More Than Just Hot Air

IN THIS SECTION, WE DISSECT FURNACES, BOILERS & INDIRECT HEATERS IN THREE PARTS

BY DAVE YATES

Technology changes in heating equipment have been pioneered in the United States by manufacturers of forced hot-air furnaces. Like any other revolution, this did not come without its problems. In the beginning, we bumped our heads on the learning curves and encountered equipment that has, mercifully, gone the way of the Dodo — extinction!

AFUE, DOE, GAMA and a host of other abbreviations, such as EER and SEER, accompanied this evolving technology, becoming a source of confusion for homeowners and contractors alike. In an industry that had long grown accustomed to little change, the advent of new regulations designed to conserve energy led to a rush for efficiency compliance.

Chimney venting of appliances requires limiting efficiencies to 80 percent in order to avoid sustained flue-gas condensation, which occurs once those combined products of combustion fall below 265° F for natural gas; 240° F for No. 2 fuel oil. In order to ensure high enough temperatures in the masonry chimney, outlet exhaust-gas temperatures at the furnaces were higher, to compensate for any cooling effect. Condensate, produced at the rate of roughly 1 gallon per 100,000 BTUs burned, is acidic and will attack bare metal and erode masonry products. The lower-efficiency furnaces sold today ride the edge of that condensation borderline temperature range and often require careful consideration of an internal chimney liner to prevent condensation.

Stainless-steel flue piping and several high-temperature plastics were introduced as efficiencies crept toward 90 percent, and chimneys were abandoned in favor of directly exhausting the flue gases to the exterior. We quickly discovered that pool chemicals and other household cleaning products — agents with chlorine are especially bad — give off gases that can have disastrous effects on system components if they are stored in areas where combustion air moves toward the furnace (or boiler). When combined with carbon-based fuels, they form hydrochloric acid. New home construction became so tight that fresh air had to be brought in for combustion in what is called direct venting (both supply and exhaust air are piped to the exterior). Indirect venting applies to those systems where only the exhaust is piped to the exterior. Some of these earlier forays into venting technologies still haunt us. For more information, visit **www.cpsc.gov/cpscpub/prerel/prhtml01/01069.html**.

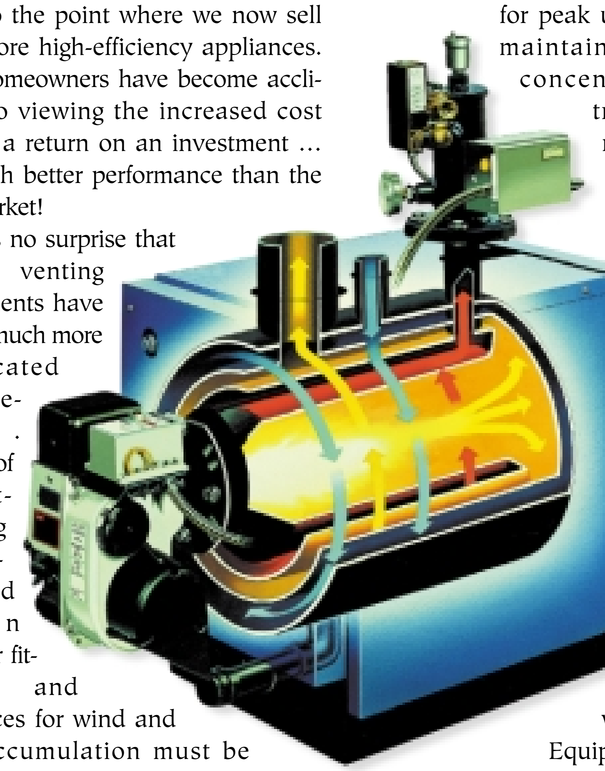
Courtesy Heat Transfer Products

While they cost more than an older model, newer furnaces provide a rapid return on investment. At right is the Munchkin, with a 92 percent AFUE.

It wasn't until the 90 percent efficiency barrier was broken that flue-gas temperatures began to fall to a range best suited for standard low-temperature plastic piping. This was also the time when electronic ignition, both spark and glow-bar, began to replace the old reliable thermocouples. Standardization of component parts virtually disappeared, which has greatly complicated inventory and service issues. Our tools began to change, too, as we adapted to emerging technologies. No longer were simple hand tools and a flashlight sufficient for diagnostic work. Electric voltmeters and ohmmeters became commonplace, along with sensitive combustion analysis gas detectors and seminars concerning proper diagnostic techniques. Technicians have had to become educated in high-tech appliances as well as staying abreast of U.S. Environmental Protection Agency regulations and — if they want to handle refrigerants — obtain an EPA license certification.

As manufactures have achieved higher furnace efficiencies, they've led the way with advanced printed circuit boards that act as the brains for managing all of the internal components. Today it's common to see efficiencies between 92 and 98 percent! Variable-speed or stepped speeds for blower airflow is being combined with staged or variable combustion inputs. This squeezes out every BTU the energy source can provide, while enhancing your comfort level. The cost between the high-efficiency systems and the old standard efficiencies of 80 to 87 percent (considered high-efficiency just a few decades ago), have narrowed to the point where we now sell many more high-efficiency appliances. Smart homeowners have become acclimated to viewing the increased cost more as a return on an investment … often with better performance than the stock market!

So it's no surprise that flue-gas venting requirements have become much more complicated and precise. Lengths of exhaust-piping runs, associated friction losses for fittings, and allowances for wind and snow accumulation must be taken into consideration. Building and home inspectors have had to jump in with both feet to keep up with the changes.



Courtesy Laars

The production of acidic condensate also presents a new twist and one that sometimes sees shortcuts, such as simply drilling a hole through the concrete floor to dump this fluid into the stone bed below the slab. Special pumps capable of lifting the condensate to a suitable drain, such as the laundry trap, are inexpensive and capable of handling the lower pH of the fluid. Some local codes require the inclusion of a buffering container to neutralize the acidic fluid prior to being introduced into a sanitary sewer line. For climates with subfreezing temperatures, pumping to an exterior location is not recommended.

We're seeing the beginning of another technology revolution as equipment becomes smart and self-diagnostic, too. Today, PC boards often include lights that flash diagnostic codes, aiding the technician. I believe we'll soon see a constant stream of innovations.

Reliable flue-gas sensors will allow continuous analysis and adjustment for peak use of fuel while maintaining the lowest concentrations of nitrogen oxides to minimize airborne pollution. We'll be able to dial in and monitor the equipment's performance before a technician is dispatched. That way, there will be no guesswork about which parts will be needed. Equipment will detect problems and call for service entirely on their own! Advancements will enable self-monitoring equipment to predict problems before they occur, eliminating middle-of-the-night or weekend service calls.

Wireless sensors will provide feedback to the heating equipment's brain

Courtesy Laars

Counter-flow design preheats cool return water before it reaches the inner jacket in the boiler at left. Above, this boiler uses automatic burner modulation ranging from 57 percent to full fire, preventing short cycling.

for an infinite variety of personal preferences based on things such as voice recognition or infrared signatures that designate who is where within the conditioned space. Computers will use outdoor and indoor sensors to compute the number of BTUs needed at any given moment to offset the heat loss of the structure. This will enable the equipment to run at lower speeds, more quietly and at peak efficiencies.

Many have long considered these advancements impossible, but I think they're just around the corner. ▪

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What's New With Hot Water

BY DAVE YATES & JOHN VASTYAN

Boiling Over

There's a rift in the home-heating industry that pits professionals on the water side against those on the air side. That is: hydronic vs. forced warm air. Some contractors prefer one type of heat to the other, but many have learned that to serve their customers well they must offer both types of heat.

The term *hydronic heat* may sound like an obscure, futuristic form of heat production. Yet, it has been around for centuries and is widely regarded as the finest type of heat available for the home. The term simply refers to water that is heated, then circulated in liquid form, or as steam. Since steam is ... well, losing its steam, we'll focus on systems that circulate heated water. After all, the best natural convector of heat is water, making it the perfect medium for heating your home.

Few will dispute that water is often the most comfortable and efficient source of heat. Although more expensive to install than other forms of residential heat, hydronic heat is cleaner because it doesn't circulate dust, dander, molds and allergens. It doesn't forcefully dehumidify the air or push the air around; it is quiet, and it heats very uniformly.

Hydronic heat's incredible flexibility is a huge advantage for homeowners. It can be served up through traditional, standing radiators, or by sleek, sculpted panels for walls or ceilings. Also, hot water running through tubing installed either in or under floors and walls effectively turns them into huge radiant heat panels.

Hydronic heat is also easy to zone. Heating large or small areas of the house — depending on your need — can be controlled precisely. This increases comfort and substantially reduces home energy costs. Using programmable thermostats for each zone, you can set the daytime living areas to cool down at night and warm up in the morning before you leave the bedroom.

Hydronic heating produces hot water for cooking, washing, hot tubs and swimming pools; it can also be circulated within walkways, garage floors and driveways to melt ice and snow.

There's even a method called hydro-air that combines hydronic and forced-air heat. It consists of a coil of tubes placed within a central air-conditioning system. Hot water from the boiler goes to the coil. Air heats by passing through the coil and then circulates into the living space.

The heart of a hydronic system is a boiler (or in some instances, a water heater). But don't let those dusty old recollections trick you into thinking of a boiler as a menacing mass of metal and twisted pipes. The new generation of high-efficiency boilers combines art and function beautifully!

Boilers typically outlive furnaces, and the hydronic system — as a whole — is uncomplicated with few moving parts. And because hydronic heat is a sealed system, it doesn't add or remove moisture in the house, so there's usually no need to install equipment to balance indoor humidity.

The chart below looks at some of best of these systems, listing features, prices and AFUE (annual fuel utilization efficiency) for each.

BOILERS

Make	Model/Series	Fuel	Highlights	AFUE	Warranty	MSRP
Buderus	G124X	Nat. gas, LP	Can be installed on combustible surfaces	81.5% to 85%	10-year limited	$1,700 to $2,200
Heat Transfer	Munchkin	Nat. gas, LP	Compact, self-diagnostic	92%	12-year limited	$2,730 to $4,841
Laars	Endurance	Nat. gas, LP	Boiler/water heater combo	85%+	20-year limited	$2,560 to $2,978
	Max	Oil	minimal standby heat loss	87%	Lifetime limited	$2,424 to $3,115
Weil-McLain	Ultra Series	Nat. gas, LP	Freestanding or wall-hung	92.8%+	15-year limited	Set by individual dealers

In an Indirect Manner

Indirect water heaters may be the most significant technology enhancement to enter the residential hot-water industry in the last 30 years. Two key needs have driven demand for these incredibly useful and practical heating units: fuel efficiency and an ever-increasing need for more hot water. Hot tubs, large baths, multihead showers and bigger homes with more bathrooms all create a major appetite for hot water. Fortunately, these heaters can generate it faster than anything else.

Though electric water heaters are quite efficient, operating costs are high. Direct fossil-fuel-fired tank water heaters are typically inefficient, unless specifically designed for high efficiency, but that means a substantially higher expense on the front end. And all tank-type water heaters are great collectors of precipitates. Incoming water slows suddenly, heats up and gives up its mineral particulates, which fall to the bottom, insulating the tank from the heat source over time, adding to thermal stress and decreasing efficiency.

Indirect-fired water heaters, on the other hand, use the high efficiency and sturdiness of modern hydronic boilers by becoming an attached "zone." Typically, the boiler sends 180° F water into a coil within the super-insulated tank, where the water is heated without the stress and with the efficiency that's so hard to combine in direct-fired tanks.

As an indication of their efficiency and ability to produce hot water, many indirect-fired water heaters provide two to four times the recovery rate of gas-fired water heaters. They also offer three to six times the peak output for comparably sized electric water heaters.

Indirects, like any popular product, are available in a wide variety of configurations and sizes from a number of manufacturers, European and domestic.

All of the leading manufacturers of indirect units insulate their tanks very well. Most claim losses of 2° or less per hour during standby; some measure heat loss at less than 1/4° F per hour.

The majority of tanks range in size from 20 to 120 gallons. Prices range from $500 to $2,000, and from $1,000 to $4,200 for 120-gallon units. The wide range in pricing is due to quality of craftsmanship, accommodation for faster heat recovery, ease of installation and maintenance, resistance to deterioration and mineral buildup, integration with boiler controls, efficiency, standby losses and expected service life. They do not reflect differences in installation labor, which can be substantial.

Again, refer to the chart to compare features and highlights at a glance. ■

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INDIRECTS

Make	Model	Options	Highlights	Warranty	MSRP
Buderus www.buderus.net 800-283-3787	Thermoglaze	11 sizes from 32 to 79 gallons	Exceptionally well insulated, loses less than 1/4° F per hour	15-year limited	$700 to $1,700
Heat Transfer www.htproducts.com 800-323-9651	Super Stor Ultra	7 sizes from 20 to 119 gallons	Stainless-steel construction, cupronickel coils, 2-inch-thick insulation keeps heat loss at less than 1/2° F per hour	Nontransferable limited	$903 to $2,492
Laars www.laars.com 805-529-2000	Duraflow	90,000 BTUs/hr	Counter-flow design virtually eliminates scaling; top-mounted coil provides easy inspection & maintenance	20-year limited	$780
Peerless www.peerless-heater.com 610-367-2153	Partner	5 sizes from 30 to 119 gallons	2-inch-thick insulation keeps heat loss at less than 1/2° F per hour	Nontransferable limited lifetime w/ exclusions	$858 to $2,264
Triangle Tube www.triangletube.com 856-228-8881	Phase III	6 sizes from 40 to 100 gallons	Tank-in-tank water barrier between heat source and domestic water eliminates lime buildup, excellent heat transfer and rapid recovery	Nonprorated nontransferable lifetime	$850 to $1,800
Weil-McLain www.weil-mclain.com 219-879-6561	various	4 sizes from 30 to 80 gallons	No coil to maintain, self-cleaning design reduces calcification w/in system	Nontransferable limited lifetime w/ exclusions	$715 to $1,099