

BY GLENN MATHEWSON



## How a New Roof Poisoned a Family

**“Nothing is an island.”** I often use this phrase when I’m teaching or administering the building codes. Whether you’re building a deck, remodeling a kitchen, or just replacing asphalt shingles, every system in a structure is connected to something else. Successful contractors must be aware not only of the building phases that they control, but also of all aspects of a building that could be affected by the work they do.

### HAIL STORM EQUALS ROOF REPLACEMENT

Recently I was called in to inspect a roof-shingle replacement job that had inadvertently and adversely affected the health of the family living below. A neighborhood in my jurisdiction had gotten hit with a severe hail storm; so severe, in fact, that nearly all the houses in that neighborhood needed to have their roofing replaced. To satisfy insurance requirements, roof

replacement needed to be done within a short period of time after the damage, creating a boon of available work for roofing contractors, but a backlog of work for building inspectors.

In one of the houses that got a new roof, the family members began to complain of headaches and nausea. When their symptoms didn’t abate, their doctors started looking into possible causes, such as carbon monoxide poisoning. Winter had just set in with two weeks of very cold weather, so the home’s gas furnace had been running hard. The homeowners called in an HVAC technician to inspect it, and on finding a small crack in the heat exchanger, he called for a red-tag lock-off (immediate shut down) of the furnace—or for the unit to be replaced. With winter making its presence felt, shutting down the furnace and going without heat was not an option for the homeowners, so they decided to replace it.



### RED FLAG MISSED

While replacing the furnace, the HVAC technician noted moisture in the vent and the beginning signs of corrosion. He suggested that the new roof—which was still in my queue, waiting for its inspection—could be leaking. The homeowners then called my office to voice their concerns, and I noted on their inspection ticket that they wanted to discuss these issues with the inspector during on-site inspection of the new furnace. But with the roof now covered in snow, inspection of the roof was still weeks away.

Assuming that the health issues they were experiencing stemmed from the cracked heat exchanger and that a bad flashing boot on the roof was causing the leak that the tech had found, the family went back to their lives. But the health symptoms did not go away.

When I arrived to inspect the new furnace, the homeowners mentioned contacting the city about their concerns with not

getting the roof inspection. And after listening to them explain their circumstances, I was convinced that there were issues that had not been considered. But the roofing contractor had verified that the flashing had been properly installed around the existing furnace vent, and the furnace contractor had verified that the furnace had been installed correctly. So where could the problems be coming from?

### B-VENT CAP IS THE CULPRIT

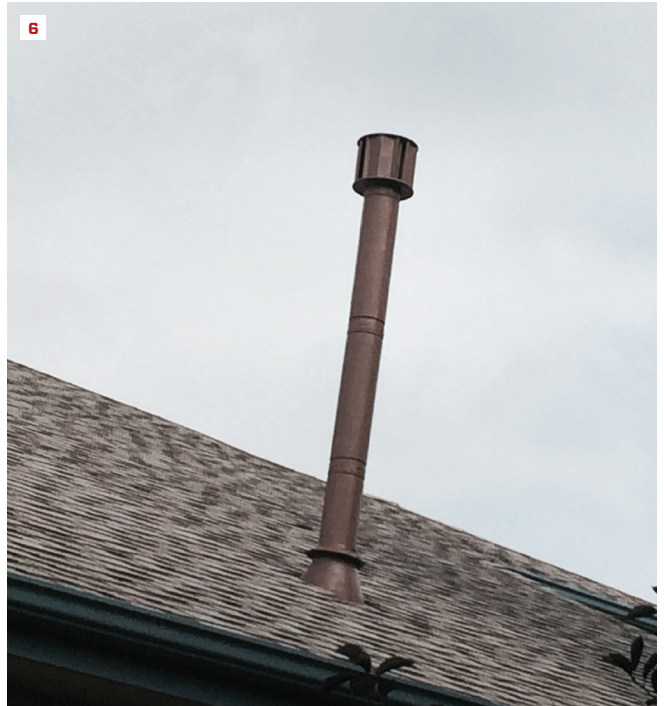
Both the original furnace and the new furnace were connected to Type-B vent to exhaust combustion gases up and out of the house. This commonly used metal vent has a double-wall construction with an insulating layer of air that allows it to be installed with tight clearances to combustible materials. Type-B vents are made by a variety of companies, each of which uses proprietary mechanical twist-and-lock connection joints between segments. These connections allow you to assemble

separate lengths into a continuous vent quickly without using fasteners. Each company also makes a termination hood or vent cap that covers the vent after it exits through the roof. Exposed to the elements, the vent cap on this house's furnace vent had been badly damaged during the hail storm, so the insurance company listed the cap for replacement in its scope of work.

Matching a new roof cap to the specific manufacturer of an existing vent pipe is almost impossible on older homes because of the differences in the locking joints. So roofing contractors typically replace a damaged hood with a universal model that doesn't connect with a twist connection but rather just slides over the end of the vent. To function properly, these replacement caps must be installed at the proper height above the end of the vent before being tightened in place with the integral clamp (1).

On this particular job, the cap had been pushed down too far over the vent, ultimately blocking off the top of the vent. With





the vent blocked, the hot exhaust gases from the furnace could no longer escape, introducing carbon monoxide into the home. Then as these gases began to cool in the sections of vent that passed through the cold attic and outside air above the roof, moisture vapor in the gas condensed into liquid water inside the vent. This explained the moisture that the HVAC technician found in the vent, a red flag that was misread. The roof replacement had created a problem with the furnace venting, and as a result, the family was suffering from carbon monoxide poisoning.

Raising the cap and securing it at the proper level (2) solved the problem of the condensation, which stopped the “leak.” But more importantly, it removed the source of carbon monoxide entering the home, and the family’s health improved immediately.

#### OTHER COMMON B-VENT PROBLEMS

When properly installed, B-vent pipe is a quick, efficient, and relatively inexpen-

sive way to vent a gas furnace or water heater. But to prevent problems, roofing contractors and other professionals that interact with B-vent in the course of their work need to have an understanding of how B-vent works.

Besides installing the roof cap too low, another common mistake is accidentally turning the whole vent when removing a cap, instead of turning just the cap. Once the joints between the sections of pipe are no longer interlocked, the sections can disconnect inside the building—and reconnecting them is often impossible from the top of the roof. A sure sign of a disconnected joint is B-vent that moves horizontally in all directions on the roof instead of being rigid (3, 4).

Yet another mistake is snipping the flange around a cap that has a larger diameter than the vent (5). It is then impossible to clamp or secure the cap to the vent.

It is also common to see B-vent pipe that extends unusually high above the roof sur-

face because of a nearby air inlet (like an evaporative cooler) or the adjacent sidewall of an upper floor. (Generally, vents must be at least 8 feet away from a wall or extend above it). In these cases, braces extending from the pipe down to the roof must be installed to provide lateral restraint. Without these braces, the vent is subject to movement and possible disconnection caused by wind (6). I’ve had to fail many roof replacement jobs where these braces were not reinstalled.

The takeaway for contractors: If you touch it, understand it. When you replace or repair a portion of a system, always check to make sure it will work with the rest of the existing system.

The takeaway for inspectors: Look at every inspection as the work of a life-safety professional—something to take very seriously.

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