

Water Heater Dip Tubes-Why all the Fuss?

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By Danny T. Hutchins, PhD.

In 1995, the Charter Township of Clinton (Mich.) Water and Sewer Department investigated complaints at an apartment building for seniors. In two apartments, tenants had found small, white or light green-tinted particles in their aerators and strainers and had problems with pressure and flow in their hot water supplies. The investigating crew removed strainer screens in the dishwasher, the aerator screen on the kitchen sink, and the showerhead in both apartments.

In the first apartment, the sink aerator was plugged with white granular or eggshell-like particles. The tenant said she had to clean the aerator every other day. She also said the sink fixture had become plugged so badly that it had to be completely taken apart. Water to her washing machine and dishwasher had been completely blocked. The crew found that the hot-water temperature at the kitchen sink was 141°F (60°).

In the second apartment, the sink aerator and the showerhead were partially plugged with the particles. The tenant said that he often ran out of hot water much more quickly than when he had first moved into the apartment. The hot-water temperature at the kitchen sink was 128°F (53°).

Samples of the particles and the hot and cold water were collected from both apartments. Initially, the particulate material collected was tested to determine what percentage of the sample if any, consisted of calcium or magnesium. No calcium or magnesium was found. Portions of the sample were observed through a surface microscope at 100 x, 1,000 x, and 1,500 x. Pieces of the sample had smooth sides and a non-crystalline structure. Further analysis indicated that the sample was some type of plastic. To validate the analysis, it was decided to remove and dissect one of the two water heaters.

The mechanical staff removed the hot-water heater from one of the apartments and replaced it with a 40-gal(150-L) heater. The crew also cleaned the strainers in the dishwasher and washing machine and the aerators in the kitchen, lavatory, and shower fixtures.

Water Heater Autopsy

The water heater was cut open to analyze the epoxy lining, dip tube, drain plug, and any plastic plugs, washers, or seals that might have been used as part of the heater's construction. As soon as the heater tank was opened, it was obvious that the dip tube was missing. The epoxy coating was intact but exhibited serious damage. On the tank wall were a dozen spots where a white, oatmeal-like paste was the same plastic material taken from the apartment aerators.

In the bottom of the heater, larger pieces of tube were found. When examined, several of the pieces crumbled into a grain-like mush. Analysis of the tube-shaped pieces and the oatmeal-like paste showed that they were the same material as the samples collected from the aerators and strainers-plastic dip tube.

What Happens in the Heater

The dip tube is an extension of the cold-water inlet to the water heater tank, extending nearly to the bottom of the tank.

Figure 1 shows a normal dip tube as it extends from the copper cold-water inlet pipe down to the bottom of the heater to be heated, allowing hot water to rise to the top of the tank. By directing cold water to the bottom of the tank, the incoming cold water pushes the heated water out in front of it. This allows the hot water to be used without diluting the temperature of the hot water that occupies three-fourths of the tank.

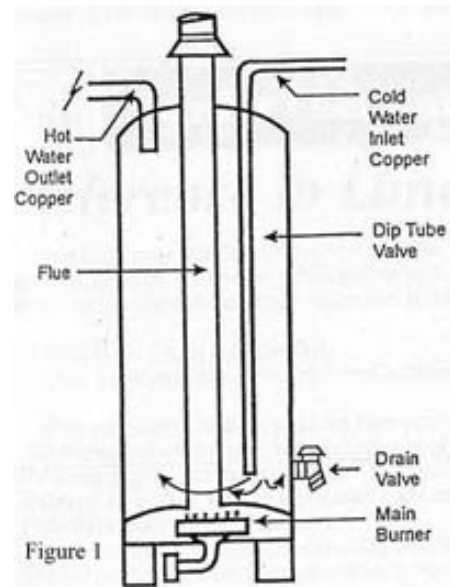


Figure 2 shows that heat has softened the plastic dip tube, and turbulence created inside the water heater has caused the dip tube to break off. With the dip tube broken away the cold water comes into the top of the tank, creating more turbulence while reducing temperatures and requiring the thermostat to be adjusted upward. The hot water continues to change the structure of the nonmetallic dip tube, causing it to become brittle.

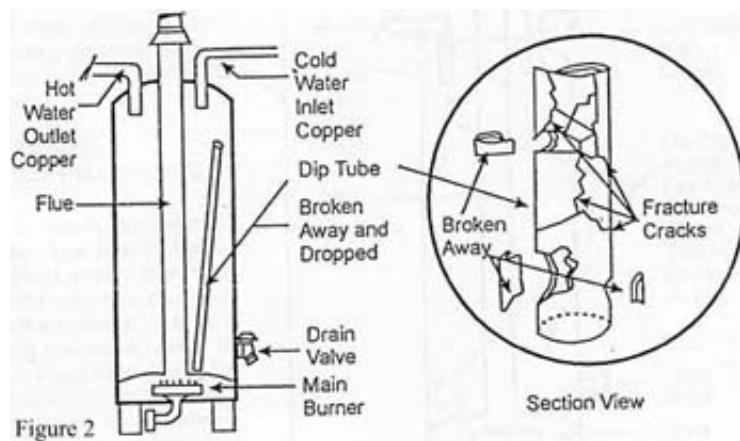
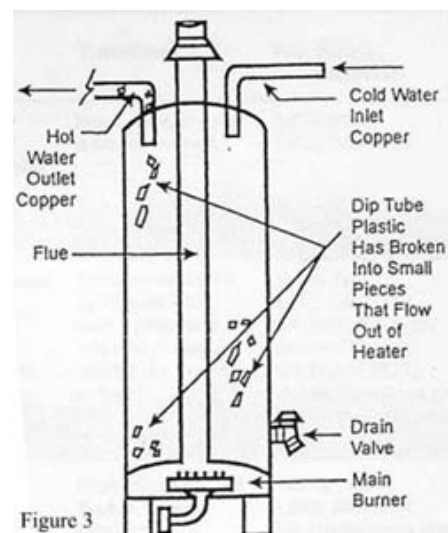


Figure 3 shows that over time, the dip tube continues to change. Cracks and fractures from all over the dip tube surface. The turbulence created inside the tank breaks the tube into increasingly smaller pieces. The pieces are eventually flushed out of the tank through the hot water outlet. The missing dip tube also reduces the supply of hot water.



Remedies

There are two solutions:

1. Flush the debris from the heater tank, install a new dip tube, and flush the strainers and aerators. In order to flush the heater tank, a full-port drain valve has to be installed for each heater. In the case of the apartment complex, the approximate cost to flush the heater and replace the dip tube was \$280 to \$300 per unit. It took 45 minutes to an hour to clean all the strainers, aerators, and fixtures in one apartment.
2. Replace the water heater and clean and flush the strainers and aerators. The cost of this method was projected at \$450 to \$500.

Regardless of the approach you use, the fixtures, strainers, and aerators will have to be cleaned over and over until all of the small pieces of the dip tube are flushed from the distribution piping.

Advice to Customers on Water Heater Dip Tubes

The various articles on water heater dip tube deterioration which have appeared in *Opflow* during the last year have been both interesting and helpful to me in my side duty of answering customer complaints which our Customer Service Department have referred to our lab. Prior to becoming aware of this phenomenon I probably issued an unnecessary line flush work order or two in an attempt to clear a customer's line of these unknown crystals or particles.

Now when a customer complains of such particles accumulating in his or her faucet aerators, I think dip tube first. While your stories about infrared spectroscopic identification and a water heater "autopsy" were quite interesting, in most cases a utility will not have to go to such lengths to confirm the cause of particle accumulations.

I instruct the customer to remove the affected aerator, clean it, flush the line in question for several minutes with cold water, and reinstall the aerator. At that point the customer should then determine if the accumulation occurs only with hot water. In most cases I don't hear from the customer again, indicating the hot water heater was in fact the cause of the problem and not our incoming water. It is also helpful to have the customer check to see if a neighbor is experiencing the same problem. Sometimes they already have, and usually the neighbor is not having a problem. This again points toward the hot water heater as the culprit.

Common Questions in Response To This Article

I have received more than 100 phone calls since you published my article "Water Heater Dip Tubes – Why all the Fuss?" in the December 1998 *Opflow*. I have received calls from Texas, New Jersey, Indiana, Ohio, Kentucky, Minnesota, and the list goes on. The callers are water supply people, homeowners, plumbing contractors, and two reporters from the general media.

Here are typical questions asked by homeowners and the answers I give them.

Q. Are the plastic parts toxic?

A. The eggshell-like plastic particles are not toxic.

Q. Does the deterioration of the plastic dip tube make the water toxic?

A. No, it does not make the water toxic.

Q. What is the average time before a dip tube fails?

A. Failure of the plastic dip tube depends on the water heater operating temperature (the higher the temperature, the faster the tube fails), the water chemistry (soft water and aggressive water chemistries will accelerate the deterioration process). The calls I received indicate the average time before a dip tube fails is three to five years.

Q. Will the manufacturer replace the dip tube in my heater?

A. That depends upon how old the water heater is and the warranty provided by the manufacturer. The resident should call the manufacturer to find out what, if anything, the manufacturer will do.

One homeowner called Rheem, and was told to purchase a new copper dip tube for \$7 - \$10 and replace it himself. Rheem's instructions sheet for replacing the tube contained 16 steps, some of which were either impossible (i.e., disconnecting soldered pressure valves, inserting inflexible 5-ft tube in top of tank, etc.) or required technical or professional skills and tools (disconnecting electrical and gas service lines, testing for leaks).

Few homeowners have the tools or experience to replace a dip tube themselves, and it is extremely difficult to flush out all of the fine plastic shell-like particles on the tank walls. The tube could be replaced and still plastic particles could plug showerheads and dishwashers. The least disruptive approach is to have a plumber remove the problem heater and install a new one with a copper dip tube pipe. This may also be the least expensive, in terms of time and aggravation.

Every caller has expressed their gratitude to *Opflow* for printing this article. Without this article, they would have had no idea what the material was that plugged up their appliances. All of the homeowners were concerned about their family's health. The article and our phone conversation made them feel safer.

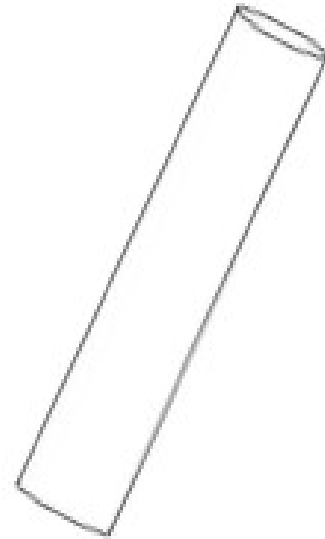
The discussion and awareness of the problem with dip tube heaters needs to continue.

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Water Heater Makers Agree to Settle Dip Tube Suit

A federal district judge has given preliminary approval of a settlement of nearly a dozen class-action lawsuits against six national manufacturers of water heaters with defective plastic dip tubes that have caused considerable consumer problems. Judge Howard F. Sachs of the Western District of Missouri Division agreed to allow the manufacturers to reimburse customers up to \$175 each for already-completed repairs to their water heaters and to compensate plumbers up to \$185 for replacing a dip tube and flushing pipes.

The cases were filed in 1999 in Michigan, Missouri, and other states against tank manufacturers Rheem, A.O. Smith, Bradford White, American Water Heater, Lochinvar, and State Industries. The settlement allows for replacement of nearly 14 million dip tubes manufactured between August 1993 and October 1996 by Perfection Corp., which chose not to be part of the settlement. Perfection has acknowledged that during that time it made tubes without a key chemical ingredient, according to the Kansas City Star.



Dip tubes are an internal pipe that extends from the cold water inlet nearly to the bottom of the hot water heater. Normally, the tube directs cold water to the bottom where it will be heated before rising to the top of the heater. Many older heaters have copper dip tubes, but the defective ones in the lawsuit were made of plastic that deteriorated over time, decreasing the effectiveness of the heater, clogging faucets and pipes with plastic chips, and prompting many customers to call their water suppliers with complaints about contaminated water.

The court order is preliminary to a hearing in April, but customers can begin filing claims through Crawford & Co., the company hired to administer the settlement. For more information, call 800-329-0561.