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FABRIC FILTER

BAG LEAK DETECTION GUIDANCE

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Prepared for
U. S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emissions, Monitoring and Analysis Division
Emission Measurement Center (MD-19)
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FABRIC FILTER BAG LEAK DETECTION GUIDANCE

This document provides guidance on the use of triboelectric monitors as fabric filter bag leak detectors. It does not impose regulatory requirements. The guidance addresses only one suggested approach to the use of bag leak detectors. However, proper setup and operation of a bag leak detector can vary with site-specific conditions and those conditions may dictate variances from the approach suggested in this guidance.

This document includes fabric filter and monitoring system descriptions; guidance on monitor selection, installation, set up, adjustment, and operation; and quality assurance procedures. The monitoring system description and information on monitor selection and installation was taken primarily from information received from one instrument vendor.[1] The monitor set up procedure in this guidance was developed based on testing conducted on shaker and pulse-jet baghouses; however, the guidance is expected to apply to reverse-air baghouses as well.[2,3]

1.0 APPLICABILITY

Several types of instruments are available to monitor changes in particulate emission rates for the purpose of detecting fabric filter bag leaks or similar failures. The principles of operation of these instruments include electrical charge transfer and light scattering. This guidance applies to charge transfer monitors that use triboelectricity to detect changes in particle mass loading. Charge transfer monitors based on electrostatic induction are also potentially applicable, but sufficient information was not available to include them in this guidance.

The set up procedures described in this guidance are intended to allow the operator to identify upset conditions within the baghouse (e.g., torn bags) using real time data. This guidance is not intended to evaluate changes in the long term performance of the baghouse system, nor does it apply to applications in which the monitoring system attempts to quantify emission rates. The guidance assumes an emission source with relatively constant exhaust gas flow rate and particulate matter (PM) characteristics. This guidance is not appropriate for applications in which these factors vary significantly. In addition, only fabric filters (both positive and negative pressure) with exhaust gas stacks are covered by this guidance.

2.0 EMISSION SOURCE AND CONTROL DEVICE DESCRIPTIONS

This section contains information on the different types of fabric filters and the types of emission sources they are used to control. Information on fabric filter types and fabric filter operation was taken from References 4 and 5.

2.1 FABRIC FILTERS

Fabric filters are one of the most widely used devices for controlling emissions of PM. A fabric filter system typically consists of multiple filter elements, or bags, enclosed in a compartment, or housing. The process stream typically enters the housing and passes through the filter elements, and PM accumulates as a dust cake on the surface of the bag. This dust layer becomes the effective filter medium. The filter elements are cleaned periodically to remove the collected dust. A short-duration spike in particulate emissions occurs immediately following cleaning due to the loss of the dust cake.

Fabric filters generally are classified by cleaning method. The four types of cleaning methods are reverse-air, shaker, pulse-jet, and sonic cleaning. Reverse-air fabric filters are cleaned by back-flushing the filters with low pressure air flow, which is provided by a separate fan. Figure 1 depicts the reverse-air cleaning method. In shaker-type systems (Figure 2), a reciprocating motion is mechanically applied to knock the filter cake off the bags. Pulse-jet fabric filters use high-pressure compressed air, which creates a shock wave that travels along the bag, thereby loosening accumulated dust from the filter material (see Figure 3). Sonic cleaning employs a sonic horn to induce acoustic vibrations in the fabric. This method generally is used to enhance shaker and reverse-air cleaning systems.

Fabric filters also can be can be classified as either positive- or negative-pressure designs, depending upon the location of the fan(s) that provides the motive force for the exhaust stream through the unit. The fan is located upstream of the filter housing in a positive-pressure (forced-draft) unit, and downstream of the filter housing in a negative-pressure (induced-draft) unit. Positive-pressure baghouses require no ductwork or exhaust stack downstream of the unit, making bag leak detection more difficult. As such, this guidance does not apply to positive pressure baghouses without exhaust ductwork or an exhaust gas stack.

Fabric filters are capable of extremely high control efficiencies of both coarse and fine particles; outlet concentrations as low as 20 mg/dscm (0.01 gr/dscf) can be achieved with most

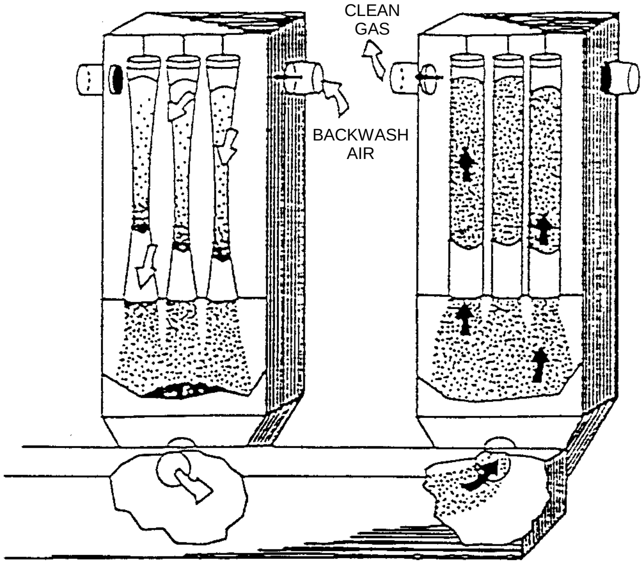

Figure 1. Reverse-air cleaning method.[4]

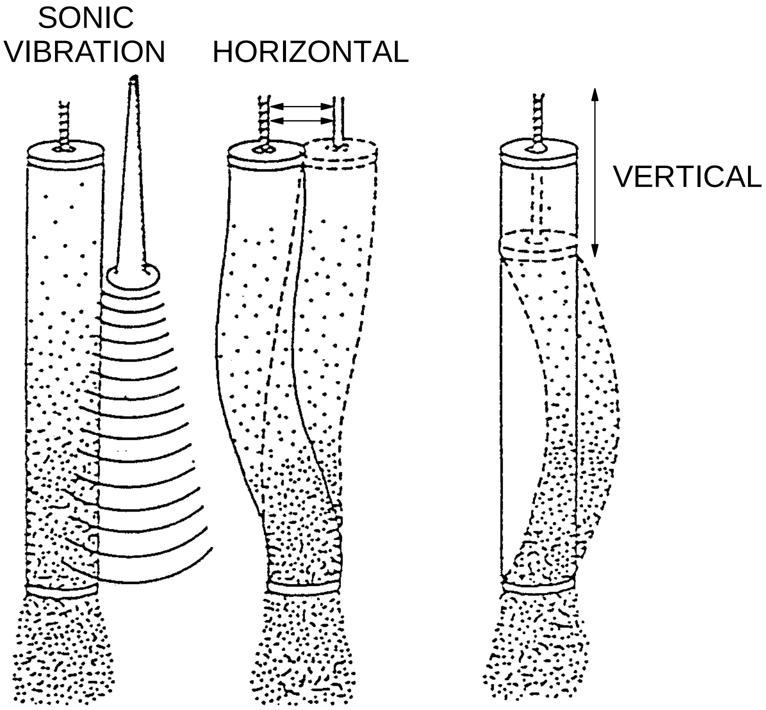

Figure 2. Shaker-type cleaning method.[4]

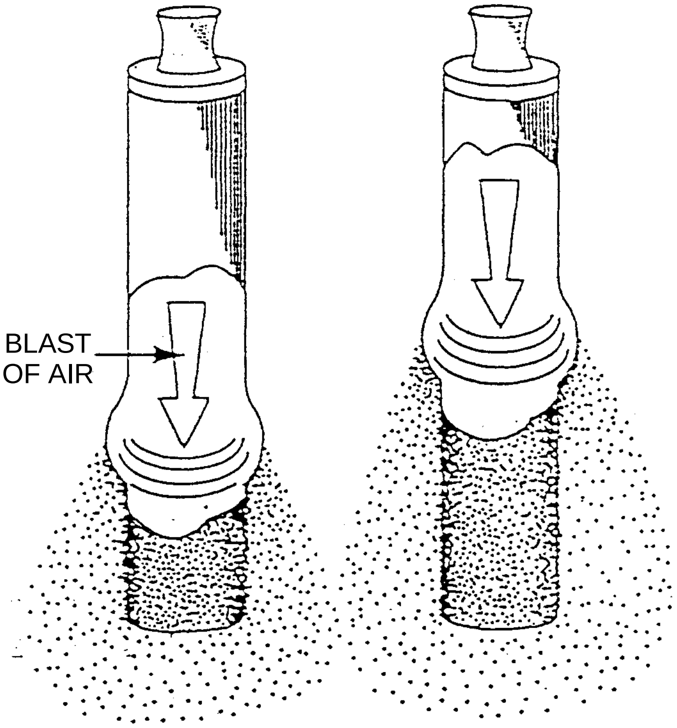

Figure 3. Pulse-jet cleaning method.[4]

fabric filter systems. Fabric filters are not suitable for use if the emission stream contains hygroscopic materials, a high moisture content, or sticky substances; clogging (blinding) of the filter media can occur in these conditions. Gas stream temperatures in excess of approximately 288°C (550°F) must first be cooled, unless special ceramic or refractory fiber bags are used. Either of these modifications can add significantly to the cost of the control system. In addition, fabric filters generally are not preferred for use on highly corrosive exhaust streams or to remove high levels of soluble gases from exhaust streams. Charge transfer monitors are particularly suited to the same type of applications that use fabric filters for control of particulate emissions.

2.2 EMISSION SOURCES

Fabric filters are used in a wide variety of industrial applications for which efficient removal of PM from relatively dry exhaust streams is desired. In the mineral product industries, fabric filters are commonly used for emission control and product recovery for milling operations such as crushing, grinding, and screening. Fabric filters also are the preferred control device for mineral product pyroprocesses such as cement and lime kilns. In the metallurgical industries, fabric filters are often used to control emissions from furnaces and boilers. Table 1 lists some of

TABLE 1. COMMON INDUSTRIAL APPLICATIONS FOR FABRIC FILTERS

Industry	Sources
Steel	Electric arc furnaces[a] Sintering plants[a] Boilers[a]
Foundries	Cupolas[a]
Nonferrous metals	Lead furnaces[a] Copper smelting furnaces[a] Zinc furnaces[a]
Grain handling	Cleaning operations Grinding mills Mixers and blenders Material transfer
Mineral processing	Crushers Grinding mills Screening operations Air classifiers Dryers Kilns[a] Calciners[a]
Cement	Raw mills Kilns[a] Finish mills
Asphalt concrete	Drum mixers
Glass	Melting furnaces[a]
Chemical	Dryers Grinding mills
Power plants	Coal-fired boilers[a]
Waste disposal	Incinerators[a]

[a] Cooling of the gas stream or use of refractory fiber bags may be required.

the more common industrial applications for fabric filters. Fabric filters generally are not used with sources characterized by moist and/or sticky exhaust streams, such as those from wood product dryers.

3.0 MONITORING SYSTEM DESCRIPTION

Triboelectric monitoring systems typically consist of one or more in-stack probes, a cable from the sensor assembly to the main instrument box, and signal-processing electronics housed in the main box. An example monitoring system is shown in Figure 4.

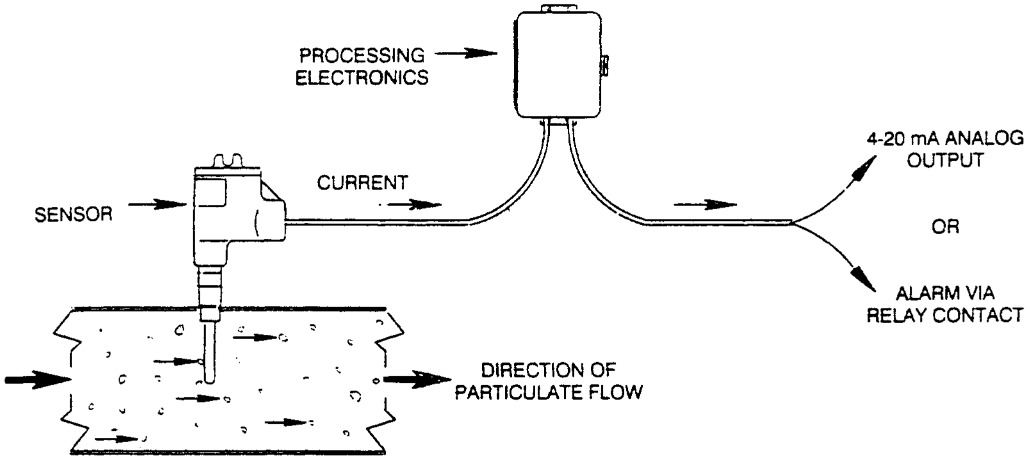

Figure 4. Monitoring system schematic.[1]

The following sections describe the principles of operation of triboelectric monitoring systems, factors that affect the performance of these systems, and signal monitoring and alarms.

3.1 PRINCIPLE OF OPERATION

When two solids come into contact, an electrical charge is transferred between the two bodies. This charge transfer is known as the triboelectric principle, or contact electrification. As particles in a gas stream collide with a sensor placed in the stream, the charge transfer generates a current that can be measured using triboelectric monitoring equipment. The current signal produced by the triboelectric effect is generally proportional to the particulate mass flow, though it can be affected by a number of factors as described below. The current, which can be as low as 10^{-13} amperes, is amplified and transmitted to the processing electronics. The processing electronics are tuned to the specific installation and configured to produce a continuous analog output (i.e., 4-20 mA signal) and/or an alarm at a specific signal level.

All fabric filter bags allow some amount of PM to pass through; this constant bleedthrough is used to establish a baseline signal. The monitoring system detects gradual or instantaneous increases in the signal from the baseline level. According to vendor literature (see Reference 1), triboelectric monitoring systems have been shown to detect baseline emissions as low as 0.1 mg/dscm (0.00005 gr/dscf).

3.2 FACTORS THAT AFFECT TRIBOELECTRIC MONITOR PERFORMANCE

The effects of various PM and gas stream parameters on the triboelectric signal are discussed below. The discussion is based on information obtained primarily from one vendor of triboelectric monitors.

3.2.1 Composition of PM and Probe

The materials that compose the triboelectric probe and the PM in the gas stream have direct bearing on the triboelectric signal generated. The farther apart the probe and PM materials are on the triboelectric table, the greater the charge generated by their contact. Generally, contact between a good electrical conductor and a good insulator produces the greatest signal. With the standard stainless steel triboelectric probe (a good conductor), a stronger signal is generated by PM composed of insulating materials than by metallic PM.

3.2.2 Velocity

The greater the velocity of a given particle, the greater the signal generated. Depending on the materials involved, the relationship of signal to velocity ranges from linear to exponential. Observed exponents have ranged up to a power of 2 (i.e., triboelectric signal increases with the square of velocity). Thus, the signal output can be very sensitive to changes in gas stream flow rate.

3.2.3 Particle Size

All other factors being equal, the triboelectric signal per unit mass is greater for smaller particles. Small particles have a greater surface area per unit mass of material, allowing for more efficient charge transfer. Thus, up to a point, the triboelectric monitor is more sensitive to small particles. However, at some point in the submicron range, particles no longer strike the probe because they lack sufficient momentum to break out of the gas stream as it flows around the probe. The aerodynamic diameter at which this phenomenon occurs varies with the material; denser materials are detected at smaller sizes than less dense materials.

3.2.4 Charge

Charged particles generate a signal independent of the triboelectric effect when they strike the triboelectric probe. As a result, the instrument is more sensitive to charged particles than to particles without charge. Conditions that cause variations in the charge on the PM will result in variable sensitivity.

3.2.5 Accumulation of PM on the Probe

When material accumulates on the surface of the probe, the sensitivity of the triboelectric monitor may be reduced. Harder materials tend to accumulate slowly, if at all, while softer, stickier materials accumulate more rapidly. Accumulation of conductive PM on the probe can also cause an electrical bridge between the probe and ground, generating a large signal.

3.2.6 Particle Shape

Particle shape is likely to have some effect on triboelectric signal because, as discussed above for particle size, shapes with greater surface area per unit mass are expected to generate a greater signal than those with a lower surface-to-mass ratio. No data, however, are available to quantify what effect, if any, particle shape has on the signal.

3.2.7 Temperature

Gas stream temperature has no direct effect on the signal as long as the temperature remains above the dew point and below about 1100°F. The triboelectric current generated in the probe is so small that the resistance of the probe is insignificant, making temperature-induced variation in the conductivity of the probe insignificant. If the temperature drops below the dew point, water droplets generate a signal in addition to the PM signal. In addition, liquid water on the probe causes PM to accumulate. Above about 1100°F, the standard stainless steel probe begins to generate electrons, interfering with the triboelectric signal; this effect increases as temperature increases.

If gas stream temperature affects the nature of the PM, indirect effects on triboelectric signal may occur. For example, temperature effects on the chemical composition or particle size of the PM would be expected to result in variations in triboelectric signal. Changes in the gas stream temperature could also indicate a change in process conditions that could have an effect on PM characteristics.

Any affect of ambient temperature on the electronic components of the instrument can be compensated for automatically.

3.2.8 Relative Humidity

No direct gas stream humidity effects have been observed as long as the temperatures of the exhaust gas is above the dew point. If the temperature of the gas stream prior to the monitor drops below the dew point, condensation may occur and cause false alarms. Indirect effects are possible when the PM is hygroscopic or the PM characteristics are otherwise sensitive to humidity.

3.3 SIGNAL MONITORING AND ALARMS

Triboelectric monitors include on/off (switch type) and analog designs. These designs differ in the output signal generated by the electronics. On/off systems operate only with an alarm relay output that is activated at a pre-set level to indicate a high emission level. Analog systems operate with a continuous 4 to 20 mA signal that corresponds directly to the relative particulate emission level. Analog systems usually also include one or more alarm relays. The simplest analog monitor has an analog gauge with a needle indicating the current signal (percent of scale) and an on/off relay that is tripped when the input signal reaches the level set by the user. Other monitors may include analog output signals and gauges, low and high alarms, digital readouts, internal diagnostics, and quality assurance functions. Analog systems are recommended over on/off systems, so baghouse activity (baseline signal and cleaning peaks) may be tracked visually and recorded.

4.0 SYSTEM MATERIAL SELECTION AND PROBE LOCATION

The following sections provide guidance on sensor material selection, probe location, and signal processing electronics.

4.1 SENSOR ASSEMBLY MATERIAL SELECTION

The materials for the probe and insulator should be selected based on the service environment, and selections should be approved by the manufacturer. Material selection for the insulator is especially important. The insulator is positioned between the probe and the housing to electrically isolate the probe, and this isolation must be maintained to assure valid signal transmission. If PM accumulates on the probe sufficiently to bridge over the insulator to the housing, the current will flow from the housing to the probe, generating false alarms.

Several materials of construction are available for sensors. Probes are often made from stainless steel for standard applications. Other mateirals that may be used are tungsten carbide for abrasive applications or Inconel for corrosive applications. Insulators may be made from Teflon (e.g., for abrasive, noncorrosive applications), high-performance polymers (e.g., for moist gas streams), or ceramics (e.g., for high temperature and/or pressure applications). Air purge can be used to minimize the buildup of particulate matter on the insulator.

4.2 SENSOR LOCATION

The sensor, or probe, is designed to be mounted directly on the ductwork downstream of the fabric filter housing. Where practicable, the probe should be installed so that it extends at least halfway across the duct cross-sectional area. The maximum probe length may be limited (for example, 36 inches). For large ducts (greater than 72 inches), multiple sensors can be installed and electrically connected in parallel. The insulator sleeve should be flush with, or protrude slightly from, the inner duct wall; it should not be recessed within the duct wall.

The probe should be located, where practicable, in a length of straight duct, a minimum of 2 duct diameters downstream and one-half duct diameter upstream from any flow disturbance, such as a bend, expansion, or contraction in the stack or duct. A velocity traverse is recommended, in order to insure the probe is sited in a location that has similar flow characteristics to the overall exhaust gas stream. In nonmetallic ducts, an electrostatic (Faraday) shield should surround the duct and be electrically connected to the probe along with an earth ground to isolate the signal from stray electrical fields. It is important that the probe is well grounded. In addition, the probe should not be installed in a location that experiences excessive vibration or is in close proximity to a high voltage or current source.

To avoid potential build-up of particles around the probe, it should not be installed at the bottom of horizontal ducts or pipes. The location should allow ready access for maintenance and allow for removal of the sensor from the duct for inspection and cleaning. An example installation location for a negative-pressure fabric filter application is shown in Figure 5.

4.3 SIGNAL PROCESSING ELECTRONICS

The signal processing electronics can be connected directly to the sensor assembly or located at a distance using coaxial cable. The electronics should not be exposed to temperatures outside the range specified by manufacturers. The electronics should be protected from excessive vibration and physical damage and accessible for maintenance. The display should be visible to the operator.

5.0 MONITORING SYSTEM OPERATION

The following sections provide guidance on monitor set up (sensitivity, response time, and alarm levels) and operation. Methods for checking system response and drift are also included.

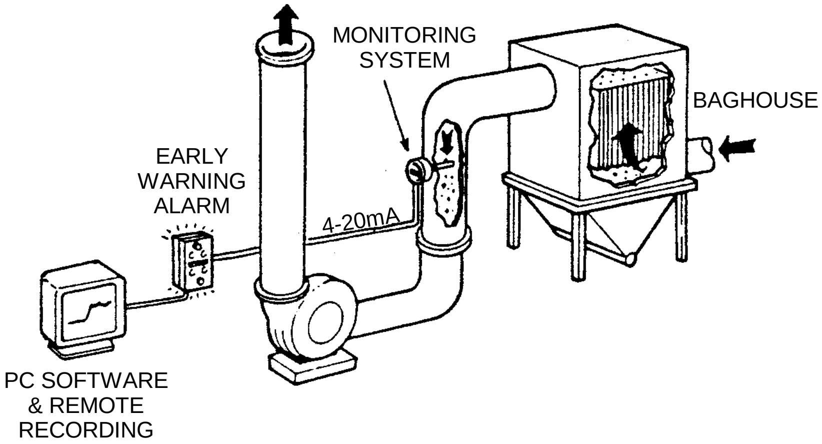

Figure 5. Installation location for a negative-pressure fabric filter application.

5.1 APPROACH TO MONITOR SET UP

After installation, the sensitivity and response time of the signal processing system are adjusted to establish signal levels for baseline operation and alarms. Sensitivity is the amplification, or gain, of the system, and this adjustment is used to establish the baseline signal level as a percent of the system full-scale (for analog systems). The scale is simply a relativescale from 0 to 100 percent, and the relationship of the signal to the particulate mass emission rate is linear. The selected baseline level determines the full scale level.

Increasing the sensitivity decreases the range to be measured; decreasing the sensitivity increases the range to be measured. For example, if the sensitivity is set so that baseline emissions are at 2 percent of scale, 100 percent of scale corresponds to an emission rate of 50 times baseline. However, if the sensitivity is set so that baseline is at 10 percent, full scale is only 10 times the baseline emission rate. Figure 6 illustrates these effects of sensitivity adjustments.

Decreasing the sensitivity to lower the baseline level results in smaller scale reading changes for a given change in the input signal level, which reduces the system's ability to detect small changes in PM levels (e.g., changes due to small bag leaks). A better approach is to use a short response time, discussed below, to smooth the cleaning peaks. Conversely, increasing the sensitivity to raise the baseline setting results in larger scale reading changes for a given change

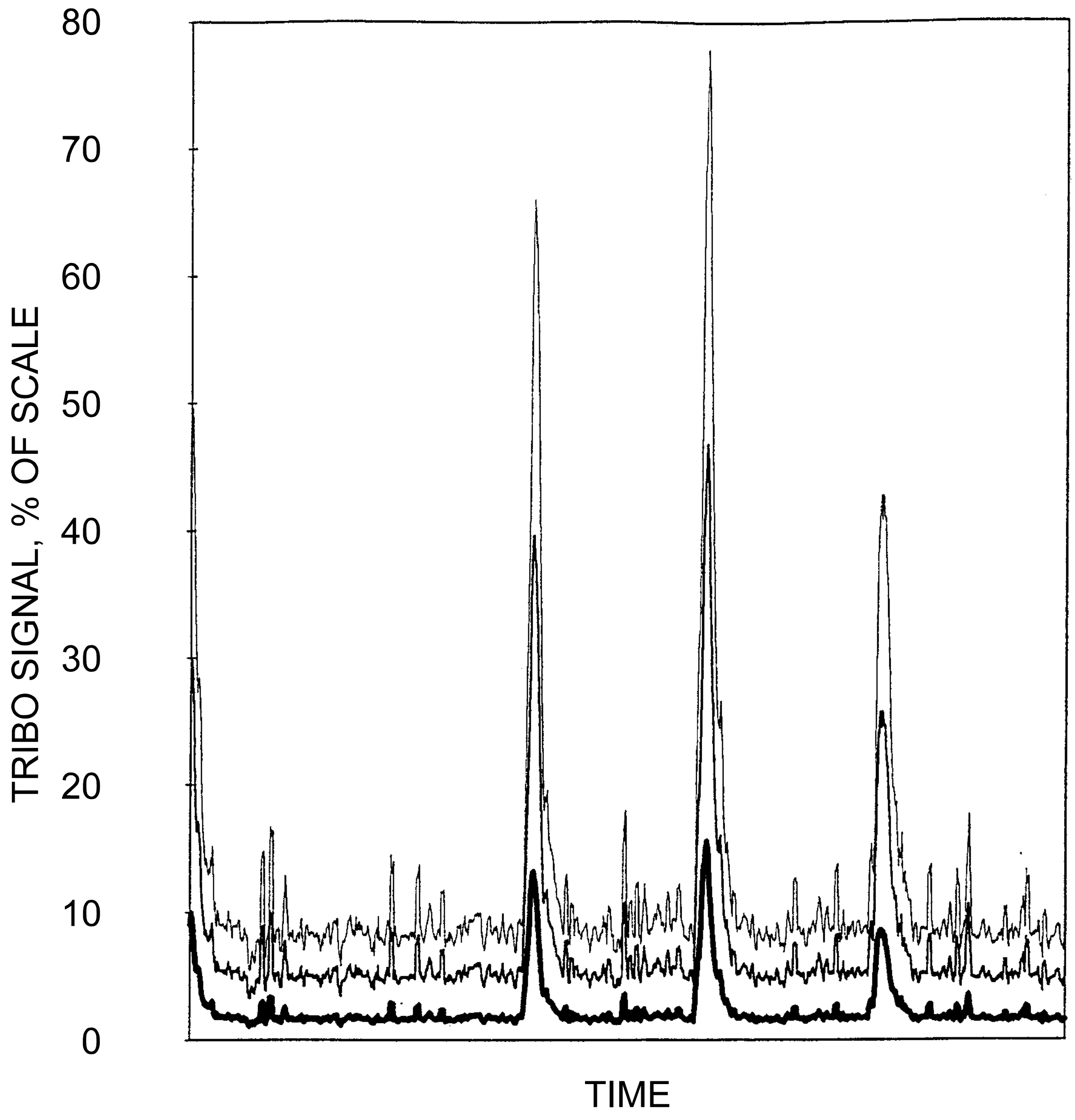

Figure 6. Effects of sensitivity adjustment.

in input signal level, which can result in nuisance alarms from small changes in PM levels (e.g., from emission spikes associated with normal cleaning cycles) or cause the cleaning cycle spikes to exceed the scale of the instrument. The sensitivity is typically set so that normal baseline PM loading is at some level near the bottom of the scale, usually less than 10 percent.

With a baseline greater than 10 percent, moderate to high cleaning peaks may leave no room for an adequately high broken bag alarm on scale. Sensitivity is best set so a typical cleaning peak reaches around 30 percent of scale, leaving plenty of room for an broken bag alarm as a multiple of the typical cleaning peak height, while still allowing medium and high cleaning peaks to stay within the scale of the graph.

Response time has a smoothing effect on the output signal by allowing the system to average the signal over a small period of time, thus lessening the effects of a momentary high signal. On a chart recording of the output, a longer response time results in lower, broader peaks, while a shorter response time results in taller, narrower peaks. In either case, the area under the curve is identical, and adjusting the response time does not alter the indicated emissions levels.

The shortest response time setting shows the sharp peaks associated with the filter bag cleaning cycle, and the signal can be used to identify the row or compartment of bags that may require maintenance. However, false alarms may result from momentary high signals that do not correspond to cleaning cycle peaks. Increasing the response time from the minimum setting results in a dampening of momentary high signal spikes and smooths cleaning cycle peaks. Long-term trending of bag wear and overall emissions increases is best monitored by using a long response time; however, a response time of 5 to 10 seconds is typically recommended by the manufacturer for most filter types because it smooths momentary high signal spikes while still providing a good representation of baghouse cleaning cycle activity.

Based on data analyzed by the EPA, a response time of 5 seconds typically serves to smooth the baseline and dampen momentary high signals not associated with a cleaning cycle peak, but still provides an accurate depiction of the baghouse activity. Figure 7 depicts a typical cleaning peak at 1, 5, 10, and 15 seconds of response time. At a 1 second response time, the signal is very jagged. At 5 seconds, it is smoothed out well, without overly dampening the cleaning peak. The response time of 15 seconds provides the most smoothing, but decreases the height of this particular cleaning peak from around 20 percent of scale to approximately

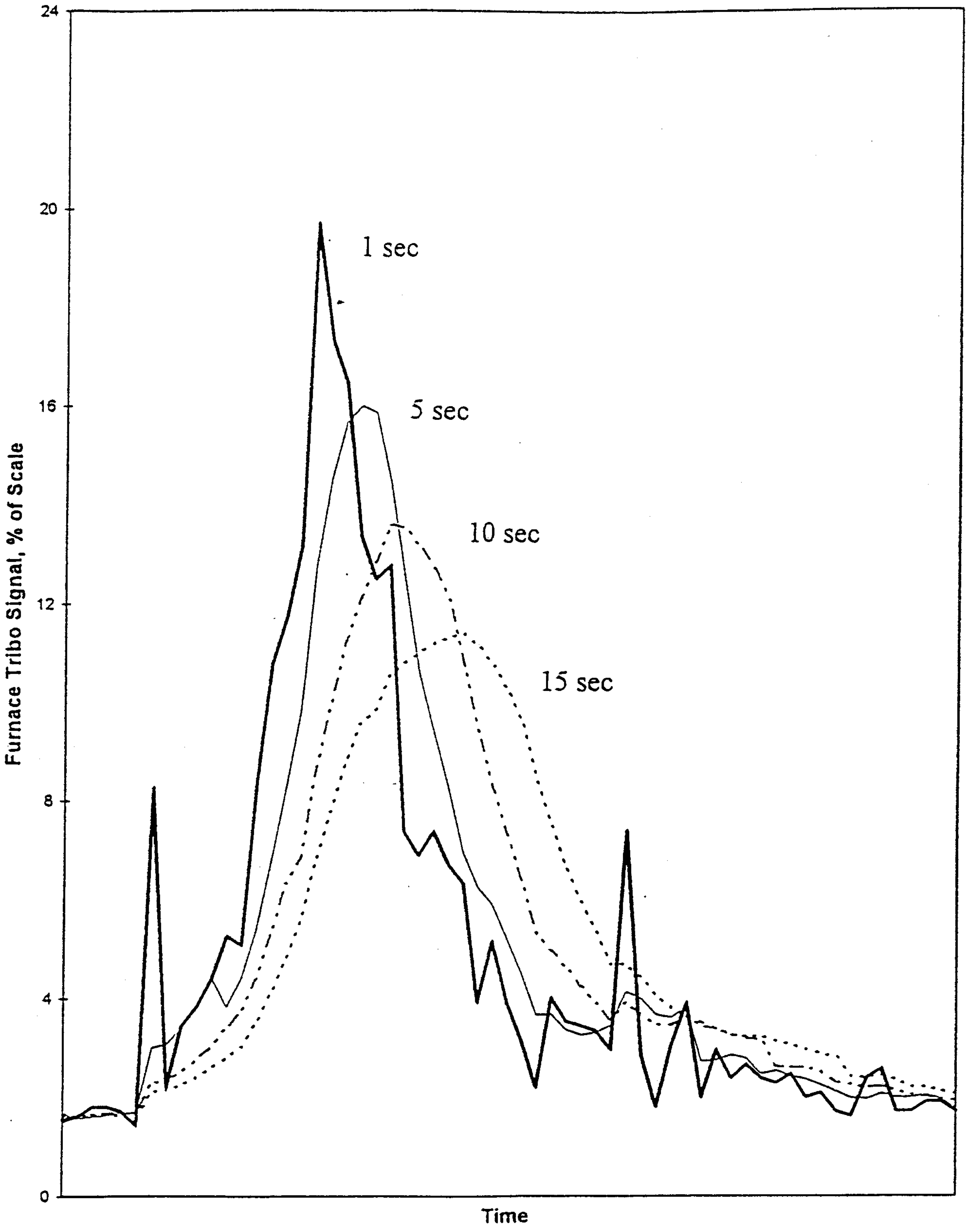

Figure 7. Effect of response time on a typical baghouse cleaning peak.

11 percent of scale. A long response time, such as 15 seconds, may permit a ruptured bag to go unnoticed for a longer time, while the 5 and 10 second response times prevent false alarms by dampening momentary high spikes very well and only slightly decreasing the height of the cleaning peak.

Some instruments can be set to incorporate a delay time. When a delay time is used, the monitor does not indicate an alarm until some set time after an emission increase is detected. The alarm is only activated when the signal remains above the alarm level for the full delay period.

5.2 MONITOR SET UP PROCEDURES

The following procedures provide a recommended set up when applicable to a given site. Changes to these procedures or alternate procedures may be necessary to address site-specific conditions.

The baseline level is established as a percentage of output scale by adjusting the sensitivity and response time of the output signal from the sensor assembly. The alarm level is then set based on the baseline emission level and/or cleaning cycle peaks. Operating characteristics vary for each baghouse, and these settings are unique to each installation. The general procedures for setting the baseline and alarm levels for analog systems are given below. The procedures for on/off systems are similar.

The general procedures for setting the baseline and alarm levels for analog type systems are as follows:

1. Ensure that the process is operating normally with air and particulate flow past the probe and that the fabric filter system is in good repair (filter bags in good condition, pressure drop normal, etc.).

2. Set the response time to minimum, and delay time to zero.

3. Adjust the sensitivity setting until the baseline emissions are 5-10 percent of scale and typical spikes during filter bag cleaning are below 50 percent of scale.

4. Increase the response time so that the baseline signal is smoothed and momentary high signals are damped, but the cleaning peaks can still be seen; a response time of 5-10 seconds is recommended.

5. Set the alarm level at 2 times the maximum height of a typical cleaning spike for bag leak detection. (For example, if the maximum height of a typical cleaning cycle peak is 30 percent of scale, the alarm level should be set to 60 percent of scale.) If there are no discernable cleaning peaks, the alarm level may be set as a multiple of the baseline, such as three times the baseline.

Some triboelectric monitors have the capability for dual alarm levels. One level may be set as a multiple of the cleaning peak height with no delay time to detect broken bags, and a second level may be set as a multiple of baseline emissions with a delay time set at least as long as the cleaning cycle in order to detect increases in the baseline emission level.

For on/off systems, the alarm level may be fixed at some percent of full range. Therefore, the alarm level is effectively adjusted by adjusting the sensitivity to a level which results in normal cleaning peaks occurring below the alarm level and high cleaning peaks triggering the alarm. A response time of 5-10 seconds is also recommended for on/off type systems so momentary high spikes do not cause an alarm.

Since a short response time is recommended for use in dampening momentary high signals and the alarm level is recommended to be set as a multiple of the typical cleaning peak height (once sensitivity is adjusted), the use of delay time is not recommended. This guidance addresses the use of triboelectric monitors as bag leak detectors, not as means of measuring a mass emission rate. Therefore, the alarm must prompt maintenance of the baghouse and must be able to detect an abnormally high cleaning cycle peak. The use of delay time may prevent a high cleaning cycle peak from activating the alarm.

Alternate procedures to set alarm levels may be needed to address site specific conditions. For example, during one EPA study [3], the monitor response to a bag leak was predominantly seen in the baseline signal. In cases such as this one, it may be appropriate to consider an alarm level that is a multiple of the baseline level and incorporates a delay time and a longer response time. For this particular study, setting the baseline at 10 percent of scale, the response time at 2 minutes, the alarm level at 30 percent (three times the baseline), and incorporating a delay time of 1 minute was appropriate. This setting produced alarms during simulated bag leaks. Again, however, monitor setup details will be site specific.

Another example of an alternate procedure may be when high humidity conditions cause false alarms. In this case, a procedure to detune the monitor or otherwise prevent the false alarms may be appropriate. Such procedures should clearly define when the period that alarms are prevented starts and ends.

5.3 MONITORING SYSTEM ADJUSTMENTS

An initial 30-day trial period is recommended to verify that the set up of the instrument is appropriate, in order to prevent frequent false alarms and ensure that the instrument has sufficient detection capability. Another reason such a trial period is recommended is to verify the system selected will perform reliably in the application and environment to which it is exposed. Some monitors may have higher sensitivity upon initial installation, but over a period of several days will stabilize and remain repeatable. The monitor lacks the ability to compensate for a buildup of particulate on the probe, so conditioning the system to the process environment is critical to reliable and repeatable operation.

After the sensitivity, response time, alarm levels, and alarm delay (if applicable) have been set and undergone the 30-day trial period, they should not be readjusted unless normal process conditions change in a manner that affects the characteristics of the particles or exhaust gas stream, such as:

1. Change out of filter bags, repair of leaks, or other process improvement that would reduce particulate emissions;

2. Slow drift of signal due to environmental factors such as humidity. If the sensitivity drifts more than -50 to 100 percent from the initial set up, the monitoring system and control device should be inspected and any necessary repairs performed.

3. Equipment is taken out of service for repair, replacement, or upgrading.

5.4 RESPONSE TEST

The response test is meant to be a check on the operational status of the monitor; it is not an accurate measure of electronic drift. The system should be tested monthly to ensure a repeatable and reliable response. A test port should be installed upstream of the probe where a known quantity of dust can be injected into the exhaust gas stream to simulate a broken filter bag. A specified dusty material and injection procedure should be prescribed that will always be used for this test. Various quantities of the selected material should be injected until the amount necessary to trigger the alarm is determined. This quantity of dust should be doubled and used to test the system monthly, in order to verify operation of the monitor. If the monitor is equipped with a continuous output, the signal response during the dust injection test should be recorded and compared to testing conducted during previous months. If signal levels differ significantly from the initial response test, action should be taken to investigate the cause of the discrepancy.

5.5 ELECTRONICS DRIFT CHECKS

The electronics drift checks are meant to be an accurate measure of the monitoring system’s electronic drift. A zero drift check can be conducted by disconnecting the sensor or shielding it from particulate. A sensitivity check can be conducted with an instrument which generates a low level current similar to the signal generated by the sensor. The sensor is disconnected from the electronics (or the process is shut down) and the signal generator is connected in its place. The instrument is then used to send a controlled input signal to the electronics to test the accuracy of the system. Some models perform automatic internal drift checks at specified time intervals. The electronics should be adjusted if the drift is greater than 20 percent, or as specified by the manufacturer. Manufacturer's instructions should be consulted for procedures specific to each model.

6.0 QUALITY ASSURANCE PROCEDURES

Quality assurance (QA) is a critical element of any environmental data collection. It is a system of management activities designed to ensure that the data collected are of the type and quality needed by the data user. QA procedures should include the necessary checks of the monitor’s functioning, measurement performance criteria, maintenance procedures, and documentation to assess and document the continuing functioning and accuracy of the bag leak detection monitor. The following QA procedures are suggested to ensure proper monitoring system operation.

6.1 SENSOR INSPECTION AND CLEANING

Each sensor should be inspected at regular intervals to remove any build-up of material that may collect on the probe or insulator. A build-up of material on the probe may dampen or decrease the signal strength, and material on the insulator can form a conductive electrical bridge across the insulator, increasing the signal strength and resulting in a high alarm.

The rate of material buildup on the sensor assembly is dependent upon many factors and will vary for each installation. Thus, the interval between inspections or probe cleaning may vary considerably among installations. Inspection and cleaning of the probe and insulator should be in accordance with the manufacturer's recommendations.

6.2 MONTHLY CHECKS

Monthly QA checks should be performed to ensure the monitor is operating properly. If the results of the response test or electronics drift check are not favorable, the cause should be investigated and any malfunctions corrected.

6.2.1 Response Test

According to the procedures specified in section 5.4, inject the previously determined type and quantity of dust into the port installed in the duct to test the operation of the triboelectric monitor and alarm. A specific injection procedure and dust type should be defined on a case-by-case basis during the set up of the monitoring system. The output signal response should be recorded and compared to the reading obtained during the initial monitor set up. If the readings differ significantly, corrective action should be initiated.

6.2.2 Electronics Drift Check

According to the procedures specified in section 5.5, a signal generator should be used, with signal strengths that match those determined when the monitor was initially set up, to check the baseline and alarm level readouts. A zero drift check should be conducted; the readouts should be within 20 percent of the set levels. If the readouts do not meet this criteria, corrective action should be initiated.

6.3 ANNUAL INSTRUMENT SET UP

If the monitor’s settings have not been adjusted within a year’s time, an annual instrument set up should be performed. The set up procedures given in section 5.2 should be repeated and documented.

6.4 RECORDKEEPING

A record that includes the date, time, condition of each sensor as-found, and a description of any actions taken should be maintained of all inspections (e.g., probe/insulator cleaning). Records should also be maintained for all drift checks and response tests performed. Each entry in the log should be signed by the person conducting the inspection, testing, or maintenance.

The initial instrument set up procedures should also be documented so the annual instrument set up will be performed consistently. Documentation should include values for the baseline (sensitivity) setting, response time setting, and alarm level(s) and a description of how each was established. If process changes require the system parameters to be adjusted (see Section 5.3 of this guidance), the date, adjustments, and reasons for the adjustments should be documented and signed by the personnel responsible for the modifications. The instrument set up procedures should then be revised accordingly.

7.0 REFERENCES

1. Auburn International, Triboflow and Triboguard Dust Emission Monitors and Broken Bag Detectors, General Guidelines for Operation, April 1995.

2. Midwest Research Institute, Evaluation of Triboelectric Monitors, Final Test Report, prepared for U.S. Environmental Protection Agency, Emission Measurement Center, March 1997.

3. Midwest Research Institute, Evaluation of Triboelectric Monitors on Pulse Jet Fabric Filters, prepared for U.S. Environmental Protection Agency, Emission Measurement Center, September 1997.

4. U.S. Environmental Protection Agency, APTI Course 413: Control of Particulate Emissions, Student Manual, EPA 450/2-80-066, Research Triangle Park, NC, October 1981.

5. U.S. Environmental Protection Agency, Operation and Maintenance Manual for Fabric Filters, EPA/625/1-86/020, Research Triangle Park, NC, June 1986.