Fire-Safety Alarms

An electrician describes what kinds to get, where to put them and how to wire them to save lives and homes

BY ROBERT MARINO

Nobody wants to die in a fire. Yet fire is the third-leading cause of accidental death in the United States. And four out of five people who die in fires die at home. That's why we install fire and/or smoke-detection systems in homes.

Residential fire detectors are designed to provide early warning so that residents can escape before smoke and toxic gases accumulate, let alone before flames block exits. Early warning is the key to residential fire safety. And avoiding false alarms by installing, the right kinds of detectors in the right places will help homeowners to take those early warnings seriously. The photo at left shows the results of a fire that grew out of control because the homeowner removed the battery from a smoke detector that tended to give false alarms.

I've done mostly commercial electrical work, including fire-safety systems, for 14 years, but when I started to remodel my own house, I decided that I had better check out residential fire-safety equipment. Here's what I found.

Choosing the best smoke detector for the space

When most people think of fire-protection systems, they think smoke detectors, and they're right. Smoke detectors form the backbone of residential fire-alarm protection. Unfortunately, homeowners and builders alike tend to throw smoke detectors here and there and think their bases are covered. Not so. Two kinds of smoke detectors commonly are used for residential applications (photos facing page). One kind isn't better than the other; each detects different sizes of smoke particles, so they offer overlapping protection. I also suggest adopting a third commercial unit in certain circumstances.

The first kind of common residential smoke detector is the ionization type. In this type of detector, a sensor ionizes the air between two electrodes. When smoke particles disrupt the electrical conductivity of the air between the electrodes, an alarm sounds. An ionization-type detector works well with the small particles associated with open, flaming fires, but it is not as successful sensing the larger particles associated with smoldering fires. Ionization-type detectors are also the most prone to false alarms.

Enter the next type of detector, the photoelectric smoke detector. Photoelectric detectors direct a light into a chamber, aimed past

Photo this page: Steven MacGillivray

Ionization-type smoke detectors
These devices monitor changes in the electrical conductivity of the air around a sensor. Ionization-type alarms tend to signal false alarms when placed near kitchens.

Photoelectric smoke detectors
These detectors sense when smoke particles deflect a light beam inside the unit. Photoelectric units are less likely than ionization-type detectors to sound a false alarm when you open the oven door.

THEY ALL LOOK ABOUT THE SAME, BUT THEY WORK DIFFERENTLY

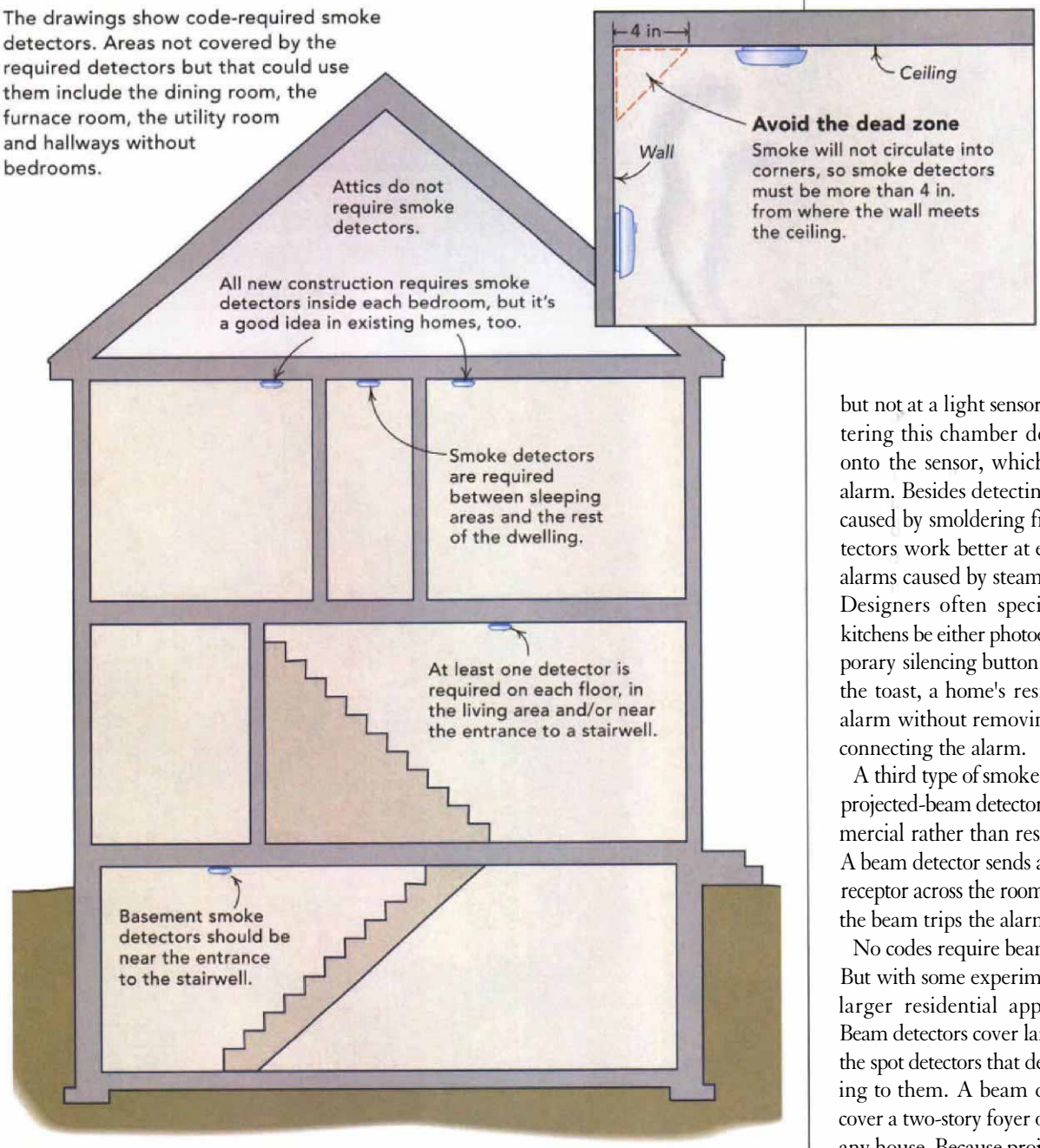
The two most common smoke-detector designs are ionization-type and photoelectric (photos above). But fire-safety alarms include more than just smoke detectors. Carbon-monoxide and heat detectors (photos below) alert you to other problems. Because smoke detectors are sensitive to humidity and temperature extremes, heat detectors work better in attics or in dirt-floor basements. Carbon monoxide is a product of any combustion process and therefore can be released into the house by combustion appliances as well as by fires.

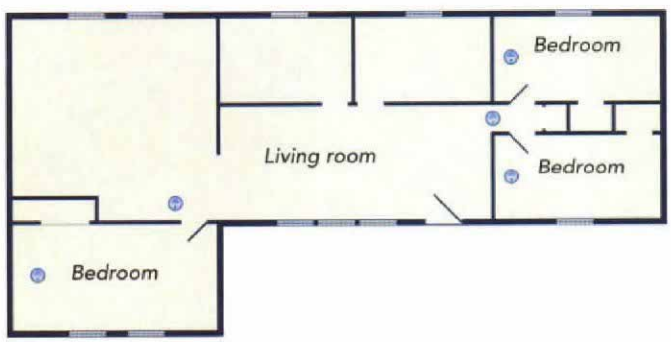
Heat detectors
These devices are like thermometers with an alarm. Heat detectors sense either a preset temperature or the rate of temperature rise or both. The author installed one in his attic because the temperature fluctuations there would damage a smoke detector. He also recommends a heat detector in a dirt-floor basement, where humidity might damage a smoke detector.

Carbon-monoxide detectors
These units detect a silent killer. Carbon-monoxide (CO) detectors should not be installed directly over combustion appliances, but they should be close enough to catch rising CO levels in the house so that residents can evacuate before being exposed to this colorless, odorless gas.

LOCATING SMOKE DETECTORS

The drawings show code-required smoke detectors. Areas not covered by the required detectors but that could use them include the dining room, the furnace room, the utility room and hallways without bedrooms.





This one-story plan has two sleeping areas Because there are bedrooms in two distinct parts of this house, each sleeping area requires its own set of smoke detectors.

but not at a light sensor. Smoke particles entering this chamber deflect the light beam onto the sensor, which in turn sets off an alarm. Besides detecting the larger particles caused by smoldering fires, photoelectric detectors work better at eliminating nuisance alarms caused by steam and cooking vapors. Designers often specify that alarms near kitchens be either photoelectric or have a temporary silencing button so that after burning the toast, a home's residents can mute the alarm without removing the battery or disconnecting the alarm.

A third type of smoke-detection device, the projected-beam detector, is designed for commercial rather than residential applications. A beam detector sends an infrared beam to a receptor across the room. Smoke that disrupts the beam trips the alarm.

No codes require beam detectors in homes. But with some experimenting, they could fit larger residential applications very well. Beam detectors cover large open areas, unlike the spot detectors that depend on smoke coming to them. A beam detector easily could cover a two-story foyer or the biggest room in any house. Because projected-beam detectors are designed for larger spaces than most houses have, the smallest units probably are best for residential settings. For example, the FireRay 50R by Fire Fighting Enterprises (www.ffeuk.com) covers rooms starting at 15 ft. in length.

Heat and carbon-monoxide detectors cover what smoke detectors can't

Another fire-safety device I recommend for optimum protection is a heat detector (photo to p. 93). Of several different types, the most common residential heat detector sends an

Drawings: Dan Thornton

alarm signal when a preset temperature (usually 165°F) is reached. Heat detectors work best where smoke detectors cannot go. In an unfinished basement with a dirt floor, humidity can disrupt the sensor in a standard smoke detector. Similarly, an unfurnished attic can be too hot in the summer and too cold in the winter.

Heat detectors should never replace smoke detectors in or around a bedroom because heat detectors sound an alarm only after fire has created untenable conditions in the area being protected. They do not provide the early warning necessary for easy evacuation.

You can see and smell smoke, but carbon monoxide (CO) is an odorless, invisible gas generated by any combustion process, either in a heater or in a house fire. So an additional safety device I recommend is a CO detector (photo p. 93). (For an introduction to CO detectors, see *FHB* #138, pp. 130,132.) The CO detector can either be incorporated into the fire-alarm system or be installed as a battery-operated, stand-alone unit. Both of these types work well, but both must provide an audible alarm that residents won't confuse with a fire alarm.

Smoke detectors should go where the smoke goes

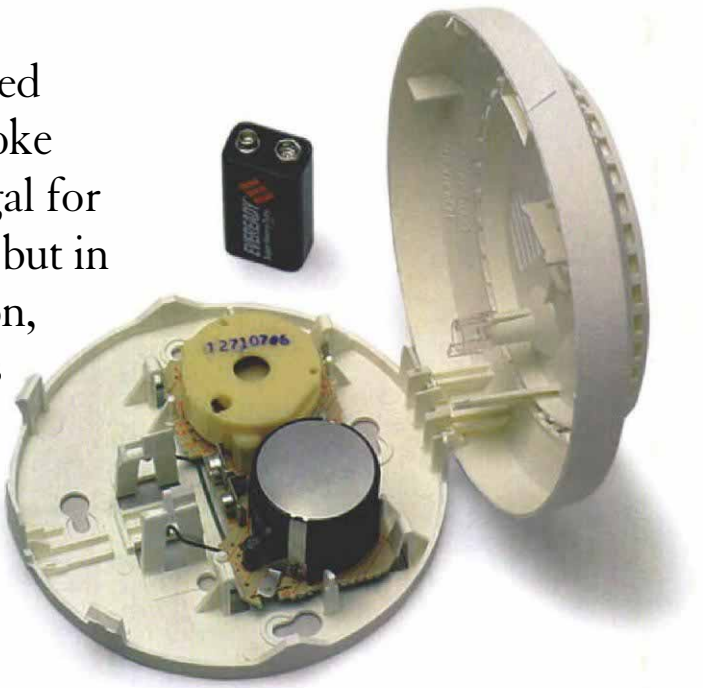
To learn where to install fire-safety devices, the best source is chapter 8 of the National Fire Alarm Code *(NFPA* 72, published by the National Fire Protection Association). I prefer to use the NFPA 72 *Handbook* (available at www.nfpa.org) because it supplements the dry prescriptions of the code with plain-language translations and explanations. NFPA 72 has distinct requirements for the minimum number and most effective location of smoke detectors to be placed in both new and existing homes.

According to the handbook, at least one smoke detector must be installed on each story of a residence, including the basement, even if there is no bedroom area on that floor. In existing homes with only one bedroom area (a hallway with entry doors to the bedrooms is called a bedroom area), code requires just one smoke detector in that hall. If the existing home contains more than one bedroom area, then smoke detectors should go between each bedroom area and the adjacent living space, as well as inside each bedroom.

In new construction, minimum requirements are the same as for existing homes except that a smoke detector must always be installed in each bedroom, even if there is only one bedroom area.

Like any national code, NFPA 72 establishes only minimum requirements. Local authorities can institute their own fire-safety requirements. For example, one municipality near me requires that hard-wired smoke detectors be put on the same circuit as a commonly used light so that you'll notice if the circuit is failing. Other jurisdictions now require residential sprinklers and CO detectors. It is a good idea to consult local building officials first to make sure that a planned fire-detection system is up to code.

"Battery-powered stand-alone smoke detectors are legal for existing homes, but in new construction, smoke detectors must be wired together."



In addition to the required locations, I recommend placing a smoke detector at the top of a laundry chute, which can act like a chimney to transport smoke from lower levels. Depending on the home, it might be useful to install smoke detectors in hallways not covered by the bedroom-area requirement and in areas usually closed off by doors from zones with required smoke detectors. I also recommend a heat detector and a CO detector in the furnace room.

Avoiding the dead zone and other placement details

Because proper placement of smoke detectors within any of these rooms or corridors carries with it life-or-death consequences, NFPA 72 carefully specifies the exact smoke-detector location within a space:

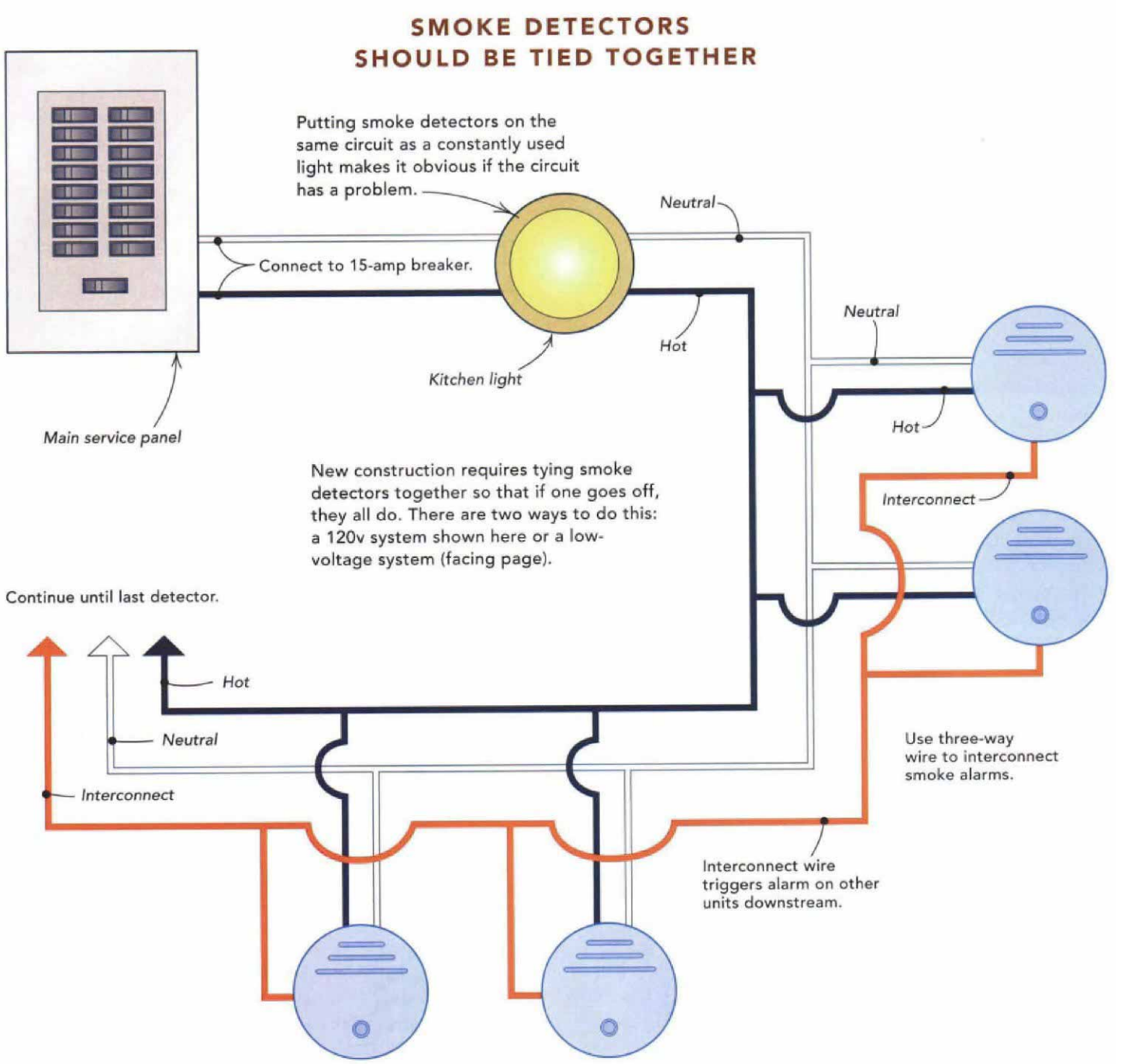
"The living-area smoke detector should be installed in the living room or near the stairway to the upper level or in both locations. The basement smoke detector should be installed in close proximity to the stairway leading to the floor above. Where installed on an open-joisted ceiling, the detector should be placed on the bottom of the joists."

No matter which room you're looking at, smoke detectors must never be placed within 4 in. of where the wall meets the ceiling, an area I call the dead zone (drawing facing page). Because smoke and gases spread into these corners last, detectors here are less likely to sound an alarm early enough for residents to escape.

If a ceiling directly below the roof has little or no insulation, then smoke or heat in that room takes longer to reach the detector because a cold pocket around the detector deflects airflow. In this case, smoke or heat detectors go on a wall rather than the ceiling. If the exterior wall has little or no insulation, then you should use an interior wall.

Installing a smoke detector within 3 ft. of a full bathroom might expose it to excess moisture that can cause nuisance alarms. And locating that smoke detector closer than about 3 ft. to any air register might—if the airflow deflects smoke from the alarm—prevent the device from sounding an alarm when it actually should.

When you're in doubt about placement, don't hesitate to ask for help. A smoke detector that is located on the ceiling 18 ft. from the floor is legal, but it is not easily accessible. For special situations such as a 20-ft. high ex-



posed-beam ceiling or a cathedral ceiling with paddle fans blowing air around, determining the best placement sometimes requires advice from a fire-alarm pro who knows local building and fire codes.

In new homes, smoke detectors must be wired together

The familiar battery-powered stand-alone smoke detectors are legal for existing homes, but in new construction, smoke detectors must be wired together so that when one alarm goes off, they all go off. This measure assures that someone sleeping on the second floor can hear an alarm that originates in the home's basement.

In today's new homes, installers have two choices in how the smoke detectors are going to be wired together. The most basic arrangement is a 120v hard-wired system with all of the detectors on one circuit and interconnected by an extra wire (drawing above). I shy away from using these 120v hard-wired systems, not because they do not offer adequate protection but because they lack design flexibility.

The system I installed in my own home uses low-voltage (12v) wiring to tie all the smoke, heat and CO detectors to the security-alarm panel (photos facing page). You can dedicate a separate alarm panel to fire-safety devices instead of wiring them to a security panel. But most homeowners bothering to install a fire-alarm panel already have a burglary-alarm system installed, so it makes sense to run the wires through one panel rather than two. This type of central control panel offers almost unlimited design possibilities and provides good centralized battery backup in case

of power failure. I have an eight-hour battery backup wired to my panel.

Alarms need to be heard

When a fire alarm sounds at 4 a.m., you need to wake up and wake up fast. Sirens and bells (and sometimes strobe lights) are your means of notification. Because most fire-related deaths happen at night, I prefer the central unit type of fire-alarm system because I can easily design the type of siren and its location to maximize the effect.

Low-voltage wiring makes it easier to put alarm devices wherever you want them. In my own house, for instance, I installed a small stand-alone siren in my living room to notify guests who might be sleeping on the sofa bed. That siren is in addition to the alarms on the detectors themselves.

Residents who have severe hearing disabilities may require a strobe or strobe/siren combination. The strobe/siren combinations are also available in the 120v hard-wired type smoke detector.

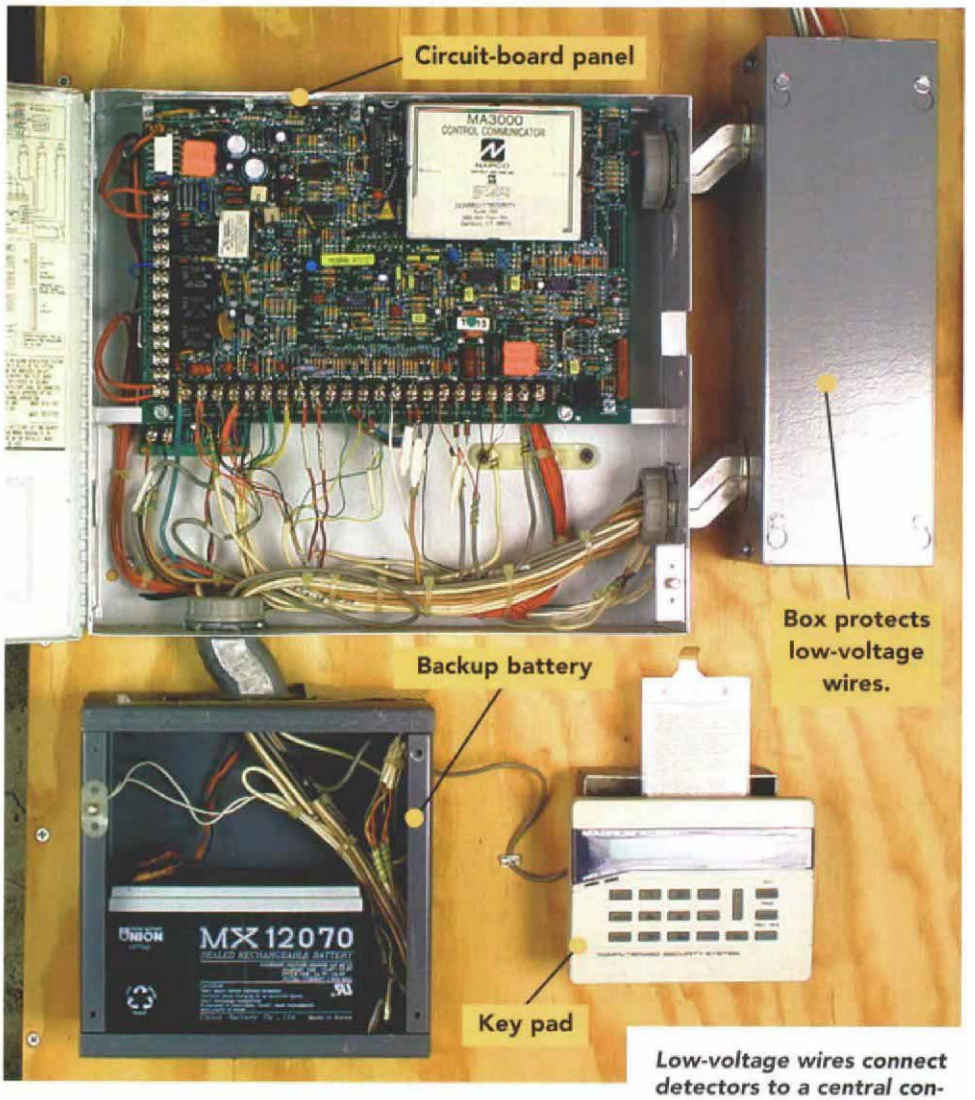
Central monitoring services call the fire department for you

Besides allowing you to customize the alarm system inside the house, a low-voltage control panel allows you to subscribe to a central (remote) monitoring service. In my area, monitoring services cost between $14 and $25 a month, including both fire and burglary alarms. Being hooked up to a central monitoring station doesn't provide an earlier warning to people in the house, but it does allow firefighters to arrive much sooner and much better informed about the situation they face.

At 1 a.m. on the night my son was born, my wife and I were at the hospital 25 miles away when my in-laws called to say that the fire department was at my house. Fearing the worst, I raced home but found my house looking normal. The fire chief informed me that the CO detector, not the smoke detector, had sent the alarm. The chief thanked me for having such a good system that his team knew to suit up for a CO leak before entering the house. And I was glad to have a system that caught the problem and let me fix it before bringing home a new infant. I think that's worth $25 a month. □

When not renovating his house in Trumbull, CT, Robert Marino is a union-trained electrician in New York City. Photos by David Ericson, except where noted.

LOW-VOLTAGE WIRES CONNECT DETECTORS



Low-voltage wires connect detectors to a central control panel. *Burglary and fire alarms run through the same panel. Red wires indicate smoke and heat detectors. The author boxed the wires for protection just to the right of the circuit board. A backup battery lives below in case of a power outage.*

The author placed *key-pad controls near each exit door and near the circuit panel. Key pads are on interior walls because this old house lacks insulation.*