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Maintenance: Steam Heat Systems

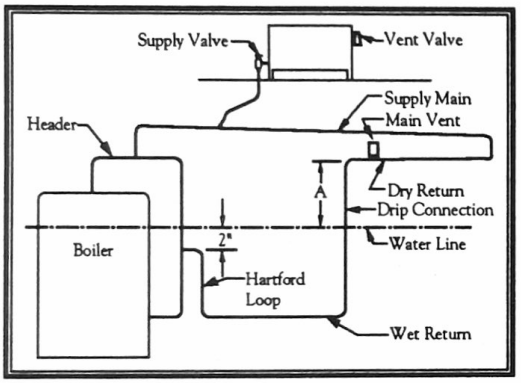
Maintaining safe and efficient heating systems is a top priority at this time of year as hard-sought dollars get turned into energy and warmth. Having efficient running systems is also one way your congregation can have a direct impact on cutting expenses and saving money.

Steam heat, one of the most popular types of systems in historic houses of worship, requires top-notch maintenance by experienced contractors and mechanics who know and appreciate its history, technology, and value. And there's a lot to know about steam heat systems. In general, they work by having a boiler heat water into hot gas which is then transported through pipes to radiators. As the gas travels throughout the system, it cools and turns into condensate which travels back to the boiler for reuse.

Guest author Dan Holohan, who has devoted his career to the study of steam heating, shares some tips with us below. Sources for more information, including checklists for annual servicing by qualified mechanics or contractors, and routine monitoring by maintenance personnel, are listed in Resources on page 15.

WHAT I WOULD TELL MY PASTOR ABOUT STEAM HEAT (*but only if he asked*)

by Dan Holohan



Schematic diagram of a one-pipe steam system from Dan Holohan's publication, *The Lost Art of Steam Heating.*

Let me begin by saying that there is a golden rule in the world of heating that states: Never do work for your relatives, your friends, or your church. These jobs cannot possibly work. With that out of the way, and against my better judgment, here's a short list of what I would tell my pastor should (heaven forbid!) he ever find out that I know a thing or two about ancient steam heating systems.

If you need a new boiler, make sure the contractor bases its size on the connected radiation load, not the church's heat loss. The radiation load is the actual measurement of the size of the radiators (tubes or columns, sections, and height) and the piping that is connected to the boiler. The boiler's ability to produce steam must match the piping and radiation's ability to condense steam.

It does not matter what the church's heat loss is. Religious buildings are peculiar because the old-timers who put all of this stuff in — I call them the "Dead Men" — were not trying to heat all that air above your head. They just wanted a system that would start up quickly, cool down just as quickly, and bathe the congregation in radiant energy for a few hours a week.

They were looking for a quiet system that would heat the people without disturbing all that cold air up there near the plaster ceiling. They deliberately undersized their steam systems (piping, radiation, and boiler) so that they could set up convective currents of air in the "lower atmosphere" of the sanctuary.

This is the reason why ceiling fans often send the fuel bills skyrocketing. A couple of fans will stir all that cold air in the upper "atmosphere" and force it down into the warmer air below. Keep in mind that heat does not rise — hot air rises. But it can only rise so high before it cools and falls back down.

The only way to size a replacement steam boiler is to go from room to room and measure the radiators. Use the published charts to figure out the heat output of each one (my book, *The Lost Art of Steam Heating*, contains these charts). Then add a suitable "pick-up" factor to allow for all that piping between the boiler and the radiators. How big a "pick-up" factor needed depends on the amount of insulation in the pipes. Bare pipes lose more heat than insulated pipes. If the asbestos has been removed, replace it with a more suitable material. The steam will travel further and you'll save money. The steam should condense in the radiators -- not in the basement before it gets to the radiators.

There has never been a steam system that did not need to be vented. Steam pipes

are never empty; they are always filled with steam, air, or condensate. To get the steam to go where you want, you have to vent the air. Old systems had some pretty strange-looking air vents. Poke around. You'll find them. If they're plugged, replace them.

Main vents are crucial to steam heating. Every steam system needs main vents near the ends of the steam mains — even if there are air vents on the radiators. You have to treat the air in the mains and the air in the radiators as two separate challenges to balance the heat.

Steam traps create steam distribution. The steam traps you'll find on radiators and at the ends of steam mains in two-pipe steam systems keep the hot side hot and the cold side cold. When they are not working you'll lose your system balance. (Various types of traps, orifices, and special fittings that control steam distribution are covered in *The Lost Art of Steam Heating* and *The Lost Art of Steam Heating Companion* listed in **Resources**.

Feeders do not maintain normal water lines, people do. Controlling the water level is crucial. This is especially true of today's highly efficient, low-water-content boilers. If you raise the level too high, you'll run the risk of having some water rush out of the boiler with the steam. But if you maintain the water line too low, the boiler will probably go off before the building is warm enough. And if you're using an automatic feeder, chances are it will flood the boiler before the condensate makes it back from the system.

Some boilers belong in sunken pits. The pit allows for a height difference between the ends of the steam lines and the boiler water line. We call this a gravity-return system. A combination of static pressure (from the height difference) and the "leftover" steam (or condensate) at the end of the main puts the water back in the boiler. Without the pit, you might not have enough static height. The water will back up into the pipes, making the system bang and hammer. If a contractor wants you to fill in that hole when it's time to replace a boiler make sure they know what they're doing.

Wet returns are the worst. Steam systems are constantly dissolving and everything eventually winds up in the wet return (the piping below the boiler water line). And once enough sludge settles there, the condensate won't be able into get back to the boiler. Instead, it will back up into the mains and cause the pipes to hammer, usually in mid-cycle.

If you have old wet returns, assume they are clogged until proven otherwise. Flush them through with a hose and see what comes out. In many cases, you will find stuff left over from the birth of the Universe. Replace those old returns, if you can. Know, too, that a partially clogged return is more likely to be a problem with a replacement boiler than it is with your existing boiler. That's because a replacement boiler holds less water than an old boiler. It can't afford to wait for the condensate to return through those clogged pipes. You might wind up with a boiler that goes off on low water all the time.

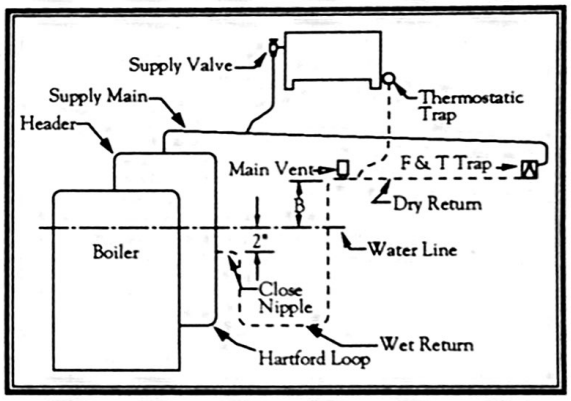
The piping around the boiler is crucial to the boiler's operation. Modern, replacement steam boilers work fast and furiously. They jump all over that old piping with a combination of steam and water. To heat the church properly, you need to dry out the steam before it leaves the boiler room. The old boiler had no trouble doing this because it was larger and it dried the steam internally. Nowadays, drying out the steam becomes the job of the near-boiler piping. Boiler manufacturers consider the near-boiler piping to be a part of the boiler. If you're replacing the boiler, make sure your contract states that the contractor will install the new boiler in accordance with the manufacturer's published instructions.

Steam boilers need to be cleaned after they're installed. And I honestly don't see how anyone can do this properly in less than a day. If the system is dirty the pipes will knock and hammer, the boiler will shut itself off on low water, or it will flood. The best cleaning agent for a steam system is tri-sodium phosphate (TSP). If you can't find that, try a commercial soap called MEX.

Steam heating pipes can support just so much radiation. If you connect too many radiators to a steam main, some of them will never get hot. Think of steam heating as a battle between the boiler's ability to make steam and the system's ability to condense steam. The Dead Men sized those pipes to carry just so much steam to the radiation. They used engineering charts to figure a certain pressure drop for the steam as it traveled. Then they figured the boiler and piping location based on that pressure drop. The more radiation you add, the larger the pipe must be. If you connect too much radiation, the system won't work.

You can heat any church in the world on less than two pounds of steam pressure. I don't care how big it is, you can heat it with extremely low pressure. How do I know this? The Dead Men told me so. They wrote it all down in dozens of ancient books. In steam heating, the pressure you need depends on the size of the piping, not the size of the building. If you lower the pressure, the steam will move more quickly to the radiators. I know that doesn't make sense, but try it once and you'll see what I'm talking about. When it doubt, crank it down!

© Dan Holohan 1997. Dan Holohan is a writer and lecturer who specializes in steam and hot water heating systems. His ten books are available through the mail (see **Resources** or visit his web site at www.danholohan.com.).



Schematic diagram of a gravity-return, two-pipe steam system from Dan Holohan's publication, *The Lost Art of Steam Heating*.