

## 7 Reasons Why Oversizing is a Bad Idea

As homes have become more efficient, oversized HVAC equipment has emerged as one of the more serious problems in building science. Although there's general awareness of this issue among industry practitioners, few understand the full extent of the problem or its consequences.

### 1. Economics

Most people understand that oversized equipment has a higher first-cost. However, oversized equipment also costs more to operate due to increased cycling losses. Short run-times are like stop-and-go driving: system efficiency drops off as cycles become shorter. Also like automobiles, excess cycling is hard on equipment, especially the compressor. On average, oversized compressors have shorter life spans than undersized or correctly sized compressors.

### 2. The high efficiency trap

The highest efficiency ratings go to multistage equipment. Multistage air conditioners and furnaces are designed to operate at reduced output (first stage) most of the time. This allows longer run-times. However, the oversizing penalty is especially severe for multistage since its high efficiency rating is derived from the expectation of greatly reduced cycling losses. When a multistage system is oversized, the efficiency gain diminishes or disappears entirely.

Many HVAC contractors intentionally size multistage equipment based on the first stage capacity and consider the high stage as reserve capacity for extreme weather conditions or a big party. By taking this approach, contractors unknowingly cheat homeowners out of the efficiency they paid for. Even when sized properly, payback for multistage usually exceeds the life of the equipment.

### 3. Comfort

Oversized equipment leads to wider temperature swings, especially in perimeter areas and remote zones. Consider what happens if on the coldest day, a furnace only operates 20 minutes an hour. As soon as the furnace cycles off, the house begins to cool from the outside in. The thermostat is purposely located away from exterior walls and windows, often in a hallway. While the furnace is off, air doesn't circulate. By the time the thermostat senses the lower temperature, perimeter areas may have dropped by several degrees. During mild weather when loads are tiny, minimum runtime logic assures significant overshoot. Either scenario causes discomfort; the greater the oversizing, the larger the temperature swings. The same occurs in cooling mode.

Indoor relative humidity plays an important role in comfort. In cooling mode, increased moisture will heighten the body's sensation of heat, often leading the occupant to compensate by lowering the thermostat setting. Oversizing compromises an air conditioner's ability to remove moisture (see Moisture Control, below), resulting in discomfort and increased energy consumption.

### 4. Ergonomics

An oversized system produces more noise than a system that is properly sized. Not only is the source equipment noisier but diffuser noise can be annoying if proper design procedures aren't followed. With proper design, a correctly sized system in a high performance home can be virtually silent. Note: Radiant heat eliminates noise during heating mode but it's rarely cost effective in moderate or mild climates, and can cause overshoot under part-load conditions.

### 5. Indoor Air Quality

Because an oversized system has shorter run-times, air filtration is reduced. During winter months, heat pumps provide the best filtration since they run nearly continuously during cold weather. Grossly oversized air conditioners can also lead to dust mites, mildew, and even mold in extreme cases, as a result of inadequate moisture removal.

## 6. Moisture control

An air conditioner's ability to remove moisture (latent capacity) is a function of the indoor coil temperature. Each time the air conditioner starts up, it takes at least 10 to 15 minutes for the coil to get cold enough to condense water vapor. Because an oversized system has shorter run-times, it spends a higher percentage of the time operating in this initial 'dry coil' phase.

Peak moisture loads tend to occur under part-load conditions, especially during the spring and fall. In this situation, an oversized air conditioner may not run long enough to condense *any* moisture, thus permitting indoor relative humidity to rise. A major selling point of multistage air conditioners is improved moisture control during part-load conditions. At best, this is an expensive solution to the part-load problem, but when a multistage system is oversized, it's no solution at all.

## 7. Structural Durability

In many areas of the country, air conditioning is necessary to manage moisture loads. Perhaps the most insidious consequence of oversizing is its impact on moisture removal. An oversized air conditioner removes less moisture than an air conditioner that's properly sized. Depending on the climate and the degree of oversizing, the consequences of excess moisture range from discomfort to serious health issues, and from minor damage to structural failure.

High relative humidity provides an ideal environment for destructive fungi to thrive. Aside from the obvious health concerns, mildew left unchecked will eventually damage the host material. Paint, drywall paper and wood products are all at risk. Atmospheric moisture also affects the dimensional integrity of wood. Solid wood products such flooring and wainscoting expand as their moisture content rises, leading to cupping or bowing if the relative humidity get too high.

**And now the bad news:** Oversizing, endemic in code-built homes, is potentially an epidemic in high performance homes. Even though most HVAC contractors have been taught the virtues of right-sizing, they can't seem to break free of their 'bigger is better' bias. As a result, high performance homes often end up with grossly oversized equipment. This not only undercuts potential energy savings, but makes these homes especially vulnerable to comfort and moisture problems.