Indirect Water Heater O&M

Common O&M issues that can be avoided at specification

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Once upon a time, I renovated an old building down on the waterfront in Brooklyn and installed a 40-gallon, sealed-combustion, direct-vent water heater in each apartment. I paid a little extra for the ten-year model instead of the standard five-year model.

They were basically standard chimney vented, direct-fired, gas water heaters modified by adding a second jacket and a flue pipe surrounding the whole heater and flue pipe. Combustion air came in the outer flue pipe, down through the outer jacket, and into the combustion chamber. Products of combustion went up the standard single flue in the middle of the water tank, and out the flue, which had to be run out a nearby wall.

One summer, I turned the gas valve from "On" to "Pilot" when I left for vacation. I didn't turn it to "Off" because I wanted to avoid having to remove the airtight cover over the pilot burner to light the pilot when I returned.

When I came back from vacation, I started using the water heater again and everything seemed fine. A few months later I noticed I was able to take a shower just fine, but if I tried to take a shower to remove the day's dirt and then take a bath to soothe the day's bruises, the bath water was not as hot as I would have liked. Soon I noticed I was hardly adding any cold water when I took a shower. Of course, after fixing everyone else's heat and hot water all day, I didn't want to bother fixing my own water heater, but by the middle of the winter it got so bad that I had to look into it.

I found that I had forgotten to turn the heater to "On" when I came back from vacation. I had been showering for months on just the heat from the pilot light. Apparently the lack of a normal chimney kept the standby losses from this unusual heater so low that the pilot light could warm the tank to showering temperature and keep it there. This wouldn't have worked if I or someone else wanted to take a shower an hour later, but I lived alone and didn't cook, so I never noticed that the heater's "recovery" was absurdly long. The heat from the pilot light was not sufficient in the winter when the water came from the street at a lower temperature, and probably more significantly the combustion air drawn in by the pilot light was much colder.

As long as I lived there I kept the water heater on "Pilot" for all but the coldest months, and marveled at how much energy a normal water heater wasted keeping the chimney warm.

PHOTO A. A plastic-lined tank rusted through at the connection.

STANDBY LOSSES

How do you know how much standby losses a particular piece of equipment has? In part I of this series in March, I reviewed the pros and cons of indirect water heaters vs. direct-fired tank heaters and touched on the topic of standby losses. To review, in smaller structures where a direct vent, sealed combustion boiler can handle the load, I prefer to connect an indirect water heater to a boiler wired for cold start, which means the boiler stays cold until a call for either heat or hot water. This combination of equipment will almost eliminate standby losses. I can think of no other equipment arrangement that can provide a better combination of safety, reliability, equipment cost, and energy efficiency.

PREVENTING RUST

There is no excuse for buying an indirect water heater that will rust out in a few years. As soon as it fails, all the money spent on buying and installing it needs to be spent again. Many companies make indirect water heaters that are made of stainless steel in all the areas that fresh water touches. At least one has a coil made of cupro-nickel, which is probably impervious to corrosion.

Many tanks without coils, and some with coils, are available in glasslined steel. I always know I am installing a genuine glasslined tank when I am tightening the pipe connections into the tappings in the tank and I hear the glass cracking. All I have to say about glasslined tanks is "just say no."

Some models are available with plastic internal liners which will never rust. True, the liners will never rust, but the plastic does not cover the openings where water flows in and out of the tank, so I've seen those tanks rust through near the pipe connections (Photo A). Therefore I suggest avoiding plastic-lined steel tanks.

Just because a tank is made of stainless steel does not mean it will last forever. Welding stainless steel is difficult. I know of some brands of indirect water heaters that fail at the welds with shameful frequency. Who cares about a free replacement tank? Who is going to install it for free, or clean up the water damage for free? I suggest asking people who have been installing indirect water heaters or

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storage tanks for many years about which brands leak and which do not. Supply houses and manufacturers are probably a bad source of information about failures because they mostly only know about their brand. Find an indirect-water heater or storage tank that is made of stainless steel, and has a reputation for long life with the particular water in your geographic area, and reward the company with lots of business.

AQUASTAT COMPATIBILITY

Some indirect water heaters are sold with built in aquastats, which can be difficult to change when new and impossible to change after a few years when corrosion holds the temperature sensor firmly into the well. I have seen numerous indirect-water heaters thrown away when the aquastats fail. Of course, if the aquastat is not available in the future, changing it is not a problem—you just throw the tank away because you cannot get the aquastat.

Another problem with built-in aquastats is that they can be difficult or impossible to replace with water-temperature sensors as used with fancy electronic controls that track the temperature of the water in the tank instead of simply receiving an on/off signal from an aquastat. Some indirect water heaters have sensors hidden behind the jacket or at the bottom of a long and difficult-to-access well. Before choosing such a tank, make sure the aquastat can be replaced with a standard aquastat or sensor.

Some indirect water heaters have built in aquastat wells, which I have seen fail. Since the well is welded into the tank, the whole tank must be discarded when the tank fails. Definitely a setup to avoid.

Fortunately, some indirect water heaters are available with standard threaded aquastat wells. This is my favorite arrangement because the well can be changed if it leaks because the aquastat can be changed if it fails or if a different model, such as one with temperature limits is desired, and because the aquastat can be replaced with a temperature sensor.

FUEL COSTS

Which uses more fuel: a separate water heater and a separate heating boiler, or an indirect water heater? I have tracked fuel bills for two indirect water heaters that replaced separate water heaters in apartment houses. In the first installation, I connected a 120-gal. indirect water heater to an atmospheric gas boiler that provided steam heat to a ten-family apartment house. The summer fuel bills went up about 20 percent. I do not know what happened to the wintertime fuel bills. The customer said they were so relieved to be rid of the headache of changing water heaters that they didn't care if the fuel bill was a little higher. (Note that the annual bill could have been either

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higher or lower because wintertime standby losses from the water heater were eliminated, but I didn't track this.)

In another installation, I connected a 120-gal. storage tank to a coil in a steel firetube boiler fired with a motorized gas burner and connected to a 70-ft tall internal brick chimney. The ease with which air flowed through the direct-fired gas water heater was offset by the high resistance to flow of air through the heating boiler and burner, but the small size of the water heater was offset by the large size of the heating boiler. I compared the annual fuel consumption, which was about one percent higher after the installation. I did not normalize for differences in weather, so the only useful information to be gained is that there was not a very large difference one way or another.

Published research on the subject of energy used by separate water heaters vs. making hot water with the same boiler that heats the building is in short supply. Available research that compares boilers installed in buildings and providing both heat and hot water to separate water heaters installed in buildings shows that separate water heaters use more energy. Computer simulation research comparing boilers to separate water heaters has concluded the opposite, which might say more about the usefulness of taxpayer financed computer simulations than it does about making hot water. My personal preference is to install an indirect water heater to make hot water in any installation where an indirect water heater can handle the load, which means any installation up to about an 8-10 family building.

LEGIONELLA AND HOT WATER TANKS

People shower at about 106 to 109 F, and complain if water is not delivered to the tap at around 117 to 118 F or so, so many apartment houses target 120 F as the temperature of the water leaving the hot water tank. Many health-care facilities limit delivered water temperature to 110 F to prevent scalding, particularly among those at high risk, such as infants, diabetics (poor circulation), and people who cannot jump out of the hot water suddenly enough.

Legionella bacteria like to live in warm or hot water. Their favorite is water at close to human body temperature. In a tank of water at 120 F they will live, and still breed, but at a reduced rate. So is it hazardous to store water at 120 F and then send it to showers where people can breathe the spray?

Maybe. There is no known case of someone catching Legionella at a residence. Most reported cases are from cooling towers, but there is reason to suspect many of the thousands of people who die from "pneumonia" every year died from undiagnosed Legionella. When otherwise healthy people get pneumonia, especially when groups of people get sick, Legionella is the chief

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Measuring Standby Losses without Government Funding

There is a fairly easy way to measure the standby loss from a combustion appliance. It is appropriately called the "idling test" by researchers such as Martha Hewitt who have led this sort of research in the United States. Just turn off the load while leaving the appliance hot, and measure the fuel usage. Most of the heat lost will have gone up the chimney while the appliance is not firing, with some small losses out the jacket. Combustion efficiency is also reflected in this test, but is a minor factor. You can expect results in the neighborhood of one to five percent of the appliance's firing rate. (Note: not percent of annual fuel use, but percent of firing rate). This wide variation obviously dwarfs all possible variations in combustion efficiency and jacket losses, which are minor factors compared to standby losses.

For example, for a direct-fired natural-gas-fired water heater, turn off the water leaving the heater (leave the cold turned on to reduce the possibility of firing the heater without water in it), leave the temperature control in the heater alone, and read the gas meter before and after a 24-hour period. This is a harder test to do during the winter, when presumably the heating boiler on the same meter will also be consuming gas.

One possibility is to get to the building at 1 am on a winter night, valve off the hot water leaving the heater, turn off the heating boiler, and read the meter. Go to sleep if you dare, or stay awake, and read the meter again before putting everything back to normal at 5 am. The gas usage during the 4-hour test period should be a decent ballpark approximation of the standby losses over any other 4-hour period.

Note that your findings would be specific to that make and model of water heater, which should not be used to generalize about standby losses from water heaters in general, especially other types and sizes of heaters. And more importantly, your findings would be specific to losses with that specific chimney, and cannot be used to generalize about standby losses that would result if the same heater was connected to a different chimney or tested on a day when a different outdoor temperature generated a stronger or weaker draft in the chimney.

suspect and for good reason. When one person who is very old, or immunocompromised because of cancer or AIDS or immunosupressive drug therapy gets pneumonia, typically nobody checks for Legionella. So there are probably many undiagnosed cases of Legionella every year.

So should water be stored at a higher temperature? If so, it can be mixed down to a lower temperature before being sent out to the building's piping. However, this does nothing to stop the growth of Legionella in the hot water distribution piping.

However, most buildings are not equipped with point-of-use mixing devices, so a decision must be made between lesser evils: Legionella hazards associated with lower temperature or scalding hazards and higher energy use associated with higher temperature. If lawsuits are a guide, there have been thousands of scalding lawsuits and few or no lawsuits resulting from Legionella associated with storing domestic water at 120 F .

I still set aquastats for 115 F to get water at about 120 F because I work in apartment houses that have no point-of-use mixing devices, but I am not sure if I am doing the right thing.

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