

March, 2007

---

## **Problem Solving:**

Reducing Detector-based Nuisance Alarms

## Reducing Detector-based Nuisance Alarms

Nuisance alarms represent one of the most significant problems facing the fire alarm industry today. Each year, nuisance alarms result in countless service calls and fire department dispatches, not to mention millions of dollars in fines. Left unchecked, nuisance alarms can become life threatening for a building's occupants, as they may become confused between nuisance alarms and true emergency situations.

Fortunately manufacturers, industry associations, and alarm companies alike have set out to combat this problem through education, training, and a variety of new product developments. System Sensor has joined the effort through innovative smoke detection techniques and capabilities, represented most recently by the introduction of the new i<sup>3</sup> series smoke detectors.

In order for you to gain a broader perspective on nuisance alarms, this paper provides a brief overview of their impact, their causes, and some of the ways in which they can be mitigated.

### Nuisance Alarms: The Facts

*Nuisance alarms are not the same as false alarms.* However, since nuisance alarms and false alarms both generate an alarm signal, the two terms are often misapplied. A nuisance alarm is caused by conditions resembling smoke, but are not generated by sources of fire. Examples include dust and steam. Conversely, a false alarm is the result of conditions that do not resemble smoke whatsoever, including defective products, vandalism, etc.

The following are just a few of the statistics that illustrate the relationship that exists between fire alarm systems, smoke detectors, and nuisance alarms.

- In 2000, United States fire departments responded to 2,126,500 unwarranted alarms – a 4.3% increase over 1999 and a 51% increase over 1988.<sup>1</sup>
- Unwarranted alarms that were estimated to result from some form of system malfunction accounted for 884,000 (or 41.6%) of these alarms – a 1.9% decrease over 1999, but a 61% increase over 1988.<sup>2</sup>
- In a recent survey, fire chiefs estimated that one false alarm occurs per 100 detectors in use each year.<sup>3</sup>
- A study of Veterans Administration hospitals found 15.8 unwanted activations for every real alarm, or one unwanted activation for every six devices per year.<sup>4</sup>

How costly are nuisance alarms? One study indicated that the Fire Department is paid \$150 for each avoidable or nuisance fire call.<sup>5</sup> Though such costs can be easily quantified, nuisance alarms also result in significant *behavioral* costs, such as non-responses during an alarm condition.

Repeated nuisance conditions often translate to a lower confidence in the fire alarm system. Case in point: In a survey conducted for the National Fire Protection Association (NFPA), *only 7% of the respondents who reported an alarm thought there was a fire, and that they should evacuate the premises.*<sup>6</sup> Given an actual emergency situation, results like these could be tragic.

### Identifying the Causes

So what exactly causes nuisance alarms in smoke detectors? Nuisance alarms occur when detectors come in contact with potential sources of smoke, steam, moisture or humidity. In fact, one third of the devices studied for nuisance alarms in the National Smoke Detector Project found that they were located in areas near (often less than five feet) a potential source of smoke, steam, or moisture sufficient to produce nuisance alarms.<sup>7</sup>

Airborne dust or accumulations of dust and dirt can also cause nuisance alarms, if the detector is not cleaned on a regular basis as recommended by NFPA 72, Inspection, Testing and Maintenance guidelines. Without the proper maintenance, over time the smoke detector may become more sensitive, which could eventually lead to a nuisance alarm.

Still other studies cite smoke detectors featuring constant threshold sensitivity as a contributor to nuisance alarms.<sup>8</sup> In other words, these detectors may not effectively discriminate between fire and non-fire sources of smoke. This restriction may have contributed to the 95% frequency of unwanted alarms reported by smoke detectors in the 1980's, according to the Fire Journal.<sup>9</sup>

## Attacking Nuisance Alarms

Fortunately, a number of industry associations, as well as the manufacturing community, are taking steps to reduce the likelihood of nuisance alarms. Organizations like the NFPA and the Automatic Fire Alarm Association (AFAA) are dedicated to promoting greater awareness and proper fire alarm installation requirements and practices. Also, NICET certification offers a means to verify that a fire professional has met the appropriate educational requirements to install or maintain a fire alarm system.

From a manufacturing perspective, fire alarm suppliers continue to develop and introduce new technologies intended to assure greater performance and avoid unnecessary nuisance alarms. As it relates specifically to smoke detectors, two areas being attacked include short duration effects, such as airborne particles within the detector's chamber, and longer-term factors like settled dust accumulations. To address these concerns, manufacturers have begun to incorporate smart features within the detector's microprocessors. Arguably the two most noteworthy are smoothing algorithms and drift compensation.

### Smoothing Algorithms – For Short-Duration Effects

All smoke detectors measure the condition of the detector's chamber on a pre-determined, periodic basis, specifically looking for smoke. As smoke enters a detector, the chamber measurement will begin to increase toward the detector's fixed alarm threshold. If enough measurements exceed the detector's alarm threshold, an alarm is then initiated.

Similarly, non-smoke effects may mistakenly cause a surge or "spike" in the detector's chamber measurements. These spikes may be caused by a number of factors including airborne dust particles, disturbances of settled dust within the chamber, RF interference, small insects, etc. As is the case with smoke particles, if enough measurements exceed the detector's alarm threshold, an alarm is then initiated. In this case however, a nuisance alarm is generated (refer to Figures 1 and 2).

Figure 1.

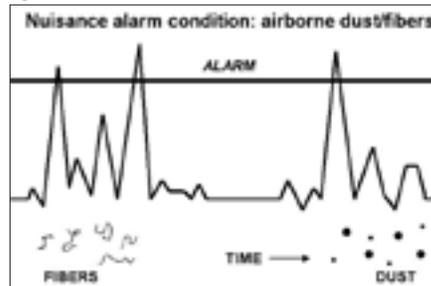


Figure 2.

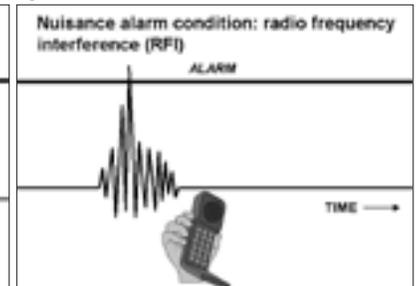


Figure 3.

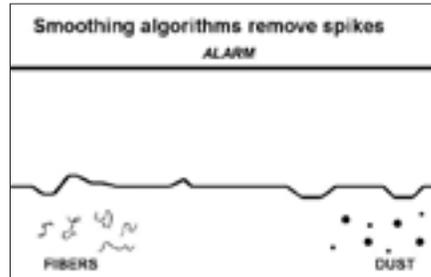
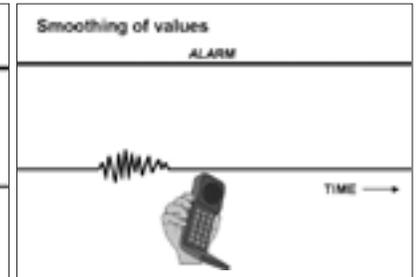


Figure 4.



Smoothing algorithms combat these effects through a series of complex decision matrices that screen out the effects of *short-duration* and *inconsistent* spikes in the detector's chamber measurements. These algorithms throw out inconsistent measurements (refer to Figures 3 and 4), hence avoiding a nuisance alarm.

### Drift Compensation – For Long-Term Effects

Unlike airborne particles, accumulated dust presents a longer-term concern for smoke detectors. Over time, dust and dirt begin to build up within the detector's chamber. As this build-up occurs, the smoke detector becomes more sensitive (refer to Figure 5). Ultimately, the detector may become so dirty that its sensitivity exceeds its alarm threshold, hereby generating a nuisance alarm.

Drift compensation automatically adjusts the sensitivity of the smoke detector, as it becomes dusty or dirty (refer to Figure 6). However, the detector's performance in measuring and responding to smoke remains unaffected. The result is a reduced chance of nuisance alarms, without sacrificing detector performance.

Both drift compensation and smoothing algorithms have been available for years. However, these features have historically been reserved for analog detectors. Through continued development efforts, these capabilities are now more readily available in conventional detector designs. And with System Sensor's new i<sup>3</sup> line of smoke detectors, they are more powerful than ever.

Figure 5.

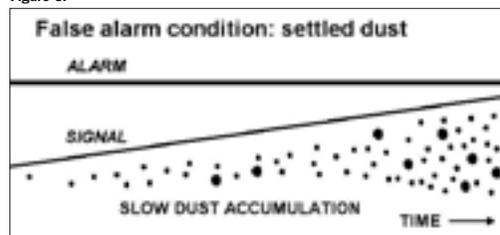
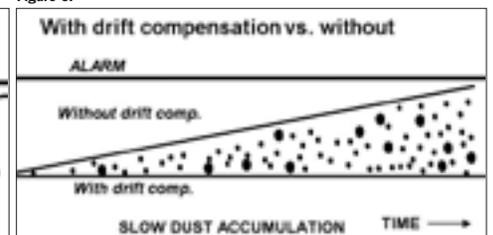


Figure 6.



## The **i<sup>3</sup>** Series Detectors – An Effective Solution

The new i<sup>3</sup> series detectors from System Sensor represent the next wave in conventional smoke detection. Though the i<sup>3</sup> name refers to Installation ease, Intelligence, and Instant inspection, it is the line's intelligent capabilities that help reduce nuisance alarms.

Traditionally, conventional smoke detectors have not featured drift compensation. Today, only a limited few offer drift compensation, while fewer still offer smoothing algorithms. The i<sup>3</sup> detectors, however, are equipped with **both** capabilities, to address both the short-duration and long-term causes of nuisance alarms.

But System Sensor didn't stop there, as the i<sup>3</sup> series' drift compensation is arguably the most robust in the industry today. As the i<sup>3</sup> detector's sensitivity changes, it continues to compensate for a longer period of time. In fact, the i<sup>3</sup> series' drift compensation is capable of compensating as much as **fifteen times** the amount of dust/dirt that other detectors equipped with drift compensation can handle. The net result is the assurance that the i<sup>3</sup> series will generate fewer nuisance alarms, to reduce unnecessary service calls, their associated costs, and the hassle.

### Summary

Nuisance alarms have been a long-standing problem facing fire alarm professionals. Fortunately this problem is being attacked on a number of fronts, through training, certification, standards, and improved fire alarm component design. And significant strides are being made.

Being the leading system smoke detector manufacturer, System Sensor has maintained a long-term commitment to this cause. And this effort has now transitioned into the world of conventional detectors with the introduction of the new i<sup>3</sup> series. By incorporating both smoothing algorithms and unsurpassed drift compensation, this translates into greater resistance to both short duration and long-term causes of nuisance alarms. The result: greater peace of mind for the building owner, the building occupants, and the fire alarm professional.

### Footnotes

- 1 Michael J. Karter, Jr., *False Alarm Activity in the U.S., 2000*, NFPA Fire Analysis and Research Division, Quincy, MA, October 2001
- 2 Michael J. Karter, Jr., *False Alarm Activity in the U.S., 2000*, NFPA Fire Analysis and Research Division, Quincy, MA, October 2001 (Source: NFPA Annual Fire Experience Survey 1998-2000)
- 3 David S. Bernstein, *The End of False Alarms?*, NFPA Journal, January/February 1998
- 4 Peter M. Dubivsky and Richard W. Bukowski, *False Alarm Study of Smoke Detectors in Department of Veterans Affairs Medical Centers (VAMCS)*, NISTIR 89-4077, Gaithersburg, MD: National Institute of Standards and Technology, May 1989
- 5 EH&S 2000 Annual Report - Fire Safety Initiatives
- 6 1997 *Fire Awareness/Escape Planning Study* for National Fire Protection Association, Quincy, MA
- 7 Charles L. Smith, *Smoke Detector Operability Survey - Report on Findings*, Bethesda, MD: U.S. Consumer Product Safety Commission
- 8 James A. Milke, *Monitoring Multiple Aspects of Fire Signatures for Discriminating Fire Detection*, Fire Technology, Volume 35, No. 3, 1999
- 9 James A. Milke, *Monitoring Multiple Aspects of Fire Signatures for Discriminating Fire Detection*, Fire Technology, Volume 35, No. 3, 1999

For more information, please contact:

System Sensor  
3825 Ohio Avenue  
St. Charles, Illinois 60174  
1-800-sensor2  
[www.systemsensor.com](http://www.systemsensor.com)

