

An inspector's journey into the land of water heaters leads to a new protocol

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New Brighton, Minn.

Not too long ago, I received a call from a client of mine who had just moved in the house I had inspected for him a month before.

He told me that the water heater didn't hold enough water to fill a tub. It seems he had gone to take a bath, and even though the water was hot when he started, it was cold before the tub was half full. To correct the problem (or so he thought), he turned the water heater thermostat up to its maximum setting. The next day when he got home from work, he discovered the water had become so hot that the relief valve popped off, and water was flooding his basement, ruining his record collection that was still in boxes on the basement floor. He thought I was to blame and should reimburse him for his loss.

Of course, I didn't feel responsible since I was not the one who had turned up his water heater to the maximum setting. I reviewed my inspection report, and saw I had followed ASHI Standards of Practice, which required me to "inspect and describe the water heating equipment and vent system."

I even reported, "The water heater is 20 years old and may require repair or replacement at

Editor's note: This article recounts how one ASHI Member took his work to heart, leading him on a personal, investigative journey into the inner workings of the water heater. It also details how he currently conducts his inspections as a result of his findings. Although the testing methods he has developed go beyond ASHI requirements, Mr. Eliason reports they only add a few minutes to his overall inspection time and have helped him identify defects in several water heaters he otherwise may have missed.

any time." What more could an inspector be asked to do?

That question kept going through my mind for the next several weeks, and only led to more questions.

Was there a way I could have reasonably determined that my

replacing it must lower the tank temperature, but by how much? While I knew I had done my job as a home inspector, I did understand why my client was upset. If I had just purchased a house and found out I couldn't even draw a bath, I wouldn't be a happy camper either.

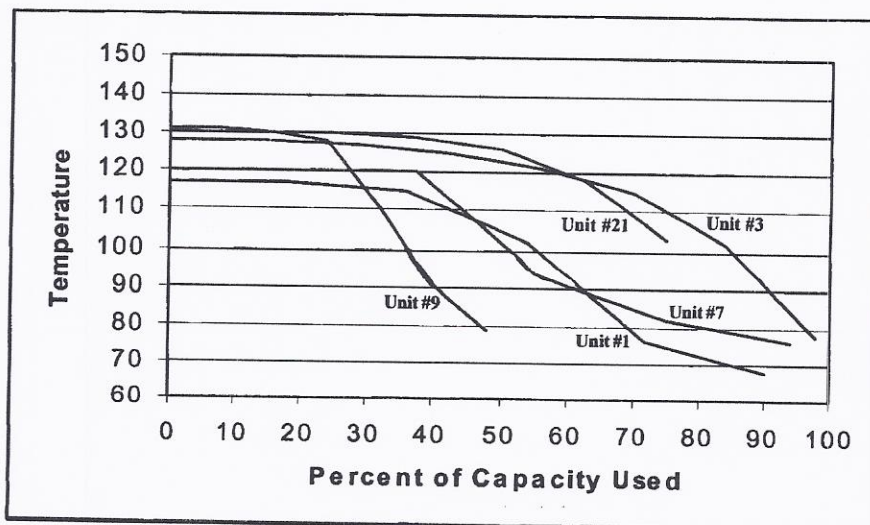
I felt I needed more information to satisfy my own curiosity. For the next few weeks, I recorded the following data on every water heater I inspected: the size and age, the flow rate in gallons per minute (GPM), and the water temperature at one-minute intervals.

I let the water run until the temperature dropped below 100 degrees, then charted the results to determine a normal temperature drop curve. I discovered that no two water heaters perform alike. However, most units function within a similar pattern, and it's easy to spot defective units using a simple testing method.

Learning how a water heat works

Water in a water heater is stratified, with the hottest water at the top. As hot water is drawn from the top of the tank, it's replaced by cold water entering the bottom via the internal dip tube. The water entering the unit mixes with the hot water, forming an area of lukewarm water between the new,

cold water in the bottom of the tank and the hot water on the top. As water continues to be drawn, this buffer zone moves up towards the top of the tank.



client's water heater lacked sufficient capacity? How much water should a water heater really hold? As hot water is used, it's reasonable to assume that the cold water

Research and recorded data

As the chart shows, (see opposite page) water heaters 3 and 23 best represent a typical temperature drop curve. The water temp is steady, within five degrees of the starting temperature, for about 40-50 percent of the tank volume.

Unit #	Volume	Age	CPM
1	50	3	9
3	52	4	7.25
7	40	22	7.5
9	75	10	6
21	40	?	5

As the mixed zone starts to reach the top of the tank, the water begins to cool. At 60 percent of volume, the water temperature drops about 10 degrees and starts to fall off more rapidly. At 70 percent of volume, it drops by 15 to 20 degrees, but is still useable hot water. Beyond 70 percent, the water is only warm to the touch, dropping to cold by about 80-90

percent. The distinguishing characteristic of the "normal" curve is the steady starting temperature followed by a gradual drop after the 40 percent point.

The defective units (such as 1, 7 and 9) often look similar up to 30 percent, but fall off rapidly in temperature, dropping as much as 30 degrees between the 30 and 50

percent range. Notice how unit 7 is steady at 120 degrees until about 37.5 percent, then drops to 92.5 degrees by 56 percent.

This rapid loss of water temperature is typical of a defective water heater. In several of these defective units, I learned there was a problem with the dip tube. It had either come off completely due to a

See *Water heater...* page 14

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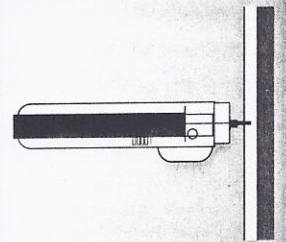


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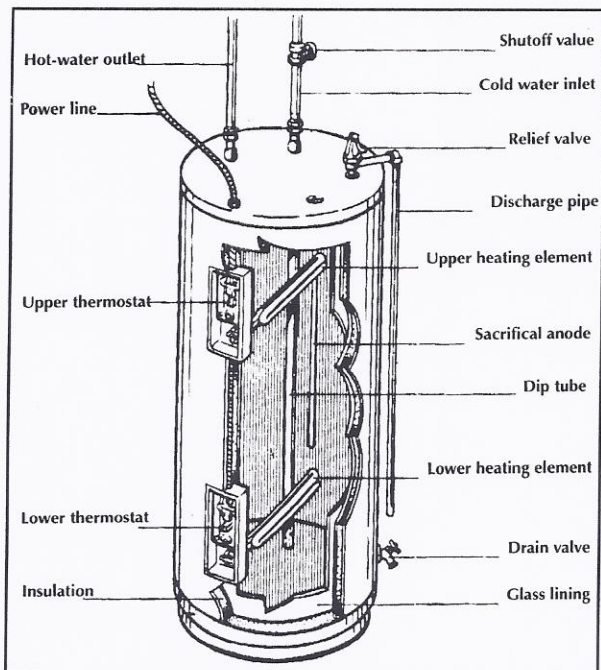


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Water heater...

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manufacturing defect, or had been damaged by the installer during installation by sweating pipe fittings to the intake nipple, thus melting the plastic dip tube. In the event of a missing or damaged dip tube, the cold water entering the water heater is not delivered to the bottom of the tank, but mixes with the hot water at the top.



hose bib at the laundry tub. If there's no laundry tub with a hose bib, or if the bib isn't threaded, I use a graduated bucket or clock the water meter to estimate the flow rate. You'd be surprised how

many houses have a two-gallon graduated bucket sitting right next to the washing machine!

I run the hot water on full and begin timing. After a one-minute warm up, I record the water

problem. If in doubt, I let the water run another minute or two and continue to take readings. If the temperature drops below 100 degrees before the tank is half empty, I include in my report that, "The water heater lacks a sufficient quantity of hot water for normal use. Repairs or replacement may be necessary."

"The seller, buyer and real estate agent all thought I was wrong when I said the water heater had a problem."

A water heater set to maximum temperature is another clue that points to inadequate capacity. People do this if they like REALLY hot water, or if they have a problem with an inadequate quantity of hot water. By cranking the temperature to 150 degrees or more, they can mix in a lot of cold and get more gallons of useable hot water. However, this is not safe or energy efficient.

"As a result of my findings, I changed my water heater inspection protocols."

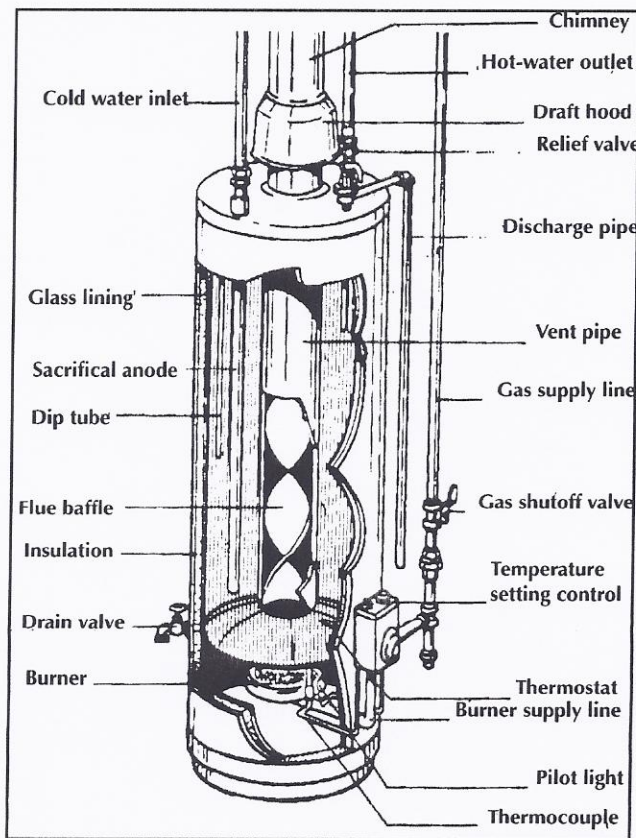
This greatly reduces the number of hot water gallons available. A burned out heating element in an electric water heater will have a similar result.

Research results

As a result of my findings, I changed my water heater inspection protocols. I still conduct the usual, physical inspection of the tank, burner covers, burner and flue. I look for dirty burners, missing doors, scorching, missing relief valves, improper discharge pipes and venting problems. I report the fuel type as well as any visible problems. I then attach a flow meter (available from several mail order tool companies) to the

temperature with a digital thermometer, then estimate how long it will take to use 40-50 percent of the tank volume. A 40-gallon tank at a 6 GPM flow rate will be nearly half used in three minutes (6 GPM x 3 minutes = 18 gallons). A 50-gallon tank at 5 GPM will need five minutes to reach the halfway mark.

I take another temperature reading around the 50 percent capacity point. If the temperature is within 10 degrees of the starting temp, there usually isn't much need for concern. However, if it has dropped more than 10 degrees and is falling rapidly, there may be a



It works for me!

Since starting this water heater testing protocol, I've found problems with nearly 10 percent of the water heaters tested.

One unit I inspected was only a few months old. The seller, buyer and real estate agent all thought I was wrong when I said the water heater had a problem. I explained that even though it was a 50-gallon tank, it ran out of hot water after drawing only 25 gallons.

I also noted the sloppy soldering on the inlet nipple and speculated that the dip tube may have been damaged during installation. The seller admitted he had installed the unit himself and agreed to remove the dip tube for inspection. Sure enough, there was a large hole melted in the dip tube right below the inlet nipple!

“This additional testing only takes a few extra minutes. While I’m waiting for the water to run, I record information in my report or check the water pressure in the bath and kitchen.”

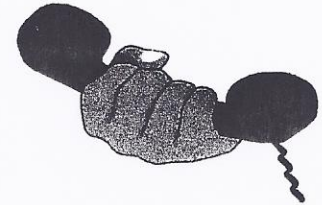
This additional testing only takes a few extra minutes. While I’m waiting for the water to run, I record information in my report or check the water pressure in the bath and kitchen. Sometimes, running a large quantity of water uncovers other problems, such as a blocked sewer line.

The testing only requires a minimal investment in new equipment. Now, when I’ve inspected a water heater, I can tell my client if he or she will be able to fill the tub for a nice hot bath on moving day, or if a quick shower would be more appropriate instead!

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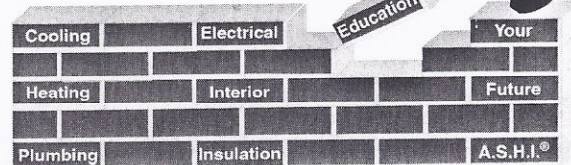
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