FIRE FINDINGS
SPECIAL REPORT

SMOKE ALARM EVALUATIONS

by Kim Mniszewski, P.E.

Most fire investigators have encountered fires that involve injuries and deaths.

A child may have been in a bedroom where a mattress burned. An elderly person may have been next to a smoldering easy chair. Fire may have blocked a family's attempt to escape. Sometimes, the media, investigators or fire officials assert the smoke alarms were problematic or not present.

Questions that resonate during such investigations include: Were any smoke alarm(s) present? If so, where were they located? Were the smoke alarms installed properly? Were they maintained properly? Did they activate during the fire? Could properly installed and maintained smoke alarms have prevented the injuries or deaths?

Whether you're a public- or private-sector fire investigator, these questions often lead you to search for any evidence of smoke alarms at the loss site and evidence relating to whether they operated properly or not. Sometimes the issues of alerting and survival even overshadow those of the fire's origin and cause.

National studies from the early 1970s to the present have shown survivability in a residential fire is very high when operational smoke alarms are on each level of a home and in close proximity to bedrooms. This is the basis for current requirements of National Fire Protection Association (NFPA) 72, the *National Fire Alarm Code*, for siting units in an existing home. Studies have shown survivability is even higher when smoke alarms are in each bedroom, as well. Most codes for new construction, and even some existing construction, require that.

Many existing smoke alarms are much older than the recommended replacement age of 10 years and are still in excellent shape; however, aging of circuits and other components can result in degradation and failure. NFPA studies indicate that while 95 percent of U.S. homes have smoke alarms, about 19 percent are non-operational.

Power source problems are the leading reason for failure in smoke alarms. Power supply problems such as poor wiring, blown fuses or tripped circuit breakers, missing batteries or dead batteries, can result in failures.

A variety of other problems may occur over time that can limit the effectiveness of these devices, rendering them non-operational in some cases. For instance, sensing-chamber debris, dust or corrosion can

(Continued on page 8.)

For more information
about smoke detectors and evaluating their remains

- Ahrens, M., "U.S. Experience with Smoke Alarms and other Fire Alarms," National Fire Protection Association (NFPA), November 2003
- Bukowski, R., et al, "Detector Sensitivity and Siting Requirements for Dwellings: A Report of the NBS Indiana Dune Tests," NFPA SPP-433, NFPA, 1974
- Bukowski, R., et al, "Performance of Home Smoke Alarms, Analysis of the Response of Several Available Technologies in Residential Fire Settings," National Institute of Standards and Technology (NIST) Technical Note 1455, December 2003, NIST
- Collwell, J., et al, "Use of Soot Patterns to Evaluate Smoke Detector Operability," *Fire & Arson Investigator*, July 2003
- Fabian, T., et al, "Smoke Characterization Project," Underwriters Laboratories Inc., for the Fire Protection Research Foundation (FPRF), April 2007
- Kennedy, P., "A Fire Analysis Tool Revisited – Acoustic Soot Agglomeration in Residential Smoke Alarms," Investigations Institute, August 2003
- Olenick, S., et al, "The Role of Smoke Detectors in Forensic Fire Investigation and Reconstruction," International Symposium on Fire Investigation (ISFI) Science and Technology, Cincinnati, Ohio, 2006
- Worrell, C., et al, "Enhanced Deposition, Acoustic Agglomeration and Chladni Figures in Smoke Detectors," *Fire Technology*, 37, 343
- Woycheese, J., et al, "An Investigation of Enhanced Soot Deposition on Smoke Alarm Horns: Experiments and Observations," ISFI Science and Technology, Cincinnati, Ohio, 2006

FF