power and instrument security.

Data Output and Usage

All new E-BAMs from Met One presently are configured with Iridium satellite radios from AIRSIS when the telemetry system option is selected. The AIRSIS Iridium radios allow for consistently fast data transfer and require only one additional hardware component to be connected to the E-BAM. AIRSIS airtime plans provide users with password protected web access. The AIRSIS telemetry system allows data migration to the USEPA AIRNow Web site for public access and also accommodates data

transfer to customized websites. The AIRNow Web site provides the public with easy access to national air quality information and offers daily AQI forecasts as well as real-time AQI conditions for over 300 cities across the US, and also provides links to more detailed State and local air quality Web sites.

Short-term exposure to particulate matter is the principal public health concern from exposure to wildfire smoke. E-BAMs are particularly useful in measuring PM_{2.5}, the respirable portion of particulate matter. E-BAMs can be moved and repositioned within impacted communities with relative ease and can be run in concert with permanent air monitoring stations, portable, or mobile particulate monitors. The raw data generated from E-BAMs (in µg/m³) can be analyzed as 1-3 hr, 8 hr, or 24 hr averages and compared against recommended actions for public health officials in the Wildfire Smoke Guide.

Particulate concentrations can also be converted to Air Quality Index (AQI) equivalents either automatically if E-BAM data are uploaded to US EPA's AIRNow website, the table of equivalents in the Wildfire Smoke Guide. The AQI is a nationally uniform index that uses standard health descriptors for ranges of particulate concentrations. The Wildfire Smoke Guide goes one step further and provides specific recommended actions that local health officials can institute at various AQI levels. It is recommended that as much information as possible is made available to the public during an air emergency incident, and uploading E-BAM data to AIRNow has proven to be very effective in disseminating that information. Uploading E-BAM data through AIRSIS to the AIRNow webpage is one way to provide real-time AQI levels and their associated recommendations to residents in affected areas. Local health officials and state agencies can also issue health advisories, press releases, or emergency warnings on local and state webpages and social media avenues. Health warnings can also be posted door-to-door in rural communities, at evacuation centers, or fire camps. Whichever route of dissemination is chosen, it is important to keep in mind that the ultimate reason for deploying E-BAMs and collecting smoke concentration data is to provide those data either directly to health officials who have the responsibility of instituting emergency health protective actions and/or informing the public so that they may take steps to protect themselves during a smoke event.

Tools required for set-up and field calibration

Allen wrenches
Phillips head screw driver
NIST-traceable flow audit device
NIST-traceable temperature/barometric pressure standard for calibrations and/or audits
Compass, level and cable ties
Laptop with a serial cable (for on-site data retrieval from E-BAM if desired).

Additional information or links

[U.S Forest Service Technology and Development Program's E-BAM Training Videos](#)
[MetOne E-BAM Specification Sheet](#)
[MetOne 034 Windset Specification Sheet](#)
[AIRSIS Homepage](#)
[AIRNow Homepage](#)
[Wildfire Smoke: A Guide for Public Health Officials](#)
[BGI's deltaCal Specification Sheet](#)
[CFR Title 40, Part 58, Subpart G](#)
[2005 CARB E-BAM evaluation \(pdf\)](#)
[2006 USDA Forest Service E-BAM evaluation and update \(pdf\)](#)
[CARB E-BAM Monitoring presentation \(pdf\)](#)
[USEPA OAQPS E-BAM Telemetry presentation \(pdf\)](#)