Installing Indirect Water Heaters

Avoiding costly mistakes at the work site

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I once got a call from one of my crews because they were unable to get a 120-gal. indirect water heater down the stairs at a job site. I wasn't happy sitting in traffic on the way to the site, knowing I was paying them to stand around and wait for me, but I didn't want to insist when safety was an issue.

Sure enough, they were right. Two people couldn't possibly get that heater down to the basement. It weighed more than 400 lbs. The supply house had to use a forklift to get it into the truck. Eventually, four of us got it down the basement without injuring anyone. However, I have never bought or specified that brand of indirect water heater again. I politely mentioned this to a company rep at a trade show once. "It is your responsibility to have heavy lifting equipment on the job," he replied. The lesson learned: it is a good idea to check the weight of a tank before you buy it.

In order to help readers avoid these types of problems, this article describes the basics of selecting, sizing, and installing indirect-water-heating tanks and pumps.

WILL THE TANK FIT?

Some tanks are much taller than other tanks with the same capacity, and some have the hot-water outlet at the top of the tank, while others have it on the side near the top. This can make the difference between the tank fitting in a low-ceiling basement or not.

Some tanks are wider than other tanks of the same capacity, and some even have removable jackets, which can make the difference between fitting the tank through a narrow doorway or not. Measure twice so you never have to cut.

COIL IN THE BOILER OR IN THE TANK?

A typical indirect water heater has a coil in the tank. A storage tank heated by pumping water through a coil in the boiler could also be considered an indirect water heater. If the boiler is a hot-water boiler, not a steam boiler, it is probably best to install an indirect water heater with the coil in the tank. This is because the lime will collect on the outside of the coil in the tank and fall off instead of collecting on the inside of the coil in the boiler and clogging the coil. A stainless-steel coil in a tank will probably outlast a copper coil in a boiler.

The question gets a little more complicated with a steam boiler. If possible, it is better to install a coil in the steam boiler and use it to heat water stored in a tank. This is because it is difficult to pump the water in a steam boiler because it is actually boiling many hours of the year.

HOW TO PUMP BOILING WATER

For steam boilers that have no place to install a coil or for situations in which the cost of reconfiguring the boiler to accept a coil is prohibitive, it is possible to pump steam boiler water. The arrangement of the pump and piping is critical. If it is not installed just right, the pump will not work more than a few hours or days.

One solution to this problem is to screw a 8-to-10-in.-long black nipple into a tapping in the side of the boiler about 6 to 8 in. below the boiler's water line. If the tapping is large enough, use a 1½-in nipple. At the very least, use a 1-in. nipple. Make sure to use a tapping that is not shared by anything else, particularly a water-level control. The pump gets mounted on a flange on the end of the nipple screwed in the boiler. Another 8-to-10-in.-long black nipple gets mounted on the pump's outlet flange. A reducing elbow goes on the end of this nipple, but in no case are there any valves or elbows or other fittings near the inlet or outlet of the pump. This arrangement reduces turbulence in the area of the pump, while maximizing net positive suction head available to the pump.

Most manufacturers publish friction and flow data on the coils in their indirect water heaters, which can be used to calculate the flow for any combination of pipe size, pipe length, and pump. The trick to making the pump last is to choose a relatively low-head, high-flow pump, and size the pipe to give enough resistance to make the pump operate at the left end of its curve, where it pumps relatively few gallons of water. This usually means ½-in or ¾-in. pipe, with 1-in. pipe usually allowing too much flow to keep the pump operating safely at the left end of its curve. Sometimes a combination of ½-in. and ¾-in. pipe gives just the right resistance.

Look for a water-lubricated pump with carbon bearings instead of ceramic bearings, which tend to seize up under the stress of pumping boiling water. Use an iron pump, as there is no need to spend the extra money on bronze.

The return water from the coil should enter the boiler down low at the other end of the boiler or be teed into the condensate return near the boiler. Some people recommend pumping water out of the bottom of the boiler, but this can be problematic because the cold water short circuits across the bottom of the boiler when it is not steaming. Also, rust and dirt in the boiler are more prone to clog the pump when it is mounted down low.

I know that one boiler manufacturer recommends installing a nipple just below the water line and piping the water down a couple of feet and then into the pump as a way of increasing the net positive suction head available to the pump. Calculations show the head lost in the elbows is more than made up for by the 2

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ft of head gained, but I have never tried it.

I have had to change pumps (for free) one day after I installed them when they were not installed as described above. I've also installed pumps costing less than $100 as described above that went on to function properly for more than five years while pumping boiling water all winter.

SIZING THE PUMP

Indirect-water-heater-manufacturers' charts show the desired flow and temperature of water through the coil necessary to achieve a particular water-heating capacity, also called recovery capacity. An important point to remember is that just because the manufacturer's chart shows a certain flow through the heater's coil, that doesn't mean the heater will not work with a lower flow rate. A lower flow rate or cooler water flowing through the coil will not heat the tank up as quickly as the manufacturer's ratings indicate, but will probably heat it up almost as quickly. This is because the relationship between flow in the coil and heating capacity is very non-linear. Put another way, reducing the flow through the coil to 60 percent of what the manufacturer asks for might reduce the coil's heating capacity by only 5 or 10 percent, which is not a big price to pay for a pump that lasts decades instead of years.

While it is always desirable to maximize recovery rate, manufacturers sometimes ask for absurdly high flows and temperatures. Who can blame them when they know some customers will select products according to recovery rating?

In sizing an indirect water heater for a particularly well insulated structure, you might find that a boiler sized for heating alone is not large enough to provide the recovery called for in the tank manufacturer's literature. This is usually not a good reason to install a larger boiler. Instead, the next size larger tank, which "needs" even more recovery, can probably store enough water to compensate for the boiler's reduced recovery capacity.

SIZING THE TANK

A tank that stores more water than will ever be used in a day can have a very slow recovery and still work well, as in the extreme example of the water heater I accidentally left set to "pilot." Conversely, a heater that stores no water but has a large enough recovery capacity can also work, as evidenced by some of the instant water heaters on the market. Many combinations of storage and recovery somewhere in between these two extremes can work.

Published charts show estimates of how much recovery and storage capacity a particular installation can be expected to need, and most indirect water heater manufacturers also provide sizing guidelines. Since actual hot water consumption patterns can never be precisely predicted, sizing is a delicate balancing act between tank size, pump capacity, and

boiler capacity.

The only decision that is intrinsically safe is to oversize the tank. Because the tank has only minor standby losses, there is almost no energy penalty associated with oversizing it, but there could be a huge energy penalty associated with undersizing it.

MEASURING THE SUCCESS OF AN INSTALLATION

No apartment house tenant has ever asked a superintendent to "please increase the storage capacity" or "increase the recovery capacity." They only ask for "more hot water," to which the super responds by doing the only thing he can do: raise the temperature setting on the aquastat. The super is not making more hot water, but is making the water hotter. This can result in scalded people and destroyed faucet washers, which causes running leaks and ever louder pleas for "more hot water."

Watching this phenomenon has led me to a very unforgiving way of measuring the success of any tank installation: If I set the aquastat at 115 F and return and find it untouched, the installation probably has an adequate combination of storage and recovery capacity. On the other hand, if I find the aquastat set to a higher temperature, the installation, the storage and/or recovery capacity are probably not adequate. If I lower the aquastat setting and ask for it to remain low and find it is raised again, I have more reason to think the installation is not adequate. I reason that if there is never a shortage of hot water, the aquastat will probably not be raised.

If a shortage of hot water has been demonstrated or is worried about in a proposed installation, my favorite cure is a larger tank. The standby losses from a larger tank are minimal, especially when compared with the energy cost of overheating the water. The only added cost is the cost of buying a larger tank, but the cost of installation is essentially the same as for a smaller tank. So, if in doubt, increase the size of the tank.

AVOID CONVECTIVE FLOW IN THE COIL

Hot water from any boiler, either a hot water boiler or a steam boiler, can flow by convection to the coil in the tank and overheat the tank. This is also a problem with storage tanks heated by a coil in a boiler. An electric zone valve can prevent this. Special flow-control valves held shut by gravity are available, but there is a better way that is cheaper and move reliable: Just install a horizontal check valve in a vertical-up position or in a pipe flowing up at 45 degrees. This should be done on every installation. See "Selecting water-heating systems: options for preventing undesirable convective flow" in the August, 2002 issue of *HPAC Engineering*.

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