ENSURE POWERSTEALING THERMOSTAT COMPATIBILITY

by Steve Ericson

Powerstealing thermostats offer many advantages, but they must be compatible with the equipment they're controlling.

Introduced in the late 1970s, electronic thermostats have become increasingly popular with homeowners as an easy, automatic way to control comfort and reduce energy costs. For contractors, these function-rich devices generate additional revenues, while allowing them to provide greater value and convenience to their residential customers.

"Powerstealing" electronic thermostats are so named because they draw the energy to operate from the home's heating and cooling equipment. They offer several benefits over battery-powered devices or those hard-wired to a transformer. But to function properly, they must be compatible with the heating and cooling equipment -- i.e., they must be able to get the right amount of current from the HVAC equipment they control.

More and more OEMs are designing their heating and cooling equipment to to be compatible with powerstealing thermostats. At the same time, thermostat manufacturers are continually enhancing these devices to work with a wider variety of HVAC systems.

In the final analysis, though, you have the most important role to play in ensuring compatibility. Any time you change a system which includes a powerstealing thermostat -- whether you're changing the heating and cooling equipment, the

thermostat, or both -- it's important to check the energy requirements of the thermostat against the HVAC system's load current.

By understanding how powerstealing thermostats work, and taking a few minutes to ensure their compatibility, you'll be well on your way to ensuring trouble-free operation and minimizing thermostat-related callbacks.

Lots of Options

Until the 1970s, all thermostats were electro-mechanical types. Still used, these devices feature a bimetal that senses temperature and then moves in response to temperature changes in the room. When it moves, the bimetal directly opens or closes an electrical circuit. When the circuit is closed, it delivers power to an electro-mechanical actuator (usually a valve or relay coil) in the HVAC equipment. This causes heating or cooling to be provided to the temperature-controlled space.

Since these thermostats don't require electrical power, the wiring connections are very simple -- one wire connected to the transformer and another wire connected to the load.

The advent of electronic thermostats brought the benefits of greater precision, convenience, and functionality.

More sophisticated both in terms of technology and control options, they sense temperature through an electronic component (a thermistor). Then, through solid-state logic circuits, they cause a relay contact to open or close.

Electronic thermostats provide temperature control to within one degree of setpoint. They give homeowners the ability to automatically set temperature levels based on daily occupancy patterns, for as many as seven days. And the newest models continue to expand functionality, with features such as lighted displays and remote sensing of the temperature outdoors.

Electronic thermostats derive their power in one of three ways: battery-operated, hard-wired, or powerstealing. Battery-operated thermostats offer very easy

installation with universal compatibility. However, these thermostats also require homeowners to periodically check and replace the batteries; otherwise, the thermostat -- and the HVAC equipment it controls -- will stop working when the batteries fail.

Hard-wired electronic thermostats draw a constant source of power directly from the transformer. Because they don't rely directly on the HVAC equipment for energy, there's no compatibility issue. At the same time, these thermostats require an extra wire to give them the 24 volts they need to operate. This can be relatively simple in new construction applications and relatively difficult in retrofit situations.

Powerstealing thermostats don't require batteries, although some models have battery memory or electronic memory (eeprom) backup in case of a power outage. Powerstealing models can be installed without costly extra wiring. Indeed, unlike the situation with a hard-wired thermostat, you can give your customers reliable installation cost estimates for a powerstealing thermostat over the phone, without needing to determine how much additional wiring must be done.

Powerstealing thermostats are an appropriate and convenient choice for the majority of home HVAC systems. At the same time, you should take steps to ensure that the thermostat in question will be compatible with the HVAC system it's going to control. And your customer should be aware of the few circumstances in which a powerstealing device won't work.

Powerstealing Limitations

Electronic thermostats' powerstealing requirements vary, depending on their age, manufacturer, and model. Newer models typically feature enhancements that make them compatible with a wider range of HVAC systems.

Listed below are some broad guidelines to keep in mind when you're installing or trouble-shooting powerstealing thermostats. These guidelines apply to most powerstealing thermostats installed or available today.

In working with a specific HVAC system, service technicians should refer to the particular thermostat's (and heating and cooling equipment's) technical specifications. And onsite, it's always a good idea to take time to directly measure the current in the thermostat's control circuit. It's a quick and easy way to ensure that the home's heating and cooling equipment has the load current to meet the thermostat's energy needs. (This is the same measurement used to determine the correct heat anticipator setting in a mechanical thermostat.)

Make sure the thermostat is connected to a load not sensitive to current fluctuations. The thermostat's need to draw a current during "off" periods requires an insensitive load, so that the heating or cooling equipment doesn't react to the 10-20mA flowing through it. This usually isn't a problem with older, 24 vac HVAC equipment, whose relay and solenoids require high-current loads to operate. But, it can be an issue with newer, high-efficiency equipment whose high microprocessor-based content may require a much smaller load current.

In such cases, the HVAC system may respond to the 10mA current by automatically turning "on" when it should stay "off," or the thermostat may lose power when it tries to start the system.

If such equipment is being installed, check oem specifications and consider upgrading the thermostat to a powerstealing model that pulls less current during "off" periods.

Loads with distorted or intermittent power can cause the thermostat to lose power. Many powerstealing thermostat models require a steady load current of 70 to 120mA through the thermostat during the "on" period. Momentary low-current conditions will cause the thermostat to cancel a call for heating or cooling even though the space still requires a change.

To address this issue, some powerstealing thermostats feature a second, voltage-derived power supply connected to the load of whichever HVAC equipment isn't being used. For instance, if the heating system is being controlled, the second voltage-derived supply is connected to the cooling load.

This second source of power ensures the thermostat continues to receive adequate power even if the heating load current drops below 80mA or the heating load circuit momentarily opens.

Troubleshooting

If you find the heating and cooling equipment is operating, yet not bringing temperatures to the desired setpoint, explore the possibility that load current fluctuations are to blame. Here are three considerations:

- Systems that feature only one piece of equipment (either heating or cooling), must provide a minimum load current of 80mA to operate a powerstealing thermostat.
- Except for the most advanced models, these thermostats won't operate with dc-powered loads or equipment.
- The load current must be 1.2 amps or less to prevent overheating of the current transformer. Some thermostat models have thermal protection to prevent device failure if there's overheating caused by excessive load current.

Advancements

Thermostat manufacturers continue to make enhancements and develop new power-supply techniques to make powerstealing devices compatible with a broader range of HVAC systems.
Here are some enhancements you can expect in the newest electronic powerstealing thermostats:

- The thermostats use electronic memory retention to keep the program and installer configuration settings without batteries. This reduces customer complaints, about battery failure and replacement.
- They require significantly less current during "off" periods, making them compatible with a broader range of high-efficiency equipment. The newest models may require a current as low as 0.1 to 1.0mA to operate, in contrast to older models' need to draw 10-20mA during "off" periods.

- Newer micro-electronic memory circuits keep program information even without backup battery power. This reduces customer complaints because of battery failure.
- New models require significantly less current during "on" periods. The most advanced of these need a minimum load current of 2.5 to 25mA to function during "on" cycles -- a significant reduction over the 80mA minimum typically required by older models.
- The most advanced models retain power even during periods of distorted or intermittent power. The "on"-cycle power stealing function has been enhanced so the full voltage of the transformer is applied to the controlled load except for short periods when the power supply is being charged.

This improved function automatically adapts to full- or half-wave loads, even when significantly distorted from "clean power."

- They are compatible with some dc-powered systems.
- They feature an integrated protection method that prevents shorted or malfunctioning loads from overheating the thermostat. Models with this feature turn off the load within 0.5 seconds if the current is excessive (up to 1.5 amps). The thermostat will automatically retry operating the load as long as there is a need for heating or cooling.

Powerstealing thermostats still aren't appropriate for some applications, including use with millivolt systems, line voltage systems, some zone valves, and other systems that open the load circuit for more than 0.5 seconds during an "on" cycle.

In most cases, however, you can find a powerstealing thermostat that is both cost-effective to install and gives your customers more of what they want -- convenience, energy cost savings, and enhanced comfort control. The key is to take time to ensure compatibility.

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