Lead in Your Drinking Water

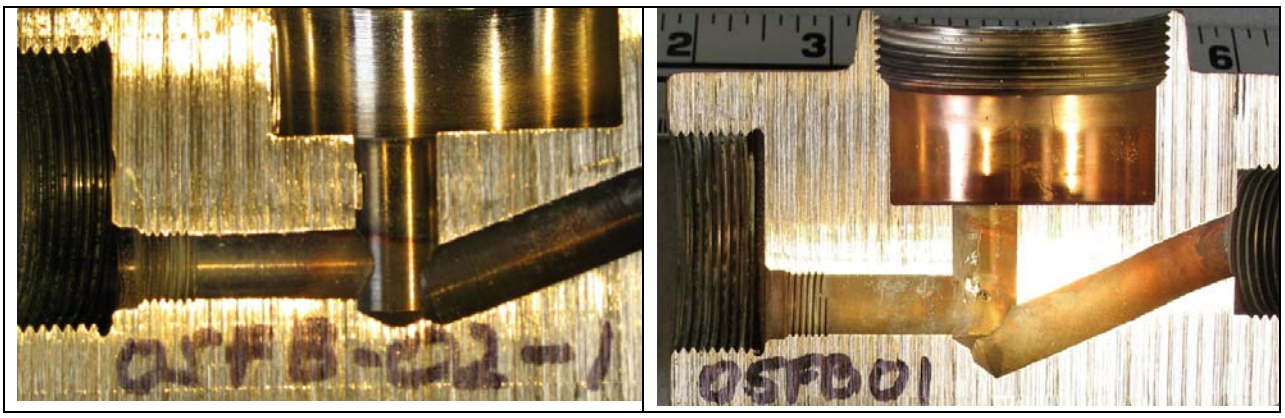
Lead (Pb) is an extremely toxic heavy metal that unfortunately occurs widely in our environment. The chief sources of exposure are from

(1) Lead paint – commonly present in the soils close to house exteriors, often also present in peeling paint that exposes older paint layers in house interiors
(2) Leaded gasoline – soils along major roadways are strongly enriched in lead. This effect diminishes rapidly over a few tens of feet from the edge of the road, but can be of concern for highway maintenance workers or for homes built very close to highways
(3) Former shooting ranges – some modern subdivisions have been built on the site of target shooting ranges that have high levels of metallic lead in the soil
(4) Drinking water – water as it leaves the treatment plant has no lead, but it can acquire it from plumbing components (our word *plumbing* comes from the Latin for lead)

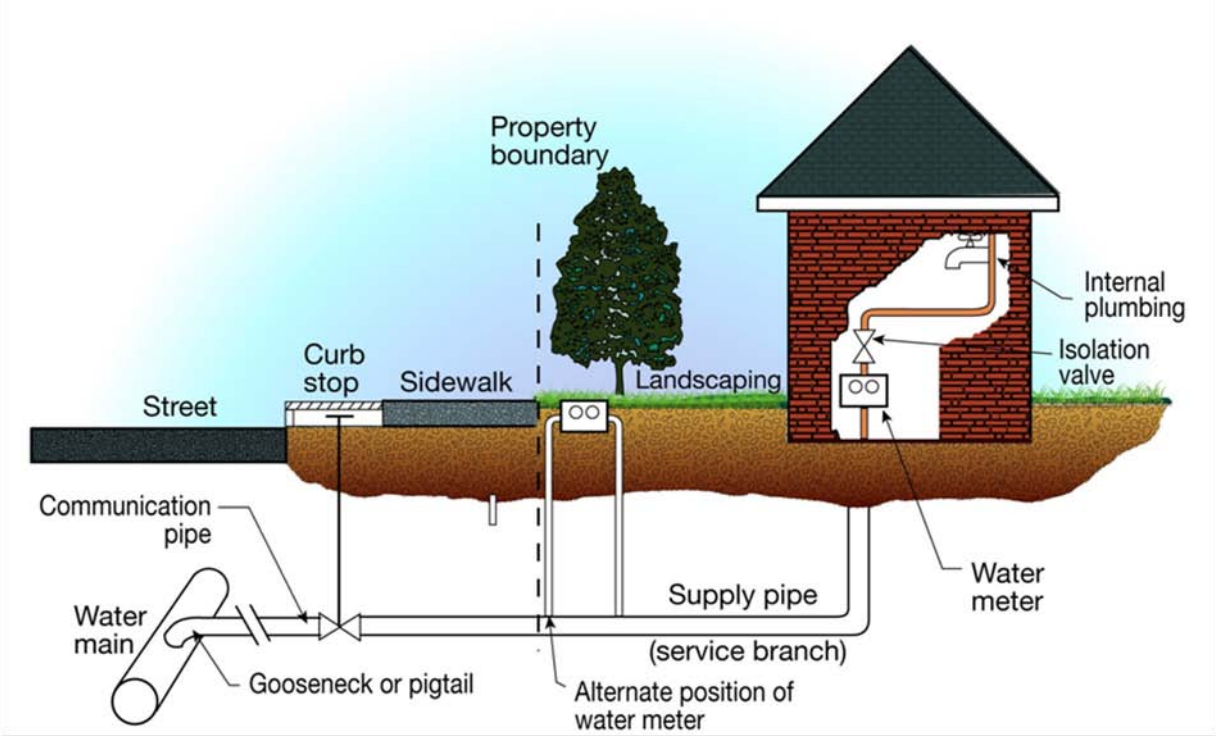
Lead from plumbing components

Your exposure to lead in drinking water is at the faucet, but the lead can come from several points along the way. These are

(1) Lead pipes connecting the house to the water main in the street, often referred to as *service branches.*
(2) Lead-containing brass used in valves, fittings, your water meter, and your faucets
(3) Lead-containing solder used to connect the plumbing components (this is thought to be minor and such solders are no longer sold)



Interior of brass faucet showing copper color from preferential loss of zinc

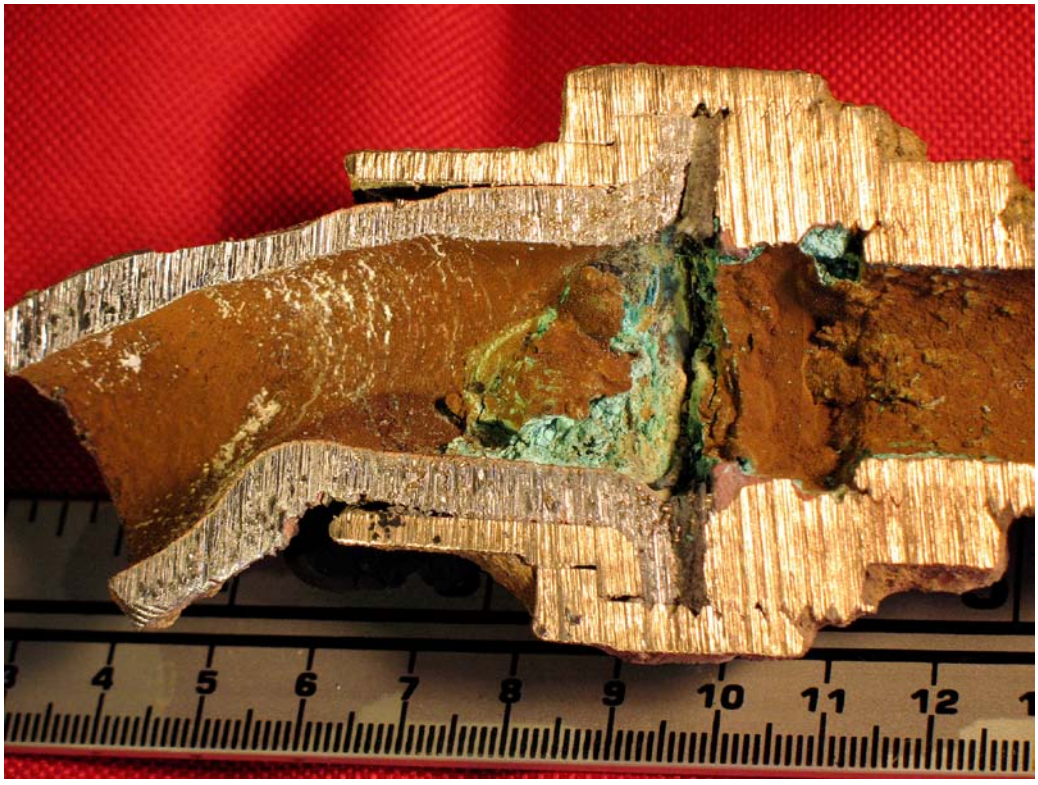


Timothy Phillips 2008

Lead service lines

Many communities, particularly in the eastern half of the US and Canada, used lead piping to connect water mains under the street to plumbing within the customer's house. The schematic above shows the arrangement of the various components in this system of connection. (In some cases, the water meter as well as the curb stop is outside the house.)

Common metals used for the supply pipe are lead, copper and galvanized iron. Also in the system are various brass components – the curb stop valve, the meter, and the shutoff valve in the house. Thus a Pb supply line will have a number of brass connections along its length. These bimetallic connections have the potential for accelerated galvanic corrosion, as illustrated below.

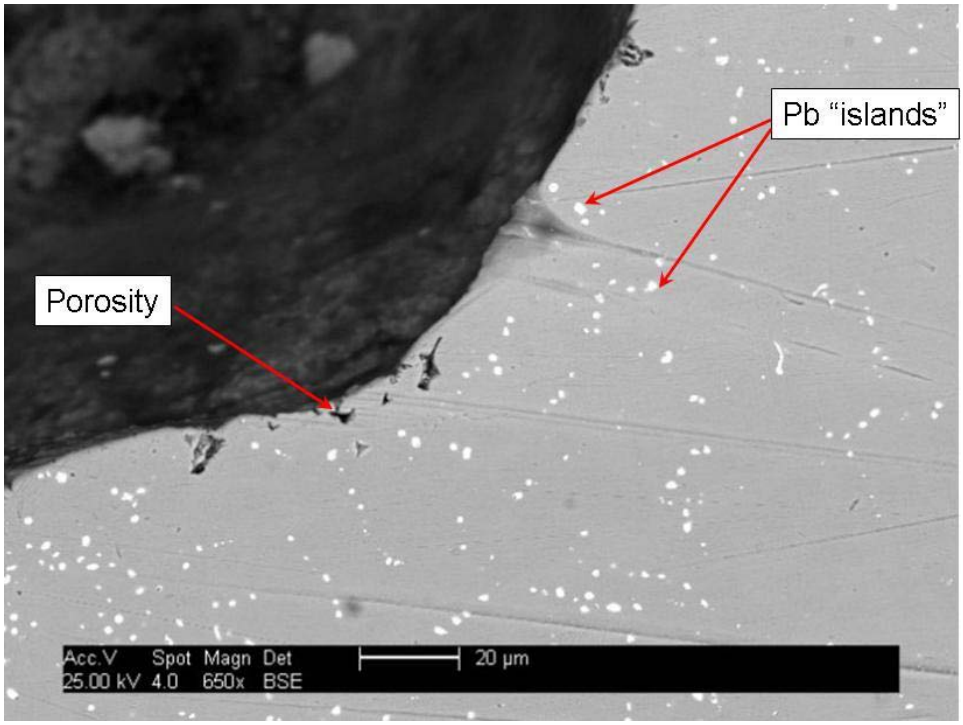


Build up of excess scale at the junction between Pb pipe and brass fitting. The brown scale to the left is dominantly PbO_2 with some white Pb carbonate underneath, whereas the scale to the right, on the brass, is dominantly Mn oxide. At the junction, Cu sulfate dominates.

Lead in brass plumbing components

The brass components themselves can have a certain proportion of Pb in their composition. Brass is an alloy of Cu, Zn, Sn, and Pb. The proportions vary widely, and Pb contents can be as high as 8 %. Be careful, these brasses can still be marketed as "lead free". In true no-lead brasses, Bi and Se are used in place of Pb (http://www.envirobrass.com). The addition of Pb or Bi is necessary to improve the machinability of the brass. Even in the absence of a lead service branch, these brass components in the system, especially the sink faucet, can be significant sources of Pb at the tap.

Pb or Bi in brass are present not in solution in the alloy but as discrete blebs or "islands" of pure metal within the alloy. Imaging using Scanning Electron Microscopy reveals this structure (Fig. 1). The image was taken in back-scatter mode, in which the brightness is proportional to the atomic number of the element. The large contrast in mass between Pb and the other elements produces the bright spots. Note also the porous zone at the wetted edge of the brass revealed by the dark areas.



Structure of brass revealed in scanning electron imaging, using back-scattered electrons. Polished section cut through a leaded brass faucet.

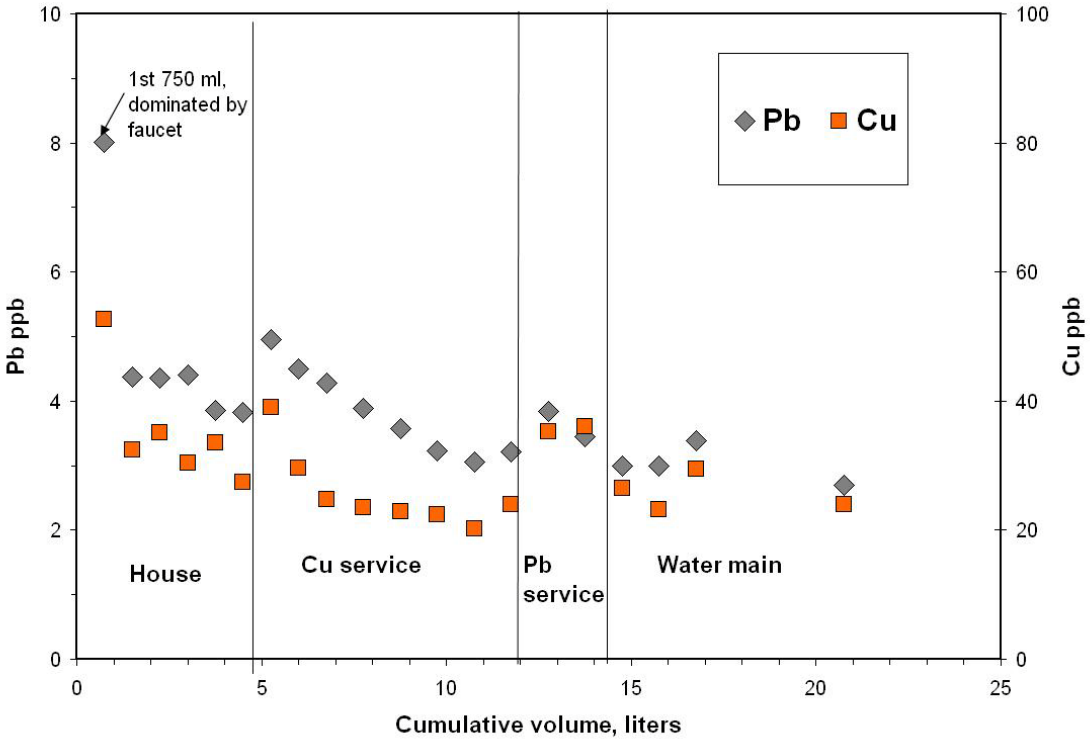
How does this lead get from my plumbing into my water?

There are two pathways by which lead migrates from service branches or from brass components to the water coming from your faucet:

(1) As lead dissolved from lead minerals coating the insides of the lead piping or from the brass
(2) As particles of lead or copper or iron minerals carrying lead along with them

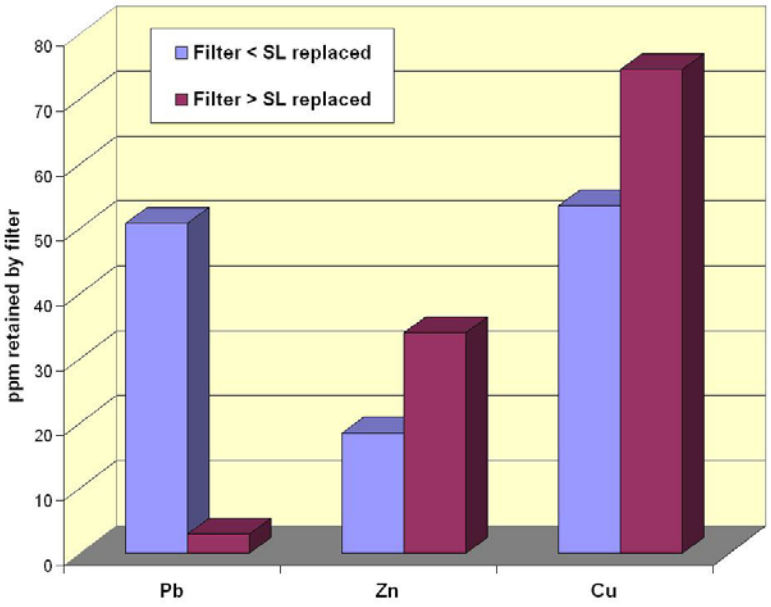
The first source is relatively easy to predict and to control. For example many utilities will raise the pH of their water to suppress the solubility of the lead minerals. Another strategy that is widely used is to add small amounts of phosphate to the water, which greatly reduces lead solubility.

The second pathway is much more difficult to deal with and is therefore more dangerous. In practice, a very simple strategy has been found to greatly reduce your lead exposure – discard the first glass of water you draw from the faucet. It is this volume of water that contains most of the lead.



Other strategies you should follow:

(1) Ask your utility whether or not you have a lead service branch – they should have a record. If so consider replacing it. Normally if you replace your portion, they will pay to replace theirs.

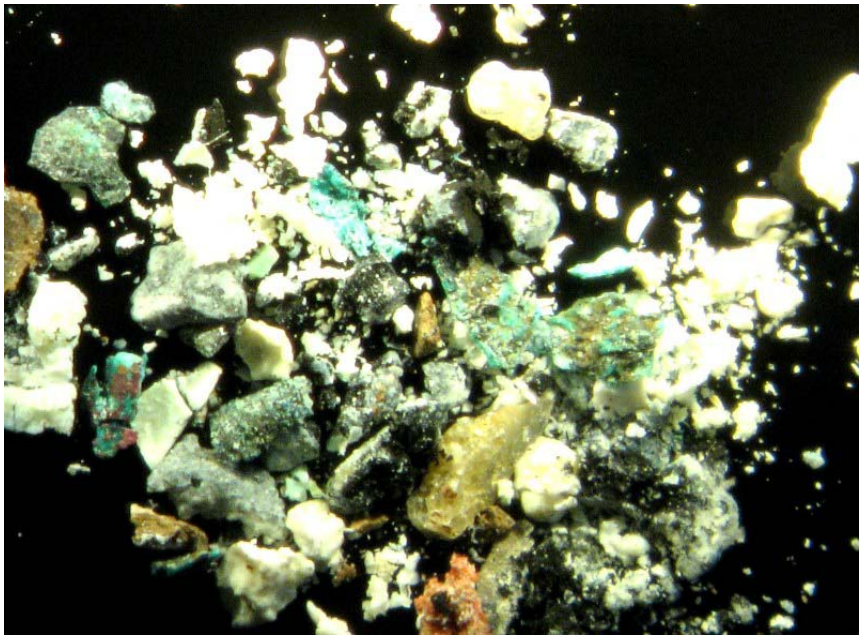


Removing the service line (SL) dramatically reduces the amount of lead (Pb) entering the house

A typical lead service branch. By gently scraping the pipe where it enters the house you may be able to see whether you have copper, which will be copper colored, or lead, which will be dull gray (if you have galvanized iron, replace it before it starts leaking)

(2) Get a test of your water in both winter and summer. Your utility should provide this service on request – they need this data in their reports.

(3) Clean the faucet aerators regularly. They can be a repository of lead-bearing particulates.



Debris recovered from a kitchen faucet aerator. The green particles are copper rich, the white particles are zinc-rich and the reddish particles are iron oxide with some lead.

(4) Use a carafe-type water filter. These are highly effective at removing lead and copper and also certain dangerous byproducts of chlorination of the water, but be sure to change the cartridge at least every three months.

A final word about galvanized pipes

There is growing evidence that galvanized iron pipes inside the house can be a reservoir of lead. The lead travels from the service line or the brass plumbing and lodges in the iron oxide scale that builds up on the interior of the galvanized pipes. This lead can lurk for years as a health threat. For both the health of your plumbing and your family, you should probably replace any galvanized lines (they're likely nearly choked with rust) with copper.