5th Storyworth A: Why I Have A Lot Less Hair Today ;-)

If you are DIY people, you will understand today's weirdness. Dawn was alarmed at the fact our Dec. power bill from Seco was over $100 vs the highest prior then was only $86. So we discussed the fact that we were adjusting the thermostat a lot because of the crazy weather. 2020 was odd because the pandemic resulted in substantially lower emissions than would otherwise have been expected, even as we had wildfires and other nightmarish weather which is consistent with climate change. It's real, folks. And one result of that is more extremes in fluxuation.

So, because when we bought the place in FL a year ago, and it had only a simple digital but not programmable thermostat, Dawn ordered one I suggested, which allows setting a range of temps for each of four time slots, on each of weekday and weekend, and includes auto changeover between heat and AC. Should have been simple enough. Famous last words ;-) I installed it two days ago, taking care to assure I followed the instructions to the letter, even if Honeywell managed to gloss over some critical points about the wire selection points.

A comment here about instructions; I read tech books like most people read Harlequin novels. It's how I understand. And when we bought the place we understood it had forced air heat and AC which had been added after the place was built. We'd been surprised that it had NOT been switched via a load center within the mobile home like all the rest of the electrics, but discovered it only because our power bill last spring had not dropped off when we left in April and shut off the main. Thankfully, we'd left a safety key with a neighbor who switched off the thermostat when we called, so we only paid for AC for the one month while we were not here.

But yesterday after removing the old thermostat, which had different dimensions from the new one, which was also a Honeywell, I had to make some adjustments to where the wires came through the wall in order for the new one to cover the unpainted part of the wall left by the old one. Not a biggie, but a necessary detail to reduce the added installation burden. The new one has a small sub-plate held by three screws to the wall, but push-in wires like a stereo system for speakers. What was confusing was the labeling, but I eventually figured it out. Based on what I could see, I expected we had a conventional forced-air with electric heat system.

So I was surprised when, having installed it all, the system started to cool, but then blew hot air. As with all AC systems, it is normal for the thermostat to wait for about five minutes before operating the compressor, so as not to try to immediately run it at full pressure, which might stall it and overheat the windings. Also happens with each cooling cycle start, for the same reason. Thermostats are designed to work with different type systems, and I could tell from the wiring that this was a 24 VAC system, which means the source voltage for the heat and AC compressor is typically 240 VAC, but there is a step-down transformer to produce a control voltage of 24 VAC within the AC unit. Most home forced air systems are similar.

The changing nature of the cooling, which of course I was doing on what was the warmest and muggiest day of the season so far, suggested a wire was not reliably making for cooling in the thermostat. I knew I had done nothing which would have changed anything in the AC unit itself, but the heat was odd indeed. When it reached 84 indoors it was getting to be too much, and looked like we might have to suffer a first night sweating.

But then it occurred to me that I might not have understood the system as we had obtained it in the first place. We had purchased from a woman whose owner son had passed away, and she knew little of its operation. As we later discovered, that was not QUITE true, since she obviously knew of the floor problems in the living room and leaks in the roof of which we were unaware, and had to pay $4500 to get fixed in Dec. But she had not mentioned that the AC/Heat system was NOT a conventional setup as we had expected.

Had she known it she might have at least told us and saved me some headache, as I spent almost two hours trying to diagnose why the new thermostat was somehow switching over to heat during the cooling cycle, something it was supposedly ABLE to do, but was NOT one of the things it was SET to do, nor did its display suggest that was what it was TRYING to do. It actually turns out the place is more valuable than we had understood, because the ONLY other way for that to happen is the AC is actually a heat pump.

It was only after I started to do "what's wrong with this picture?" review that it occurred to me the real root cause. With any conventional system, the AC compressor turns on and compresses the coolant, typically a Freon substance, to high pressure gas, which runs through the outdoor condenser, giving off heat to the outdoors as it converts the hot gas to a liquid. The liquid is then carried to the "cooling coils" in the interior airstream, where it passes through an expansion valve to allow the liquid to expand to a gas again in the coils. That expansion causes it to draw off heat energy, which is how the coils get cold, which chills the air. It also causes moisture in the air to condense on those coils, where it drips down the drain tube to either a cellar drain or outdoors. In some systems this water is used for added heat removal at the outdoor condenser because the water, slung onto the condenser by the fan, removes more energy, thereby increasing its efficiency.

A Heat Pump, on the other hand, effectively reverses the functions of the condenser and cooling coils, by use of a reversing valve. That valve is controlled by the thermostat, but ONLY if it knows it should do so. And they are made both ways – with the valve energized only when HEATING or only when COOLING. It turns out ours works in the cooling. So what was happening is that the compressor, which runs the same either way, was first lowering the gas pressure upstream of the compressor, causing the initial cooling we were feeling, only to continue to pressurize, but in the COOLING COILS. Had I gone outside and felt the "condenser" air I would have felt it was colder, and understood immediately. Lazy me ;-)

In fact, way back at Clarkson in 1972 it had been a Thermodynamics Final Exam question when they were just starting to make the things, because although running a compressor costs more electricity than a resistive heater, which gives all its BTU energy to the room, that transfer of energy takes some of the latent outside heat and brings it indoors, along with all the radiant heat of the BTUs used for the compressor. Where we are it could be as much as a 50% increase. Even in CNY, where winters are too cold for a heat pump to be worth it, it nonetheless offers the advantage in both spring and fall seasons when weather can call for either heat or cool. When Lynne and I had our home in Liverpool, we had a heat pump installed with our central air system, which more than paid for the 10% higher cost for the system vs conventional.

When it gets too cold, below about 40 deg F, the system has "makeup" resistive heaters, all of which are controlled by the system. So the thermostat is essentially identical EXCEPT for the function of that changeover valve control wire. The labels on the thermostat are usually R for the source, typically 24 VAC, which gets switched to the Y for cooling or the W for heating, with W2 typically for added heating capacity, and the fan, which can be set for auto or on, uses the G. Ours had the O, or Orange, wire at the W connection on the original thermostat, which Honeywell happened to label as CONVENTIONAL on the side the wires were mounted, and only well below them actually called out for Heat Pump. But on the new unit it required explicit selection in setup for Heat Pump completely different from the default Conventional. As soon as I changed the setting, we started to properly cool, which it has done perfectly as intended ever since. Old dogs don't learn new tricks, just new ways of doing old tricks. But ONLY after pulling out more hair ;-)

Joe Holzer 2/1/2021

5th Storyworth B: Why I Have A Lot Less Hair Today ;-) ADDENDUM

Based on an email I got from Bonnie Fulmer, I should explain that her fear of replacing a thermostat should not be exacerbated by my earlier comments. Definitely NOT the lesson I'd want anyone to take from this. FYI, I had installed twin programmable thermostats in my RV right after I first got it and started living in it full time (at the time while working for clients wherever they needed me while Lynne was at home in Liverpool with Jess) because they paid for themselves within less than two months.

Like the latest, those are actually battery operated, but switch an external voltage source to the appropriate place to perform the desired task as per the program. So, for example, if heat was desired, I wanted to have the dual fuel capability of the propane furnace AND the electric space heaters, so that if one failed the other could still do the job. Where that was tricky was that the RV furnace was a strictly 12 VDC device, much like the electrics in any automobile heater. But the space heaters and the roof air conditioners were 110 VAC systems.

So I used conventional automobile relays, and switched the automotive 12 VDC to turn the relays on and off, based on the thermostat settings. The R, or Red wire terminals have +12 VDC connected to them, so the thermostat puts that +12 VDC to the W terminal for heat, and the Y terminal for cooling as the thermostat demands. And I setup a circulating fan for each using a relay as well from the G terminal, since the fans are conventional 110 VAC units, switched by the thermostat Fan setting. Just as with the newest thermostat, the C terminal is really unneeded, unless the system somehow needs to sense that a thermostat is in use.

In the case of the RV, the original furnace thermostat is a mercury bulb type switching the 12 VDC, which I set to the maximum setting, and use that to provide for the "enable" for that function, then control the switching relays for each of the options of the furnace and space heater(s) with the thermostat W terminal.

That way, I can selectably switch the furnace off independently with the mercury bulb switch, and each of the space heaters with their internal switch in each such heater, while controlling demand for the heat with the thermostat according to its program.

Likewise the roof air units are each switched by their relays, which like the space heaters switch the main power for each device with the relay NO (Normally Open) terminals, and their relay coils with the small 12 VDC current allowed by the thermostat. So the roof air control itself is always set for max cooling, and will do so whenever the thermostat calls for cooling. As with the heaters, I can easily override cooling that way.

It sounds like more tedium than it really is, and once understood provides for comfort rarely capable in an RV. The only REAL difference vs the newest thermostat is the RV can't switch between heating and cooling all on its own. But given our weather, both are OFTEN used on the same day, at least in FL, and I'll do the same in Chittenango with the unit Dawn inadvertently sent there first by mistake when she ordered from Amazon, which we'll expect to see when we get home in April.

As was well understood by me in suggesting the units to Dawn, they work by specifying an upper Cooling temp and a lower Heating temp for each of the four daily time settings, and for week day vs weekend day, which is a model selection choice of 5-2 vs 7 day. For safety and energy reduction, the low and upper settings never cross, unless Dawn chooses an override setting because she is uncomfortable at some point, which immediately reverts to the programmed settings at the next switched time point. And makes replacing a thermostat with a programmable new unit definitely worth the hassles, in a VERY brief period of time ;-)

Joe Holzer 2/1/2021